

Cherokee Nation

Catoosa Child Development Center

Technical Specifications

August 16, 2024



Owner:

The Cherokee Nation
P.O. Box 948
Tahlequah, OK 74465

Architect:

Blue River Architects, LLC
320 South Boston Avenue, Suite 103
Tulsa, OK 74103
Phone: 918.877.9036

SECTION 00 0107
SEALS PAGE

Architect:
Chris Seat



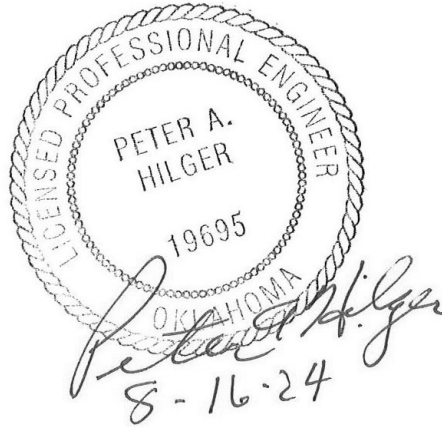
Civil Engineer:
Nick Mason



Structural Engineer:
Andrew Kern



Electrical Engineer:
Pete Hilger



Mechanical Engineer:
Abdou M. Jaafar



Fire Protection Engineer:
Abdou M. Jaafar



Registered Communications
Distribution Designer:



END OF SECTION

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**SECTION 00 3100
AVAILABLE PROJECT INFORMATION**

PART 1 GENERAL

1.01 EXISTING CONDITIONS

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions, interpretations, or recommendations. This Document and all attachments are not part of the Contract Documents.
- B. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- C. Site Survey: Entitled Topographical Survey, dated 09/21/23.
 - 1. Prepared by: Wallace Design Collective
 - 2. Reference copy is indicated on Civil Drawings.
- D. Geotechnical Report: Entitled REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL EVALUATION CHEROKEE NATION CHILD DEVELOPMENT CENTER CATOOSA, OKLAHOMA , dated March 05, 2024.
 - 1. Prepared by: Building & Earth
 - a. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - b. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
 - c. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to Owner.
 - d. Contractor is expected to examine the site and all geotechnical data and investigation reports and then decide for himself the character of the materials to be encountered. Contractor shall employ a consultant qualified to interpret the geotechnical data and investigation reports if the Contractor does not feel qualified to interpret any part of the geotechnical data and investigation reports.
 - e. The Owner, Tenant, Architect, and Architect's Consultants disclaim any responsibility for the accuracy, true location and extent of the geotechnical data and investigation reports that have been prepared by others. They further disclaim responsibility for interpretations and recommendations related to that data by Bidders, such as, but not limited to, predicting soils bearing values or the depth to soils bearing materials, rock profiles or hardness, soils stability and the presence, level and extent of underground water.
- E. CNIT Network Construction Standards Manual, dated 02/06/2024 Ver. 1.
- F. Cherokee Nation Finish Hardware Standards for New Construction and Renovations., dated August 2023

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

3.01 OBTAINMENT OF PERMITS

- A. Contractor to obtain the following required permits, at no cost to Owner:
 - 1. Building Permit for all trades.
- B. Building Permit Procedures: When required to obtain this permit:
 - 1. Complete and file permit application(s) with appropriate agency.
 - a. Submit application within five days of the Notice to Proceed.

2. Pay required fees.
3. Provide expediting services, either directly or by hiring a firm specializing in these kind of services.
4. Advise Architect if submission of modified documents is necessary to have the authorities having jurisdiction complete the plan review and approval process. Submit modified documents expeditiously.
5. Do not commence execution of any item of work for which a permit has not been obtained.

END OF SECTION



REPORT OF SUBSURFACE EXPLORATION
AND GEOTECHNICAL EVALUATION
CHEROKEE NATION CHILD DEVELOPMENT CENTER
CATOOSA, OKLAHOMA
BUILDING & EARTH PROJECT No.: TU230102

PREPARED FOR:
Blue River Architects

MARCH 5, 2024



March 5, 2024



A Native American Owned Firm

320 South Boston Avenue, Suite 103

Tulsa, Oklahoma 74103

Attention: Mr. Kevin Oyler, AIA

Subject: Report of Subsurface Exploration and Geotechnical Evaluation
Cherokee Nation Child Development Center
Catoosa, Oklahoma
Building & Earth Project No: TU230102

Dear Mr. Oyler:

Building & Earth Sciences, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluation for the referenced project in Catoosa, Oklahoma.

The purpose of this exploration and evaluation was to determine general subsurface conditions at the site and to address applicable geotechnical aspects of the proposed construction and site development. The recommendations in this report are based on a physical reconnaissance of the site and observation and classification of samples obtained from a total of twenty-two (22) test borings conducted at the site. Confirmation of the anticipated subsurface conditions during construction is an essential part of geotechnical services.

We appreciate the opportunity to provide consultation services for the proposed project. If you have any questions regarding the information in this report or need any additional information, please call us.

Respectfully Submitted,

BUILDING & EARTH SCIENCES, INC.

Certificate of Authorization #3975, Expires 6/30/2024

Dharmateja Maganti, E.I.
Project Manager



Marco V. Vicente Silvestre, P.G., P.E.
Regional Vice President - Principal
OK: 21903

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APPENDIX

1.0 PROJECT & SITE DESCRIPTION

The project site is located on the west side of Country Club Drive, approximately 0.11 miles north of the intersection with North 193rd East Avenue in Catoosa, Oklahoma. General information relative to the proposed site and the proposed development is listed in Table 1 below. Photographs depicting the current site conditions are presented on the following pages.

Development Item	Detail	Description
General Site	Size (Ac.)	Approximately 7 acres
	Existing Development	Currently a vacant lot with residential houses to the north of the property, empty lot to the west, commercial development to the east, and Hard Rock casino to the south
	Ground Surface	The project area was covered with grass and topsoil
	Slopes	Site sloped down to the southeast and south with a grade difference of approximately 25 feet across the planned construction area
	Drainage	Natural run-off to the southeast. An existing shallow drainage ditch was noted along the south property boundary. Also, a 36-inch Corrugated Plastic Pipe (CPP) was noted within the southwest portion of the project area
	Anticipated Cuts & Fills	See note 2
Proposed Buildings	No. of Buildings	One (1)
	Square Ft.	~ 44,000
	Stories	Single story
	Construction	Pre-engineered metal building (assumed)
	Column Loads	On the order of 50 to 75 kips (provided)
	Wall Loads	2 to 3 kips per linear foot (provided)
	Preferred Foundation	Conventional shallow foundation (assumed)
	Preferred Slab	Conventional slab on grade (assumed)
Pavements	Traffic	Not Provided
	Standard Duty	Flexible and rigid, 115,000 ESAL (assumed)
	Heavy Duty	Flexible and rigid, 300,000 ESAL (assumed)

Table 1: Project and Site Description

References:

- Schematic Boring Plan, prepared by Blue River Architects, dated April 13, 2023
- Schematic Design Package, prepared by Blue River Architects, dated November 20, 2023
- Civil Drawings, prepared by Wallace Design Collective, dated February 9, 2024

Table 1 Notes:

1. If final loading conditions exceed preliminary given loads, Building & Earth should be allowed to review the structural design and its effects on our recommendations for foundation design.
2. If changes are made to the provided preliminary grading plan, Building & Earth should be allowed to review the updated plan and its effects on our recommendations.

At the time of our subsurface exploration and site reconnaissance, most of the project site was covered with grass and topsoil with some scattered trees. Historical aerial photographs of the site from November 2004 and August 2012, indicate the project area was disturbed during the construction of an overflow parking lot for the casino. It also appears the site was used as a staging area for the construction of the parking lot and for the construction of the CNB Employee Health Center up until September 2021. Google Earth historic aerials and photographs depicting the current site conditions are shown in Figures 1 through 6 below.



Figure 1: Google Earth aerial image, dated August 2022



Figure 2: Google Earth Image of Site (11/2004)



Figure 3: Google Earth Image of Site (8/2012)



Figure 4: Area of boring B-09 looking southwest



Figure 5: View looking south from boring SB-01



Figure 6: Underground drainage feature noted near boring P-02

Underground utilities comprising of water, sanitary sewer, and gas were noted along the east boundary of planned construction area. A shallow drainage ditch was noted along the south property boundary. In addition, an underground 36-inch CPP was noted near boring P-02 (refer to Figure 6).

2.0 SCOPE OF SERVICES

The initial authorized subsurface exploration was performed on June 26 and 27, 2023, in conformance with our proposal TU25156, dated May 22, 2023. Notice to proceed was provided by signing our proposal on June 6, 2023.

Occasionally some modification of the scope outlined in our proposal is required to provide for proper evaluation of the encountered subsurface conditions. Following completion of drilling, Building & Earth was instructed to put the project on hold, as changes were being made to the building layout and associated parking and access drives. Preliminary design plans prepared by Wallace Design Collective, dated November 20, 2023, indicated the layout of the building had changed from what was originally planned. Due to changes in the site plan and building layout, three (3) supplemental borings were drilled on January 18, 2024, to obtain information in unexplored areas of the planned construction area.

The purpose of the geotechnical exploration was to determine general subsurface conditions at specific boring locations and to gather data on which to base a geotechnical evaluation with respect to the proposed construction. The subsurface exploration for this project consisted of a total of twenty-two (22) test borings.

The site was drilled using CME 550X ATV and Diedrich D-50 track mounted drill rigs equipped with hollow stem and solid flight augers and an automatic hammer for performing Standard Penetration Tests (SPT) to help evaluate the relative soil strength. Refer to the Appendix for a description of the drilling and sampling procedures.

The boring locations were determined in the field by a representative of our staff using a handheld GPS device. As such, the boring locations shown on the Boring Location Plan attached to this report should be considered approximate.

The soil and rock samples recovered during our site investigation were visually classified and specific samples were selected by the project engineer for laboratory analysis. The laboratory analysis consisted of:

Test	ASTM	No. of Tests
Natural Moisture Content	D2216	103
Atterberg Limits	D4318	14
Material Finer Than No. 200 Sieve by Washing	D1140	4

Table 2: Scope of Laboratory Tests

The results of the laboratory analysis are presented on the enclosed Boring Logs and in tabular form in the Appendix of this report. Descriptions of the laboratory tests that were performed are also included in the Appendix.

The information gathered from the exploration was evaluated to determine a suitable foundation type for the proposed structure. The information was also evaluated to help determine if any special subgrade preparation procedures will be required during the earthwork phase of the project.

The results of the work are presented within this report that addresses:

- General site geology.
- Summary of existing surface conditions.
- A description of the subsurface conditions encountered at boring locations.
- A description of the groundwater conditions observed in the boreholes during drilling. Long-term monitoring was not included in our scope of work.

- Presentation of laboratory test results.
- Site preparation considerations including material types to be expected at the site, treatment of any encountered unsuitable soils, excavation considerations, and surface drainage.
- Recommendations to be used for shallow foundation design, including appropriate bearing materials, bearing pressures, and depths.
- Presentation of expected total and differential settlements.
- Recommendations to be used for design of slabs-on-grade, including modulus of subgrade reaction.
- Recommendations to be used for design and construction of site retaining walls, including lateral earth pressures and subsurface drainage provisions.
- Seismic Site Classification per IBC 2018 based on SPT test boring information.
- Compaction requirements and recommended criteria to establish suitable material for structural backfill.
- Recommendations for typical minimum flexible and rigid pavement sections.

3.0 GEOTECHNICAL SITE CHARACTERIZATION

The following discussion is intended to create a general understanding of the site from a geotechnical engineering perspective. It is not intended to be a discussion of every potential geotechnical issue that may arise, nor to provide every possible interpretation of the conditions identified. The following conditions and subsequent recommendations assume that significant changes in subsurface conditions do not occur between boreholes. However, anomalous conditions can occur due to variations in existing fill and the geologic conditions at the site, and it will be necessary to evaluate the assumed conditions during site grading and foundation installation.

3.1 GENERAL SITE GEOLOGY

Based upon review of the Oklahoma Geological Survey (OGS) *Geologic Map of the Mingo 7.5' Quadrangle, Rogers, Tulsa, and Wagoner Counties, Oklahoma*, prepared by Thomas M. Stanley and Galen W. Miller (2006), the subject property is underlain by the Labette Formation. This formation is noted to consist of light olive gray to dusky yellow, medium light gray, laminated, very silty to sandy, micaceous, concretionary clayey shale.

The subsurface conditions encountered at the project site generally correlate with the referenced geologic map.

3.2 EXISTING SURFACE CONDITIONS

At the time of our subsurface exploration, most of the project site was covered with grass and sparse trees. The topsoil below the grass had a thickness of about 1 to 6 inches. The topsoil conditions reported apply only to the specific boring locations.

In areas of borings P-05 through P-07, the ground surface was covered with crushed aggregate with thickness ranging from about 2 to 3 inches.

The reported topsoil and aggregate thicknesses apply only to the specific boring locations and may vary in unexplored portions of the site. For this report, topsoil is defined as the soil horizon which contains the root mat of the noted vegetation. It should be noted that no testing has been performed to verify that soils meet the requirements of "topsoil". For this report, topsoil is defined as the soil horizon which contains the root mat of the noted vegetation.

3.3 SUBSURFACE CONDITIONS

A generalized stratification summary has been prepared using data from the test borings and is presented in the table below. The stratification depicts the general soil and rock conditions and stratum types encountered during our field investigation.

Stratum No.	Typical Thickness	Description	Consistency/ Rock Hardness	Lab Testing Data (5)
1 ⁽¹⁾	1.7 to 4.9'	Fill Materials: Lean Clays and Lean to Fat Clays (CL-CH), with roots, sand, sandstone fragments, wood, broken concrete fragments, , ferrous staining, and ferrous nodules, Various combinations and shades of brown, gray, yellow, and red	Stiff to very stiff	<i>Atterberg Limits:</i> LL = 34 to 36 PI = 13 to 18 <i>Percent Fines: 84%</i> <i>Moisture Contents:</i> 11 to 20%
2 ⁽²⁾	7.2 to 17.6'	Residuum: Lean Clays (CL), Lean to Fat Clays (CL-CH), and some Fat Clays (CH). Sandy Lean Clays (CL), and Shaley Lean Clays (CL) with roots, sand, ferrous staining and nodules, and sandstone fragments Various combinations and shades of brown, gray, yellow, and red	Generally stiff to very stiff ⁽³⁾	<i>Atterberg Limits:</i> LL = 35 to 54 PI = 16 to 32 <i>Percent Fines:</i> 83 to 93% <i>Moisture Contents:</i> 10 to 25%

Stratum No.	Typical Thickness	Description	Consistency/ Rock Hardness	Lab Testing Data (5)
3 ⁽⁴⁾	Termination Layer	<u>Weathered Rock:</u> Clayey shale, Weathered shale, and Weathered Sandy Shale with ferrous staining Various combinations and shades of brown, yellow, olive, and gray	Soft rock unit	<i>Atterberg Limits:</i> <i>LL = 30 and 33</i> <i>PI = 6 and 13</i> <i>Moisture Contents:</i> <i>10 to 16%</i>

Table 3: Stratification Summary

Table 3 Notes:

1. Encountered only in borings B-09, P-02, P-03, P-04, P-08, P-09, and SB-03.
2. Borings B-04, B-08, B-09, B-10, P-01 through P-09 and SB-03 were terminated within this stratum.
3. Medium stiff clay soils were encountered in borings B-01, B-03, B-07, B-08, B-10, P-05, and SB-01. These lower consistency clay soils extended to depths of about 2 to 5 feet below current grades. In boring B-10, medium stiff clays extended to a depth of about 7 feet.
4. Encountered in borings B-01, B-02, B-03, B-05, B-06, B-07, SB-01, and SB-02. The referenced borings were terminated within this stratum at depths of about 13.9 to 19.9 ft below current grades.
5. For Atterberg Limits: LL = Liquid Limit, and PI = Plasticity Index

Subsurface profiles have been prepared based on the data obtained at specific boring locations. The subsurface profiles are presented in the Appendix. For specific details on the information obtained from individual borings, refer to the Boring Logs included in the Appendix. The ground surface elevations at the boring locations shown on the attached Boring Logs were estimated from the contour lines shown on the grading plan provided to our office and as such should be considered approximate.

3.3.1 GROUNDWATER

The table below presents a summary of groundwater conditions encountered in the some of the borings at the time of the subsurface exploration and prior to backfilling the boreholes.

Boring	Groundwater Depth During/After Drilling (ft)	Boring	Groundwater Depth During/After Drilling (ft)
B-01	Not encountered / 9.0	B-07	17.5 / 11.5
B-02	Not encountered / 11.0	B-08	16.5 / 14.5
B-06	17.0 / 8.5	---	---

Table 4: Groundwater Summary

Groundwater was not encountered in the other borings during drilling, and they were dry at completion of drilling operations and prior to backfilling.

The water levels reported are accurate only for the time and date that the borings were drilled. Long term monitoring of the boreholes was not included as part of our subsurface exploration. The borings were backfilled the same day that they were drilled.

3.4 SEISMIC SITE CLASSIFICATION

Basis of Evaluation	Recommended Site Classification
2018 International Building Code (IBC) and ASCE 7, Chapter 20	C
This recommended seismic site classification is based on the 2018 Edition of the International Building Code, the subsurface conditions encountered in the borings, and our knowledge of the geologic conditions of the site. Our subsurface exploration extended to a maximum depth of about 19.9 feet; hence the seismic site classification should be re-evaluated in the event subsurface information is made available to a depth of 100 feet.	

Table 5: Seismic Site Classification

4.0 SITE DEVELOPMENT CONSIDERATIONS

Review of the provided grading plan indicated that the existing grades within the proposed building area range between roughly 683 and 698 feet. We understand that consideration is being given to a finished floor elevation (FFE) of 693.25 feet for the planned building. Fill heights of up to 9 feet and cut depths of about 5 feet will be required to achieve design grades within the planned building area.

Within the planned pavement areas, fill heights of up to 7 feet and cut depths of approximately 10 feet will be required to achieve design grades.

If changes are made to the provided grading plan, Building & Earth should be allowed to review its effects on our recommendations.

Based on our evaluation of the subsurface conditions, and the given foundation loads, it appears that construction with a shallow foundation system is feasible. The site development recommendations outlined below are intended for development of the site to support construction with a shallow foundation system. ***If a different type of foundation system is preferred, Building & Earth should be allowed to review the site development recommendations to verify that they are appropriate for the preferred foundation system.***

The primary geotechnical considerations for this project are:

- In borings B-09, P-02, P-03, P-04, P-08, P-09, and SB-03, fill materials were encountered below the topsoil to depths of about 2.5 to 5 feet below current grades.
- Onsite fill materials and residual lean clay soils are moisture sensitive, prone to losing strength and stability with slight increase in soil moisture contents.
- Medium stiff clay soils were encountered in borings B-01, B-03, B-07, B-08, B-10, P-05, and SB-01. These lower consistency clay soils extended to depths of about 2 to 5 feet below current grades. In boring B-10, medium stiff clays extended to a depth of about 7 feet.
- Portions of the onsite residuum comprised of lean to fat clays (CL-CH) and fat clays (CH) that exhibited medium to high plasticity characteristics with a moderate to high shrink-swell potential.
- The potential for development of perched water at the interface of residual clays with underlying rock units.
- A weathered rock unit comprised of clayey shale, weathered shale, and weathered sandy shale was encountered in borings B-01, B-02, B-03, B-05, B-06, B-07, SB-01, and SB-02 at depths of approximately 7.5 to 18 feet below present grades.
- Groundwater seepage was encountered in borings B-06 through B-08 during drilling at depths of about 16.5 to 17.5 feet below existing grades. Free water was measured in borings B-01, B-02, and B-06 through B-08 at depths of about 8.5 to 14.5 feet, prior to backfilling the boreholes.

Recommendations addressing the site conditions are presented in the following sections.

4.1 INITIAL SITE PREPARATION

All trees, vegetation, roots, topsoil, aggregate base, and any other deleterious materials, should be removed from the proposed construction areas. Approximately 1 to 6 inches of topsoil and 2 to 3 inches of aggregate base was observed in the borings; however, topsoil and aggregate thicknesses could extend to greater depths in unexplored areas of the site.

Grubbing of trees should include removal of the tree stumps and the root systems. Desiccated clay soils may be present in the zone surrounding the trees. Desiccated clay soils should be undercut and replaced with structural fill.

Because of past use of the site, buried structures could be encountered such as remnants of foundations, utility lines, septic systems, subterranean drainage structures, etc. Where encountered, they should be removed and backfilled in accordance with requirements outlined in the *Structural Fill* section of this report.

The geotechnical engineer or their designated representative should observe grubbing, and stripping operations to evaluate that all unsuitable materials are removed from locations for proposed construction.

Materials disturbed during grubbing, and stripping operations should be stabilized in place or, if necessary, undercut to undisturbed materials and backfilled with properly compacted, approved structural fill.

During site preparation activities, the contractor should identify borrow source materials that will be used as structural fill and provide samples to the testing laboratory so that conformance to the structural fill requirements outlined below and appropriate moisture-density relationship curves can be determined.

4.2 DRAINAGE FEATURES AND LOW LYING AREAS

As previously mentioned, a shallow drainage ditch was noted along the south property boundary. Moist to wet, soft/loose soils are commonly present within and adjacent to drainage features and low lying areas.

The lateral extent and depth of soft/unstable and wet soils associated with the noted drainage features, and the low-lying areas of the site was not determined as part of the scope of work presented in this report. Site development concerns relating this material include the potential for groundwater seepage, wet soils, soft/loose soils, and unstable conditions.

4.3 GENERAL CONSIDERATIONS FOR GROUNDWATER INTERCEPTION

Per the grading plan, we understand that cut depths on the order of up to 10 feet will be required to achieve design grades within the north and northwest area of the planned construction. Based on conditions encountered in the borings, groundwater or perched water is likely to be encountered in areas of deep cuts.

In addition, the grading plan indicates that proposed grades on the north and west sides generally slope down towards the planned building and pavements. It should be noted that with grades sloping towards the proposed structures, there is a risk of surface water migration into the building and pavement areas, which could result in saturation and softening of subgrade soils.

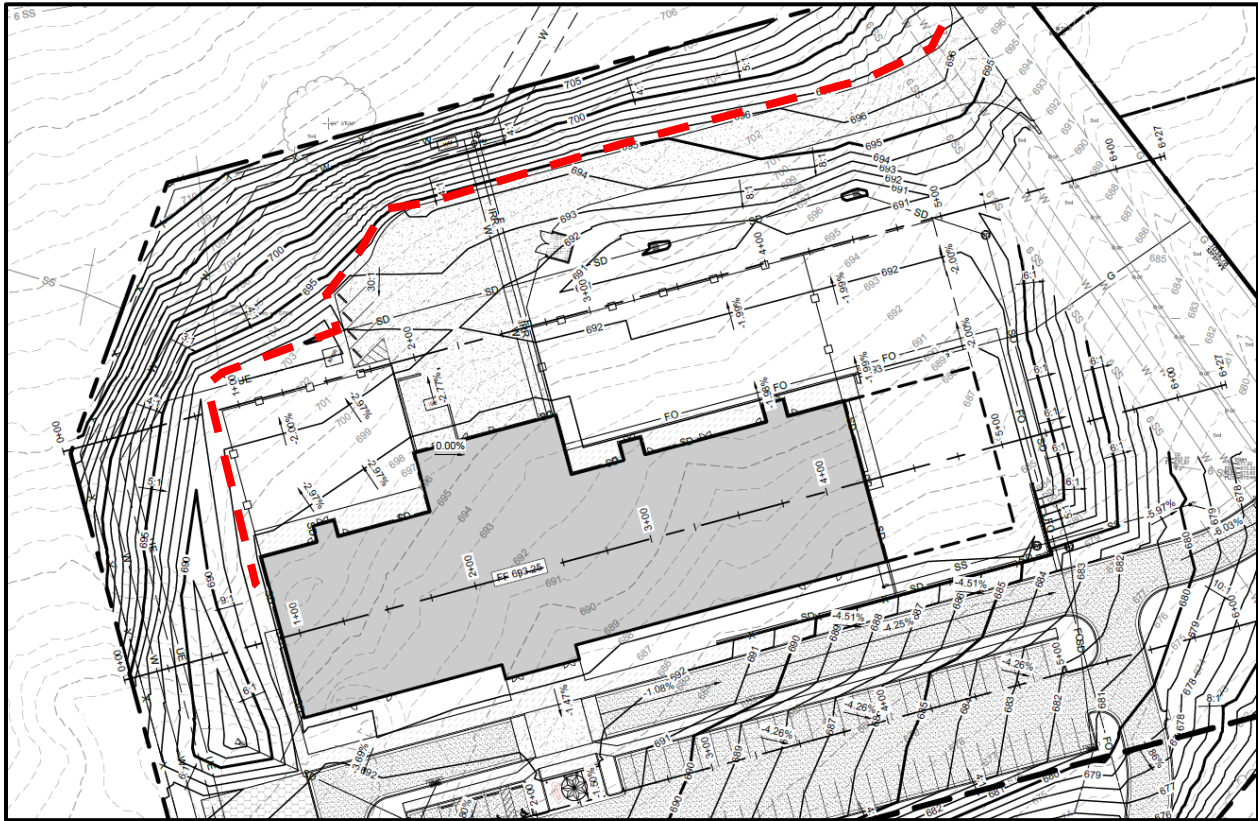


Figure 7: Approximate alignment of recommended open draining ditch/French drain

Prior to start of the construction, we recommend consideration be given to installation of an open drainage ditch or construct a French drain along the north side, between the toe of the planned slope and north access drive (see figure 7 for approximate alignment in red). The construction of an open drainage ditch or French drain is recommended to intercept water from uphill prior to infiltration into the building and pavement areas. The bottom of the open drainage ditch or French drain should extend into the top of weathered rock unit and it should be sloped such to allow for gravity flow to a suitable point of discharge. The civil engineer of record will need to be consulted to determine the alignment and profile.

4.4 MOISTURE SENSITIVE SOILS

Near-surface, moisture sensitive, lean clays were encountered across most of the site. These types of soil degrade when allowed to become wet. When saturated, these soils may not provide a stable platform for fill placement, and they may not be suitable for support of slabs-on-grade, foundations, and pavements. Therefore, not allowing water to pond by maintaining positive drainage and temporary dewatering methods (if required) is important to help avoid degradation and softening of the soils.

The contractor should anticipate some difficulty during the earthwork phase of this project if moisture levels are moderate to high during construction. Increased moisture levels will soften the subgrade and the soils may become unstable under the influence of construction traffic. Accordingly, construction during wet weather conditions should be avoided, as this could result in soft and unstable soil conditions that would require ground modification, such as in place stabilization or undercutting.

4.5 EVALUATION OF MEDIUM STIFF CLAY SOILS

The near-surface clay soils encountered in portions of the planned construction area exhibited medium stiff consistencies that extended to depths of about 2.5 to 5 feet. In boring B-10, located within a naturally low-lying area of the site, medium stiff clays extended to a depth of about 7 feet. Depending on the soil moisture contents at the time of construction, these low consistency soils may not be suitable for start of fill placement or provide adequate support for floor slabs, foundations, and pavements.

Following grading and prior to fill placement, all areas that will require fill or that will support structures should be carefully proofrolled with a fully loaded, tandem-axle dump truck (20- to 25-ton). A designated representative of the geotechnical engineer should observe the proofrolling process.

Areas passing the proofroll should be prepared in accordance with the *Subgrade Preparation and Evaluation* section of this report.

Areas with unstable or soft/loose soils should be marked in the field and further undercut to expose stiff and stable material. Where soft/unstable soils extend to depths greater than 2 feet below finished subgrade, consideration may be given to in-place stabilization by means of tracking surge stone (crushed stone with particle size ranging from 3 to 6 inches in dimension). Further detailed recommendations can be developed by the geotechnical engineer at the time of construction, dependent on the conditions encountered at that time.

4.6 EVALUATION OF FILL MATERIALS

In borings B-09, P-02, P-03, P-04, P-08, P-09, and SB-03, fill materials were encountered below the topsoil that extended to depths of about 2.5 to 5 feet below current grades. Some of the fill exhibited medium stiff consistencies and they included secondary constituents such as rock fragments, tree limbs, and broken concrete and brick.

Although encountered in only seven (7) of the twenty-two (22) borings, fill materials could be present in other unexplored areas of the proposed development.

There is a risk the existing fill contains soft zones, over-sized rock, large amounts of debris, organics, or otherwise unsuitable soils that could not be reasonably deduced from the widely spaced borings across the site.

As a minimum, we recommend that the geotechnical engineer or designated representative evaluate the fill by means of proofrolling with a heavy (20- to 25-ton), loaded tandem axle dump truck. Areas with unstable or soft/loose soils should be marked in the field. Additionally, test pits should be excavated within the delineated areas of concern to evaluate the condition of the existing fill below the exposed subgrade level.

Any soft/loose soils, organic materials, debris, over-sized rock, or any other unsuitable materials encountered in the fill should be removed full depth from construction areas and replaced with low plasticity *Structural Fill*.

4.7 BUILDING PAD PREPARATION

As previously mentioned in this report, we understand that fill heights of up to 9 feet and cut depths of about 5 feet will be required to achieve design grades within the planned building area. Based on the subsurface conditions encountered, following initial site preparation and grading, a combination of existing fill materials and residual soils are anticipated to be exposed within the planned building area.

The onsite clays generally exhibited medium to high plasticity characteristics. The potential vertical rise of the onsite soils encountered in the borings was evaluated using the Texas Department of Transportation's test method TEX-124-E, Potential Vertical Rise (PVR). This method estimates the PVR of the soils based on the plasticity characteristics, thickness of the soil strata, and surcharge loads. For this project site, an active zone of 8 feet was used in the calculations. The TxDOT method estimates a PVR of 1¼ inches for the soil moisture contents encountered at the time of drilling. If the onsite soils are allowed to dry out, the PVR estimate could increase to 1½ inches.

A generally accepted practice is an allowance for a maximum vertical movement of 1-inch or less for grade supported slabs. **To reduce the PVR to ¾- to 1-inch, we recommend that floor slabs be supported on at least 24 inches of approved low plasticity structural fill.** In areas where more than 24 inches of structural fill is needed to achieve design grades, undercutting of onsite soils will not be required provided the exposed subgrade is in a firm and stable condition.

As a minimum, following grading and above recommended undercutting, the exposed fill materials and medium stiff clays should be evaluated in accordance with the *Evaluation of Medium Stiff Clays* and *Evaluation of Fill Materials* sections of this report.

All undercutting should extend at least 5 feet outside the perimeter building lines and the appurtenances. The base stone recommended to be placed below the floor slab (reference the *Floor Slab* section of this report) should not be considered part of the recommended low plasticity structural fill section.

4.8 PAVEMENT SUBGRADE PREPARATION

The grading plan provided to our office indicated that fill heights of up to 7 feet and cut depths of approximately 10 feet will be required to achieve design grades within the planned pavement areas.

Following initial site preparation and grading, a combination of existing fill materials, residual clays, and weathered shale unit are anticipated to be exposed within the planned pavement areas.

The onsite soils have a moderate to high shrink-swell potential, that could cause uneven surfaces of pavements and development of tension cracks in pavements when soil moisture contents change post construction. Also, a weathered shale unit is anticipated to be exposed in the deep cut areas within the north portion of the project area.

To provide for uniform subgrade conditions, we recommend undercutting to a level that will allow placement of at least 10 inches of imported low plasticity structural fill in all paving areas and preparing the subgrade prior to structural fill placement in accordance with the following *Subgrade Preparation and Evaluation* section.

In areas where more than 10 inches of structural fill is needed to achieve design grades, undercutting of onsite soils will not be required provided the exposed subgrade is in a firm and stable condition. Prior to the start of fill placement, the exposed fill materials and medium stiff clays should be evaluated in accordance with *Evaluation of Medium Stiff Clays* and *Evaluation of Fill Materials* sections of this report.

4.9 SUBGRADE PREPARATION AND EVALUATION

Prior to fill placement, the exposed subgrade should be scarified, moisture conditioned, and recompact to a minimum depth of 12 inches. The subgrade soils should be moisture conditioned within a range of 1 percent below to 3 percent above the material's optimum moisture content, and the subgrade soils recompact to at least 98 percent of the material's standard Proctor maximum dry density (ASTM D698).

Weather conditions at the time of construction will affect subgrade stability and undercutting depths and quantities. We recommend that the project geotechnical engineer or a qualified representative evaluate the subgrade after the site is prepared. Some unstable areas may be present in unexplored areas of the site. All areas that will require fill or that will support structures should be carefully proofrolled with a fully loaded, tandem-axle dump truck (20- to 25-ton), at the following times.

- After an area has been stripped and undercut if required, prior to the placement of any fill.
- After grading an area to the finished subgrade elevation in a building or pavement area.
- After areas have been exposed to any precipitation, and/or have been exposed for more than 48 hours.

Some instability may exist during construction, depending on climatic and other factors immediately preceding and during construction. If any soft or otherwise unsuitable soils are identified during the proofrolling process, they should be undercut or stabilized prior to fill placement, pavement construction, or floor slab construction. All unsuitable material identified during construction should be removed and replaced in accordance with the *Structural Fill* section of this report.

4.10 STRUCTURAL FILL

Requirements for structural fill on this project are as follows:

Soil Type	USCS Classification	Property Requirements	Placement Location
<u>Imported</u> Lean Clay, Clayey Sand or Shale	CL, SC	LL<40, 7<PI≤18, γ_d > 100 pcf, P200>30%, Maximum 3" particle size in any dimension, CBR ≥4.0 for pavements	<u>Low Plasticity Structural Fill</u> to be used for construction of building pad and pavements
<u>Onsite Fill Materials and Residuum</u> Lean Clays, Lean to Fat Clays, and Fat Clays	CL, CL-CH, CH	Not Applicable	<u>Not Suitable</u> for use as structural fill due to higher plasticity characteristics (see Note 4)
<u>Onsite Weathered (Sandy) Shale and Clayey Shale</u>	Not Applicable	Same as recommended for imported structural fill	<u>Likely Suitable</u> for use as low plasticity structural fill in building and pavement areas

Table 6: Structural Fill Requirements

Notes:

1. All structural fill should be free of vegetation, topsoil, and any other deleterious materials. The organic content of materials to be used for fill should be less than 3 percent.
2. LL indicates the soil Liquid Limit; PI indicates the soil Plasticity Index; γ_d indicates the maximum dry density as defined by the density standard outlined in the table below.
3. Laboratory testing of the materials proposed for fill should be performed to verify their conformance with the above recommendations. Any fill to be placed at the site should be reviewed and approved by the geotechnical engineer.
4. Although some of the lean clay soils appear to have plasticity characteristics that meet the recommendations for use a low plasticity structural fill, most of the clay soils had LL and PI values that exceeded the recommended upper limits for use as structural fill. Since it will be difficult to differentiate suitable from unsuitable material, the use of onsite clay soils as low plasticity structural fill is not recommended. Consideration may be given to using the onsite clays as structural fill, provided they are placed at levels of at least 4 feet and 1 foot below finished subgrade level in building and pavement areas, respectively.

Placement requirements for structural fill are as follows:

Specification	Requirement
Lift Thickness	Maximum loose lift thickness of 8 to 12 inches, depending on type of compaction equipment used.
Density	At least 98% of the standard Proctor (ASTM D698) maximum density.
Moisture	Structural Fill: 2% below to 2% above the optimum moisture content as determined by ASTM D698 Onsite Clay Soils: 1% below to 3% above the optimum moisture content as determined by ASTM D698
Density Testing Frequency	Building and foundation areas: One test per 2,500 square feet (SF) per lift with a minimum of three tests performed per lift Pavement areas: One test per 5,000 SF per lift with a minimum of three test per lift Utility trenches: One test per 150 linear feet per lift with a minimum of two tests performed per lift The testing frequency can be increased or decreased by the Geotechnical Engineer of Record in the field based on uniformity of material being placed and compactive effort used.

Table 7: Structural Fill Placement Requirement

4.10.1 CHEMICAL STABILIZATION

In lieu of importing lower plasticity structural fill for preparation of the proposed building pad and pavement subgrades, consideration can be given to chemically stabilizing the onsite materials to reduce the plasticity index to less than 15. Following the Soil Stabilization Mix Design Procedure OHDL-50 developed by the Oklahoma Department of Transportation (ODOT), dated April 15, 2022, the onsite soils can be chemically stabilized using quick lime or hydrated lime. The following table presents estimated quantities of the recommended chemical additives based on soil dry weight.

Lime Stabilizing Agent	ODOT Specification ¹	Estimated Quantity of Stabilizing Agent, % of Soil Dry Weight
Quick Lime	307 & 706.02	5
Hydrated Lime	307 & 706.01	6

Table 8: Chemical Stabilization Alternates

Notes:

1. ODOT – Oklahoma Department of Transportation, 2019 edition

Cement kiln dust (CKD) with high free lime content from pre-calciner plants, lime kiln dust (LKD), and carbide lime have also been successfully used with higher plasticity clay soils to reduce their plasticity and shrink-swell potential to within acceptable level. However, these types of chemical additive are by products and their composition varies depending on the source from which they are provided.

Further laboratory testing is recommended to estimate needed concentrations for these types of chemical additive when considered for this project. Building & Earth can assist with this service prior to the start of construction.

Chemical stabilization of the onsite materials should be performed in accordance with the applicable specifications of the Oklahoma Standard Specifications for Highway Construction, 2019 edition.

4.11 BENCHING OF EXISTING SLOPES

Existing slopes within the project site steeper than 5 horizontal to 1 vertical, 5(H): 1(V), and located in fill areas should be benched prior to fill placement. Benching of the slopes provides interlocking between the new fill and on-site materials and facilitates compaction of the fill. Benches should be cut as the fill placement progresses and should have a maximum bench height of 2 to 3 feet.

4.12 FILL SLOPES

For this report, we anticipate fill up to about 10 feet may be needed to achieve design grades at the east and south ends of the proposed building and pavement areas. Fill slopes will range from about 4(H):1(V) to 6(H):1(V).

Systematic fill placement and compaction is essential for satisfactory performance of fill slopes. In addition, for proper placement and compaction, the contractor should accurately locate the toe and crest of the slopes prior to fill placement and maintain an accurate field survey during construction to verify that the slopes are being constructed to the planned configurations.

Even if properly constructed, fill embankments tend to "creep" over time. Creep is the gradual, downward movement of soils near the slope face. The movement can lead to distress in structures supported on the fill. Therefore, pavements and buildings should be set back a minimum distance of 5 and 15 feet from the crest of fill embankments, respectively, or greater if a greater offset distance is required by the International Building Code (IBC).

The long-term stability of fill embankments is dependent on a stable subgrade. Embankments constructed over low-consistency material are susceptible to settlement and slope failure. Therefore, low-strength soils should be removed from beneath the embankment and a minimum of 10 feet beyond the toe of the embankment. Excavations should be backfilled with compacted and tested engineered fill. Building & Earth should verify that the underlying, subgrade soils within the area of influence of the slope exhibit a high consistency prior to embankment construction. All material used to construct the fill embankment should conform to the project requirements for engineered fill. Unsuitable materials (organics, debris, wet or soft soil) should not be placed in embankments. On-site soils must be carefully monitored during construction to ensure only high strength engineered fill is used to construct embankments.

Fill should be placed in thin, horizontal lifts and compacted and tested in accordance with the project requirements. Due to the difficulty in compacting soils on the face of the slope, fill embankments should be overbuilt and cut back to the desired configuration upon completion. In no case should the slope be constructed or reconfigured by pushing soil over the top edge of the slope. Careful control by the contractor during construction is important to ensure that no part of the slope exceeds the design inclination. The fill should be benched into the natural soils to prevent the formation of weak zones.

4.13 EXCAVATION CONSIDERATIONS

Excavations extending to depths greater than 4 feet should be cut to a stable slope or be temporarily braced. Temporary slopes should be constructed in strict compliance with current OSHA excavation regulations.

4.13.1 DIFFICULT EXCAVATION

A weathered rock unit comprised of clayey shale, weathered shale, and weathered sandy shale was encountered in borings B-01, B-02, B-03, B-05, B-06, B-07, SB-01, and SB-02 at depths of approximately 7.5 to 18 feet below present grades.

A large track hoe, in good working condition and equipped with rock teeth likely will be required for excavations extending into the weathered rock unit. Excavation difficulty will increase with increasing depth into the shale unit, possibly requiring the use of a hydraulic hoe ram attachment.

The depth that rock can be excavated is a function of the material, the equipment used, the skill of the operator, the desired rate of removal and other factors. The contractor should review the boring logs and should use his own method to evaluate excavation difficulty.

4.13.2 GROUNDWATER OR PERCHED WATER

Groundwater seepage was encountered in borings B-06 through B-08 during drilling at depths of about 16.5 to 17.5 feet below existing grades. Free water was measured in borings B-01, B-02, and B-06 through B-08 at depths of about 8.5 to 14.5 feet, prior to backfilling the boreholes.

The site is also prone to developing perched water within the residual clays near the contact with underlying rock units.

The recommendations presented in *the General Considerations for Groundwater Interception* section of this report should be considered to intercept water from uphill prior to infiltration into the building and pavement areas.

4.14 UTILITY TRENCH BACKFILL

All utility trenches should be backfilled and compacted in the manner specified above for structural fill. It may be necessary to reduce the lift thickness to 4 to 6 inches to achieve compaction using hand-operated equipment.

At the perimeter wall crossings, we recommend that clay soils or a flowable fill be used to backfill the utility trench. The clay or flowable fill will act as a relatively impermeable plug reducing the risk of water migration from the outside into the interior of the building. The plug should be at least 36 inches wide and should extend below the perimeter walls to provide for a proper seal.

4.15 LANDSCAPING AND DRAINAGE CONSIDERATION

The potential for soil moisture fluctuations within structure areas and pavement subgrades should be reduced to lessen the potential of subgrade movement. Site grading should include positive drainage away from buildings and pavements. Excessive irrigation of landscaping poses a risk of saturating and softening soils below shallow footings and pavements, which could result in settlement of footings and premature failure of pavements. In addition, ponding of water or irrigation of landscaped areas can result in swelling of higher plasticity clay soils and subsequent heave of grade supported slabs and lightly loaded footings.

4.16 WET WEATHER CONSTRUCTION

Excessive movement of construction equipment across the site during wet weather may result in ruts, which will collect rainwater, prolonging the time required to dry the subgrade soils. During rainy periods, additional effort will be required to properly prepare the site and establish/maintain an acceptable subgrade. The difficulty will increase in areas where clay or silty soils are exposed at the subgrade elevation.

Likewise, rainwater may become perched on clay soils, which could require additional dewatering efforts not needed during dry conditions.

A perched-water condition occurs when water seeping downward is slowed by a low permeability soil layer, such as the underlying clays. The perched-water level can be any number of feet above the true groundwater level. Due to the prevalence of clay soils encountered across the project site, the successful contractor should expect to encounter perched water during wet weather construction.

Grading contractors typically postpone grading operations during wet weather to wait for conditions that are more favorable. Contractors can typically disk or aerate the upper soils to promote drying during intermittent periods of favorable weather. When deadlines restrict postponement of grading operations, additional measures such as undercutting and replacing saturated soils or stabilization can be utilized to facilitate placement of additional fill material.

5.0 FOUNDATION RECOMMENDATIONS

Based on information provided to our office, we understand that the individual column loads will be on the order of 50 to 75 kips, and wall loads will be 2 to 3 kips per linear foot. ***If changes are made to the provided preliminary loads, our office should be contacted, such that our recommendations can be reviewed and revised if needed.***

5.1 PROPOSED BUILDING AND OUTDOOR CLASSROOM

Based on the conditions encountered during our field investigation, and after our site preparation recommendations are implemented, the proposed structures can be supported on conventional shallow foundations.

Following grading and based on the subsurface conditions encountered, we anticipate that a combination of properly compacted and approved low plasticity structural fill, residual clay soils, and weathered shale will be exposed at footing bearing elevations within the proposed building and outdoor classroom areas.

Footings founded in a combination of residual clays, new structural fill, and weathered shale can be designed using a maximum net allowable bearing capacity of 2,500 psf.

With anticipated fill heights on the order of up to 9 feet within the proposed building areas, proper placement and compaction of fill is crucial to reduce the risk of foundation settlement. We recommend that the fill placed within the proposed building and pavement areas be monitored on a continuous basis by a representative of Building & Earth. The thickness, material type, compaction, and moisture content of each lift should be determined.

Total settlement of footings bearing in weathered rock or stiff residuum that is underlain by weathered rock at shallow depth is estimated to be ½-inch or less. Total long-term settlement of footings in the deep fill areas could potentially approach 1-inch. In general, differential settlement of footings is estimated at ½-inch over a distance of 40 feet; however, in areas transitioning from weathered rock to deep fill, differential settlement could be on the order of ½-inch over a shorter distance than 40 feet.

Column footings should be at least 24 inches wide and strip footings should be at least 18 inches wide. These dimensions facilitate hand cleaning of footing subgrades disturbed by the excavation process and the placement of reinforcing steel. They also reduce the potential for localized punching shear failure.

5.1.1 UPLIFT AND SHEAR RESISTANCE

Uplift resistance of spread footings can be developed from the weight of the foundation, the effective weight of the overlying soils, and from the effective weight of the structure itself. Soil uplift resistance may be calculated as the weight of the soil prism defined by a diagonal line extending around the perimeter of the foundation, from the top of the foundation to the ground surface at an angle of 25 degrees from the vertical (Figure 8).

The maximum uplift capacity should be taken as the sum of the weight of the soil, plus the weight of the foundation, divided by an appropriate factor of safety. A total unit weight of 110 pounds per cubic foot (pcf) can be used for well-compacted structural fill that has been placed over the foundation.

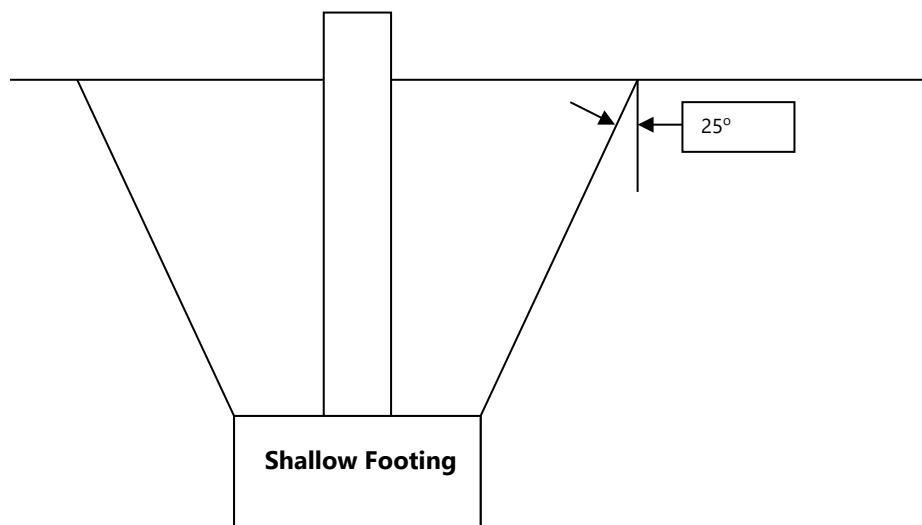


Figure 8: Soil uplift resistance sketch

Passive earth pressures of materials adjacent to the footings as well as bearing material friction at the base may be used to resist shear. The following table presents recommended friction coefficient and passive earth pressure values for the anticipated bearing materials. The structural engineer should use a factor of safety of at least 1.5 when sizing the foundations to resist shear loads using the below ultimate soil parameter values.

Material	Friction Coefficient	Equivalent Fluid Unit Weight for Passive Condition Lateral Earth Pressures (pcf)
Residuum, Structural Fill, and Weathered Shale	0.35	275

Table 9: Soil Parameter Values Resisting Shear

5.2 PROPOSED RETAINING WALLS

As mentioned previously, we understand that a new retaining wall with height up to 13 feet will be part of the new construction (southeast of the existing building). We assume the new retaining walls will be supported on shallow footings.

Per the provided grading information, we anticipate new fill on the order of 6 to 13 feet along the planned retaining wall alignment. Based on subsurface conditions encountered in borings B-10 and P-03, we anticipate stiff existing fill materials, and medium stiff to stiff residual clays to be present below the new structural fill zone.

Per the provided Grading Sections, Sheet No. C503, prepared by Wallace Design Collective, dated February 9, 2024, all retaining wall footings will be supported on at least 24 inches of new structural fill.

Provided that footings are bearing on at least 24 inches of new structural fill, a maximum net allowable bearing pressure of 2,000 psf can be used in design of the retaining wall footings.

All footings should bear at least 24 inches below the adjacent exterior grade and the edge of footing facing the slope must be at least one footing width behind the face of the slope at bearing level, as shown in the figure below.

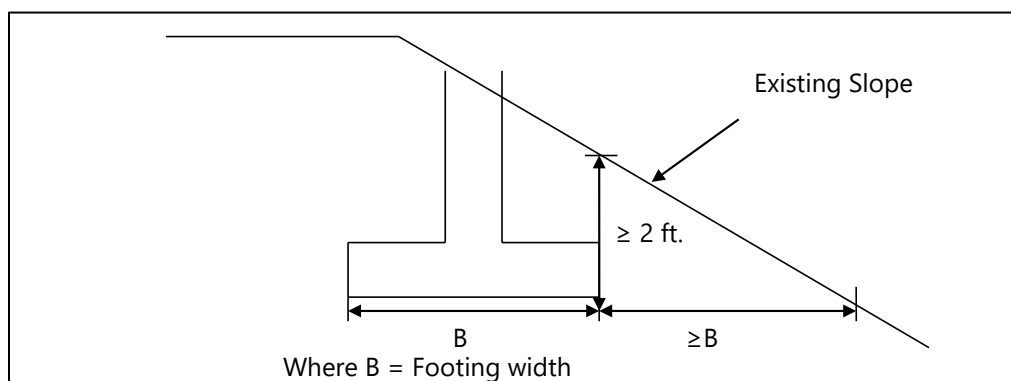


Figure 9: Recommendations for footing on slope

5.3 GENERAL CONSIDERATIONS

Due to the presence of existing fill and medium stiff clays in portions of the structure areas, a thorough evaluation of bearing materials exposed in the bottom of footing excavations is recommended. Evaluation of the bearing materials should include hand auger borings and dynamic cone penetration (DCP) testing to a level at least one (1) footing width below design bearing elevation. DCP testing will aid with verification of the in-place allowable bearing capacity of the bearing materials at the time of construction.

Materials that do not meet the recommended bearing capacity should be delineated and undercut to suitable material and replaced with approved structural fill. Lateral over-excavation of unsuitable soils should extend 8 inches beyond the edges of the footing for each foot of undercut depth below design bearing elevation. The footings should then be brought back up to design bearing elevation with properly compacted and approved *Structural Fill* (placed in loose lifts of no more than 6 inches thick and compacted to at least 95 percent of the standard Proctor maximum dry density) or controlled low-strength material (CLSM, Section 701.19 of Oklahoma Department of Transportation Standard Specifications, 2019).

The following items should be considered during the preparation of construction documents and foundation installation:

- The geotechnical engineer of record should observe the exposed foundation bearing surfaces prior to concrete placement to verify that the conditions anticipated during the subsurface exploration are encountered.
- All bearing surfaces must be free of soft or loose soil and debris prior to placing concrete.
- The bottom surface of all footings should be level.
- Concrete should be placed the same day the excavations are completed and bearing materials verified by the engineer. If the excavations are left open for an extended period, or if the bearing surfaces are disturbed after the initial observation, then the bearing surfaces should be re-evaluated prior to concrete placement.
- Water should not be allowed to pond in foundation excavations prior to concrete placement or above the concrete after the foundation is completed.
- Wherever possible, the foundation concrete should be placed "neat," using the sides of the excavations as forms. Where this is not possible, the excavations created by forming the foundations must be backfilled with suitable structural fill and properly compacted.
- Grades around the building pad should be sloped to drain away from the building foundations.
- Roof drains should be routed away from the foundation soils.

6.0 PERIMETER FOUNDATION AND UNDER-SLAB DRAINS

Perched water was encountered in the residuum near the contact with the weathered rock units. Grading plans indicate that finished grades within the building area may expose the weathered rock units or it will be slightly above the weathered rock units. Perched water seepage could potentially occur near finished subgrade level within the building area.

Consideration should be given to the installation of building perimeter foundation drains. Subdrains should consist of 4-inch diameter, high density polyethylene (HDPE) perforated pipe and should be surrounded by at least 6 inches of No. 57 stone and wrapped with a suitable geotextile filter fabric, such as Mirafi 140N or equivalent. The bottom of the pipe should be placed at least 6 inches below the bottom of the footings. The drain system should allow for gravity flow of water to a suitable point of discharge or to a sump pump.

We also recommend that consideration be given to the installation of an under-slab drainage system. Lateral drains should be located beneath the floor slabs. All subdrains should consist of 4-inch diameter, high density polyethylene (HDPE) perforated pipe and should be embedded in ASTM C33 No. 57 stone with thicknesses of 3 inches below the bottom and above the top of the pipe and wrapped with a suitable geotextile filter fabric consisting of Mirafi 140N or equivalent. The total thickness of the open graded, free draining layer of No. 57 stone should be at least 10 inches.

The lateral drains should be spaced no more than 25 feet on center. A slope of at least ½ percent should be maintained to promote gravity flow to sump pits where any collected water can be pumped to a suitable point of discharge, such as a storm sewer, or other suitable outfall for removal of groundwater.

The structural and civil engineer of records should be consulted, and construction documents should include plans, profiles, and details related to the recommended foundation perimeter and under-slab drains.

7.0 FLOOR SLABS

Site development recommendations presented in this report should be followed to provide for subgrade conditions suitable for support of grade supported slabs. Floor slabs will be supported on at least 24 inches of new lower plasticity structural fill.

Floor slabs should be supported on a layer of ½-inch up to 1½-inch, free-draining, gap-graded gravel, such as No. 57 stone, with no more than 5 percent passing the ASTM No. 200 sieve. When incorporating an under-slab drain system into the floor slab design, the layer of free draining stone should have a thickness of at least 4 inches outside the trench drain alignments and at least 10 inches within the trenches of the perforated drain lines.

The open graded stone should be consolidated in-place with vibratory equipment. The surface of these bases should be choked off with finer material. A clean fine-graded material with at least 10 to 30 percent of particles passing a No. 100 sieve but not contaminated with clay, silt or organic material is recommended.

We recommend a minimum 10-mil thick vapor retarder meeting ASTM E 1745, Class C requirements be placed directly below the slab-on-grade floors. A higher quality vapor retarder (Class A or B) may be used if desired to further inhibit the migration of moisture through the slab-on-grade and should be evaluated based on the floor covering and use. The vapor retarder should extend to the edge of the slab-on-grade floors and should be sealed at all seams and penetrations.

An effective modulus of subgrade of 150 pci can be used for slabs supported on the recommended base stone. The slab should be appropriately reinforced (if required) to support anticipated floor loads.

8.0 RETAINING WALLS

We anticipate retaining walls will retain new structural fill. We understand that retaining walls will have retained heights of 6 to 13 feet to accommodate planned grade changes. We recommended that all walls be backfilled with properly compacted and approved lower plasticity structural fill in accordance with the *Structural Fill* section of this report.

The following drained equivalent fluid pressures should be used to design the proposed walls. We recommend that a drainage blanket of ASTM No. 57 stone (chimney drain), with a minimum width of 18 inches be placed behind all walls. The clean stone should be wrapped in filter fabric to minimize intrusion of fines. A perforated drain line should be installed at the base of the wall and should extend to a sump where water can be collected and removed, or drains should discharge by gravity flow to a suitable outfall.

Retained Material	Soil Parameter Values		Equivalent Fluid Unit Weights for Active & At-Rest Lateral Earth Pressures (pcf)	
	Wet Unit Weight (pcf)	Effective Angle of Internal Friction	At-Rest Condition	Active Condition
Structural Fill	125	28°	66	45

Table 10: Soil Parameters and Lateral Earth Pressure Values (Drained Conditions)

Lateral pressures arising from surcharge loading should be added to the above earth pressures to determine the total lateral pressures. In addition, transient loads imposed on the retaining walls by construction equipment during backfilling should be taken into consideration. Excessively heavy grading equipment (that could impose temporary excessive lateral pressures) should not be allowed within 5 feet (horizontally) of the walls.

The above soil parameter and lateral earth pressure values assume the following:

- The wall backfill will be horizontal.
- Any backfill will be compacted to 98 percent of standard Proctor maximum dry density.
- No safety factor is included. The design of the stem walls should include a factor of safety of at least 1.5 against sliding and overturning using the above recommended values.

- Any surcharge is uniform.
- Wall friction is negligible.

9.0 PAVEMENT CONSIDERATIONS

Specific traffic information was not provided. For pavement design purposes, we have assumed two levels of traffic shown on the table below, for commonly used pavement sections. If the pavement were a typical roadway, according to the "AASHTO Guide for Design of Pavement Structures, 1993", these pavement sections would be adequate for the following assumed ESAL capacities:

Type	Assumed Equivalent Single Axle Loads (ESAL)
Standard Duty Parking Stalls for Passenger Vehicles	115,000
Heavy Duty Drives for Passenger Vehicles and Occasional Light Box Trucks and Trash Collection Trucks	300,000

Table 11: Assumed ESAL Capacities

In addition, we have assumed the following design parameters:

Design Criteria	Value
Design life (Years)	20
Terminal Serviceability	2.0
Reliability	85%
Initial Serviceability	4.2 (Flexible) 4.5 (Rigid)
Standard Deviation	0.45 (Flexible) 0.35 (Rigid)

Table 12: Assumed Design Parameters

All subgrade, base and pavement construction operations should meet minimum requirements of the Oklahoma Department of Transportation (ODOT), Standard Specifications for Highway Construction, dated 2019. The applicable sections of the specifications are identified as follows:

Material	Specification Section
Portland Cement Concrete Pavement	414 & 701
Bituminous Asphalt Wearing Layer	411 & 708
Bituminous Asphalt Binder Layer	411 & 708
Mineral Aggregate Base Materials	303 & 703

Table 13: ODOT Specification Sections

9.1 FLEXIBLE PAVEMENT

The asphalt pavement sections described herein were designed using the “AASHTO Guide for Design of Pavement Structures, 1993”. Alternative pavement sections were designed by establishing the structural numbers used for the AASHTO design system and substituting materials based upon structural equivalency as follows:

Material	Structural No.
Asphalt Concrete	0.44
Crushed Stone Base	0.14
Approved Structural Fill	0.02

Table 14: Structural Equivalent Coefficient

Based on the materials encountered at the boring locations and after our recommendations for site preparation are implemented, flexible pavements at the subject site may be designed based on an estimated California Bearing Ratio (CBR) of 3. The following flexible pavement sections are based on the design parameters presented above:

Minimum Recommended Thickness (in)		Material
Standard Duty	Heavy Duty	
1.5	2.0	HMAC Surface Course (Superpave “S4”)
2.5	3.0	HMAC Binder Course (Superpave “S3”)
6.0	6.0	Crushed Aggregate Base (ODOT Type “A”)
10.0	10.0	Approved Structural Fill (CBR ≥4.0)

Table 15: Asphalt Pavement Recommendations

In accordance with the ODOT specifications, asphaltic concrete should be compacted within 92 to 97 percent of the theoretical maximum specific gravity of the asphaltic concrete mix. The underlying aggregate base course should be compacted to at least 98 percent of the material’s standard Proctor maximum dry density with a moisture content range of ± 2 percent of the optimum moisture content at the time of placement.

9.2 RIGID PAVEMENT

The following rigid pavement sections are based on the design parameters presented above. We assume a modulus of subgrade reaction (k) of 100 pci. We have assumed concrete elastic modulus (Ec) of 3.1 X 10⁶ psi, and a concrete modulus of rupture (S’c) of 600 psi.

Minimum Recommended Thickness (in)		Material
Standard Duty	Heavy Duty	
5.0	6.0	Portland Cement Concrete, $f'_c=3,500$ psi
4.0	4.0	Crushed Aggregate Base (ODOT Type "A")
10.0	10.0	Approved Structural Fill (CBR ≥ 4.0)

Table 16: Rigid Pavement Recommendations

For access drive approaches, trash compactor pads, loading areas, and other pavement areas that are frequently subject to high traffic loads with frequent braking and turning of wheels, consideration should be given to using a reinforced rigid pavement section comprised of seven (7) inches of Portland cement concrete and 6 inches ODOT Type "A" crushed aggregate base course.

The recommended aggregate base course will serve as a leveling course, improve the subgrade support properties, and reduce the risk of pumping of fine-grained subgrade soils through the joints.

The concrete should be protected against moisture loss, rapid temperature fluctuations, and construction traffic for several days after placement. All pavements should be sloped for positive drainage. We suggest that a curing compound be applied after the concrete has been finished.

For rigid pavements, we recommend a jointing plan be developed to control cracking and help preclude surficial migration of water into the base course and subgrade. If a jointing plan includes a widely spaced pattern (spacing typically greater than 30 times the slab thickness), consideration should be given to include steel reinforcement in rigid pavements, per Section 3.4 of the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures 1993, and Section 3.8 of the American Concrete Institute (ACI) Guide for the Design and Construction of Concrete Parking Lots. Additionally, we recommend the joints be sealed to further preclude surficial moisture migration into the underlying supporting soils.

Although not referenced in the ODOT specifications, based on our experience with project sites in this region and anticipated traffic loads, we recommend Portland cement concrete should have a minimum 28-day compressive strength of 3,500 psi, maximum slump of 4 inches, and air content of 5 to 7 percent.

9.3 GENERAL PAVEMENT DESIGN CONSIDERATIONS

With the use of aggregate base course, the aggregate should have uniform thickness and the subgrade graded such as to provide positive drainage from the granular base. The aggregate base section should grade toward a storm sewer or drainage ditch to provide drainage from the aggregate base.

Pavements should be sloped, approximately $\frac{1}{4}$ inch per foot, to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature deterioration of the pavements due to loss of strength and stability.

Periodic maintenance of the pavement should be anticipated. This should include sealing of cracks and joints and maintaining proper surface drainage to avoid ponding water on or near the pavement areas.

10.0 SUBGRADE REHABILITATION

The subgrade soils often become disturbed during the period between initial site grading and construction of surface improvements. The amount and depth of disturbance will vary with soil type, weather conditions, construction traffic, and drainage.

The engineer should evaluate the subgrade soil during final grading to verify that the subgrade is suitable to receive pavement and/or concrete slab base materials. The final evaluation may include proofrolling or density tests.

Subgrade rehabilitation can become a point of controversy when different contractors are responsible for site grading and building construction. The construction documents should specifically state which contractor will be responsible for maintaining and rehabilitating the subgrade. Rehabilitation may include moisture conditioning and re-compacting soils. When deadlines or weather restrict grading operations, additional measures such as undercutting and replacing saturated soils or chemical stabilization can often be utilized.

11.0 CONSTRUCTION MONITORING

Field verification of site conditions is an essential part of the services provided by the geotechnical consultant. To confirm our recommendations, it will be necessary for Building & Earth personnel to make periodic visits to the site during site grading. Typical construction monitoring services are listed below.

- Periodic observations and consultations by a member of our engineering staff during site grading
- Field density tests during structural fill placement on a continuous basis
- Observation and verification of the bearing surfaces exposed after foundation excavation
- Reinforcing steel inspections
- Molding and testing of concrete cylinders
- Structural steel inspections, including field welded and bolted connections
- Continuous monitoring and testing during pavement installation

12.0 CLOSING AND LIMITATIONS

This report was prepared for Blue River Architects for specific application to the subject project located in Catoosa, Oklahoma. The information in this report is not transferable. This report should not be used for a different development on the same property without first being evaluated by the engineer.

The recommendations in this report were based on the information obtained from our field exploration and laboratory analysis. The data collected is representative of the locations tested. Variations are likely to occur at other locations throughout the site. Engineering judgment was applied regarding conditions between borings. It will be necessary to confirm the anticipated subsurface conditions during construction.

This report has been prepared in accordance with generally accepted standards of geotechnical engineering practice. No other warranty is expressed or implied. If changes are made, or anticipated to be made, to the nature, design, or location of the project as outlined in this report, Building & Earth must be informed of the changes and given the opportunity to either verify or modify the conclusions of this report in writing, or the recommendations of this report will no longer be valid.

The scope of services for this project did not include any environmental assessment of the site or identification of pollutants or hazardous materials or conditions. If the owner is concerned about environmental issues Building & Earth would be happy to provide an additional scope of services to address those concerns.

This report is intended for use during design and preparation of specifications and may not address all conditions at the site during construction. Contractors reviewing this information should acknowledge that this document is for design information only.

An article published by the Geoprofessional Business Association (GBA), titled *Important Information About Your Geotechnical Report*, has been included in the Appendix. We encourage all individuals to become familiar with the article to help manage risk.

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GEOTECHNICAL INVESTIGATION METHODOLOGIES

The subsurface exploration, which is the basis of the recommendations of this report, has been performed in accordance with industry standards. Detailed methodologies employed in the investigation are presented in the following sections.

DRILLING PROCEDURES – STANDARD PENETRATION TEST (ASTM D1586)

At each boring location, soil samples were obtained at standard sampling intervals with a split-spoon sampler. The borehole was first advanced to the sample depth by augering and the sampling tools were placed in the open hole. The sampler was then driven 18 inches into the ground with a 140-pound automatic hammer free-falling 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded. The initial increment is considered the “seating” blows, where the sampler penetrates loose or disturbed soil in the bottom of the borehole.

The blows required to penetrate the final two (2) increments are added together and are referred to as the Standard Penetration Test (SPT) N-value. The N-value, when properly evaluated, gives an indication of the soil’s strength and ability to support structural loads. Many factors can affect the SPT N-value, so this result cannot be used exclusively to evaluate soil conditions.

The SPT testing was performed using a drill rig equipped with an automatic hammer. Automatic hammers mechanically control the height of the hammer drop, and doing so, deliver higher energy efficiency (90 to 99 % efficiency) than manual hammers (60 % efficiency) which are dropped using a manually operated rope and cathead system. Because historic data correlations were developed based on use of a manual hammer, it is necessary to adjust the N-values obtained using an automatic hammer to make these correlations valid. Therefore, an energy correction factor of 1.3 was applied to the recorded field N-values from the automatic hammer for the purpose of our evaluation. The N-values discussed or mentioned in this report and shown on the boring logs are recorded field values.

Samples retrieved from the boring locations were labeled and stored in plastic bags at the jobsite before being transported to our laboratory for analysis. The project engineer prepared Boring Logs summarizing the subsurface conditions at the boring locations.

BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

DEPTH AND ELEVATION

The depth below the ground surface and the corresponding elevation are shown in the first two columns.

SAMPLE TYPE

The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

SAMPLE NUMBER

Each sample collected is numbered sequentially.

BLOWS PER INCREMENT, REC%, RQD%

When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 5. When rock core is obtained the recovery ratio (REC%) and Rock Quality Designation (RQD%) is recorded.

SOIL DATA

Column 6 is a graphic representation of four different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 6 is summarized below:

- **N-value**- The Standard Penetration Test N-value, obtained by adding the number of blows required to drive the sampler the final 12 inches, is recorded . The graph labels range from 0 to 50.
- **Qu** – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- **Atterberg Limits** – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Remarks column on the far right of the boring log. The Atterberg Limits graph labels range from 0 to 100%.
- **Moisture** – The Natural Moisture Content of the soil sample as determined in our laboratory.

SOIL DESCRIPTION

The soil description prepared in accordance with ASTM D2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line and the elevation of the change indicated on the right side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

GRAPHIC

The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

REMARKS

Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.

Major Divisions			Symbols		Group Name & Typical Description
			Lithology	Group	
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel and Gravelly Soils More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (Less than 5% fines)		GW	Well-graded gravels, gravel – sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel – sand mixtures, little or no fines
		Gravels with Fines (More than 12% fines)		GM	Silty gravels, gravel – sand – silt mixtures
				GC	Clayey gravels, gravel – sand – clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (Less than 5% fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		Sands with Fines (More than 12% fines)		SM	Silty sands, sand – silt mixtures
				SC	Clayey sands, sand – clay mixtures
Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid Limit less than 50	Inorganic		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Organic		OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50	Inorganic		MH	Inorganic silts, micaceous or diatomaceous fine sand, or silty soils
				CH	Inorganic clays of high plasticity
		Organic		OH	Organic clays of medium to high plasticity, organic silts
Highly Organic Soils				PT	Peat, humus, swamp soils with high organic contents

Table 1: Soil Classification Chart (based on ASTM D2487)

Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.

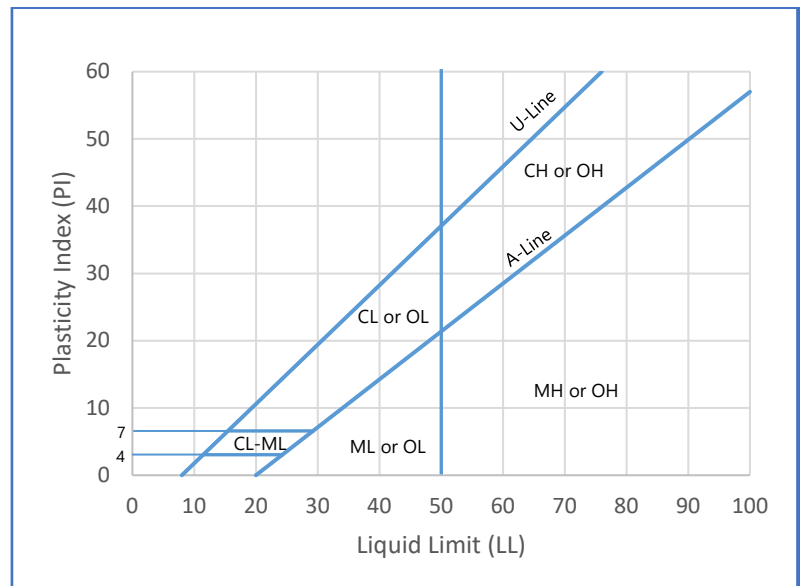


Figure 1: Plasticity Chart (based on ASTM D2487)

Non-cohesive: Coarse-Grained Soil			Cohesive: Fine-Grained Soil			
SPT Penetration (blows/foot)		Relative Density	SPT Penetration (blows/foot)		Consistency	Estimated Range of Unconfined Compressive Strength (tsf)
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)

* - Modified based on 80% hammer efficiency

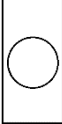
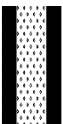
	Standard Penetration Test ASTM D1586 or AASHTO T-206		Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
	Shelby Tube Sampler ASTM D1587		No Sample Recovery
	Rock Core Sample ASTM D2113		Groundwater at Time of Drilling
	Auger Cuttings		Groundwater as Indicated

Table 1: Symbol Legend

Soil	Particle Size	U.S. Standard
Boulders	Larger than 300 mm	N.A.
Cobbles	300 mm to 75 mm	N.A.
Gravel	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
Sand	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
Fines	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

Table 2: Standard Sieve Sizes

N-Value 	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.	Atterberg Limits 	A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
Qu 	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).	% Moisture 	Percent natural moisture content in general accordance with ASTM D2216.

Table 3: Soil Data

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

Table 4: Soil Drilling Methods

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

Table 5: Descriptors

Manual Hammer	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
Automatic Trip Hammer	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

Table 6: Sampling Methods

Non-plastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Table 7: Plasticity

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, usually soil is below water table.

Table 8: Moisture Condition

Stratified	Alternating layers of varying material or color with layers at least 1/2 inch thick.
Laminated	Alternating layers of varying material or color with layers less than 1/4 inch thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensides	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Table 9: Structure

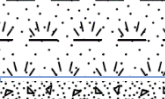
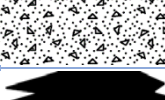
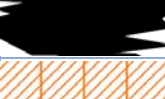
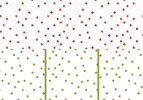
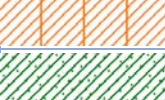
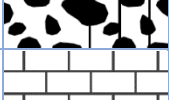
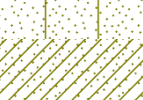
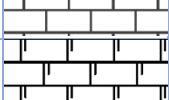
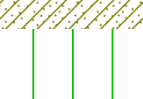
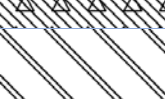
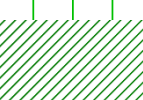
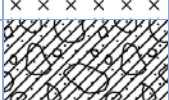
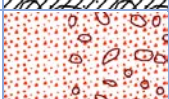
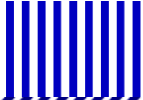
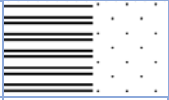
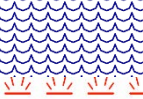
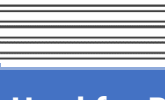
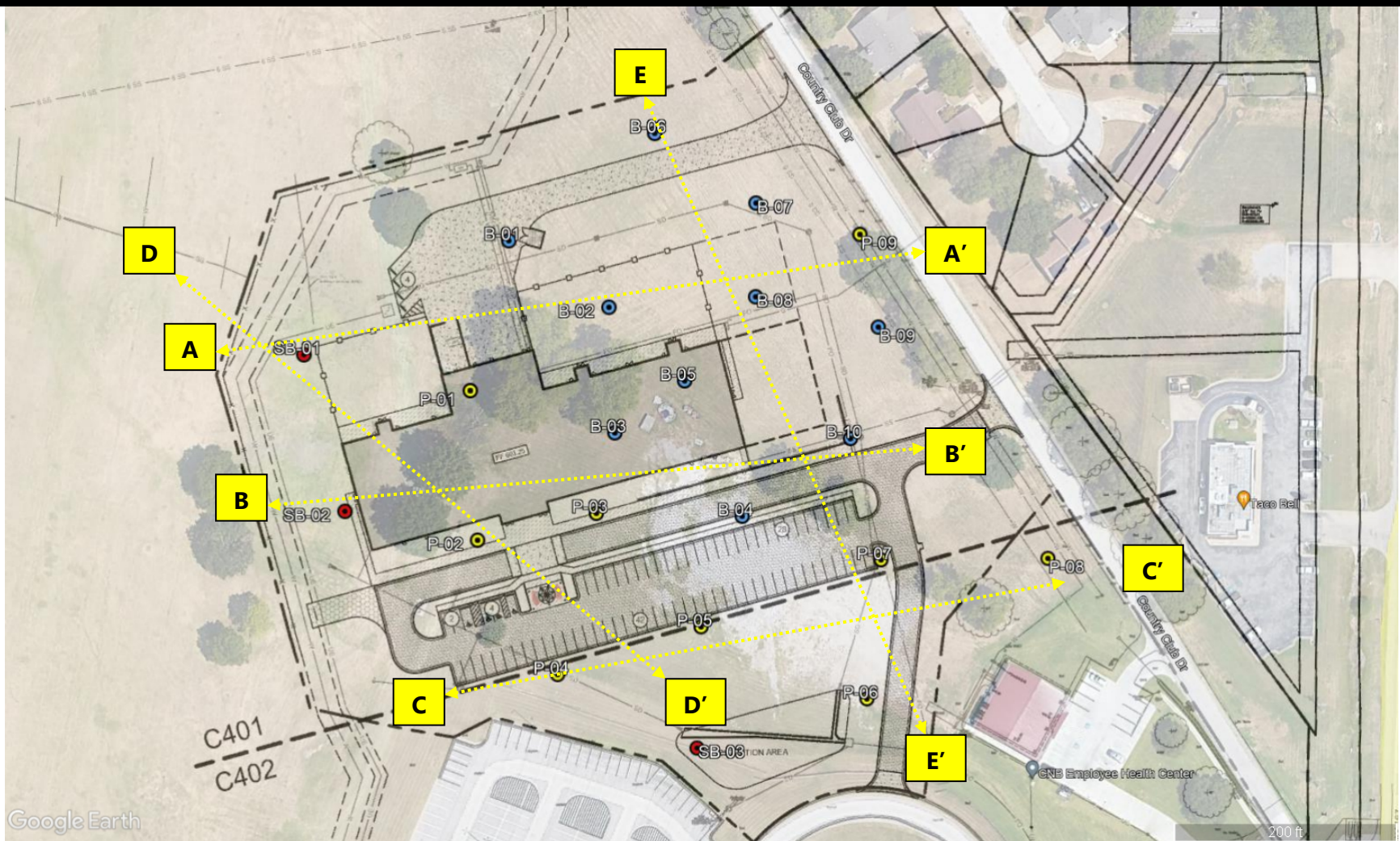
<i>Hatch</i>	<i>Description</i>	<i>Hatch</i>	<i>Description</i>	<i>Hatch</i>	<i>Description</i>
	GW - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	GP - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	GM - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	GC - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	SW - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	SP - Poorly-graded sands, gravelly sands, little or no fines		CL-ML - Silty Clay		Gravel with Silt
	SM - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	SC - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	OL - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	MH - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	CH - Inorganic clays of high plasticity		Weathered Rock		Coral
	OH - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	PT - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock

Table 1: Key to Hatches Used for Boring Logs and Soil Profiles

BORING LOCATION PLAN



**REFERENCE USED
TO PRODUCE THIS
DRAWING:**

Google Earth Satellite
Imagery dated 8/11/2022
with overlay of Site Plan -
Overall, prepared by Wallace
Design Collective, dated
02/09/2024

BORING LOCATION PLAN

PROJECT NO.

TU230102

PROJECT NAME / LOCATION:

Cherokee Nation Child
Development Center
Catoosa, Oklahoma

DATE: 01/18/2024

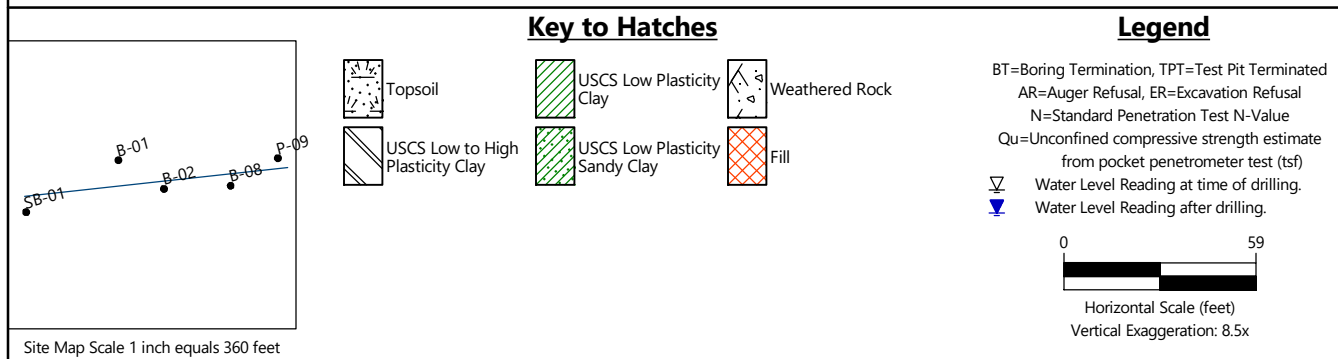
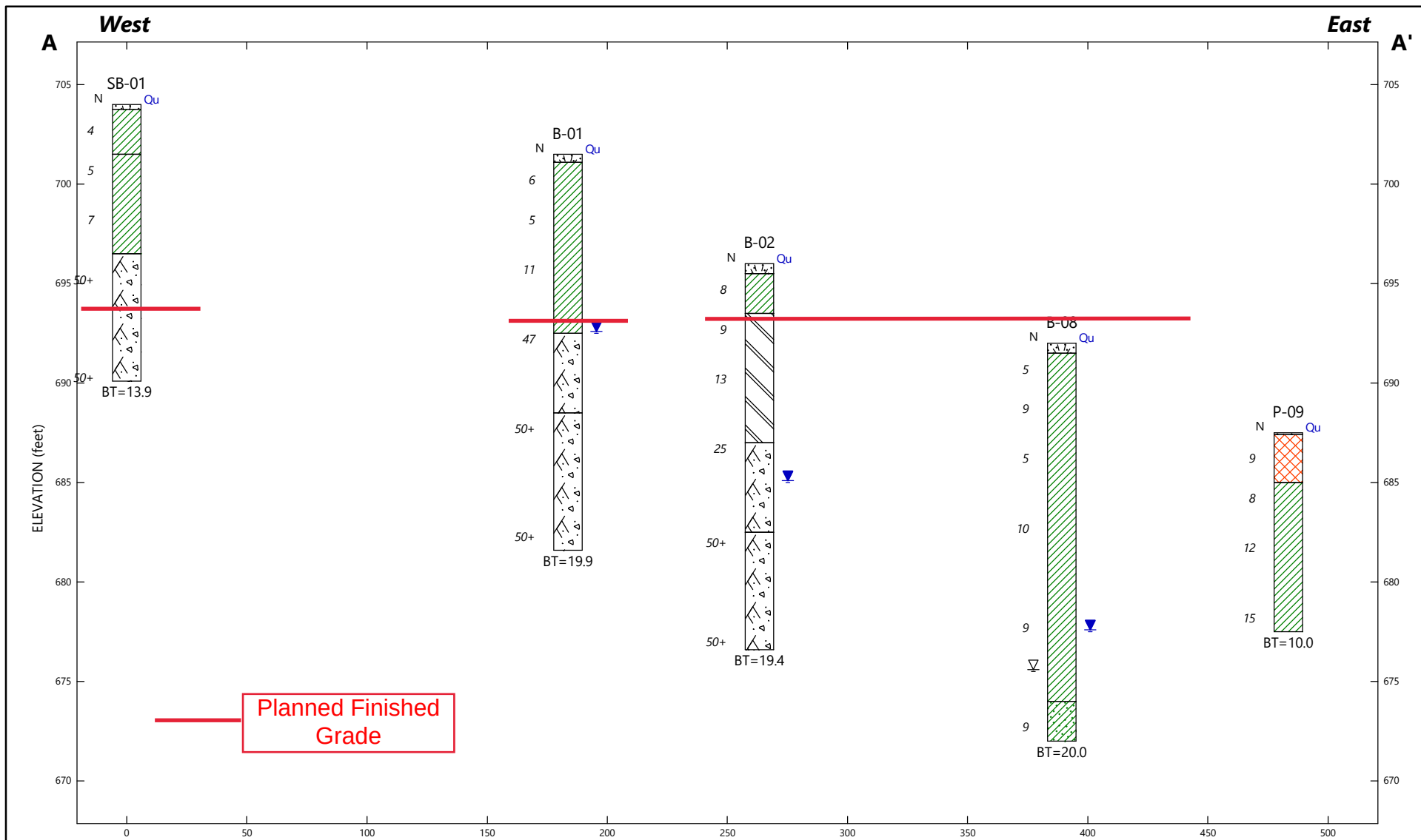
SCALE:

As Shown

BUILDING & EARTH

Geotechnical, Environmental, and Materials Engineers

SUBSURFACE PROFILES



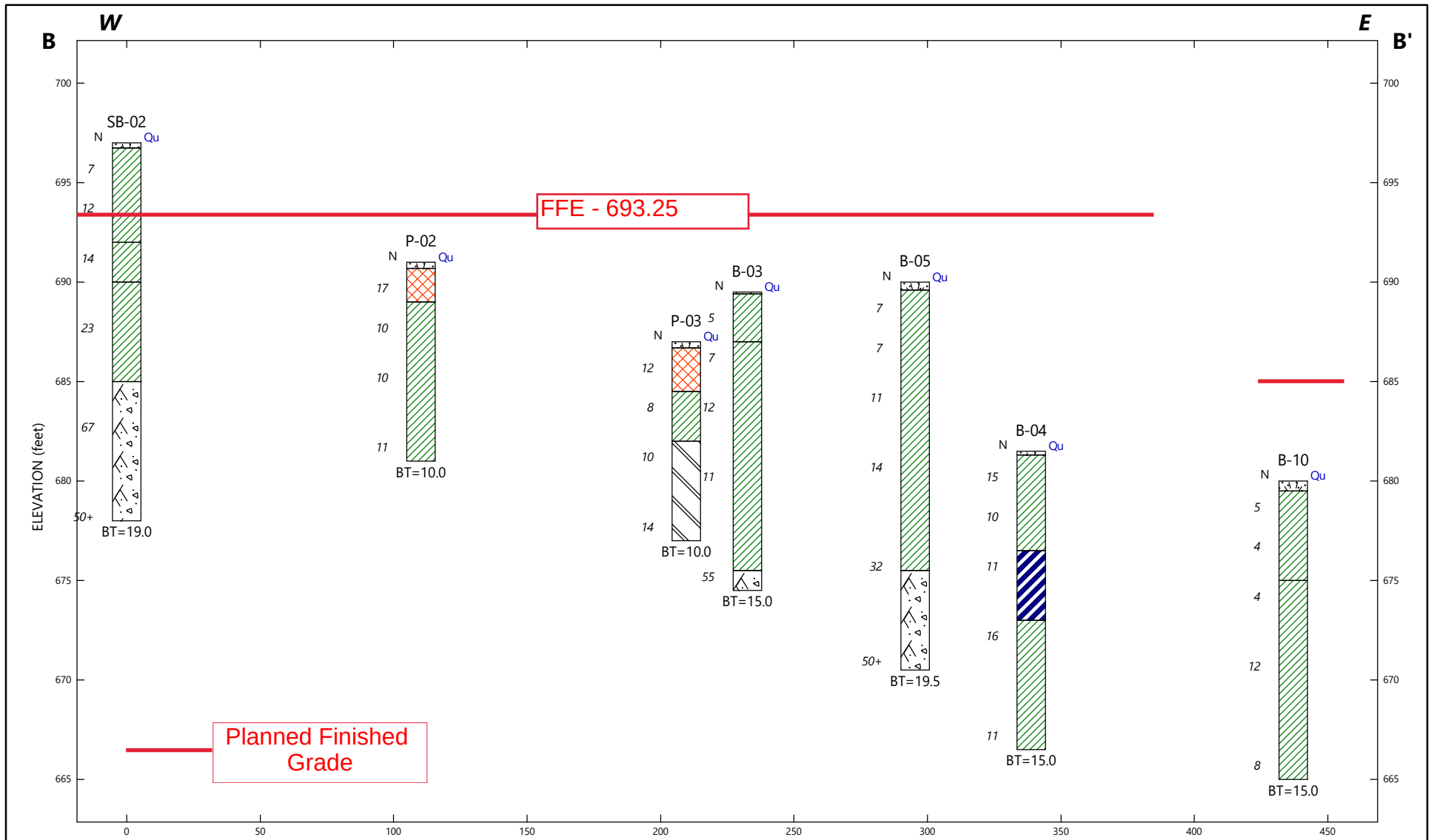
Building & Earth Sciences, Inc.
 1403 South 70th East Avenue, Tulsa, Oklahoma 74133

Cherokee Nation Child Development Center
 Catoosa, OK

A-A': Subsurface Profile

PROJECT NO: TU230102	PLATE NO: A-1	DATE: 3/4/24
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BUILDING & EARTH
 Geotechnical, Environmental, and Materials Engineers



Site Map Scale 1 inch equals 325 feet

Key to Hatches

Topsoil	USCS Low Plasticity Clay	Weathered Rock
USCS High Plasticity Clay	Fill	USCS Low to High Plasticity Clay

Legend

BT=Boring Termination, TPT=Test Pit Terminated
 AR=Auger Refusal, ER=Excavation Refusal
 N=Standard Penetration Test N-Value
 Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)

Water Level Reading at time of drilling.
 Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 7.5x

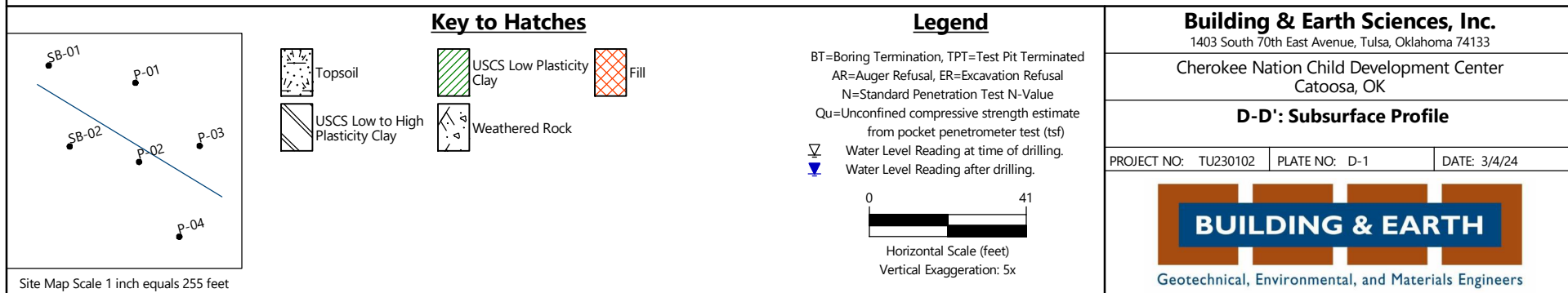
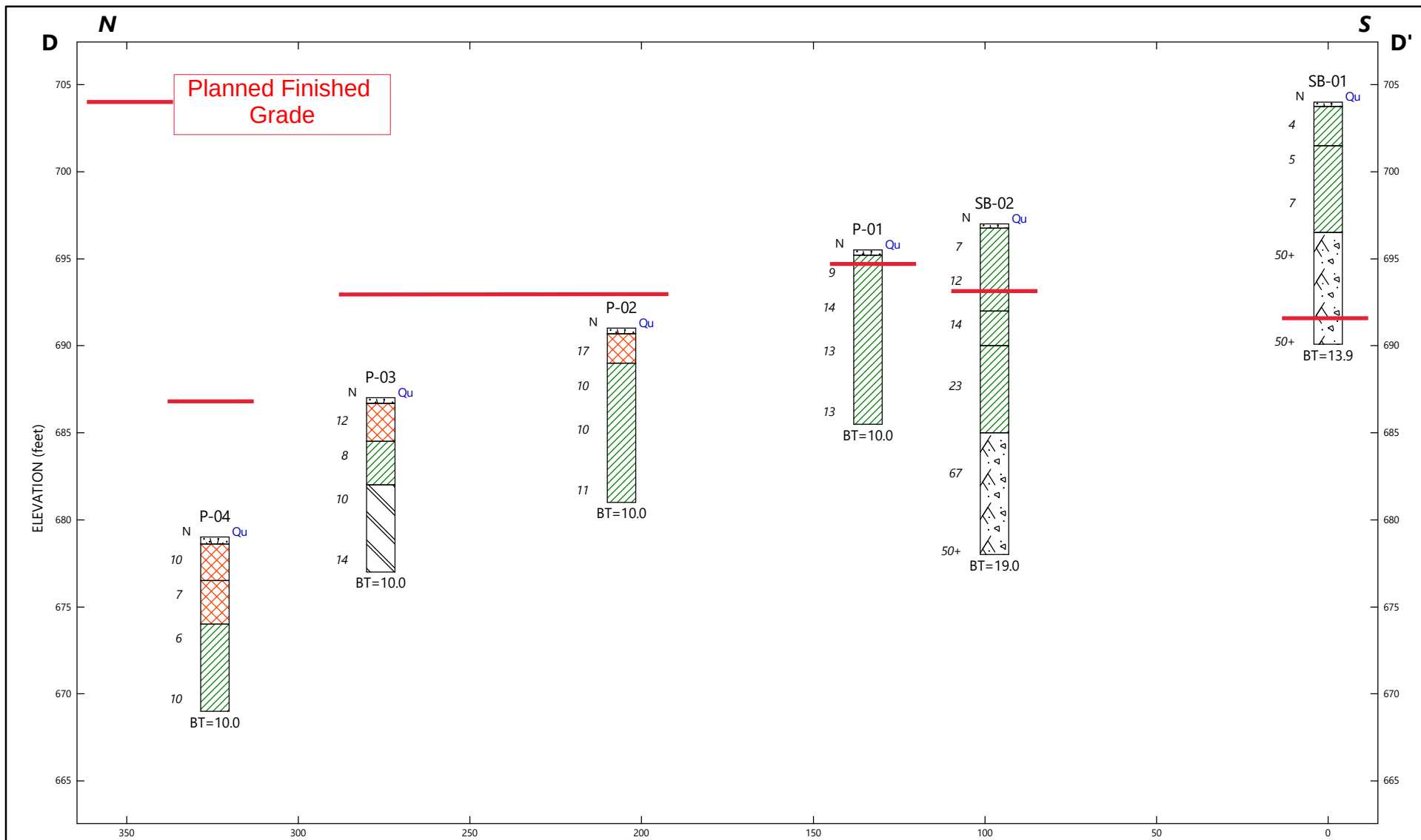
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 1403 South 70th East Avenue, Tulsa, Oklahoma 74133

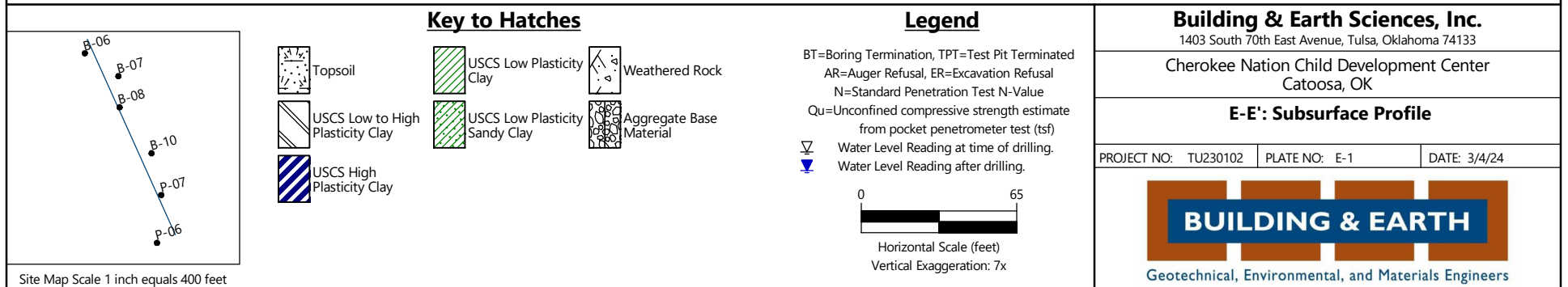
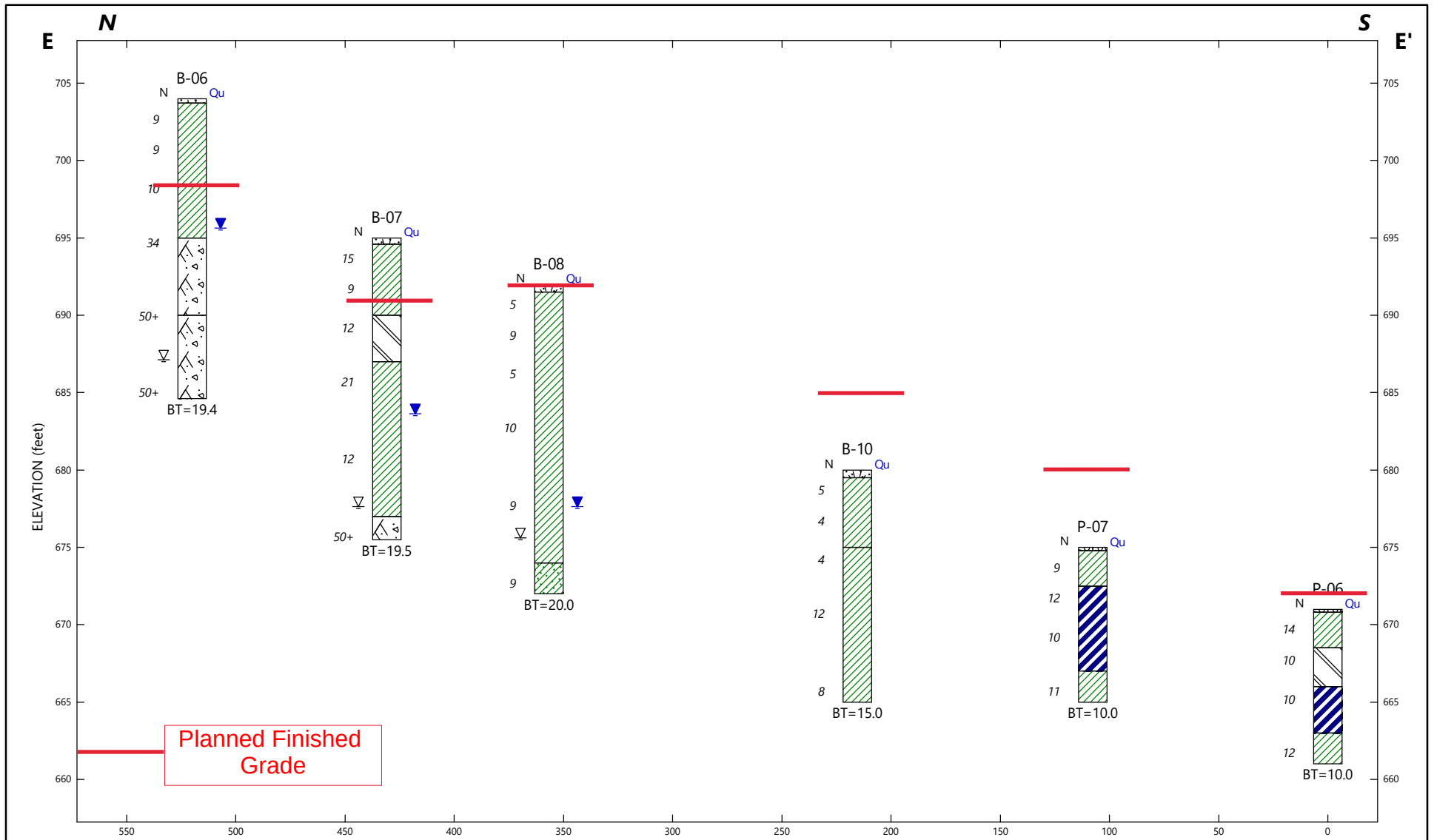
Cherokee Nation Child Development Center
 Catoosa, OK

B-B': Subsurface Profile

PROJECT NO: TU230102	PLATE NO: B-1	DATE: 3/4/24
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BUILDING & EARTH
 Geotechnical, Environmental, and Materials Engineers

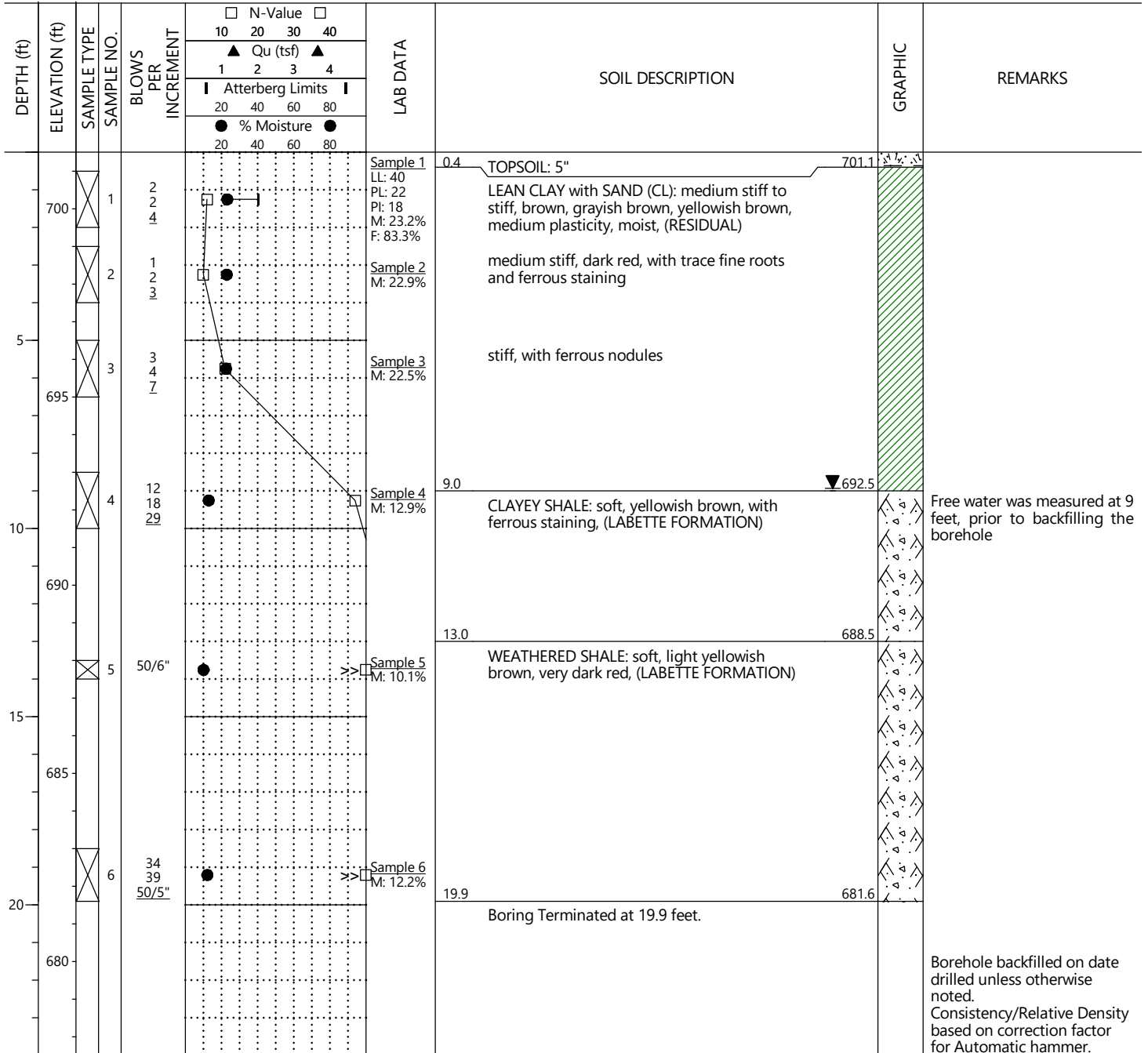




BORING LOGS

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170481, -95.764222

LOCATION: Catoosa, OK
DATE DRILLED: 6/26/23
WEATHER: Sunny
ELEVATION: 701.5
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

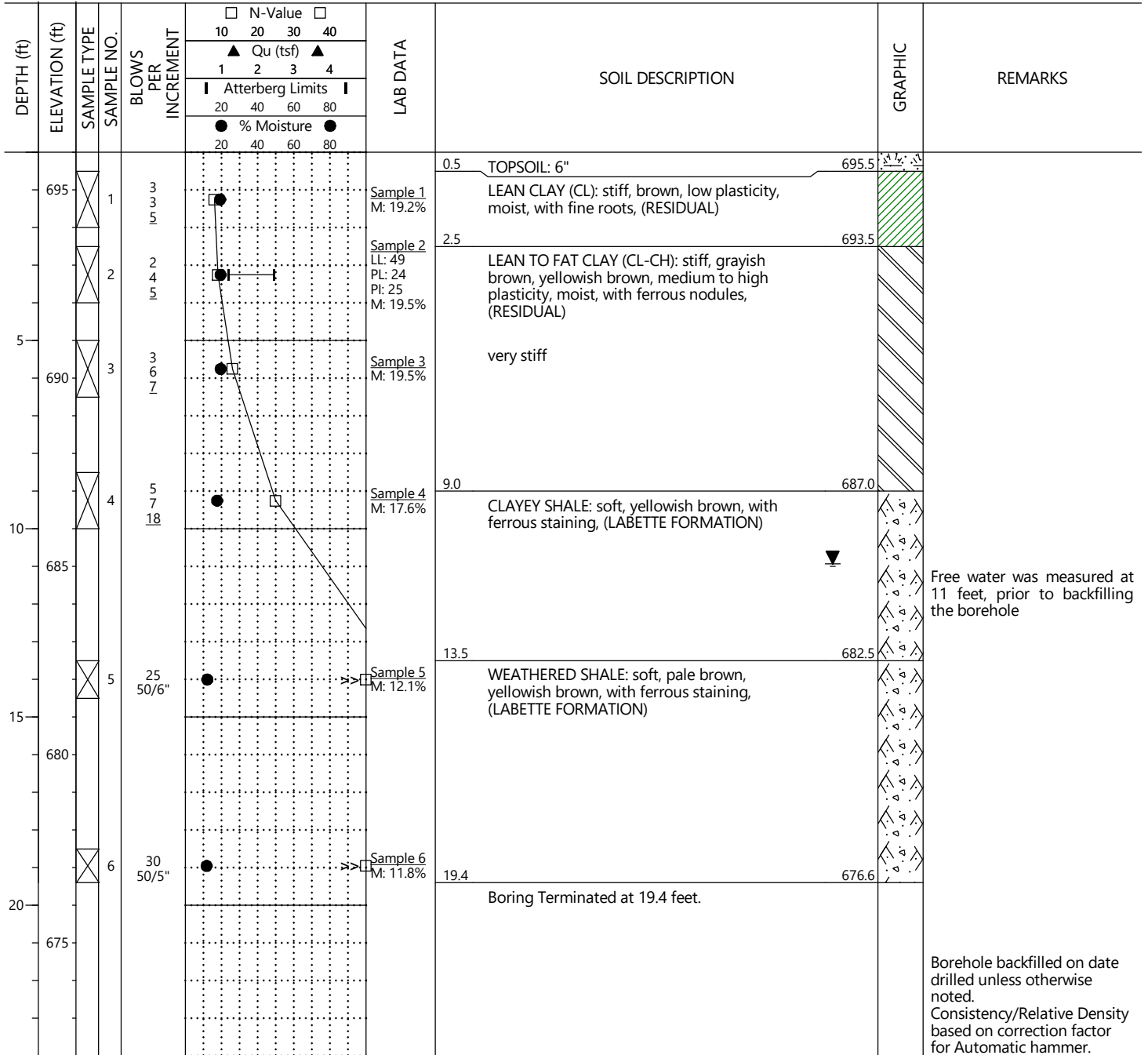
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170328, -95.763936

LOCATION: Catoosa, OK
DATE DRILLED: 6/26/23
WEATHER: Sunny
ELEVATION: 696
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

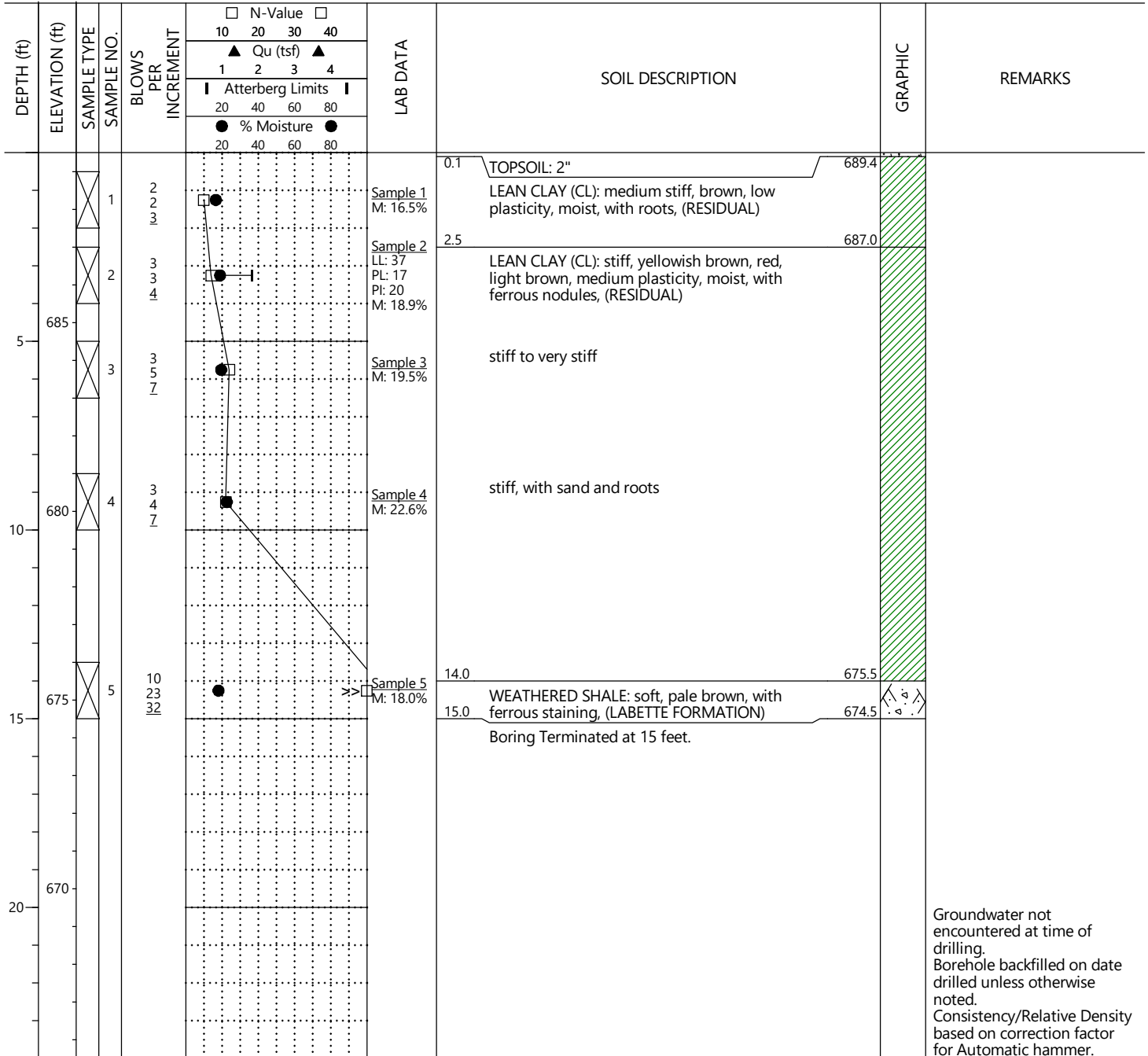
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170035, -95.763920

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 689.5
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

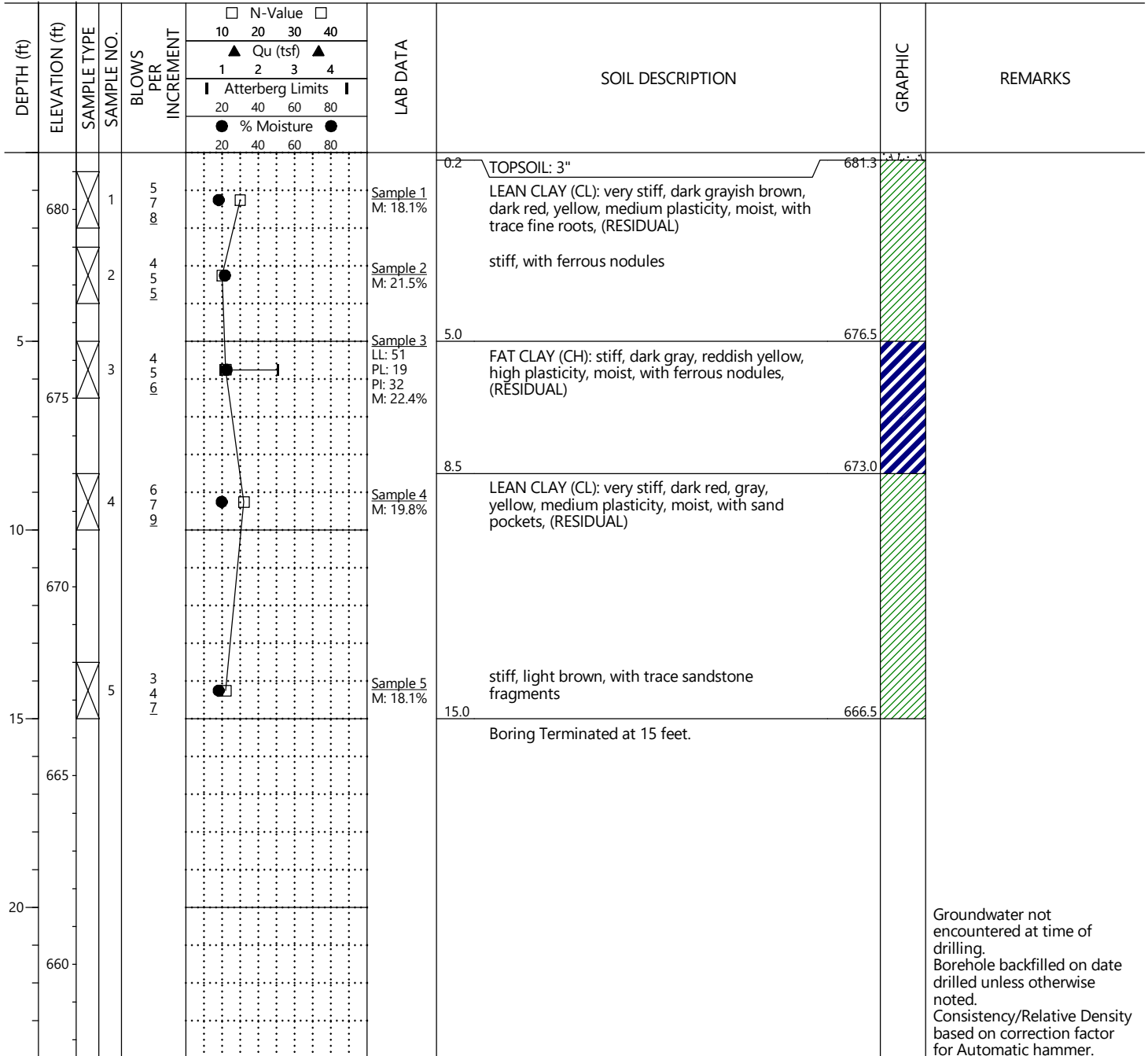
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169837, -95.763548

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 681.5
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

LOG OF BORING

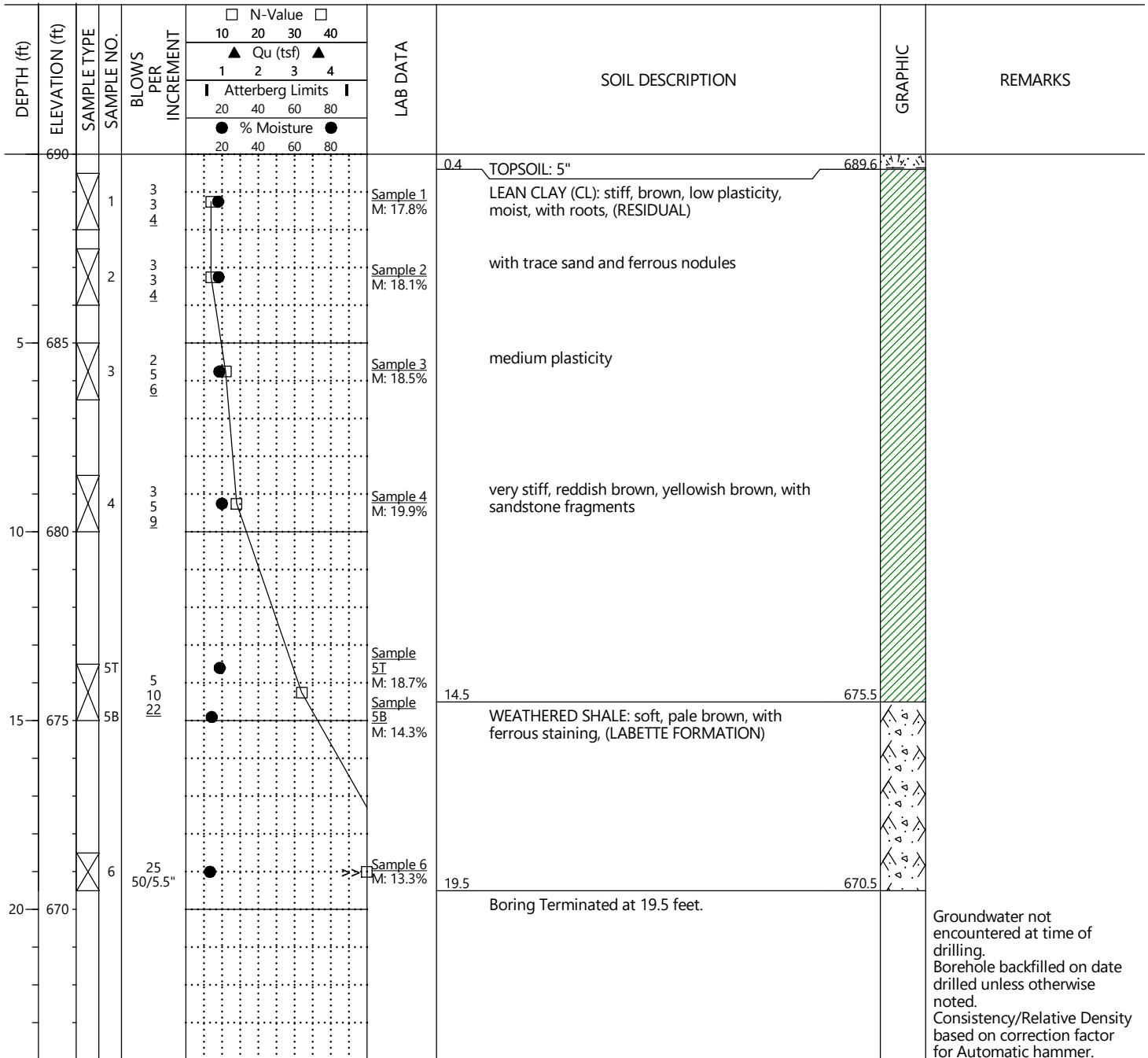
Designation: B-05

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
 PROJECT NUMBER: TU230102
 DRILLING METHOD: Solid Flight Auger
 EQUIPMENT USED: CME 550X ATV
 HAMMER TYPE: Automatic
 BORING LOCATION: 36.170157, -95.763717

LOCATION: Catoosa, OK
 DATE DRILLED: 6/26/23
 WEATHER: Sunny
 ELEVATION: 690
 DRILL CREW: DSO
 LOGGED BY: S.Harris

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT

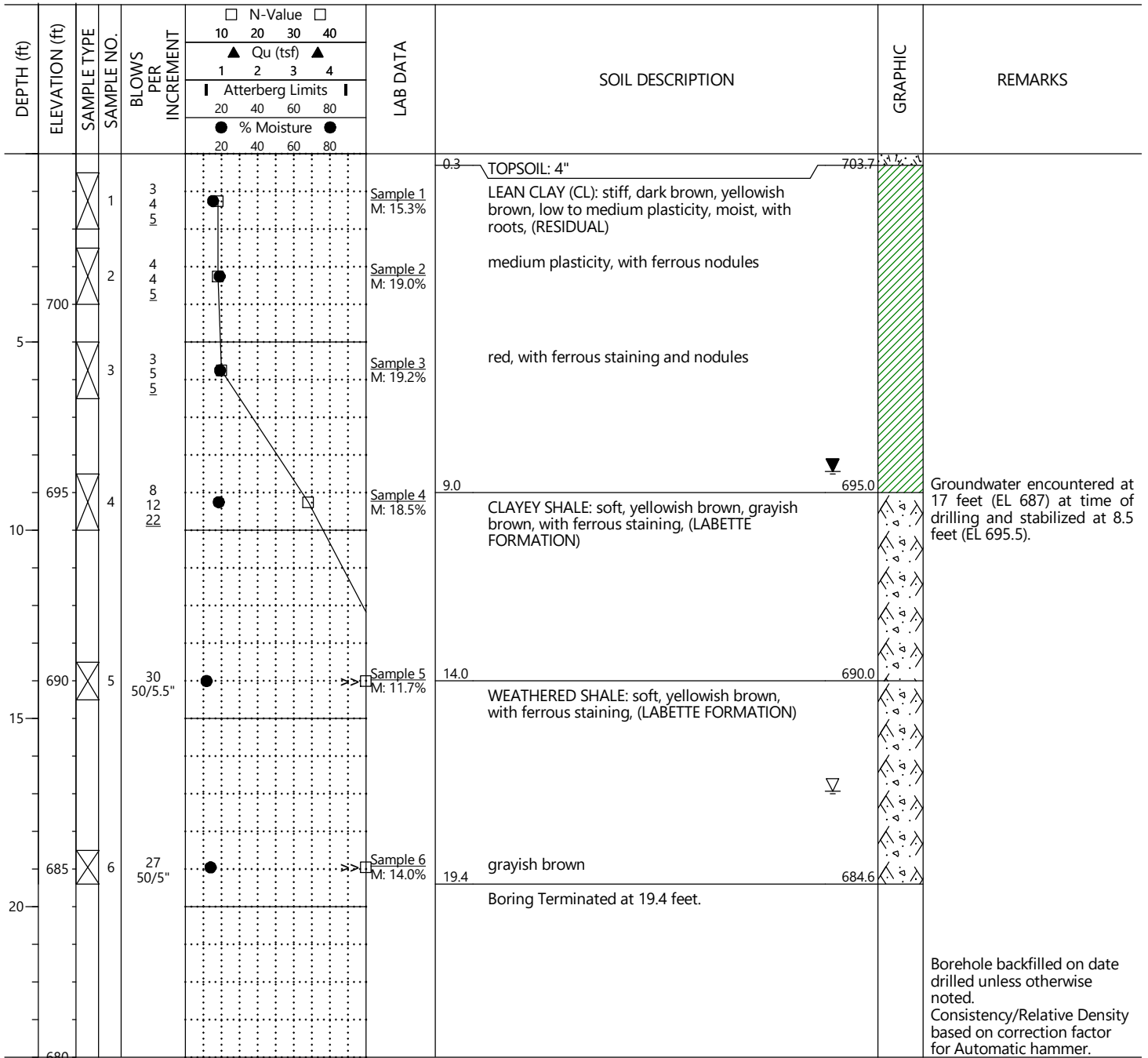
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling.
 Borehole backfilled on date drilled unless otherwise noted.
 Consistency/Relative Density based on correction factor for Automatic hammer.

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170728, -95.763802

LOCATION: Catoosa, OK
DATE DRILLED: 6/26/23
WEATHER: Sunny
ELEVATION: 704
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

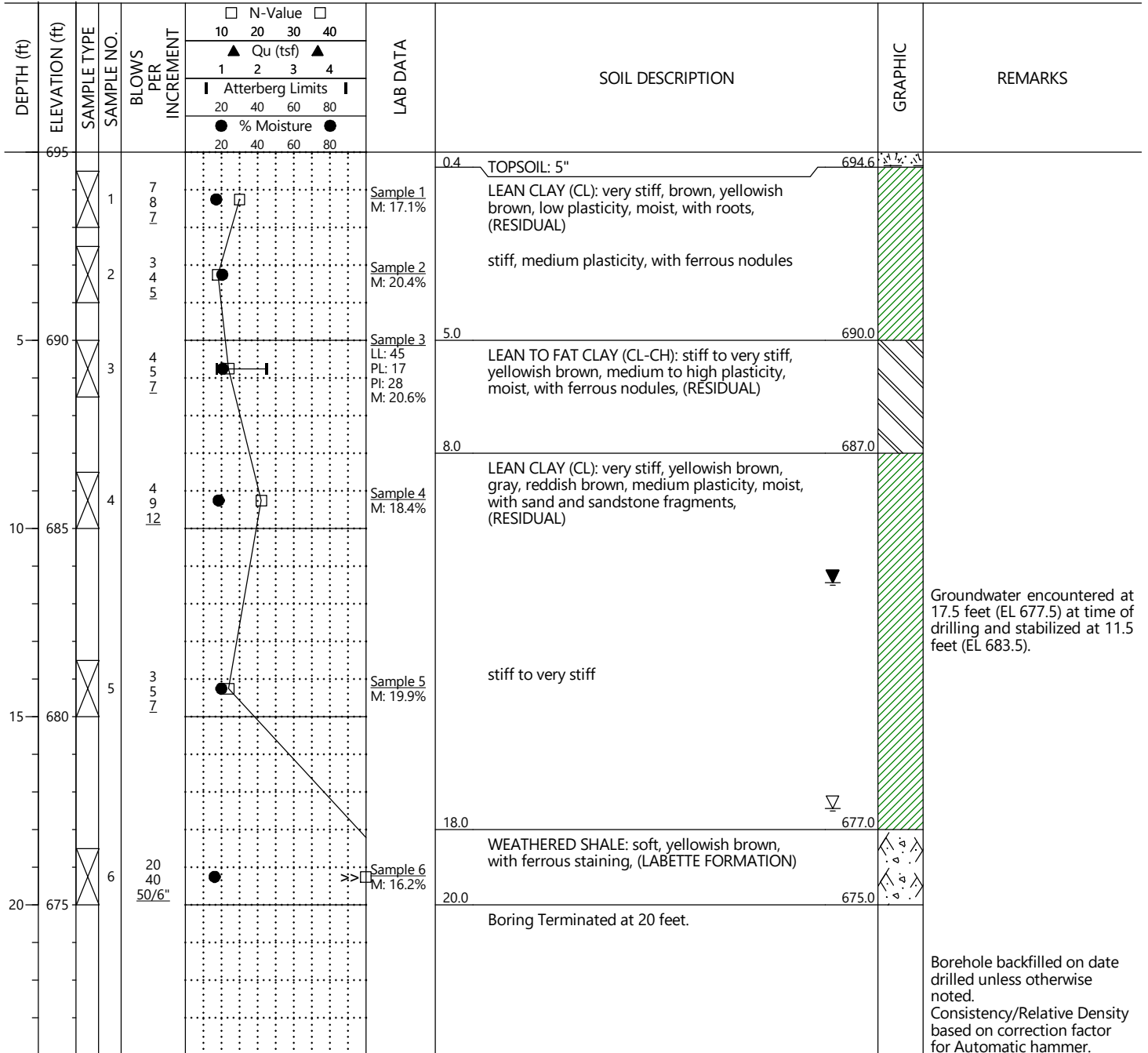
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170572, -95.763509

LOCATION: Catoosa, OK
DATE DRILLED: 6/26/23
WEATHER: Sunny
ELEVATION: 695
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

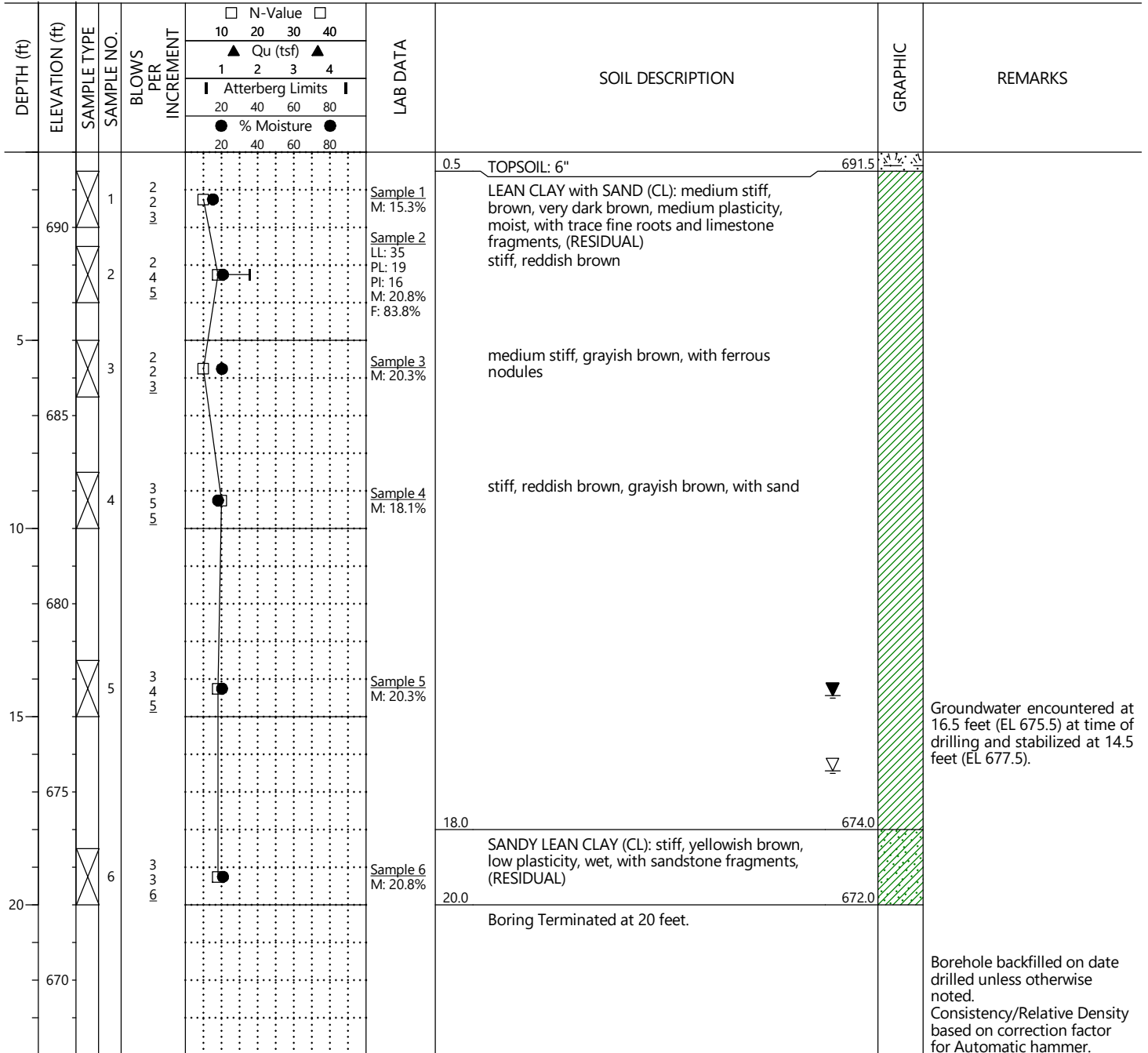
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170354, -95.763510

LOCATION: Catoosa, OK
DATE DRILLED: 6/26/23
WEATHER: Sunny
ELEVATION: 692
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170284, -95.763151

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 684
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

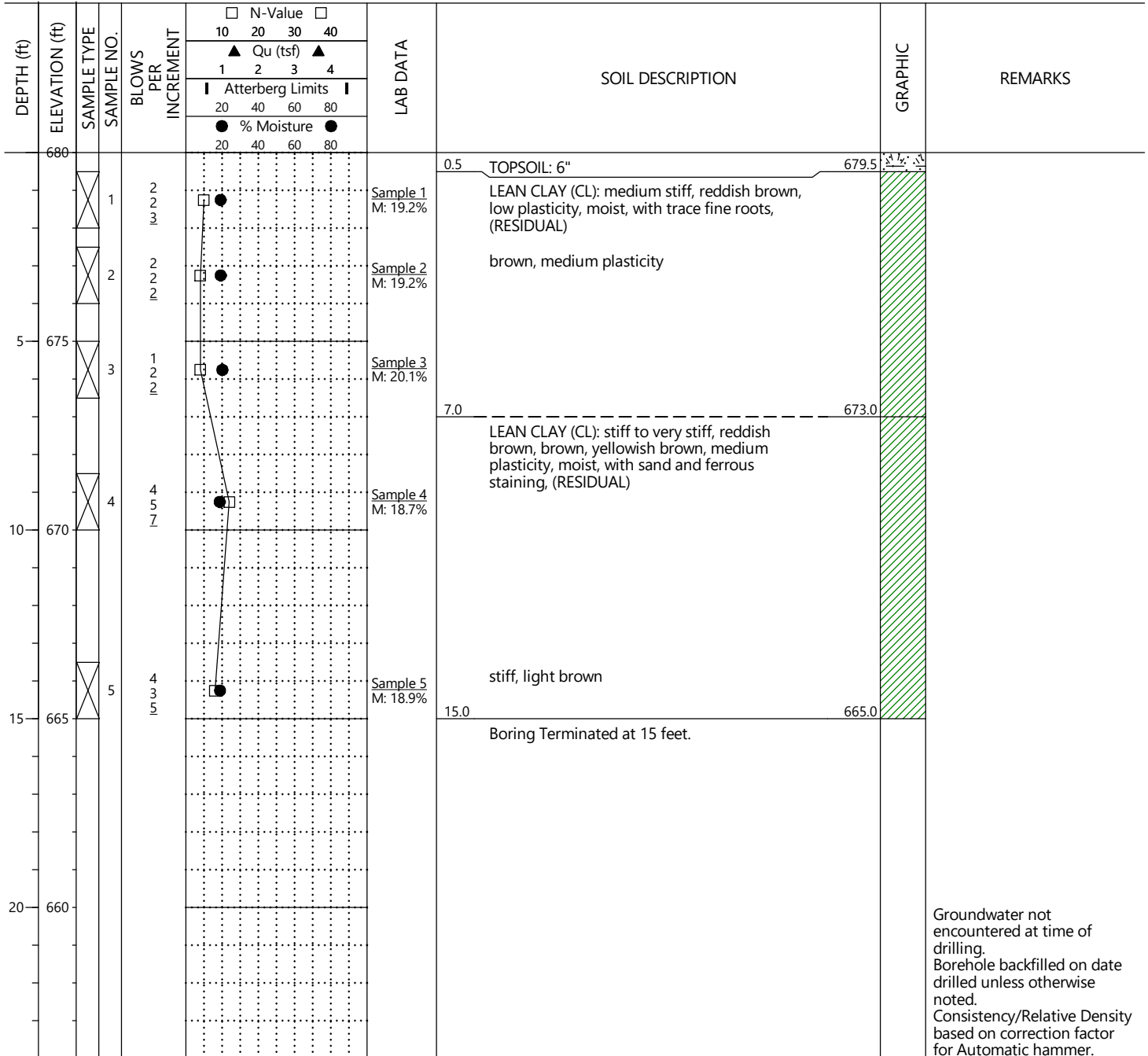
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170021, -95.763230

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 680
DRILL CREW: DSO
LOGGED BY: S.Harris



LOG OF BORING

Designation: P-01

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170133, -95.764337

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 695.5
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS	
					10	20	30	40					
					▲ Qu (tsf) ▲	1	2	3					4
					Atterberg Limits								
					20	40	60	80					
% Moisture				20	40	60	80						
695			1	4 5 4					Sample 1 M: 17.2%	TOPSOIL: 4" LEAN CLAY (CL): stiff, brown, yellowish brown, low plasticity, moist, with sandstone fragments and roots, (RESIDUAL)			
			2	4 6 8					Sample 2 M: 20.3%	very stiff, medium plasticity, with ferrous nodules			
690			3	4 5 8					Sample 3 M: 19.1%	dark reddish brown, dark red			
			4	5 5 8					Sample 4 M: 20.8%	light brown			
685										Boring Terminated at 10 feet.			
680													
675												Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.	

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

 STABILIZED GROUNDWATER LEVEL**REC** RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

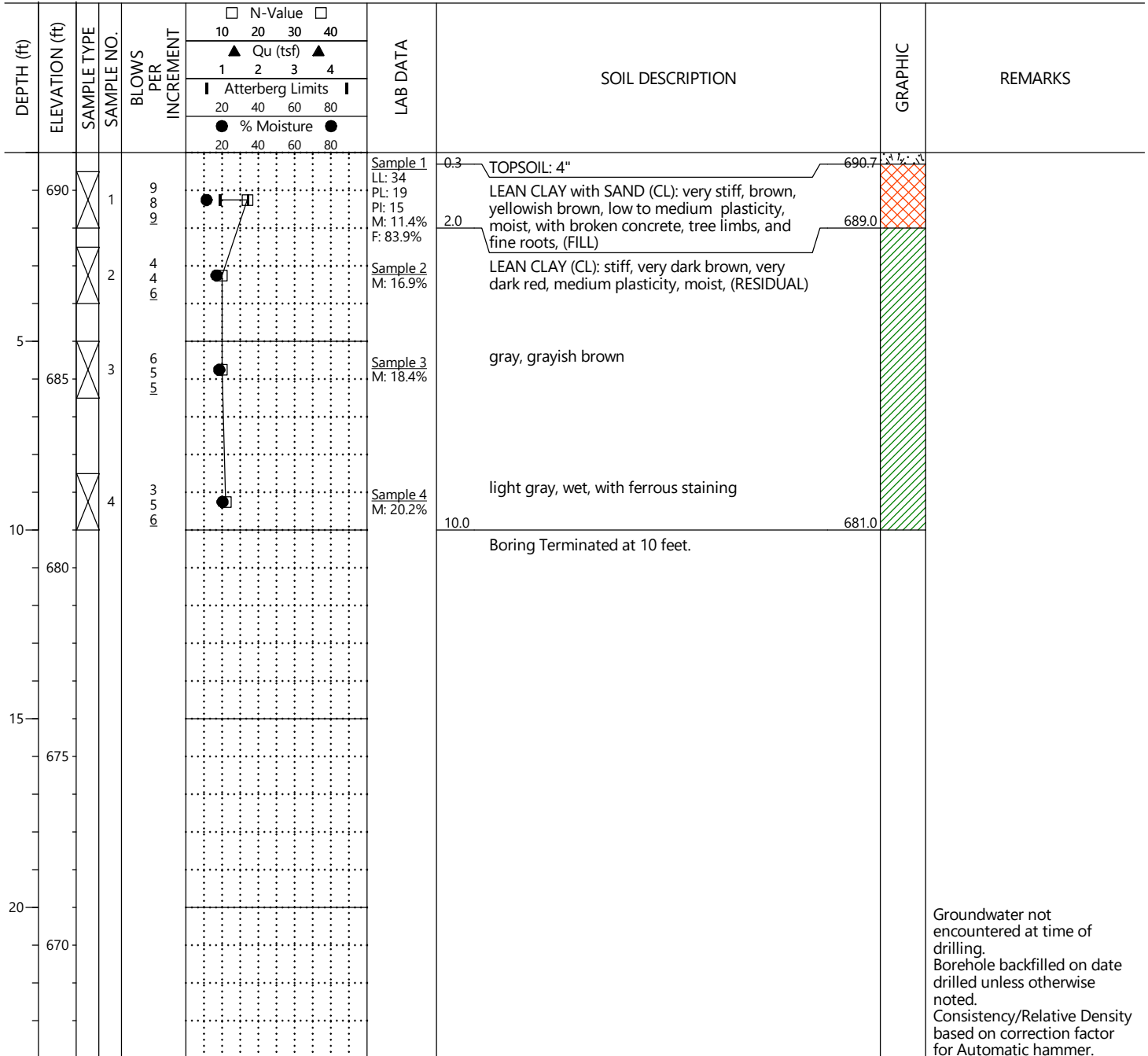
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Birmingham, AL • Auburn, AL • Huntsville, AL • Montgomery, AL
Tuscaloosa, AL • Columbus, GA • Louisville, KY • Raleigh, NC • Dunn, NC
Jacksonville, NC • Springdale, AR • Little Rock, AR • Ft. Smith, AR • Tulsa, OK
Oklahoma City, OK • DFW Metroplex, TX • Virginia Beach, VA

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169783, -95.764319

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 691
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

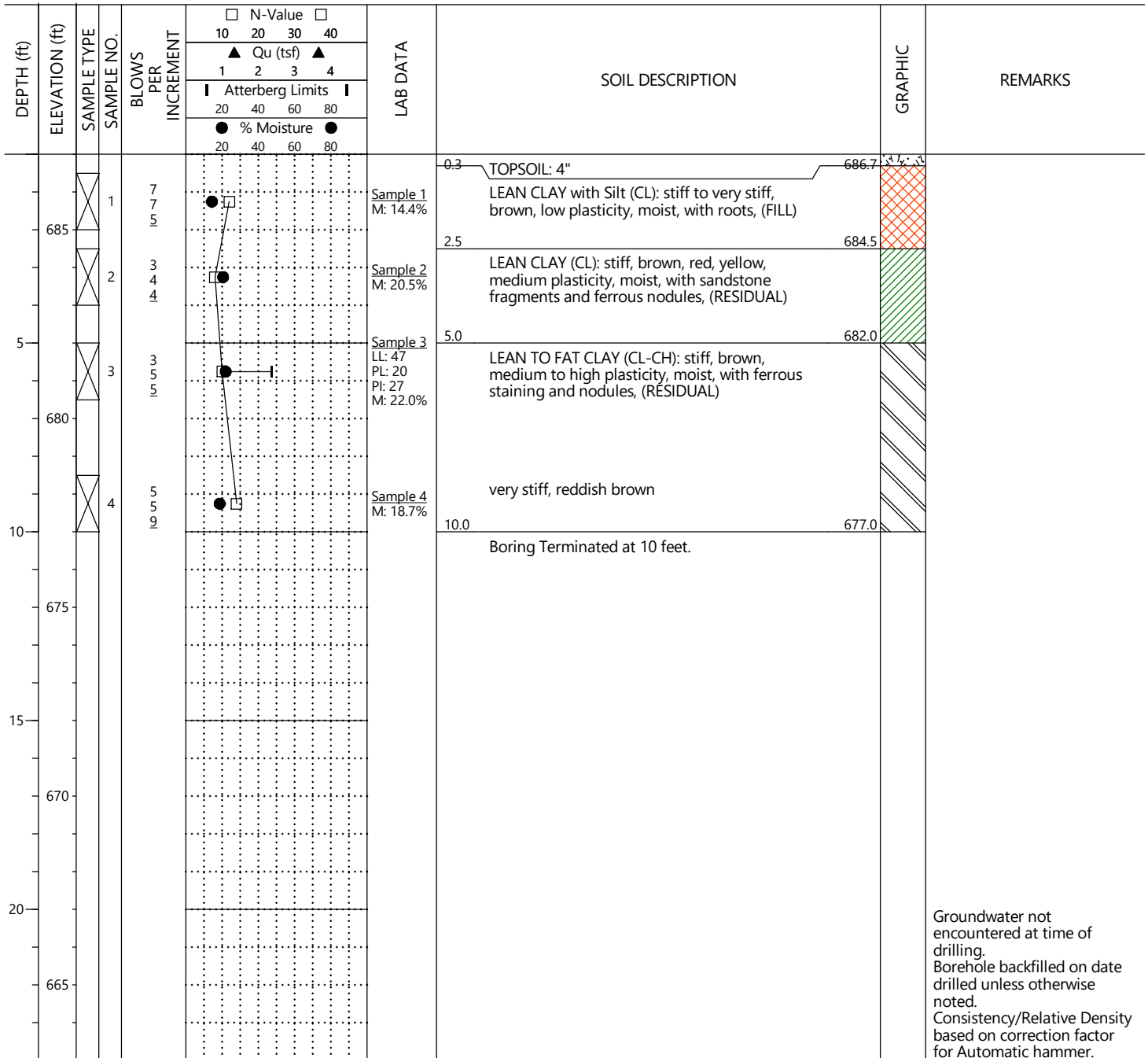
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169845, -95.763975

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 687
DRILL CREW: DSO
LOGGED BY: S.Harris



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

LOG OF BORING

Designation: P-04

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169463, -95.764090

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 679
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
					▲ Qu (tsf) ▲				
					Atterberg Limits				
					% Moisture				
		X	1	11	Sample 1	M: 12.7%	TOPSOIL: 5"		
		X	2	3	Sample 2	M: 19.1%			
		X	3	2	Sample 3	M: 24.7%			
		X	4	3	Sample 4	M: 18.2%			
							Boring Terminated at 10 feet.		Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

 STABILIZED GROUNDWATER LEVEL**REC** RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169574, -95.763669

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 678.5
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS		
					N-Value		Qu (tsf)						
					10	20	30	40					
					1	2	3	4					
					Atterberg Limits								
20 40 60 80													
% Moisture													
20 40 60 80													
			1T	2				Sample 1T M: 19.6%	0.2	AGGREGATE BASE: 2"	678.3		
			1B	3			Sample 1B M: 24.1%		LEAN CLAY (CL): medium stiff, dark brown, pale brown, low plasticity, moist, (RESIDUAL) medium plasticity	678.0			
	675		2	5			Sample 2 LL: 54 PL: 22 PI: 32 M: 24.7% F: 93.4%	2.5	FAT CLAY (CH): stiff, brown, reddish brown, gray, high plasticity, moist, with ferrous nodules, (RESIDUAL)	676.0			
5			3	5			Sample 3 M: 24.0%			670.5			
	670		4	5			Sample 4 M: 20.6%	8.0	LEAN CLAY (CL): stiff, light brown, yellowish brown, medium plasticity, moist, (RESIDUAL)	670.5			
10				6				10.0	Boring Terminated at 10 feet.	668.5		Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.	
	665												
15													
	660												
20													
	655												

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169399, -95.763177

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 671
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	□ N-Value □ 10 20 30 40 ▲ Qu (tsf) ▲ 1 2 3 4 ┌ Atterberg Limits ┐ 20 40 60 80 ● % Moisture ● 20 40 60 80	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
670			1	5 7 Z	Sample 1 M: 20.2%	0.2	AGGREGATE BASE: 3"	670.8	
			2	4 4 6	Sample 2 M: 23.1%	2.5	LEAN CLAY (CL): very stiff, very dark brown, low to medium plasticity, moist, (RESIDUAL)	668.5	
5			3	3 4 6	Sample 3 M: 23.5%	5.0	LEAN TO FAT CLAY (CL-CH): stiff, brown, reddish brown, medium to high plasticity, moist, with ferrous nodules, (RESIDUAL)	666.0	
665			4	3 5 Z	Sample 4 M: 19.5%	8.0	FAT CLAY (CH): stiff, brown, reddish brown, reddish yellow, high plasticity, moist, (RESIDUAL)	663.0	
10						10.0	LEAN CLAY (CL): stiff to very stiff, yellowish brown, yellow, medium plasticity, moist, with ferrous nodules, (RESIDUAL)	661.0	
660							Boring Terminated at 10 feet.		
15									
655									
20									
650									

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☐ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling.
Borehole backfilled on date drilled unless otherwise noted.
Consistency/Relative Density based on correction factor for Automatic hammer.

LOG OF BORING

Designation: P-07

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169732, -95.763137

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 675
DRILL CREW: DSO
LOGGED BY: S.Harris

[illegible]

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

 STABILIZED GROUNDWATER LEVEL**REC** RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

LOG OF BORING

Designation: P-08

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.169734, -95.762638

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Partly Cloudy
ELEVATION: 689.5
DRILL CREW: DSO
LOGGED BY: S.Harris

[illegible]

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

LOG OF BORING

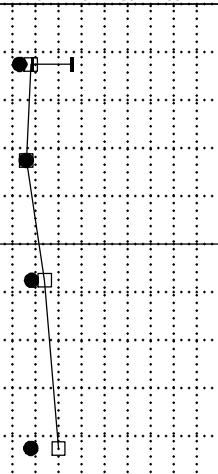
Designation: P-09

Sheet 1 of 1

1403 S 70th E Ave
Tulsa, OK 74112
Office: (918) 439-9005

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Automatic
BORING LOCATION: 36.170501, -95.763206

LOCATION: Catoosa, OK
DATE DRILLED: 6/27/23
WEATHER: Overcast
ELEVATION: 687.5
DRILL CREW: DSO
LOGGED BY: S.Harris

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS				
					N-Value		Qu (tsf)								
					10	20	30	40							
					1	2	3	4							
					Atterberg Limits										
20				40				60				80			
● % Moisture				●											
20				40				60				80			
0 5 10		X	1 2 3 4	4 4 5 3 4 4 3 5 7 5 7 8		Sample 1 LL: 36 PL: 18 PI: 18 M: 13.1%	0.1 TOPSOIL: 2"	687.4	 	LEAN CLAY (CL): stiff, brown, yellowish brown, medium plasticity, moist, with sandstone fragments and trace roots, (FILL) LEAN CLAY (CL): stiff, brown, reddish brown, medium plasticity, moist, with ferrous nodules and trace fine roots, (RESIDUAL) stiff to very stiff, yellowish brown, medium plasticity very stiff, reddish brown, with ferrous staining	Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.				
						Sample 2 M: 16.0%	2.5	685.0							
						Sample 3 M: 18.3%									
						Sample 4 M: 18.0%	10.0	677.5							
Boring Terminated at 10 feet.															

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

 STABILIZED GROUNDWATER LEVEL**REC** RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

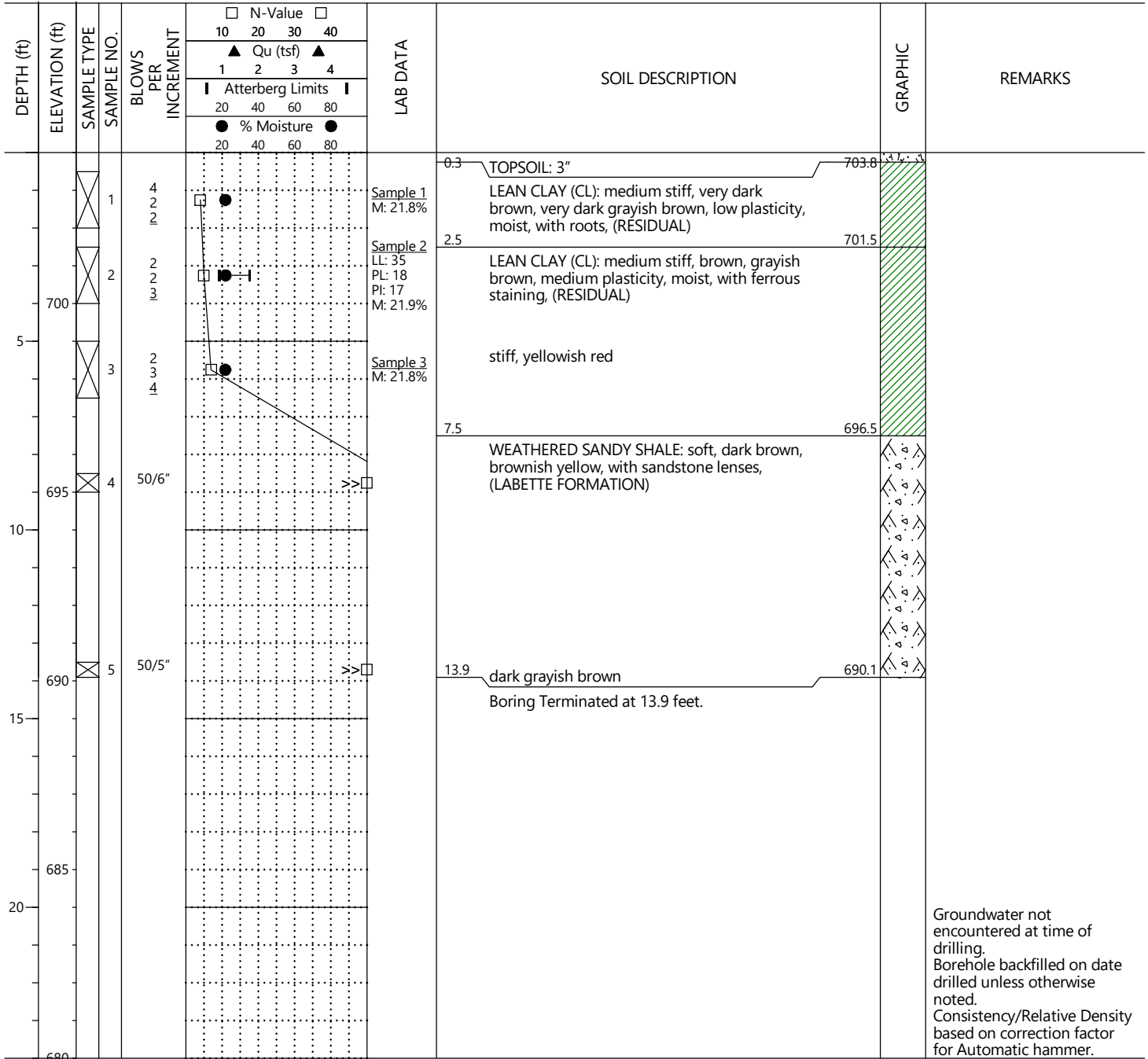
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: Diedrich D-50
HAMMER TYPE: Automatic
BORING LOCATION: 36.170216, -95.764809

LOCATION: Catoosa, OK
DATE DRILLED: 1/18/24
WEATHER: Sunny, cold
ELEVATION: 704
DRILL CREW: Building & Earth
LOGGED BY: J. Swyden



Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

▽ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

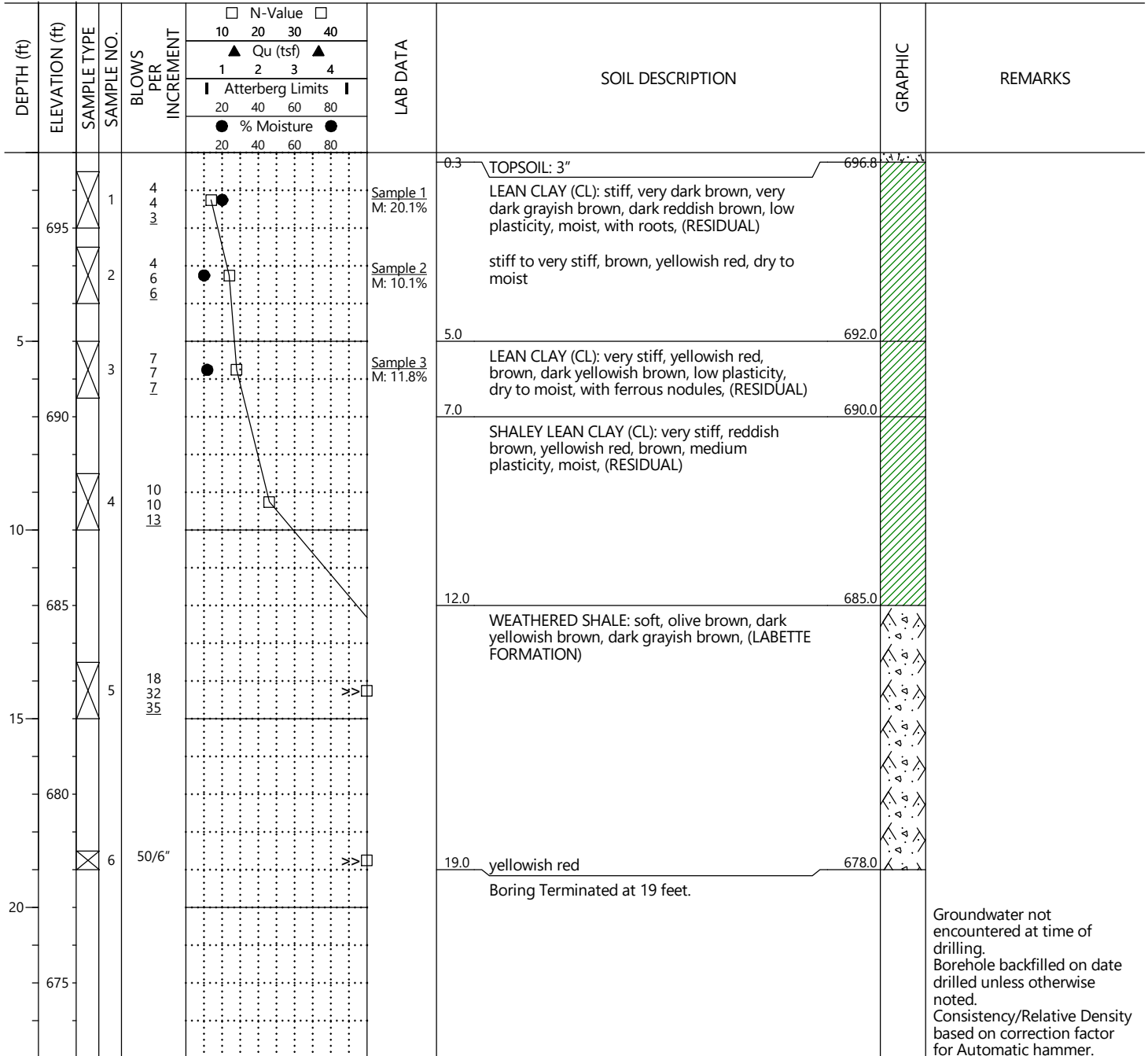
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: Diedrich D-50
HAMMER TYPE: Automatic
BORING LOCATION: 36.169852, -95.764699

LOCATION: Catoosa, OK
DATE DRILLED: 1/18/24
WEATHER: Sunny, cold
ELEVATION: 697
DRILL CREW: Building & Earth
LOGGED BY: J. Swyden



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

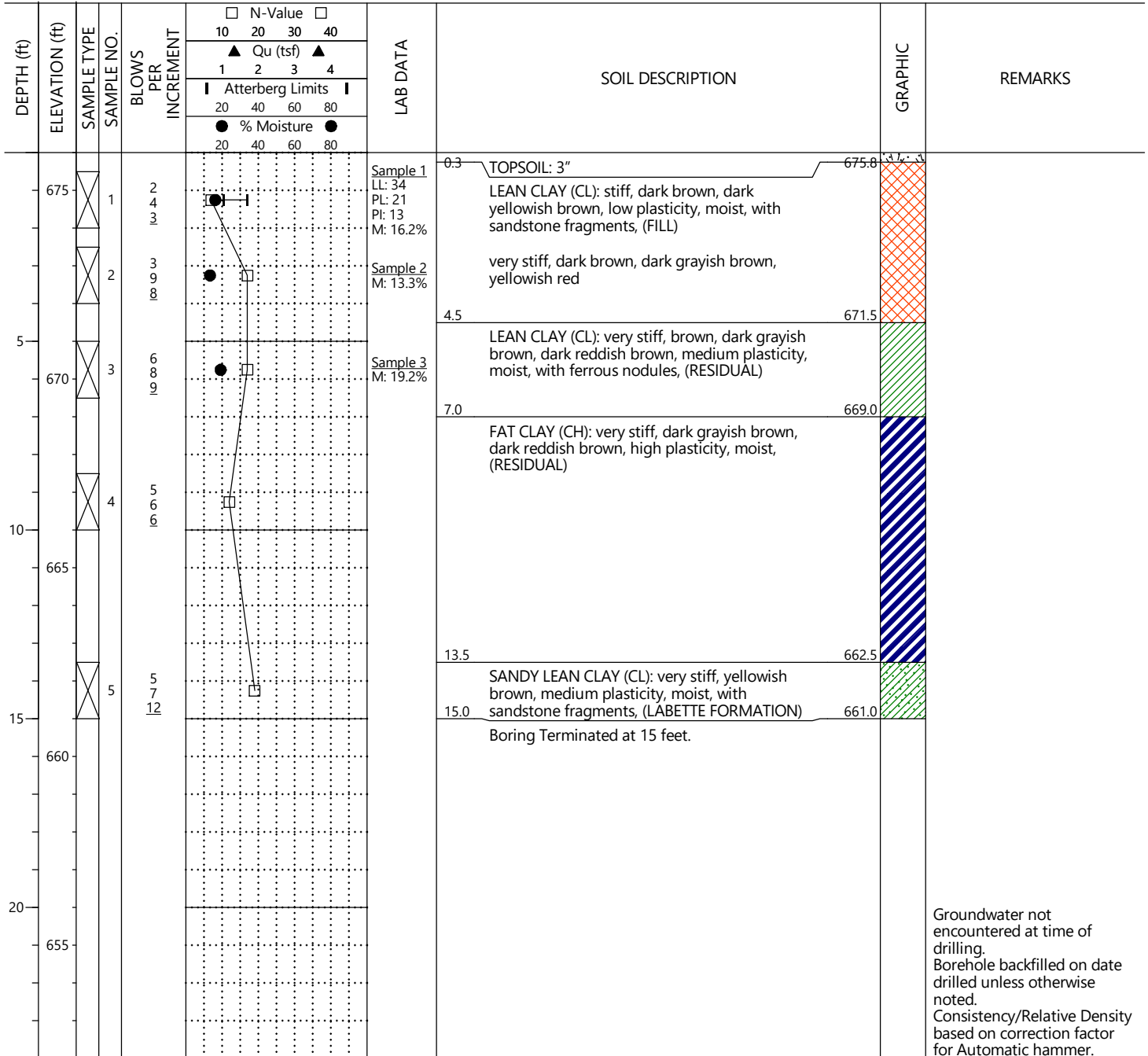
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

PROJECT NAME: Cherokee Nation Child Development Center
PROJECT NUMBER: TU230102
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: Diedrich D-50
HAMMER TYPE: Automatic
BORING LOCATION: 36.169284, -95.763681

LOCATION: Catoosa, OK
DATE DRILLED: 1/18/24
WEATHER: Sunny, cold
ELEVATION: 676
DRILL CREW: Building & Earth
LOGGED BY: J. Swyden



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)

% MOISTURE PERCENT NATURAL MOISTURE CONTENT

☒ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING

☒ STABILIZED GROUNDWATER LEVEL

REC RECOVERY

RQD ROCK QUALITY DESIGNATION

UD UNDISTURBED

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT

PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE

PI: PLASTICITY INDEX

Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

NATURAL MOISTURE CONTENT (ASTM D2216)

Natural moisture contents (M%) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

ATTERBERG LIMITS (ASTM D4318)

The Atterberg Limits test was performed to evaluate the soil's plasticity characteristics. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index ($PI = LL - PL$) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

MATERIAL FINER THAN NO. 200 SIEVE BY WASHING (ASTM D1140)

Grain-size tests were performed to determine the partial soil particle size distribution. The amount of material finer than the openings on the No. 200 sieve (0.075 mm) was determined by washing soil over the No. 200 sieve. The results of wash #200 tests are presented on the boring logs included in this report and in the table of laboratory test results.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
B-01	0.5 - 2.0	23.2	40	22	18	83	CL
B-01	2.5 - 4.0	22.9					
B-01	5.0 - 6.5	22.5					
B-01	8.5 - 10.0	12.9					
B-01	13.5 - 14.0	10.1					
B-01	18.5 - 19.9	12.2					
B-02	0.5 - 2.0	19.2					
B-02	2.5 - 4.0	19.5	49	24	25		
B-02	5.0 - 6.5	19.5					
B-02	8.5 - 10.0	17.6					
B-02	13.5 - 14.5	12.1					
B-02	18.5 - 19.4	11.8					
B-03	0.5 - 2.0	16.5					
B-03	2.5 - 4.0	18.9	37	17	20		
B-03	5.0 - 6.5	19.5					
B-03	8.5 - 10.0	22.6					
B-03	13.5 - 15.0	18.0					
B-04	0.5 - 2.0	18.1					
B-04	2.5 - 4.0	21.5					
B-04	5.0 - 6.5	22.4	51	19	32		
B-04	8.5 - 10.0	19.8					
B-04	13.5 - 15.0	18.1					
B-05	0.5 - 2.0	17.8					
B-05	2.5 - 4.0	18.1					
B-05	5.0 - 6.5	18.5					
B-05	8.5 - 10.0	19.9					
B-05	13.6	18.7					
B-05	14.9	14.3					
B-05	18.5 - 19.5	13.3					
B-06	0.5 - 2.0	15.3					
B-06	2.5 - 4.0	19.0					

TABLE L-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic

⁽¹⁾ Indicates visual classification. WR indicates weathered rock.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
B-06	5.0 - 6.5	19.2					
B-06	8.5 - 10.0	18.5					
B-06	13.5 - 14.5	11.7					
B-06	18.5 - 19.4	14.0					
B-07	0.5 - 2.0	17.1					
B-07	2.5 - 4.0	20.4					
B-07	5.0 - 6.5	20.6	45	17	28		
B-07	8.5 - 10.0	18.4					
B-07	13.5 - 15.0	19.9					
B-07	18.5 - 20.0	16.2					
B-08	0.5 - 2.0	15.3					
B-08	2.5 - 4.0	20.8	35	19	16	84	CL
B-08	5.0 - 6.5	20.3					
B-08	8.5 - 10.0	18.1					
B-08	13.5 - 15.0	20.3					
B-08	18.5 - 20.0	20.8					
B-09	0.5 - 2.0	15.3	36	19	17		
B-09	2.5 - 4.0	15.3					
B-09	5.0 - 6.5	17.8					
B-09	8.5 - 10.0	20.0					
B-09	13.5 - 15.0	16.2					
B-10	0.5 - 2.0	19.2					
B-10	2.5 - 4.0	19.2					
B-10	5.0 - 6.5	20.1					
B-10	8.5 - 10.0	18.7					
B-10	13.5 - 15.0	18.9					
P-01	0.5 - 2.0	17.2					
P-01	2.5 - 4.0	20.3					
P-01	5.0 - 6.5	19.1					
P-01	8.5 - 10.0	20.8					
P-02	0.5 - 2.0	11.4	34	19	15	84	CL

TABLE L-1: General Soil Classification Test Results

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LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
P-02	2.5 - 4.0	16.9					
P-02	5.0 - 6.5	18.4					
P-02	8.5 - 10.0	20.2					
P-03	0.5 - 2.0	14.4					
P-03	2.5 - 4.0	20.5					
P-03	5.0 - 6.5	22.0	47	20	27		
P-03	8.5 - 10.0	18.7					
P-04	0.5 - 2.0	12.7					
P-04	2.5 - 4.0	19.1					
P-04	5.0 - 6.5	24.7					
P-04	8.5 - 10.0	18.2					
P-05	0.6	19.6					
P-05	1.9	24.1					
P-05	2.5 - 4.0	24.7	54	22	32	93	CH
P-05	5.0 - 6.5	24.0					
P-05	8.5 - 10.0	20.6					
P-06	0.5 - 2.0	20.2					
P-06	2.5 - 4.0	23.1					
P-06	5.0 - 6.5	23.5					
P-06	8.5 - 10.0	19.5					
P-07	0.5 - 2.0	18.9					
P-07	2.5 - 4.0	22.7	50	22	28		
P-07	5.0 - 6.5	23.5					
P-07	8.5 - 10.0	18.6					
P-08	0.5 - 2.0	13.2					
P-08	2.5 - 4.0	19.5					
P-08	5.0 - 6.5	21.0					
P-08	8.5 - 10.0	18.1					
P-09	0.5 - 2.0	13.1	36	18	18		
P-09	2.5 - 4.0	16.0					
P-09	5.0 - 6.5	18.3					

TABLE L-1: General Soil Classification Test Results

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LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

[illegible]

TABLE L-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic

⁽¹⁾ Indicates visual classification. WR indicates weathered rock.

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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**Cherokee Nation Government Information Technology
Network Design and Construction Standards and Requirements Manual**

INTRODUCTION

The following are the Cherokee Nation Government Information Technology Network Construction Standards and Requirements and shall be adhered to until replaced. All preceding documentation is superseded by this document. The requirements contained in this document shall be followed when designing, constructing, or refurbishing any building that requires a network to be installed or upgraded. If there are any questions, please contact Cherokee Nation Government Information Technology (CNGIT).

PART 1 – GENERAL

1.1 REQUIREMENTS

- A. Summary: Furnish and install complete with all accessories a Structured Cabling System (SCS). The SCS shall serve as a vehicle for the transport of data, video, and voice telephony signals throughout the network from designated demarcation points to outlets located at various desks, workstation, wireless access points (AP), cameras, access control equipment and other locations that support the infrastructure as indicated on the contract drawings and described herein.
- B. Submittals
 - 1 Construction Documents
 - (a) Where or when a Project Manual is created for Construction Documentation, the Project Manual and Documentation, i.e., Divisions 25, 26, 27, and 28, shall reference this Document as to be the requirements of the Owner.
 - (b) Division 27 – Communications: Shall cover the Information Transport System for all networking, communications, paging, wireless access points, video surveillance and audio-visual systems.
 - (c) Division 28 – Electronic Security Systems: Shall cover:
 - 1) Access Control Systems
 - 2) Video Surveillance Systems
 - 3) Personal Body Alarm Systems
 - 4) Panic/Duress Alarm Systems
 - 5) Perimeter Detection Systems
 - 6) Burglar Alarms and Fire Alarm systems and others are not covered in this document. This does not preclude them from following all applicable codes and standards.
 - (d) Integration with Other Systems
 - 1) In the project's programming stage, it is important to coordinate the systems listed above (WHICH shall be called "Telecommunications") and the required infrastructure requirements related to these systems. This is especially critical for all design/build projects.
 - 2) Where other Divisions need Communications or SCS, they can reference Divisions 27 and 28.
 - 2 Drawings – General Requirements
 - a) Telecommunications construction drawings shall show all necessary cabling and equipment for the project. The telecommunications construction drawings shall be designed so that the contractor is able to use the proper combination of materials, techniques, and manpower to accomplish the overall installation.
 - b) Technology device locations shall be coordinated with conduit, back boxes, and other required Div. 26 items on the E Series Drawings.
 - c) The A/E/C shall keep the Telecommunications drawings from overlapping or crowding too many systems. A minimum of two (2) separate the systems using the disciplines below.
 - d) The use of "TECHNOLOGY" in the sheet titles is suggested. This designation matches TIA/AIA description of the construction discipline and is inclusive of voice, data (network), audiovisual and various distributed systems (paging, clocks, sound-masking, the systems listed above and etc.).

- e) Where not integrated with “E” series sheets, telecommunications drawings should use a “T” designation.
- f) Where the project includes work at multiple buildings, it is acceptable to include a building designator in the sheet number.
- g) The sheet naming and numbering should follow the TIA/AIA guidelines. The following outline is provides TIA guidelines and required information:

TIA 606-C DRAWING LABELING SCHEMA	
T = TECHNOLOGY	
TA = AUDIO VISUAL	
TY = ACCESS CONTROL	
TSS = TECHNOLOGY SPECIAL SYSTEMS (Paging, Intercom, Network Monitored Equipment, Distress Buttons, etc.)	
T0	LEGEND/NOTES/CAMPUS/SITE
	T0 drawings show physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus cabling on plan view drawings, major system nodes, and related connections on the logical system drawings
T1	LAYOUT OF COMPLETE FLOOR
	T1 drawings show the layout of the complete building per floor. The drawing indicates location of building areas, serving zones, telecommunications rooms, access points, pathways and other systems that need to be viewed from the complete building perspective.
T2	SERVING ZONES/AREAS
	T2 drawings show a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
T3	ENLARGED SPACES/ROOMS PLAN AND ELEVATION
	T3 drawings provide telecommunications room details. These drawings indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevations, and backboard elevations.
T4	TYPICAL DETAILS
	T4 drawings provide details of symbols and typical components such as faceplate labeling, faceplate types, installation procedures, racking, and raceways
T5	SCHEDULES
	T Schedules might show cable cut over and/or patching information TY Schedules might show Door Hardware and Camera information TA schedules might show AV equipment by room type

- h) The outline structure should be the same for all disciplines.
- i) Terminology
- j) Edit drawings to use terminology consistent with what is used in the specification.

- k) The meaning of all Acronyms used should be clearly explained on the Symbols & Abbreviations sheet.
- l) In notes to avoid ambiguity as to contractor responsibilities restructure sentences to be direct, e.g., using “active voice.” For example:
 - 1) Use “DEMOLISH” rather than “IS TO BE DEMOLISHED.”
 - 2) Use “COORDINATE” rather than “CONTRACTOR SHALL COORDINATE.”
 - 3) Use “PROVIDE [PRODUCT]” rather than “[PRODUCT] SHALL BE PROVIDED” or “CONTRACTOR SHALL PROVIDE AND INSTALL.”
 - 4) Use “DISCONNECT AND REMOVE [ITEM]” rather than “[ITEM] IS TO BE DISCONNECTED AND REMOVED”
- m) Product Descriptions
 - 1) CNGIT has a standardized material list for Technology Infrastructure.
 - 2) Manufacture and model numbers may be used in specifications as a basis-of-design example or where sole-source specification is allowed. However, it is recommended that the Bill of Materials be inserted as an Appendix to provide for updating and substitution alignment.
 - 3) As an alternative the verbiage “Or Approved Equal” may be inserted.
 - 4) All pertinent performance and features must be included in the specification.
 - 5) The technical content of the section will be the basis on which equals are determined. Features of a “basis-of-design” product not included in the technical language may not be considered.
 - 6) Only generic terms are to be used on drawings.
- n) Symbols and Abbreviations
 - 1) On Equipment Outlet symbol(s) include attributes necessary to clarify configuration, number of cables, mounting height/location, application, etc. as applicable.
- o) Site Plans
 - 1) Show major pathway routes for telecommunications services including all underground or overhead services, duct banks, manholes, and other important feature. Include all conduit requirements from signal maintenance vaults to Building Entrance Facility for services such as fire alarm reporting, security reporting, voice/data/video service, campus automation system connection, multi-conductor exterior lighting control, etc.
- p) Floor Plans
 - 1) Show all Telecommunications Outlets (TO), Technology Spaces (backboards, racks, and cable runway), major penetrations (floor and wall sleeves and conduits) and major cable pathways (cable tray, conduit).
 - 2) Confirm that the required power circuits and telecommunications cabling provisions for security, and other miscellaneous systems required by project program are shown.
- q) Technology Spaces Enlarged Plans and Rack Elevations
 - 1) CNGIT requires that enlarged plans of Technology Spaces be included.
 - 2) Show equipment rack placement, wire management, cable runway routing, overhead and vertical cable tray, conduit entry points, grounding busbars, wall-mounted connectivity, and equipment, etc.
 - 3) Show Equipment Rack(s) to-scale and include dimensions depicting required clear space for access, door swing, etc.
 - 4) CNGIT requires that Rack Elevation drawings be included. Show connectivity and equipment.
 - 5) Include work by the contractor and space allocated for work “by others.”
- r) Schematics / One-line Diagrams (Risers)
 - 1) Provide one-line schematic (“riser”) diagrams to depict the telecommunications backbone cabling arrangement for the project.
 - 2) This applies to all new building distribution systems and additions/changes to existing building distribution systems.
- s) Grounding and Bonding
 - 1) Detail the requirements of the grounding system in the drawings and specifications.

- 2) References only to the NEC or TIA are not sufficient.
- 3) Include Grounding Schematic (riser) and applicable details. Coordinate preparation of the schematic with the electrical system designer. Grounding infrastructure is typically installed by the Division 26 contractor.
- t) Construction Details
 - 1) Provide construction details on drawings to specify construction requirements.
 - 2) Provide plan view, elevation and/or detail drawings to cover all telecommunications and other related low-voltage equipment, equipment rack elevations, Equipment Outlet faceplate configurations. Provide cross sections and details of the manholes and duct banks.
 - 3) Provide installation details for Video Surveillance, [Card] Access Control and Audiovisual system devices.
- u) Equipment Schedules
 - 1) Structured Cabling drawings to describe Equipment Outlet configurations.
 - 2) Provide detailed schedules for Video Surveillance, [Card] Access Control and Audiovisual system devices.
- 3 Terminology
 - a) Undefined phrases on the drawings such as “properly seal,” “locations to be determined,” “by others”, and “as required” shall be avoided. Provide information adequate to clearly define technical requirements and contractor responsibilities to allow for accurate bidding.
 - b) Include all details, diagrams, schedules, etc. in the drawings, not in the specifications. Often just the drawings will be at the job site.
 - c) On each floor plan sheet, show graphic scale, compass point, room names and numbers, and key plan corresponding to the architectural drawings.
 - d) For large alteration/remodel projects, separate demolition drawings are required for all areas involved in the project.
 - e) Remodeling project drawings shall indicate all removal and disconnection of existing telecommunications equipment and shall indicate required repair of finishes.
 - f) For medium and large projects, provide separate floor plans for lighting, power, fire alarm systems, telecommunication systems, A/V systems, and security systems. Combining of systems drawings is allowed if clarity of design can be maintained. The drawings shall be combined on smaller projects.
 - g) The Technology drawings shall be coordinated and actively crosschecked with the drawings of all other disciplines. Consultant may be asked to provide a ¼” scale drawing of selected telecommunications equipment rooms, showing all disciplines equipment, to ensure that coordination is being achieved.
- 4 Product Data
 - a) CNGIT shall provide a list of standard parts required for the contract. Any additional parts that are used requires the vendor/contractor to provide the manufacturer’s catalog information showing any technical specifications, dimensions, colors, and configurations.
 - b) Submittals shall include all items called for in PART 2 – PRODUCTS of the specifications document.
 - c) Technical data sheets shall include the physical specifications as well as the electrical and transmission characteristics for balanced twisted pair channels.
- 5 Manufacturer Material Guarantee
 - a) Selected vendor shall provide a Structured Cabling System warranty for a minimum of 25 years. The Structured Cabling System warranty shall guarantee the electrical performance to meet or exceed the requirements as outlined in documents TIA/EIA 568A and ISO DIS 11801 and offer a twenty-five, (25) year warranty within the Structured Cabling SYSTEM Channel, beginning at acceptance by the Purchaser. The warranty shall include complete parts and labor replacement of defective products. The manufacturer shall warrant the product for a minimum of twenty (20) years. The Structured Cabling System warranty shall have provisions for replacing the contracting organization at no cost to the customer should the contractor lose his status as an

authorized installer or otherwise not fulfill his obligation to the customer as outlined in the Structured Cabling System warranty program.

- b) The Structured Cabling System (SCS) wiring vendor/contractor shall guarantee at the time of the bid that all Category 6, 6A and 6E cabling and components meet or exceed specifications (including installation) as referenced in 1.2.
- c) The successful wiring vendor/contractor (installer) shall insure that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor/contractor shall submit complete parts and part numbers to the Construction Manager prior to installation of equipment.
- (d) Application Warranty:
 - 1) Minimum twenty (20) year application assurance: The application assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future for a minimum twenty (20) year period.
- d) Certifications
 - 1) The successful vendor/contractor shall meet the current year Panduit Business Partner Agreement – Panduit Certified Installer (and/or Addendum) and shall provide a copy of the PCI certificate before awarding contract.
 - 2) A copy of certification not less than 6 months from expiration for the vendors/installer Panduit Certified Copper and Fiber Technicians (PCT) shall be submitted upon awarding of contract before first cable is pulled and or installed.
 - 3) If the successful vendor/contractor subcontracts the job (and so on), then each awarded vendor/installer shall comply with the same certifications as above.

1.2 LIFE OF THIS MANUAL

- A. This Manual is a living document. The criteria contained in this Manual are subject to revisions and updating as warranted by advances in building construction techniques and telecommunications technology.

1.3 COMPLIANCE WITH INTENT OF THIS MANUAL

- A. Where no specific standards or requirements are specified in this Manual or within other codes or regulations adopted by Cherokee Nation Government. Compliance with the applicable standards of the National Fire Protection Association, American National Standard Institute (ANSI), National Electrical Code, or other nationally recognized standards approved by the Cherokee Nation Government is prima facie evidence of compliance with the intent of this Manual.

1.4 CONFLICTS

- A. If a conflict exists between any of the above referenced installation standards listed in sections 2 and 3 above, the more stringent standard shall apply.
- B. If a conflict exists between any of the above referenced codes or standards listed in sections 2 and 3 above and this Manual, the requirements in this Manual shall apply.
- C. If a conflict exists and cannot be remediated by the above referenced codes, standards, and this Manual, **CNGIT will have overall authority and such decisions shall be considered final.**

PART 2 – DESIGN, PRODUCTS AND SYSTEM EQUIPMENT

2.1 SYSTEM REQUIREMENTS

- A. Expansion Capability: Provide spare conductor pairs in telecommunication cables, positions in cross connect and patch panels, terminal strips to accommodate 20 percent future increase in the number of

workstations shown on Drawings. All components and cabling shall be capable of 10G Bandwidth speed throughout the entire system.

- B. CNGIT understands that products and equipment can be End of Life, replaced or have a long manufacturer lead-time. The contractor, vendor or bidder shall notify CNGIT of the extended lead times. Said providers can submit replacement part numbers with specifications and installation documentation from the manufacturer **OR** CNGIT will provide a replacement part number with updated installation documentation if needed.
- C. The provider, contractor or vendor shall submit a confirmation of part descriptions, part numbers and quantities prior to ordering.
- D. All warranties need to be registered in CNGIT name, not the contractor or vendor. System ID's and Names shall be provided at the time of bidding or architectural submissions.

2.2 TECHNOLOGY SPACES

- A. All Technology spaces shall be Air Conditioned with a separate unit on a separate thermostat.
- B. The HVAC shall be provided on a 24 hours-per-day, 365 days-per year basis. If a standby power source is available in the building, consideration should be given to connecting the HVAC system serving the telecommunications equipment room to the standby supply.
- C. The temperature and humidity shall be controlled to provide continuous operating ranges of 18° C (64° F) to 24° C (75° F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions.
- D. A positive air pressure differential with respect to surrounding areas should be provided.
- E. Need 120v/208v power receptacles on all walls with dedicated circuits. The rack vertical management shall have twist lock and quad receptacles as depicted on Technology Drawings.
- F. Walls - A minimum of two walls should be covered with rigidly fixed 20 mm (3/4 in) A-C plywood, shall be void free, 2440 mm (8 ft) high, capable of supporting attached equipment. Plywood should be fire-rated or painted on all 6 sides with two coats of fire-retardant paint. Fire rating stamp shall be taped off prior to painting and tape removed so that stamp remains visible.
- G. Equipment not related to the support of the equipment room (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed in; pass through or enter the equipment room.
- H. No water sprinklers shall be installed in a designated IT/SERVER ROOM. A separate fire suppression system, based on one of the approved replacements for Halon, shall be installed in coordination with CNGIT and CNGIT and Risk Management. Appropriate safety signage and notifications shall be used according to the manufacturer, codes and standards.
- I. All IT rooms/server rooms shall have installed access control utilizing card readers per the Owners instructions, specifications, and diagrams.

2.3 BUILDING ENTRANCE FACILITY/ROOM (BEF/R)

- A. A Building Entrance Facility/Room (BEF/R) is where the building entrance conduits terminate. It should be located on an exterior wall of the ground floor.
- B. The BEF/R is the location where Internet Service Providers (ISP) enter the building and handoff circuits for connection to the Owners CD/BD/FD.
- C. When designing the BEF/R floor space, allowance shall be made for non-uniform occupancy, throughout the building. The practice is to provide 0.07 m² (0.75 ft²) of equipment room space for every 10 m² (100 sq/ft) of work area space. The equipment room shall be designed to a minimum of 10 m² (100 sq/ft). See section 8.2 of TIA/EIA-569 pg.72 for more information. In the case of smaller buildings see annex B.3 of the TIA/EIA-569.

2.4 CAMPUS/BUILDING DISTRIBUTORS (CD/BD)

- A. The Campus/Building Distributor (CD/BD) is the Highest level of distribution spaces, housing the network headend, server, storage, core switching equipment.

- B. The CD/BD should not be located on an exterior wall and should be located on the ground floor.
- C. When designing the CD/BD floor space, an allowance shall be made for non-uniform occupancy, throughout the building.
- D. The CD/BD room shall be designed to a minimum of 15 m2 (150 sq/ft).
- E. See TIA/EIA-569 for more information. In the case of smaller buildings see annex B.3 of the TIA/EIA-569.

2.5 FLOOR DISTRIBUTOR (FD)

- A. FDs are smaller than CD/BDs.
- B. The FD shall be designed to a minimum of 10 m2 (100 sq/ft).
- C. They are the cabling hubs for floors within a building. They also contain network electronics, typically mounted in 19" - 4 post racks.
- D. The practice is to provide 0.07 m2 (0.75 ft') of equipment room space for every 10 m2 (100 sq/ft) of work area space. The equipment room shall be designed to a minimum of 10 m2 (100 sq/ft). See section 8.2 of TIA/EIA-569 pg.72 for more information.
- E. All FDs shall have installed access control utilizing card readers per the Owners instructions, specifications, and diagrams.

2.6 ACCESS CONTROL EQUIPMENT

- A. Security equipment shall be located within the area serving CD/BD or FD.
- B. No security hardware shall be mounted as a bare board to the wall. All boards, controllers and power distribution units shall be mounted in a lockable:
 - 1 Wall mount cabinet.
 - 2 Rackmount drawer.
 - 3 Manufactured case as a whole unit.
- C. Power to the ACS PDU shall be 120v/20a dedicated circuit hardwired within the PDU cabinet.

PART 3 – EXECUTION

3.1 INSTALLATION STANDARDS

- A. Reference Part 1 – GENERAL
 - 1 STANDARDS AND CODE COMPLIANCE REFERENCES
 - 2 ADDITIONAL SUPPORT
 - 3 COMPLIANCE WITH INTENT OF THIS MANUAL
 - 4 CONFLICTS
- B. APPLICATION OF MEDIA
 - 1 Backbone Cable for Network Service: 24 strand OS2 single mode fiber cable for runs between BD and each FD.
 - 2 All fiber to terminate on fusion spliced duplex LC connectors.
 - 3 Backbone Cable for Paging to run from BD to each FD, terminated at wall mounted 110 blocks with legs/label kit.
 - 4 Horizontal Cable for Data Service: 10Gig UTP Category 6A cable for runs between FDs and equipment/workstation outlets.
 - 5 Horizontal Cable for Security Cameras: UTP Category 6A cable for runs between wiring closets and equipment. Starting at port 1 on Security Camera patch panel.
 - 6 Fiber Optic 6-fiber cable for runs from closet to lamp posts in parking lot. Terminating in fiber box.
- C. GROUNDING
 - 1 Grounding shall be in accordance with the Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications J-STD-607 -A.

- 2 Reference NFPA 70 (latest Edition) Article 250 for other grounding requirements.
- 3 Grounding of patch panels, fiber boxes or equipment brackets to the racks can be accomplished by one Panduit bonding screw on each side securing the bracket to the rack. Use of antioxidant paste is required.

D. IDENTIFICATION

- 1 Comply with TINEIA-606-A.
- 2 Administration class for this Project shall be Class 4.
- 3 Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
- 4 Jacks shall be the color of the network/discipline they are in.
 - a) Admin Network Cable segment 1 – Blue
 - b) Admin Network Cable segment 2 – Blue
 - c) Wireless Access Point – Blue
 - d) Television – Blue
 - e) AV Control – Blue
 - f) Access Control and Security Cameras – Yellow

E. FIELD QUALITY CONTROL

- 1 One hundred percent of the installed cable plant shall pass the requirements of the applicable standards.
- 2 Any failing link shall be diagnosed and corrected.
- 3 The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section I.2.2 of ANSI/TIA/EIA-568-B.2). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter shall Pass or Pass*.

F. CONSTRUCTION REVIEW

- 1 The following shall be examined and shall comply satisfactorily in all instances.
 - a) Design documentation complete.
 - b) All cables properly labeled, from end-to-end. Utilizing provided CNGIT template.
 - c) All terminated cables properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition, and presence of AC and/or DC voltage.
 - d) The cable type suitable for its pathway.
 - e) The cables bundled in parallel.
 - f) The pathway manufacturer's guidelines have been followed.
 - g) All cable penetrations installed properly, and fire stopped according to code.
 - h) No cable sheath exhibits signs of excessive cable bending or stressing.
 - i) Potential EMI and Radio Frequency Interference (RFI) sources have been considered.
 - j) Cable Fill is correct.
 - k) All hanging supports are within 1.5 meters (5 feet).
 - l) Hanging cable exhibit less than 6" of sag.
 - m) BD/FD terminations are compatible with applications equipment.
 - n) Patch Panel instructions have been followed:
 - (1) Jacket removal point.
 - (2) Termination positions
 - (3) All pair terminations tight with minimal pair distortions
 - (4) Twists maintained up to Index Strip
 - o) Modular Panel instructions have been followed:
 - (1) Cable dressing first
 - (2) Jackets remain up to the Connecting Block

- (3) All pair terminations tight and undistorted
 - (4) Twists maintained up to the Connecting Block
 - (5) Connectors are properly turned right side up in the Jack Panels without cables wrapped or twisted around the Mounting Collars.
 - (6) The correct outlet connectors have been used.
 - (7) Outlets have been wired correctly (T568B)
 - (8) The cable jacket maintained up to Jack.
 - (9) Identification markings uniform, permanent and readable.
- G. The Owner, its Consultants, Construction Manager, CNGIT, and their agents shall review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.
- H. Review, observation, assistance, and actions by the Owner, its Consultants, Construction Manager, CNGIT, and their agents shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The Owner, Consultants, its Construction Manager, CNGIT, and their agents review, and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.

Cherokee Nation Finish Hardware Standards for New Construction and Renovations.



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SECTION 08 71 00FINISH HARDWARE**SECTION 08 71 00 – DOOR HARDWARE**

GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

- 1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Gates.
- 2. Electronic access control system components, including:
 - a. Biometric access control reader.
 - b. Electronic access control devices.
- 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
- 4. Lead-lining door hardware items required for radiation protection at door openings.
- 5. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:

- 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Quantity, type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
5. Key Schedule:
 - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

- 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
- 2. Product data for electrified door hardware:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- 3. Certificates of Compliance:
 - a. UL listings for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
- 4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

- 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Factory order acknowledgement numbers (for warranty and service)
 - d. Name, address, and phone number of local representative for each manufacturer.
 - e. Parts list for each product.
 - f. Final approved hardware schedule, edited to reflect conditions as-installed.
 - g. Final keying schedule
 - h. Copies of floor plans with keying nomenclature
 - i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

- A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
- G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

H. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 1. Promptly replace products damaged during shipping.
 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys to Owner by registered mail or overnight package service.

1.07 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.08 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: **LCN 4000 series, 30 years**
 - 2) Electrified: 2 years.
 - b. Automatic Operators: **LCN/Stanley, 2 years**
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: Schlage ND series, 10 years
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty.
 - f. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

- A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PRODUCTS

2.01 MANUFACTURERS

- A. NO SUB: The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 2. Use materials which match materials of adjacent modified areas.
 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
 4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
10. Provide mortar guard for each electrified hinge specified.
11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.04 CONTINUOUS HINGES

A. Stainless Steel

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Markar, Stanley.
2. Requirements:
 - a. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
 - b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
 - c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
 - d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

B. Cold-Rolled Steel

1. Manufacturers:

- a. Scheduled Manufacturer: Ives.
- b. Acceptable Manufacturers: Markar, Stanley.

2. Requirements:

- a. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
- b. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
- c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
- d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

C. Aluminum Geared

1. Manufacturers:

- a. Scheduled Manufacturer: Ives.
- b. Acceptable Manufacturers: Select, Stanley.

2. Requirements:

- a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
- b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
- c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

- A. Manufacturers:
 - a. Scheduled Manufacturer: Von Duprin EPT-10.
 - b. Acceptable Manufacturers: ABH PT1000, Securitron CEPT-10.
- B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.
- C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 PIVOT SETS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Dorma, Rixson.
- B. Requirements:
 - 1. Provide pivot sets complete with oil-impregnated top pivot, unless indicated otherwise.
 - 2. Where offset pivots are specified, Provide one intermediate pivot for doors less than 91 inches (2311 mm) high and one additional intermediate pivot per leaf for each additional 30 inches (762 mm) in height or fraction thereof. Intermediate pivots spaced equally not less than 25 inches (635 mm) or not more than 35 inches (889 mm) on center, for doors over 121 inches (3073 mm) high.
 - 3. Provide appropriate model where pivot sets are scheduled at fire rated openings.
 - 4. Provide lead-lined model where pivot sets are specified at lead-lined doors.
 - 5. Provide pivots with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electrified pivot nearest to electrified locking component. If manufacturer of electrified locking component requires another device for power transfer then provide recommended power transfer device and appropriate quantity of pivots.
 - 6. Provide mortar guard for each electric pivot specified, unless specified in hollow metal frame specification.

2.07 EMERGENCY HARDWARE

- A. Double Lipped Strike
 - 1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: ABH, Hager.
 - 2. Provide double lip strike offset-hung to allow door to swing open in opposite direction unless detailed otherwise. Size for specific frame depth. Coordinate special latchbolt-hole location and special template, as required, to operate with mortise lock being used as specified.

3. Provide compatible emergency stop/release as recommended by manufacturer of double lip strike or engineered to operate with double lip strike.

B. Emergency Stop/Release

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Hager, Stanley.
2. Provide emergency stop/release for doors with double lip strikes offset-hung to allow door to swing open in opposite direction unless detailed otherwise.

2.08 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.09 SURFACE BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Surface bolts to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.

2.10 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.11 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage ND series. – No Substitutions

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: Schlage RHO.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.12 HOSPITAL LATCHES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage HL6 series.
2. Acceptable Manufacturers and Products: ABH 6000 series, Sargent 114P/115P series.

B. Requirements:

1. Provide hospital latches conforming to ANSI/BHMA A156 with covers engraved "Push" and "Pull".
2. Provide hospital latches with standard 5 inches (127 mm) backset, unless noted otherwise, with 1/2 inch (13 mm) latch throw. Provide proper latch throw for UL listing at pairs.
3. Dampened paddle action – depression and snap back – to reduce noise associated with lock operation.

4. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
5. Mount trim with push paddle mounted up and pull paddle mounted down except at psychiatric or security areas provide both paddles mounted down, unless noted otherwise.

2.13 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin **98/35A Series** – No Substitutions

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. **QM 98/99** Rim Exit Devices: provide devices with damper controlled re-latching to reduce operational noise. Where lever trim is specified, provide damper controlled lever return.
15. Top latch mounting: double or single tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
 - a. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.14 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 6000 Series.
2. Acceptable Manufacturers and Products: Folger Adam 300 Series, HES 1006 Series.

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary-resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.15 PASSIVE INFRARED MOTION SENSORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage SCAN II Series.
2. Acceptable Manufacturers and Products: RCI 915 Series, Securitron XMS Series, Security Door Controls MD-31D Series.

B. Requirements:

1. Provide motion sensors as specified in hardware groups.

2.16 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage/Von Duprin PS900 series.
2. Acceptable Manufacturers and Products: Precision ELR series, Sargent 3500 series, Dynalock 5000 series, Securitron BPS series, Security Door Controls 600 series.

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.

- e. Polarized connector for distribution boards.
- f. Fused primary input.
- g. AC input and DC output monitoring circuit w/LED indicators.
- h. Cover mounted AC Input indication.
- i. Tested and certified to meet UL294.
- j. NEMA 1 enclosure.
- k. Hinged cover w/lock down screws.
- l. High voltage protective cover.

2.17 CYLINDERS: **MATCH EXISTING KEY SYSTEM**

A. Manufacturers:

1. Scheduled Manufacturer: Schlage Everest 29R SFIC cores – Restricted. No Substitutions

B. Requirements:

1. Provide **permanent interchangeable** cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

C. Construction Keying:

1. Temporary Construction Cylinder Keying.

- a. Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
 - 1) 3 construction control keys, and extractor tools or keys as required to void construction keying.
 - 2) 12 construction change (day) keys.
- b. Owner or Owner's Representative will void operation of temporary construction keys.

2. Replaceable Construction Cores.

- a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
- b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.18 KEYING

- A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. **For factory registered existing system:** Provide cylinders/cores keyed into Owner's existing factory registered keying system.

- C. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- D. **For non-factory existing system:** Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
 - 1. Firm Name:
 - 2. Contact Person:
 - 3. Telephone:
- E. Requirements:
 - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
 - b. No Master Keying: Cylinders/cores only operated by change (day) keys.
 - 2. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - 3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s) **for Schlage Everest 29** until the year, 2029.
 - 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - 5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. **SFIC:** Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.19 KEY CONTROL SYSTEM

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Telkee.
 - 2. Acceptable Manufacturers: HPC, Lund.

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.20 KEY MANAGEMENT SOFTWARE**A. Manufacturers and Products:**

1. Scheduled Manufacturer and Product: Schlage SITEMASTER 200.
2. Acceptable Manufacturers and Products: Best Keystone 600N, Corbin-Russwin KeyWizard, Medeco KeyWizard, Sargent KeyWizard, Yale KeyWizard.

B. Requirements:

1. Software: Provide tracking, issuing, collecting and transferring information regarding keys. Provide customized query, reporting, searching capability, comprehensive location hardware listings, display key holder photos and signature for verification, and provide automatic reminders for maintenance, back-ups and overdue keys.
2. Provide training for Owner's personnel on proper operation and application of key management software.

2.21 DOOR CLOSERS**A. Manufacturers and Products:**

1. Scheduled Manufacturer and Product: LCN 4040XP series – No Substitutions

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.

7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.22 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.23 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson.
2. Acceptable Manufacturers: Rixson, Sargent.

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.24 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.25 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.
2. Acceptable Manufacturers: National Guard, Reese.

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.26 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.27 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: LCN.
2. Acceptable Manufacturers: Rixson, Sargent.

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.28 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage.
2. Acceptable Manufacturers: GE-Interlogix, Sargent.

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.29 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Continuous Hinges: BHMA 628 (US28)
4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
5. Protection Plates: BHMA 630 (US32D)
6. Overhead Stops and Holders: BHMA 630 (US32D)
7. Door Closers: Powder Coat to Match
8. Wall Stops: BHMA 630 (US32D)
9. Latch Protectors: BHMA 630 (US32D)
10. Weatherstripping: Clear Anodized Aluminum
11. Thresholds: Mill Finish Aluminum

EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door

assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
 - 2. **Furnish permanent cores to Owner for installation.**

- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 FIELD QUALITY CONTROL

- A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.
 - 1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.04 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

Hardware items are referenced in the following hardware sets. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements. Doors 42" and greater in width to receive 5" high heavyweight ball bearing hinges. Overhead stops may be required where wall stops are not practical.

Windstorm Doors are to be provided with tested, approved, and specified windstorm hardware.

3.07 HARDWARE SETS

For specific project hardware sets please contact:

Philip Sanderson

(405) 202-7282

Philip.Sanderson@Allegion.com

END OF SECTION

SECTION 01 1000 SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: CN Catoosa Child Development Center
- B. Owner's Name: Cherokee Nation of Oklahoma.
- C. Architect's Name: Blue River Architects, LLC.
- D. The Project consists of the construction of a new Child Development Center.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: Refer to bidding information for Cherokee Nation

1.03 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied by Owner and installed by Contractor after Substantial Completion.
 - 1. It is the responsibility of the Contractor to coordinate all NIC and / or Owner-furnished items with Owner. Contractor is responsible for rough-in power and backing requirements.

1.04 OWNER OCCUPANCY

- A. Owner intends to occupy the Project by the date stated in the Agreement as the contract completion date.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Arrange use of site and premises to allow:
 - 1. Work by Others.
 - 2. Work by Owner.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
 - 1. Limit conduct of especially noisy exterior work to the hours of 8am to 8pm.
 - 2. As requested by Owner.
- F. Utility Outages and Shutdown:
 - 1. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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**SECTION 01 2000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section.
- D. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit one electronic copy of each Application for Payment.
- I. Include the following with the application:

1. Transmittal letter as specified for submittals in Section 01 3000.
 2. Construction progress schedule, revised and current as specified in Section 01 3000.
 3. Current construction photographs specified in Section 01 3000.
 4. Partial release of liens from major subcontractors and vendors.
 5. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 2. Promptly execute the change.
- D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
- E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
- G. Substantiation of Costs: Provide full information required for evaluation.
 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

- H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2200 UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Defect assessment and non-payment for rejected work.

1.02 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Measurement Devices:
 - 1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - 3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.
- E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- G. Measurement by Area: Measured by square dimension using mean length and width or radius.
- H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
- J. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- K. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes, calculate and certify quantities for payment purposes.

1.05 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.

5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

1.06 DEFECT ASSESSMENT

- A. Replace Work, or portions of the Work, not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
 1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Architect.
 2. The defective Work will be partially repaired to the instructions of the Architect, and the unit price will be adjusted to a new unit price at the discretion of Architect.
- C. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
 1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
 2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.
- D. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.
- E. The authority of Owner to assess the defect and identify payment adjustment is final.

1.07 SCHEDULE OF UNIT PRICES

- A. Earth Moving.
 1. Common Excavation; Unit: CY.
 2. Disposal of Unsuitable Soil material offsite; Unit: CY.
 3. Imported Structural Fill, complete in place; Unit: CY.
- B. Cast-in-Place Concrete.
 1. Slab-on-grade, complete in place; Unit: CY.
 2. Retaining Wall, complete in place; Unit: CY.
 3. Mass concrete footing for building, complete in place; Unit: CY.
 4. Mass concrete footing for signs, masts, site elements, complete in place; Unit: CY.
- C. Metal Fabrications; Section 055000 - Metal Fabrications. Unit: 100 pounds.
- D. Gypsum Board Assemblies.
 1. Patching and replacing gypsum wallboard; (for 0 to 32 sq. ft). Provide price per square foot of finished wall / ceiling. Price is to include removing existing wallboard, installing new wallboard, finishing, and painting. Unit price to be used at locations not indicated on drawings.
 2. Patching and replacing gypsum wallboard; (for 32 sq. ft and above). Provide price per square foot of finished wall / ceiling. Price is to include removing existing wallboard, installing new wallboard, finishing, and painting. Unit price to be used at locations not indicated on drawings.
- E. Acoustical Ceilings.
 1. ACT; Provide price per ceiling tile. Price is to include new ceiling tile to match existing, where applicable, and for each type specified, and removal of existing tile, where applicable. Unit price to be used at locations not indicated on drawings. Any tile damage by the Contractor shall be replaced at Contractor's expense.
 2. ACT Grid; Provide price per 100 sq. ft of metal grid. Price is to include new ACT grid to match existing, where applicable, and for each type specified, and removal of existing grid, where applicable. Unit price to be used at locations not indicated on drawings. Any grid damage by the Contractor shall be replaced at Contractor's expense.
- F. Painting.
 1. Painting; Provide price per square foot of painting; (for 0 to 100 sq. ft.) Price to include preparation of existing surface and painting as specified.

2. Painting; Provide price per square foot of painting; (for 100 sq. ft. and above) Price to include preparation of existing surface and painting as specified.
- G. Electrical Work.
1. One-inch PVC Conduit Underground, complete in place; Unit: LF.
 2. One-inch Galvanized Conduit Attached under ceiling / slabs / decks; Unit: LF.
 3. Two-inch PVC Conduit Underground, complete in place; Unit: LF.
 4. Four-inch PVC Conduit Underground, complete in place; Unit: LF.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2300 ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.
- C. Documentation of changes to Contract Sum and Contract Time.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate 1: Country Club Drive
 - 1. Base Bid: Specified road surface is to remain as existing, excluding all construction required to connect to new roads including but not limited too curbs, curb cuts, and repairs due to utility trenching.
 - 2. Alternate Item: Provide heavy duty asphalt pavement as indicated in drawings at Country Club Drive.
 - 3. Refer to Sheet: Civil Series.
- B. Alternate 2: Generator
 - 1. Base Bid: Provide Generator power for portion of the building.
 - 2. Alternate Item: Provide generator for entire building electrical system
 - 3. Refer to Sheet: Electrical Series, E300

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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**SECTION 01 2500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 01 2300 - Alternates, for product alternatives affecting this section.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- C. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.
- D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Restrictions on emissions of indoor substitute products.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REFERENCE STANDARDS

- A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.

- D. Where "basis of design" or named products are specified, alternate equivalent manufacturers and materials may be proposed provided they are of equal quality and appearance to that specified, in the opinion of the Architect. Contractor shall provide an item-by-item and side-by-side comparison of proposed substitutions. Include all deviations and / or differences between proposed product and specified product. Include side-by-side images to indicate differences in appearance. Substitution forms without this information or incomplete proposals will be returned without review. Contractor to coordinate alternate substrate and backing requirements that may be required and compatibility with other adjacent materials and systems.
- E. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - 2) Owner's, Architect's, and Contractor's names.
 - 3) Additional information as required to facilitate review.
 - b. Substitution Request Information:
 - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
 - 2) Issue date.
 - 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 4) Description of Substitution.
 - 5) Reason why the specified item cannot be provided.
 - 6) Differences between proposed substitution and specified item.
 - 7) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - (e) Photos or images.
 - (f) Provide clear, legible, high resolution electronic documents.
 - (1) Blurry, distorted, or miss-aligned text or images, or low-quality scans of printed materials will not be reviewed.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- F. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.
- G. Substitution requests that do not follow all specified procedures or contain all specified requirements and information will be returned without review.

1. All substitution requests must be reviewed by architect.
2. Vendor correspondence or solicitation to engineers or architect's consultants does not constitute a substitution request.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Architect will consider requests for substitutions only within 30 days after date of Agreement.
- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 15 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 15 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by Owner.
 - c. Other unanticipated project considerations.
- D. Substitutions will not be considered under one or more of the following circumstances:
 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION

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**SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Progress photographs.
- G. Coordination drawings.
- H. Submittals for review, information, and project closeout.
- I. Number of copies of submittals.
- J. Requests for Information (RFI) procedures.
- K. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- B. Section 01 6000 - Product Requirements: General product requirements.
- C. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- D. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

- A. AIA G716 - Request for Information; 2004.
- B. AIA G810 - Transmittal Letter; 2001.
- C. CSI/CSC Form 12.1A - Submittal Transmittal; Current Edition.
- D. CSI/CSC Form 13.2A - Request for Information; Current Edition.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

1.05 PROJECT COORDINATOR

- A. Project Coordinator: Construction Manager.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1000 - Summary.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- F. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for Information.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.

4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service: The selected service is:
 1. Mutually agreed upon by Architect, Contractor and Owner.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
 1. Representatives of Owner are scheduled and included in this training.
- E. Project Closeout: Contractor may determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
 1. Execution of Owner-Contractor Agreement.

2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Submission of initial Submittal schedule.
 6. Designation of personnel representing the parties to Contract.
 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with copy to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 1. Contractor.
 2. Owner.
 3. Architect.
 4. Special consultants.
 5. Contractor's superintendent.
 6. Major subcontractors.
 7. Owner's Vendors, as appropriate for coordination.
- D. Agenda:
 1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Review of off-site fabrication and delivery schedules.
 8. Maintenance of progress schedule.
 9. Corrective measures to regain projected schedules.
 10. Planned progress during succeeding work period.
 11. Coordination of projected progress.
 12. Maintenance of quality and work standards.
 13. Effect of proposed changes on progress schedule and coordination.
 14. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216

3.05 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- C. Photography Type: Digital; electronic files.
- D. Provide photographs of site and construction throughout progress of work produced by photographer, acceptable to Architect.
 1. Contractor may take photos. Professional photography is not required.

- E. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.
 - 5. Enclosure of building, upon completion.
 - 6. Final completion, minimum of ten (10) photos.
- F. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Consult with Architect for instructions on views required.
 - 3. Provide factual presentation.
 - 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.06 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

3.07 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Owner.
 - a. Use AIA G716 - Request for Information .
 - b. Use CSI/CSC Form 13.2A - Request for Interpretation.
 - 3. Prepare using an electronic version of the form appended to this section.
 - 4. Prepare using software provided by the Electronic Document Submittal Service.
 - 5. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::

- a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
- 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
- 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. Owner's, Architect's, and Contractor's names.
 - 3. Discrete and consecutive RFI number, and descriptive subject/title.
 - 4. Issue date, and requested reply date.
 - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 - 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
 - 3. Highlight items requiring priority or expedited response.
 - 4. Highlight items for which a timely response has not been received to date.
 - 5. Remove improper or frivolous RFIs.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.

2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
 1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.

5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 1. After review, produce duplicates.
 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
 1. Use a single transmittal for related items.
 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 3. Transmit using approved form.
 - a. Use form generated by Electronic Document Submittal Service software.
 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - b. Clearly indicate marks made by Contractor and marks made by others prior to submitting to Architect. Use prefix before each mark, color coded legend or another method that is clearly understandable.
 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format via email to Architect.
 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 10. Provide space for Contractor and Architect review stamps.
 - a. Include Architect's review stamp on all submittals. Blanks to be filled out as part of Architect's review. Architect will provide stamp in electronic format.
 - b. Provide space for Engineer review stamps.
 11. When revised for resubmission, identify all changes made since previous submission.
 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 14. Submittals not requested will not be recognized or processed.
 15. Architect will return submittals and shop drawings to the Contractor. The Contractor shall be responsible for transmitting the reviewed submittals and shop drawings.

- B. Product Data Procedures:
 1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
 4. Provide size and scale of shop drawings appropriate for type of material, system or assembly. All text, drawings, dimensions or other graphics shall be clearly legible.
 - a. Shop drawings that are not clearly legible will be returned without review.
- D. Samples Procedures:
 1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Reviewed", or language with same legal meaning.
 - b. "Furnish as corrected or reviewed - comments noted", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Reviewed, comments noted - Submit for record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:

- a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

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**SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016.

1.03 SUBMITTALS

- A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.
- F. Submit in PDF format.

1.04 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Include conferences and meetings in schedule.
- D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- E. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- F. Indicate delivery dates for owner-furnished products.
- G. Coordinate content with schedule of values specified in Section 01 2000 - Price and Payment Procedures.
- H. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.05 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

**SECTION 01 3553
SECURITY PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Security measures including entry control, personnel identification, and miscellaneous restrictions.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: use of premises and occupancy.
- B. Section 01 5000 - Temporary Facilities and Controls: Temporary lighting, site fence, and barriers and enclosures.

1.03 SECURITY PROGRAM

- A. Protect Work , existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
- B. Initiate program in coordination with Owner's existing security system at project mobilization.
- C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.

1.04 ENTRY CONTROL

- A. Restrict entrance of persons and vehicles into Project site .
- B. Allow entrance only to authorized persons with proper identification.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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**SECTION 01 4000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Contractor's design-related professional design services.
- G. Control of installation.
- H. Mock-ups.
- I. Tolerances.
- J. Manufacturers' field services.
- K. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Document 00 3100 - Available Project Information: Soil investigation data.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures.
- C. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2024.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2018.

1.04 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design,

and are not intended to alter the aesthetic aspects of the design.

- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary falsework for support of spanning or arched structures.
 - 5. Temporary foundation underpinning.
 - 6. Temporary stairs or steps required for construction access only.
 - 7. Temporary hoist(s) and rigging.
 - 8. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Information to Architect if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Concrete Mix Design: As described in Section 03 3000 - Cast-in-Place Concrete.
 - 2. Structural Design of Steel Connections: As described in Section 05 1200 - Structural Steel Framing.
 - 3. Structural Design of Steel Connections: As described in Section 05 2100 - Steel Joist Framing.
 - 4. Structural Design of Steel Decking: As described in Section 05 3100 - Steel Decking.
 - 5. Structural Design of Metal Framing: As described in Section 05 4000 - Cold-Formed Metal Framing.
 - 6. Structural Design of Metal Fabrications: As described in Section 05 5000 - Metal Fabrications.
 - 7. Structural Design of Railings: As described in Section 05 5213 - Pipe and Tube Railings.
 - 8. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 4313 - Aluminum-Framed Storefronts.
 - 9. Structural Design of Awnings: As described in Section 10 7313 - Awnings.
 - 10. Structural Design of Walkway Coverings: As described in Section 10 7326 - Walkway Coverings.
 - 11. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Section 21 1300 - Fire-Suppression Sprinkler Systems.
 - 12. Additional design as indicated.
 - a. Contractor shall employ a consultant qualified to interpret structural criteria and other applicable criteria that pertains to the project.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.

- a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 - 2. Include required product data and shop drawings.
 - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 - 1. Submit report in duplicate within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of

- remedies of any deficiencies reported by the inspection.
3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.
 - 10) Project materials certification.
 - 11) Managerial continuity and flexibility.
 - c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
 - d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

1.09 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, ASTM D3740, and as required for project.
 - 2. Inspection agency: Comply with requirements of ASTM D3740, ASTM E329, and as required for project.
 - 3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - 4. Laboratory: Authorized to operate in the State in which the Project is located.
 - 5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
 - 1. Provide the minimum integrated exterior mock-up, unless more stringent requirements are indicated on drawings:
 - a. 12 ft x 12 ft size to include all specified exterior wall materials, including complete assembly from exterior face to interior face. Include all sealants, flashing and trim and at least one window unit.
- D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
 - 2. Make corrections as necessary until Architect's approval is issued.
- I. Accepted mock-ups shall be a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.
- K. Legally salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Attend preconstruction meetings and progress meetings.
 - 7. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.

- d. To provide storage and curing of test samples.
- 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
- 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

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**SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

1.02 RELATED REQUIREMENTS

- A. Section 01 3553 - Security Procedures
- B. Section 01 5500 - Vehicular Access and Parking.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

1.04 TEMPORARY UTILITIES - SEE SECTION 01 5100

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. New permanent facilities may be used.
- C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.05 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Contractor's option.

1.06 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.07 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- E. Traffic Controls: As indicated on drawings.

1.08 FENCING

- A. Construction: Contractor's option.
- B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 SECURITY - SEE SECTION 01 3553

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.11 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500

1.12 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13 PROJECT IDENTIFICATION

- A. Provide project identification sign of design, construction, and location approved by Owner.
 - 1. One vinyl banner, 48 sq ft, minimum.
 - 2. Graphic Design, Colors, Style of Lettering: Designated by Architect.
- B. No other signs are allowed without Owner permission except those required by law.

1.14 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate a minimum of 10 persons.
- C. Locate offices a minimum distance of 100 feet (30 m) from existing and new structures.

1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5100 TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

- A. Section 01 5000 - Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Connect to Owner's existing power service.
 - 1. Do not disrupt Owner's need for continuous service.
 - 2. Exercise measures to conserve energy.
 - 3. Provide separate metering and reimburse Owner for cost of energy used.
- C. Provide temporary electric feeder from existing building electrical service at location as directed.
- D. Complement existing power service capacity and characteristics as required.
- E. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- F. Provide main service disconnect and over-current protection at convenient location and meter.
- G. Permanent convenience receptacles may be utilized during construction.
- H. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be utilized during construction.

1.06 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.07 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.

- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F (26 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.08 TEMPORARY VENTILATION

- A. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.09 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor.
- B. Connect to existing water source.
 - 1. Exercise measures to conserve water.
 - 2. Provide separate metering and reimburse Owner for cost of water used.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 5500
VEHICULAR ACCESS AND PARKING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access roads.
- B. Parking.
- C. Existing pavements and parking areas.
- D. Permanent pavements and parking facilities.
- E. Construction parking controls.
- F. Flag persons.
- G. Flares and lights.
- H. Haul routes.
- I. Traffic signs and signals.
- J. Maintenance.
- K. Removal, repair.
- L. Mud from site vehicles.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: For access to site, work sequence, and occupancy.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Temporary Construction: Contractor's option.
- B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.02 ACCESS ROADS

- A. Tracked vehicles not allowed on paved areas.
- B. Construct new temporary all-weather access roads from public thoroughfares to serve construction area, of a width and load bearing capacity to provide unimpeded traffic for construction purposes.
- C. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- D. Extend and relocate as work progress requires, provide detours as necessary for unimpeded traffic flow.
- E. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING

- A. Use of designated areas of existing parking facilities by construction personnel is permitted.
- B. Use of designated areas of new parking facilities by construction personnel is permitted.
- C. Provide temporary parking areas to accommodate use of construction personnel.
- D. When site space is not adequate, provide additional off-site parking.

- E. Locate as approved by Owner.

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

- A. Prior to Substantial Completion the base for permanent roads and parking areas may be used for construction traffic.
- B. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.06 FLAG PERSONS

- A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.07 FLARES AND LIGHTS

- A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.08 HAUL ROUTES

- A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.09 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
- B. Relocate as work progresses, to maintain effective traffic control.

3.10 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.11 REMOVAL, REPAIR

- A. Remove temporary roads when permanent paving is usable.
- B. Repair existing facilities damaged by use, to original condition.
- C. Remove equipment and devices when no longer required.
- D. Repair damage caused by installation.

3.12 MUD FROM SITE VEHICLES

- A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION

**SECTION 01 5713
TEMPORARY EROSION AND SEDIMENT CONTROL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 REFERENCE STANDARDS

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- B. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.
- C. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2015.

1.03 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Best Management Practices Standard: FHWA FLP-94-005.
- C. Runoff Calculation Standard for Urban Areas: USDA TR-55.
- D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
- F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

- J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 - 1. Submit not less than 30 days prior to anticipated start of clearing, grading, or other work involving disturbance of ground surface cover.
 - 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Measurements of existing turbidity of waterways.
 - c. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - d. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - e. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - f. Other information required by law.
 - g. Format required by law is acceptable, provided any additional information specified is also included.
 - 3. Obtain the approval of the Plan by authorities having jurisdiction.
 - 4. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 3 EXECUTION

2.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

2.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

2.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 20 feet (7 m), minimum.
 - 2. Length: 50 feet (16 m), minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
 - a. Unless otherwise indicated.
- C. Linear Sediment Barriers: Made of silt fences, straw bales, or brush (during clearing operations only).
 - 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart (at maximum of 60 m apart).
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet (30 m)..
 - b. Slope Between 2 and 5 Percent: 75 feet (23 m).
 - c. Slope Between 5 and 10 Percent: 50 feet (15 m).
 - d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
 - e. Slope Over 20 Percent: 15 feet (4.5 m).
 - 1) Unless otherwise indicated on drawings.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
 - a. Unless otherwise indicated on drawings.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
 - a. Unless otherwise indicated.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

2.04 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.

- C. Clean out temporary sediment control structures weekly and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

2.05 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Sustainable design-related product requirements.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Identification of Owner-supplied products.
- B. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- C. Section 01 4000 - Quality Requirements: Product quality monitoring.
- D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

1.03 REFERENCE STANDARDS

- A. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute; Current Edition.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- C. CAN/CSA Z809 - National Standard for Sustainable Forest Management; CSA International Inc.; 2016.
- D. EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products; 2014.
- E. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; Current Edition.
- F. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; Current Edition.
- G. ISO 14044 - Environmental management - Life cycle assessment - Requirements and guidelines; 2006 (Amended 2020).
- H. ISO 21930 - Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services; 2017.
- I. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2015.

1.04 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

- A. Cradle-to-Cradle Certified: End use product certified Cradle-to-Cradle v2 Basic or Cradle-to-Cradle v3 Bronze, minimum, as evidenced by C2C (DIR).
- B. GreenScreen Chemical Hazard Analysis: Ingredients of 100 parts-per-million or greater evaluated using GreenScreen (METH).
 1. Good: GreenScreen (LIST) evaluation to identify Benchmark 1 hazards; a Health Product Declaration includes this information.
 2. Better: GreenScreen Full Assessment.
 3. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.
 4. Acceptable Evidence: GreenScreen report.
- C. Health Product Declarations (HPD): Complete, published declaration with full disclosure of known hazards, prepared using one of the HPDC (HPD-OLT) online tools.
- D. Rapidly Renewable Materials: Made from agricultural products that are typically harvested within a 10-year or shorter cycle.
- E. Reused Products: Materials and equipment previously used in this or other construction, salvaged and refurbished as specified.
 1. Wood fabricated from timber abandoned in transit after harvesting is considered reused, not recycled.
 2. Acceptable Evidence: Information about the origin or source, from Contractor or supplier.
- F. Sustainably Harvested Wood: Solid wood, wood chips, and wood fiber certified or labeled by an organization accredited by one of the following:
 1. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit <http://www.fsccanada.org>, for the USA visit <http://www.fscus.org>.
 2. Acceptable Evidence: Copies of invoices bearing the certifying organization's certification numbers.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 1. Made using or containing CFC's or HCFC's.
 2. Made of wood from newly cut old growth timber.
 3. Containing lead, cadmium, or asbestos.
- D. Where other criteria are met, Contractor shall give preference to products that:
 1. If used on interior, have lower emissions, as defined in Section 01 6116.
 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
 4. Have longer documented life span under normal use.
 5. Result in less construction waste.
 6. Are made of vegetable materials that are rapidly renewable.
 7. Are made of recycled materials.
 8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
 9. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.
 10. Are Cradle-to-Cradle Certified.
 11. Have a published Environmental Product Declaration (EPD).
 12. Have a published Health Product Declaration (HPD).
 13. Have a published GreenScreen Chemical Hazard Analysis.
 14. Have a published Manufacturer's Inventory of Chemical Content.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 1000 - Summary for identification of Owner-supplied products.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- C. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.

- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide off-site storage and protection when site does not permit on-site storage or protection.
- I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- J. Comply with manufacturer's warranty conditions, if any.
- K. Do not store products directly on the ground.
- L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- M. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- N. Prevent contact with material that may cause corrosion, discoloration, or staining.
- O. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- P. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 6116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.
- B. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Flooring.
 - 4. Composite wood.
 - 5. Products making up wall and ceiling assemblies.
 - 6. Thermal and acoustical insulation.
 - 7. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
 - 1. Stone.
 - 2. Concrete.
 - 3. Clay brick.
 - 4. Metals that are plated, anodized, or powder-coated.
 - 5. Glass.
 - 6. Ceramics.
 - 7. Solid wood flooring that is unfinished and untreated.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- C. BIFMA e3 - Furniture Sustainability Standard; Business and Institutional Furniture Manufacturers Association; 2019.
- D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.

- E. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- F. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2019.
- G. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.
- H. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- I. GreenSeal GS-36 - Standard for Adhesives for Commercial Use; 2013.
- J. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- L. SCS (CPD) - SCS Certified Products; Current Edition.
- M. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
 - 1. Wet-Applied Products: State amount applied in mass per surface area.
 - 2. Paints and Coatings: Test tinted products, not just tinting bases.
 - 3. Evidence of Compliance: Acceptable types of evidence are the following;
 - a. Current UL (GGG) certification.
 - b. Current SCS (CPD) Floorscore certification.
 - c. Current SCS (CPD) Indoor Advantage Gold certification.
 - d. Current listing in CHPS (HPPD) as a low-emitting product.
 - e. Current CRI (GLP) certification.
 - f. Test report showing compliance and stating exposure scenario used.
 - 4. Product data submittal showing VOC content is NOT acceptable evidence.
 - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
 - b. Published product data showing compliance with requirements.
 - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scs-certified.com.
 - b. Report of laboratory testing performed in accordance with requirements.
 - c. Published product data showing compliance with requirements.
 - d. Certification by manufacturer that product complies with requirements.
- D. Furnishings Emissions Standard and Test Method: BIFMA e3 Sections 7.6.1 and 7.6.2, tested in accordance with BIFMA M7.1.
 - 1. Evidence of Compliance:
 - a. Test report showing compliance and stating exposure scenario used.

- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
 - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
 - 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 - 2. Aerosol Adhesives: GreenSeal GS-36.
 - 3. Joint Sealants: SCAQMD 1168 Rule.
 - 4. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

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**SECTION 01 7610
TEMPORARY PROTECTIVE COVERINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary protective coverings for installed floors, walls, and other surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 01 7000 - Execution and Closeout Requirements: Coordination of requirements for materials specified in this section.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (R2020).
- B. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- E. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes available; and installation instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:
 - 1. Water resistant.
 - 2. Vapor permeable.
 - 3. Impact resistant.
 - 4. Slip resistant.
 - 5. Flame retardant.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove dirt and debris from surfaces to be protected.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Trim or overlap sheet materials to fit area to be covered.
- C. Roll out and cut rolled materials to fit area to be covered.
- D. Tape seams. Avoid taping directly to finished surfaces.
- E. Stretch self-adhering film materials to completely cover surface.
- F. Install door jamb protection to full height of opening.

3.03 REMOVAL

- A. Remove protective coverings prior to Date of Substantial Completion. Reuse or recycle materials if possible.

END OF SECTION

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**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final review.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.

- Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - 1. Include HVAC outdoor and exhaust air damper calibration strategy.
 - a. Include provisions which ensure that full closure of dampers can be achieved.
 - 2. Include Carbon Dioxide Monitoring Protocol.
 - 3. Include Carbon Monoxide Monitoring Protocol.
 - 4. Include Frost Mitigation Strategy for ventilation heat-recovery system.
 - G. Provide servicing and lubrication schedule, and list of lubricants required.
 - H. Include manufacturer's printed operation and maintenance instructions.
 - I. Include sequence of operation by controls manufacturer.
 - J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - K. Provide control diagrams by controls manufacturer as installed.
 - L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
 - M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - O. Include test and balancing reports.
 - P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.

- b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.
- K. Coordinate additional requirements with Owner.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

**SECTION 01 7900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Conveying systems.
 - 6. Landscape irrigation.
 - 7. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.

3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 1. Format: DVD Disc. Verify with Owner.
 - a. Additional Format: USB Flash Drive or Digital download.
 2. Label each disc and container with session identification and date.
 3. Label each recording file with the session identification and date, plus project title.
 4. Audio-video recordings shall be delivered in Mp4 digital format, in minimum 1080 dpi resolution, without compression (other than H-264) applied.
 5. Audio-video recordings shall be edited to eliminate any outtakes or extended interruptions or delays that occur during the presentation, as well as any pre or post presentation preparation or wrap-up activities or conversations.
 6. Deliver all video recordings on a single USB or external hard drive, with a gallery layout or list showing all recorded sessions by title and date, linked to the respective recording for immediate playback when clicked.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.
- B. Videographer Qualifications
 1. Provide examples of prior work and a minimum of three references in recording training sessions.
 2. Ensure that the video image is stable (employing image stabilization or use of a tripod when appropriate) and composed to include presenter and associated equipment systems.
 3. Ensure audio track records presenter with minimal interference from ambient sound and equipment noise. "Mic-up" the presenter individually to ensure proper sound recording and ask presenter to repeat Q&A questions before answering.
 4. Any audio-video recordings that do not meet the above standards shall be rescheduled and re-recorded, with the original presenter, or an approved alternate.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- D. Provide training in minimum two hour segments.
- E. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- F. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- G. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- H. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- I. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

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**SECTION 03 0516
UNDERSLAB VAPOR BARRIER**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 03 3000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Samples: Submit samples of underslab vapor barrier to be used.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m² Pa)), maximum.
 - 2. Complying with ASTM E1745 Class A.
 - 3. Thickness: 20 mils (0.5 mm).
 - 4. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1.
 - 5. Basis of Design:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (20-mil):
www.stegoindustries.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches (150 mm) with manufacturer's seam tape.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. For interior forming applications, avoid the use of non-permanent stakes driven through vaporbarrier. Use Beast Form Stake and Beast Foot as a vapor barrier-safe forming system. Ensure Beast Foot's peel-and-stick adhesive base is fully adhered to the vapor barrier
- G. Use reinforcing bar supports with base sections that eliminate or minimize the potential for puncture of the vapor barrier.
- H. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Form liners.
 - 3. Shoring, bracing, and anchoring.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Form liners.
 - 4. Form ties.
 - 5. Waterstops.
 - 6. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect and Structural Engineer of Record.
 - 3. Indicate location of waterstops.
 - 4. Indicate form liner layout and form line termination details.
 - 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
- C. Samples:
 - 1. For waterstops.
 - 2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete exposed to view, limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than 1/600 of the wall height for architectural concrete exposed to view and not more than 1/360 of the wall height for other concrete members

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 3000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form Liners:
 - 1. As indicated on drawings

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 - 1. Profile: Flat dumbbell with center bulb.
 - 2. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat dumbbell with center bulb.
 - 2. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.

- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch for concrete not exposed to view.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch for concrete slabs.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch for architectural concrete exposed to view.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.

2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect and Structural Engineer of Record prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated on Drawings or 25'-0" maximum.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 4. Secure waterstops in correct position at 12 inches on center.
 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 6. Clean waterstops immediately prior to placement of concrete.
 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 and manufacturer's instructions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Install forms in running bond pattern.
 1. Align joints.
 2. Align furring strips.
 3. Coordinate snap-tie hole layout and spacings with architect on architectural appearance quality concrete.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is approved.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

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**SECTION 03 1119
INSULATING CONCRETE FORMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating concrete forms: Modular unit formwork system for cast-in place concrete walls; formwork designed to remain in place after concrete work is complete.
- B. Shoring, bracing and anchorage.
- C. Openings for other work.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Conventional concrete forms designed to be removed after concrete is poured and related accessories.
- B. Section 03 2000 - Concrete Reinforcing: Reinforcing steel to be placed at the same time as formwork specified in this section.
- C. Section 03 3000 - Cast-in-Place Concrete: Concrete to be placed into formwork specified in this section.
- D. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Concrete Construction; 2020.
- B. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- C. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- E. ASTM C203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation; 2022.
- F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
- G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.
- H. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
- I. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
- J. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
- K. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging; 2020.
- L. ASTM D2863 - Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index); 2023.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties; reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and the insulating concrete form system manufacturer's requirements.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.
- B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulating concrete form system units and accessories with manufacturer's printed installation instructions and in manufacturer's original packaging.
- B. Protect insulating concrete form system units and accessories from exposure to sunlight.
- C. Store insulating concrete form system units off ground in ventilated and protected manner to prevent damage and deterioration from moisture.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fox Blocks; Fox Blocks: www.foxblocks.com/#sle.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FORMWORK - GENERAL

- A. Provide insulating concrete forms, accessories, shoring, and bracing as required to accomplish insulated cast-in-place concrete work.
- B. Design and construct to provide resultant concrete that complies with design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication and erection of formwork.
- D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.03 INSULATING CONCRETE FORMS

- A. Performance Requirements:
 - 1. Thermal Insulance, R-value (RSI-value), of Assembled System: Calculated thermal insulance when tested in accordance with ASTM C177.
- B. Insulating Concrete Form Units for Walls: Rigid, expanded polystyrene boards; boards connected horizontally with injection--molded polypropylene webs and vertically by means of interlocking edges.
 - 1. Board Thickness: 2-1/2 inches (63.5 mm) .
 - 2. Concrete Core Thickness: 8 inches (203.2 mm).

2.04 COMPONENTS

- A. Expanded Polystyrene (EPS) Insulation Board, General: Comply with the minimum requirements of ASTM C578, Type II and the specified characteristics below.
 - 1. Density: 1.35 pounds per cubic foot (22 kg/cu m) when tested in accordance with ASTM D1622/D1622M.

2. Compressive Strength: 15 psi (104 kPa) when tested in accordance with ASTM D1621.
3. Flexural Strength: 35 psi (240 kPa) when tested in accordance with ASTM C203.
4. Water Absorption: 3.0 percent by volume, maximum.
5. Dimensional Stability: 2.0 percent, maximum, when tested in accordance with ASTM D2126.
6. Oxygen Index: 24 percent by volume, minimum, when tested in accordance with ASTM D2863.
7. Flammability; when tested in accordance with ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.

2.05 MATERIALS

- A. Concrete, for Use with insulating Concrete Forms: Comply with the applicable requirements of Section 03 3000 and specific requirements listed below.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with insulating concrete form work. Ensure that dimensions agree with drawings.
- B. Verify placement of dowels and other anchors in foundations comply with the approved Contract Documents and the recommendations of the insulating concrete form manufacturer.

3.02 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing as recommended by the manufacturer. Protect forms from damage.
- B. Brace forms as recommended by manufacturer to ensure stability. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Align joints. Install units in running bond.
- D. Ensure webs and attachment strips are properly aligned.
- E. Install steel reinforcement as insulating concrete form work progresses and as indicated in the approved design data documents.
- F. Install alignment system as recommended by manufacturer and as work progresses.

3.03 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Remove insulating concrete form material and provide sleeves or other means to create formed openings where required. Cut forms for utility penetrations as needed. Coordinate location of openings for items to be embedded in or pass through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.04 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.05 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Inspect insulating concrete form system, shoring, and bracing to ensure that work complies with the approved shop drawings and to verify that supports, fastenings, webs, alignment devices, attachment strips and other items are secure.

3.06 CLEANING

- A. Clean forms as installation progresses. Remove dirt, dust, debris, excess material, etc. within forms.

B. Clean formed cavities and openings.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.
- B. Related Requirements:
 - 1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
 - 2. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement. Reinforcement schedules alone are not acceptable. The reinforcement shop drawings shall also include sections and details showing reinforcement placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 3. Reproduction of Contract Drawings shall not be used for shop drawings.
 4. Shop drawings shall be coordinated with other trades, construction fit up and project site conditions. The General Contractor shall coordinate this prior to submission of the Shop Drawings.
 5. Design Team Review of Shop Drawings:
 - a. Shop drawing review is for bar size, spacing, details and general conformation of the Contract Drawings only.
 - b. Shop drawings will only be reviewed if transmitted in their entirety, unless previously approved to submit in phases. Incomplete shop drawings will be marked revise and resubmit. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals beyond the first time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.
 - c. Fabrication of materials prior to review of the shop drawings is at the Contractor's risk.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of the Architect and Structural Engineer of Record.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For delegated-design engineer and testing and inspection agency.
- B. Delegated-Design Engineer Qualifications: Include the following:
1. Experience providing delegated-design engineering services of the type indicated.
 2. Documentation that delegated-design engineer is licensed in the state in which Project is located.
- C. Welding certificates.
1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
- D. Material Test Reports: For the following, from a qualified testing agency:
1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 ALLOWANCES

- A. Include an allowance in bid price for an additional ten (10) percent of the total reinforcing steel. This allowance shall include, but is not limited to, the fabrication, shipping, placement, labor, material, detailing, overhead and profit of the reinforcing steel as directed by the Architect or Structural Engineer of Record.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Galvanized.
- D. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

- D. Provide concrete coverage in accordance with ACI 318 or as specified on the Drawings.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, 24 inches, or as specified on Drawings, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect or Structural Engineer of Record.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections: Steel-reinforcement placement.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 0516 "Underslab Vapor Barrier" for vapor barriers.
 - 2. Section 03 1000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
 - 3. Section 03 2000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
 - 4. Section 31 2001 "Structural Earth Moving" for drainage fill under slabs-on-ground.
 - 5. Section 32 1313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.

2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.
 - f. Cold and hot weather concreting procedures.
 - g. Concrete finishes and finishing.
 - h. Curing procedures.
 - i. Forms and form-removal limitations.
 - j. Shoring and reshoring procedures.
 - k. Methods for achieving specified floor and slab flatness and levelness.
 - l. Floor and slab flatness and levelness measurements.
 - m. Concrete repair procedures.
 - n. Concrete protection.
 - o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
 - p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
9. Color pigments.
10. Vapor retarders.
11. Floor and slab treatments.
12. Curing materials.
13. Joint fillers.
14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification and intended location of placement.
2. Minimum 28-day compressive strength.
3. Proportions of ingredients used for the composition of design mixtures.
4. Durability exposure class.
5. Maximum w/cm.
6. Slump limit.

7. Air content.
 8. Nominal maximum aggregate size.
 9. Dosage of Admixture
 10. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 11. Documentation of average strength
 12. Intended placement method.
 13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect and Structural Engineer of Record.
- D. Samples: For manufacturer's standard colors for color pigment.
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
 2. Fly ash.
 3. Slag cement.
 4. Blended hydraulic cement.
 5. Silica fume.
 6. Performance-based hydraulic cement.
 7. Aggregates.
 8. Admixtures.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 1. Slab-On-Ground: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.
 - a. Divide panel into four equal panels to demonstrate saw joint cutting.
 2. Formed Surfaces: Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.9 ALLOWANCES

- A. Include an allowance in bid price for an additional ten (10) percent of the total concrete. This allowance shall include, but is not limited to, the manufacture, shipping, placement, labor, material, detailing, overhead and profit of the concrete as directed by the Architect or Structural Engineer of Record.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.
- B. Concrete supplier shall have sufficient capacity and adequate facilities to provide continuous delivery at the rate required for continuous placement throughout any sequence of placement.
- C. Storage of Concrete Materials:
 1. Store cement in weather tight buildings or bins which prevent intrusion of moisture or contaminants. Store different types of cement in separate facilities.
 2. Stockpile aggregates to prevent segregation and contamination with other materials. Thaw frozen aggregates before use.
 3. Sand shall be drained to a uniform moisture content before use.
 4. Store admixtures securely to prevent contamination, evaporation damage or temperature variation in excesses of the range recommended by the manufacturer.

1.11 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Fly Ash: ASTM C618, Class C or F. Use only one type and source throughout the project
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Silica Fume: ASTM C1240 amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S for concrete exposed to weather; Class 1N for interior applications; coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
2. Maximum Coarse-Aggregate Size: 1 inch nominal
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
 - a. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
 - b. Manufacturers:
 - 1) Basis-of-design; MasterLife 300D Crystalline Waterproofing integral admixture: BASF
8. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
9. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

10. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.
11. Moisture-Reducing Admixture:
 - a. Non-toxic, volatile organic compound (VOC) free, liquid admixture formulated to react with hydroxide ions produced by cement hydration process, creating additional hydration products within capillary pores, blocking moisture vapor movement through concrete
 - b. Physical characteristics:
 - 1) Hydraulic conductivity: Project specific maximum of 6.0 E-8 cm/s per ASTM D5084.
 - 2) Toxicity: None.
 - 3) Odor: None.
 - 4) Flammability: None.
 - 5) Volatile Organic Compound (VOC) content: 0 grams per liter.
 - 6) Freeze temperature: 32 degrees F (0 degrees C).
 - 7) pH: 11.3
 - c. Add admixture per manufacturer's instructions.
 - d. Use with firm experienced in manufacture of concrete MVRA.
 - e. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) VaporLock 20/20
 - 2) ISE Logik MVRA 900
 - 3) Barrier One
 - 4) Xypex
- F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments, color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 1. Color: As selected by Architect from manufacturer's full range.

2.3 FLOOR AND SLAB TREATMENTS

- A. See Division 9

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.

- D. Curing Paper: Eight-foot-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
 2. Required Average Strength for each type of concrete:
 - a. Where suitable test records for the concrete production facility are available, design strength may be tested on the standard deviation in accordance with ACI 318.
 - b. Where strength test records are not available, design strength and documentation of average strength as noted in ACI 318, Chapter 5.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows, unless noted otherwise in specific concrete mix design specification:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use water-reducing or high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, concrete for parking structure slabs, and concrete with a w/cm below 0.50.
 4. Slump limits noted are prior to adding water-reducing admixtures. Slump limits shall be no more than 8 inches after adding water-reducing admixtures.

5. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 6. Use permeability-reducing admixture in concrete mixtures where indicated.
 7. Use moisture-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings and pedestals.
1. Exposure Class: ACI 318: F0, S0, W0, C1.
 2. Minimum Compressive Strength: 3000 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 5. Slump Limit: 4 inches, plus or minus 1 inch.
- B. Class B: Normal-weight concrete used for exterior slabs-on-ground.
1. Exposure Class: ACI 318: F3, S0, W0, C2.
 2. Minimum Compressive Strength: 5000 psi at 28 days.
 3. Maximum w/cm: 0.40.
 4. Maximum Coarse-Aggregate Size: 1 inch nominal.
 5. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318: F0, S0, W0, C1.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Maximum Coarse-Aggregate Size: 1 inch nominal.
 5. Slump Limit: 4 inches, plus or minus 1 inch.
- D. Class D: Normal-weight concrete used for slabs on composite deck.
1. Exposure Class: ACI 318: F0, S0, W0, C0.
 2. Minimum Compressive Strength: 3500 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 5. Slump Limit: 4 inches, plus or minus 1 inch.
- E. Class E: Normal-weight concrete used for interior topping slabs:
1. Exposure Class: ACI 318: F0, S0, W0, C0.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Maximum Size Aggregate: 1/2 inch.
 5. Slump Limit: 4 inches, plus or minus 1 inch.
- F. Class F: Normal-weight concrete used for interior walls:
1. Exposure Class: ACI 318: F0, S0, W0, C0.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Maximum Size Aggregate: 3/4 inch.

5. Slump Limit: 6 inches, plus or minus 1 inch.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect or Structural Engineer of Record.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings or 25'-0": on-center maximum. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints:
 - a. Primary Method: Soft-Cut System method, by Soff-Cut International, Corona, CA (800) 776-3328. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within 2 hours after final finish at each saw cut location.
 - b. Optional Method (Where Soft-Cut System Method Equipment is Not Available): Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks. Properly time cutting with the set of the concrete. Saw-Cut control joints within 12 hours after finishing. Complete cutting before shrinkage stresses become sufficient to produce cracking.

3. Spacing: Provide joints at locations as noted on Contract Drawings.
 - a. Placement of saw joints must be coordinated with the tile joints and this requirement governs over locations shown on the Contract Drawings.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings or as alternate to dowel bars indicated in the slab-on-grade. Contractor shall verify with Structural Engineer of Record that substitution locations are acceptable prior to installation of dowel plates.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect or Structural Engineer of Record in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required. Confirm with Architect and Structural Engineer of Record before proceeding with a specific slope or on exterior concrete without a specific slope.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
 2. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view.
- B. Rubbed Finish: Apply the following to as cast surface finishes on concrete surfaces where indicated on Drawings:
 1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match mockups.
- C. Related Unformed Surfaces:
 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 3. Apply scratch finish to surfaces to receive concrete floor toppings.
- C. Float Finish:
 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish:
 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate to concrete stair treads, platforms, ramps as indicated on Drawings
 - 1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
 - 1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 - 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 - 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 - 4. After final floating, apply a trowel finish.
 - 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.8 FINISH FLOOR TOLERANCES

- A. Finish floor tolerances shall meet the following:
 - 1. Trowel finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
 - 2) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
 - b. Finish elevated concrete slab on metal deck to the following tolerances, to the elevation specified and as indicated on the Construction Documents:

- 1) Construct slabs to the minimum thicknesses indicated on the drawings. ACI 117 tolerances for slab thicknesses shall not apply to concrete slabs-on-metal-deck.
 - a) Tolerance on slab thickness: -1/4"
- 2) In-place top of concrete elevations shall be as indicated on the drawings within a tolerance of + 3/8"/-5/8" and meeting the overall local flatness values specified below.
 - a) Finish slabs to the overall local flatness F(F) values according to ASTM E1155.
 - b) Measure and report F(F) values within 72 hours of placing concrete.
 - c) Required overall flatness, F(F) 35; Required local flatness F(F) 25, unless noted otherwise.
- 3) Finish slabs to provide top of concrete elevations that vary by no more than [+/-3/8"] in 10 feet.
 - a) Survey, record and report finish floor elevations within 72 hours of placing concrete.
 - b) Measure floor elevations at survey points located at intersecting grids established on all column lines in both directions and at 10 feet on center (maximum) between column lines.
- 4) Provide and place additional concrete as required to compensate for deflection of the metal deck and deflection of the structural steel framing to achieve the required finished top of slab elevations within the tolerances noted above. The maximum amount of additional concrete that is allowed is specified on the Construction Documents. This additional concrete may be required to be used in discrete low areas to achieve the specified tolerance noted. This item shall be addressed in the preconstruction meeting with the Engineer of Record.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base. Drill and epoxy into concrete base with approved concrete epoxy material.
5. For supported equipment, install approved anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

- a. Verify with Structural Engineer of Record the location, size and thickness of equipment base/
- b. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- c. Cast anchor-bolt insert into bases.
- d. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Cold-Weather Placement: Comply with ACI 306.1, ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 1. When the average of the highest and lowest ambient temperature from midnight to midnight is expected to be less than 40 degrees F for more than three successive days, deliver concrete to meet the following minimum temperatures immediately after placement:
 - a. 55 degrees F for sections less than 12 inches in the least dimension;
 - b. 50 degrees F for sections 12 to 36 inches in the least dimension;
 - c. 45 degrees F for sections 36 to 72 inches in the least dimension; and
 - d. 40 degrees F for sections greater than 72 inches in the least dimension.
 2. The temperature of concrete as placed shall not exceed these values by more than 20 degrees F. If exceeded, concrete shall not be placed and engineer of record shall be notified.
 3. The minimum requirements may be terminated when temperatures above 50 degrees F occur during more than half of any 24 hour duration.
 4. When the outdoor temperature is less than 40 degrees F, maintain temperature of placed concrete at not less than 50 degrees F for required curing time.
 5. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 6. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- C. Hot-Weather Placement: Comply with ACI 301, ACI 305.1, ACI 305R, and as follows:
 1. Maintain concrete temperature below 90 deg F at time of placement. If exceeded, concrete shall not be placed and engineer of record shall be notified. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
 3. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.
- D. Windy Weather Placement: Comply with ACI 301, ACI 305.1, ACI 305R and as follows:

- E. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.
- F. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period with one of the following:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- G. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

- a) Water.
- b) Continuous water-fog spray.

b. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

c. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least six months or as recommended by the manufacturer.
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect or Structural Engineer of Record.
 2. Remove and replace concrete that cannot be repaired and patched to Architect's or Structural Engineer of Record's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

- a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
- 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect or Structural Engineer of Record's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 1. Headed bolts and studs.
 2. Anchor Rods
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
 7. Batch Plant Inspections: On a random basis, as determined by Architect.
 8. All other special inspection items as noted on the Contract Drawings.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof. For slabs, obtain at least one composite sample for the minimum of each 150 cubic yard or each 5,000 square feet of slab placed each day.
 - a. One Composite sample shall consist of a minimum of four cylinders.
 - b. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of four standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:

- a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
- 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
- 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
 - 14. Inspection Reports shall include items inspected, inspection locations and verification of compliance or deviations from the Contract Documents.
 - 15. Concrete strength tests made and tested by testing laboratory shall be the sole criteria of concrete strength unless in-situ tests are made in accordance with the Building Code by a qualified independent testing laboratory. Concrete for which strength tests do not meet criteria for acceptance shall be considered inadequate until proven otherwise.
 - 16. Where concrete strength tests fail to meet the criteria specified herein, the Structural Engineer of Record shall be the sole judge of structural adequacy of concrete.
 - a. The burden of proof of structural adequacy shall be the responsibility of the Contractor.
 - b. If upon the evaluation of structural adequacy the testing is inadequate strength, in opinion of the Structural Engineer of Record, portions of the structure shall be repaired or removed and replaced as directed by the Structural Engineer of Record at no additional expense to the owner.
 - 17. If strength tests fall below the specified strength, Contractor shall either improve curing conditions or shall modify the design mixtures to improve strength.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

- A. Protect concrete surfaces as follows:
- 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION

**SECTION 03 3511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.
- C. Clear coatings.
- D. Clear penetrating sealers.
- E. Locations are indicated on drawings.
- F. Finish floor elevations and control / expansion joint locations / requirements are indicated on structural and architectural drawings.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
- C. Section 03 3000 - Cast-in-Place Concrete: Curing compounds that also function as sealers.
- D. Section 03 3000 - Cast-in-Place Concrete: Concrete mix design.

1.03 REFERENCE STANDARDS

- A. American Concrete Institute (ACI): ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- B. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- C. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.
- D. ASTM C 779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- E. National Floor Safety Institute (NFSI): NFSI Test Method 101-A - Standard for Evaluating High-Traction Flooring Materials.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
 - 1. VOC content in accordance with Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- C. Samples: For each type of product requiring color selection.
- D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- E. Manufacturer's installation instructions.
- F. Concrete Mix Design: Include manufacturer's recommendations for each type of finish.
- G. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed phase Two Level of certification when tested by Method 101-A. ANSI B-101.1 2009 non-slip properties.
- H. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- I. Operation and Maintenance Data: Submit operation and maintenance data for installed products.

1. Manufacturer's instructions on maintenance renewal of applied treatments.
 2. Protocols and product specifications for joint filing, crack repair and/or surface repair.
- J. Warranty Documentation: Manufacturer warranty, Installer warranty, and Finish warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.
- K. Specimen Warranty: Manufacturer warranty, Installer warranty, and Finish warranty.

1.06 QUALITY ASSURANCE

- A. Concrete finishing components and materials shall be from single manufacturer.
- B. Regulatory Requirements: Comply with NFSI Test Method 101-A Phase Two Level High Traction Material.
- C. Pre-installation Meetings: Conduct a pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:
1. Environmental requirements.
 2. Scheduling and phasing of Work.
 3. Coordinating with other Work and personnel. Remind all trades that they are working on a surface that is to become a finished surface.
 4. Protection of adjacent surfaces.
 5. Surface preparation.
 6. Repair of defects and defective work prior to installation.
 7. Cleaning.
 8. Application of liquid hardener, densifier.
 9. Protection of finished surfaces after installation.
 10. placing of materials on the concrete surface that may cause staining, etching, or scratching.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver materials in manufacturer's sealed packaging, including application instructions.
- C. Sequence with other Work: Comply with manufacturer's written recommendations for sequencing construction operations.

1.08 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.09 PERFORMANCE REQUIREMENTS

- A. Use of markers, spray paint and soapstone are prohibited.
- B. Vehicle parking over concrete surfaces is prohibited.
- C. Pipe-cutting operations or other operations over concrete surfaces that may damage surfaces is prohibited.
- D. Ferrous metal storage over concrete surfaces is prohibited
- E. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces.
- F. Protect from painting activities over concrete surfaces.
- G. Protect from acids and acidic detergents contacting concrete surfaces.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

- B. Correct defective work within a five-year period commencing on the Date of Substantial Completion.
- C. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Liquid Densifier and Hardener:
 - 1. Use at following locations: Sealed concrete floor finish.
- B. Penetrating Clear Sealer:
 - 1. Use at following locations: Sealed concrete floor finish.
- C. Clear Coating:
 - 1. Use at following locations: Sealed concrete floor finish.
- D. Slip Resistant Coating: Finely-ground aggregates added to coatings.
 - 1. Use at following locations: Rooms where sealed concrete is specified.

2.02 SURFACE TREATMENTS

- A. Troweling Aid, Densifier and Curing Agent: Liquid reactive colloidal silica-based topical treatment, spray-applied to wet concrete and floated or troweled into the surface.

2.03 DENSIFIERS AND HARDENERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Unless otherwise recommended by manufacturer for application.

2.04 COATINGS

- A. Low Gloss Clear Coating: Transparent, nonyellowing, water- or solvent-based coating.
 - 1. Composition: Acrylic polymer-based.
- B. Clear Coating: Clear coating recommended by manufacturer for finishing concrete floors and slabs.
 - 1. Gloss: Matte.
- C. Penetrating Sealer: Transparent, nonyellowing, water-based coating.
 - 1. Sealed Concrete: Water-based sealer as recommended by manufacturer for application.

2.05 JOINT FILLER

- A. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing, polyurea control joint and crack filler with Shore A 80 or higher hardness.
- B. Color: To be selected by Architect from manufacturer's full range of colors.
 - 1. Design intent is to match adjacent concrete color and finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.
- C. Do not begin installation until substrates have been properly prepared.
 - 1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of concrete finishing materials.
- E. Examine surface to determine soundness of concrete for polishing.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

3.04 ADJUSTMENT AND CLEANING

- A. Remove defects and re-polish defective areas.
- B. Re-polish those areas not meeting specified gloss levels of the approved mock-up.
- C. Neutralize and clean polished floor surfaces.
- D. Upon completion, remove surplus and excess materials, rubbish, tools, and equipment.

3.05 PROTECTION

- A. Protect installed product from damage during construction in accordance with manufacturer's recommendations.

END OF SECTION

**SECTION 04 7200
CAST STONE MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Architectural cast stone.
- B. Units required are:
 - 1. Exterior wall units, including wall caps and sills.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- D. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.
- E. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- H. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a.
- J. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
- K. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Test results of cast stone components made previously by the manufacturer.
- C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
 - 1. Show interface with adjacent stone and other adjacent materials.
- D. Mortar Color Selection Samples.
- E. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.
- F. Full-Size Samples, For Review:
 - 1. Basic Shapes: One of each.
- G. Source Quality Control Test Reports.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. A firm with a minimum of 10 years experience producing cast stone of types required for project.
 - 2. Current producer member of the Cast Stone Institute or the Architectural Precast Association.

3. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of documented experience.

1.06 MOCK-UP

- A. Provide full size cast stone components for installation in mock-up of exterior wall.
- B. See Section 01 4000 - Quality Requirements for additional requirements.
- C. Approved mock-up will become standard for appearance and workmanship.
- D. Mock-up may remain as part of the completed work.
- E. Remove mock-up not incorporated into the work and dispose of debris.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.
- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Architectural Cast Stone:
 1. Any current producer member of the Architectural Precast Association.
 2. Any current producer member of the Cast Stone Institute.

2.02 ARCHITECTURAL CAST STONE

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural limestone, complying with ASTM C1364.
 1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
 2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
 3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
 4. Color: Selected by Architect from manufacturer's full range.
 5. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Provide shapes indicated on drawings.
 1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
 2. Unless otherwise indicated on drawings, provide:
 - a. Wash or slope of 1:12 on exterior horizontal surfaces.
 - b. Drips on projecting components, wherever possible.
 - c. Raised fillets at back of sills and at ends to be built in.

- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

2.03 MATERIALS

- A. Portland Cement: ASTM C150/C150M.
 - 1. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
 - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of shapes and sizes as required for conditions.
- J. Mortar: Portland cement-lime, ASTM C270 Type N .
 - 1. Color: Selected by Architect from manufacturer's full range.
- K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cast stone components in conjunction with manufactured stone masonry, complying with requirements of Section 04 7200.
- C. Mechanically anchor cast stone units indicated; set remainder in mortar.
- D. Setting:
 - 1. Drench cast stone components with clear, running water immediately before installation.
 - 2. Set units in a full bed of mortar unless otherwise indicated.
 - 3. Fill vertical joints with mortar.
 - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.03 TOLERANCES

- A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
 - 1. Rake mortar joints 3/4 inch (19 mm) for pointing.
 - 2. Remove excess mortar from face of stone before pointing joints.
 - 3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
 - 4. Leave the following joints open for sealant:
 - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
 - b. Joints in projecting units.

- c. Joints between rigidly anchored units, including soffits, panels, and column covers.
 - d. Joints below lugged sills and stair treads.
 - e. Joints below ledge and relieving angles.
 - f. Joints labeled "expansion joint".
- B. Installation Tolerances:
- 1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
 - 2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
 - 3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
 - 4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.04 REPAIR

- A. Repair chips and other surface damage noticeable when viewed in direct daylight at 10 feet (3 m).
- B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
- C. Repair methods and results subject to Architect 's approval.

3.05 CLEANING

- A. Keep cast stone components clean as work progresses.

3.06 PROTECTION

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION

**SECTION 04 7300
MANUFACTURED STONE MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered manufactured stone masonry veneer (AMSMV).
- B. Installation materials.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- B. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.
- C. Section 09 2116 - Gypsum Board Assemblies: Cementitious backer board and gypsum sheathing.

1.03 REFERENCE STANDARDS

- A. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2019.
- B. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
- C. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a.
- D. ASTM C847 - Standard Specification for Metal Lath; 2018.
- E. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2021.
- F. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2021.
- G. ASTM C1670/C1670M - Standard Specification for Adhered Manufactured Stone Masonry Veneer Units; 2021a.
- H. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.
- I. ASTM C1780 - Standard Practice for Installation Methods for Adhered Manufactured Stone Masonry Veneer; 2018a.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- K. ICC-ES AC51 - Acceptance Criteria for Precast Stone Veneer; 2016.
- L. MVMA (AMSV) - Installation Guide and Detailing Options for Compliance with ASTM C1780 For Adhered Manufactured Stone Veneer; 2018.
- M. NCMA TEK 20-01 - Key Installation Checkpoints for Manufactured Stone Veneer; 2014.
- N. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for AMSMV units, mortar, lath, and rainscreen drainage material, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Color charts.
 - 4. Installation methods.

- C. Shop Drawings: Submit detail drawings depicting proper installation and flashing techniques. Coordinate locations with those found on drawings. Show interface with adjacent materials. Show proposed control joint locations.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Specimen Warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified, with at least five years of documented experience and approved by manufacturer.

1.07 MOCK-UP

- A. Construct mock-up panel 8 feet (2.4 m) long by 6 feet (1.8 m) high; include AMSMV, mortar, accessories, substrate, and representative wall openings in mock-up.
- B. See Section 01 4000 - Quality Requirements for additional requirements.
- C. Locate where directed.
- D. Mock-up may not remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Prevent mechanical damage and contamination by other materials.
- C. Protect products from precipitation combined with freezing temperatures. Do not install products with visible frozen moisture.
- D. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.

1.09 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a one year period after Date of Substantial Completion.
- C. Provide 50 year manufacturer warranty for AMSMV.
- D. Provide 15 year manufacturer warranty for mortar and other installation materials used in exterior installations over steel or wood framing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Adhered manufactured stone masonry veneer (AMSMV):
 - 1. ST-1: Basis-of-design: Impressions in Stone: www.impressionsinstone.biz.
 - 2. ST-2: Basis-of-design: Coronado Stone Products: www.coronado.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ADHERED MANUFACTURED STONE MASONRY VENEER (AMSMV)

- A. AMSMV: Cast masonry units using a mixture of cement, lightweight aggregates, concrete additives and color pigments to replicate appearance of natural stone and designed to be applied with a cementitious mortar to a backing surface, complying with ASTM C1670/C1670M and ICC-ES AC51.

1. Style:
 - a. ST-1: Cobblestone, 35% Tan, 40% Cream, 25% Salmon
 - b. ST-2: Refined Woodstone - Antique White
- B. AMSMV Trim: Provide as indicated.
- C. Accessory Components: Provide electrical outlets and as indicated and required for project.

2.03 MORTAR APPLICATIONS

- A. At Contractor's option, mortar may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Color: Selected by Architect from manufacturer's full range.
- C. Dash Bond Coat: One part Portland cement, with maximum two parts sand.
- D. Scratch Coat Mortars: Scratch coat mortars for application directly to metal lath.
 1. Site-Mixed: ASTM C270, Type S, using the Proportion Method as specified in Section 04 0511.
 2. Prepackaged/Preblended: ASTM C1714/C1714M, Type S.
- E. Setting Bed Mortars: Setting bed used to adhere AMSMV units to scratch coat mortar or to bondable concrete or concrete masonry.
 1. Site-Mixed: ASTM C270, Type S, using the Proportion Method as specified in Section 04 0511.
 2. Prepackaged/Preblended: ASTM C1714/C1714M, Type S.
 3. Prepackaged/Preblended Latex Modified: ANSI A118.4 or ANSI A118.15.
- F. Setting Bed Mortars: Setting bed used to adhere AMSMV units to cement board.
 1. Prepackaged/Preblended Latex Modified: ANSI A118.4 or ANSI A118.15.
- G. Pointing Mortars: Pointing or grouting mortars used to fill the joints between individual AMSMV units once the setting bed mortar has sufficiently cured.
 1. Site-Mixed: ASTM C270, Type S, using the Proportion Method as specified in Section 04 0511.
 2. Prepackaged/Preblended: ASTM C1714/C1714M, Type N or Type S.
 3. Prepackaged/Preblended Latex Modified: ANSI A118.4 or ANSI A118.15.

2.04 ACCESSORIES

- A. Metal Lath with Rainscreen Drainage Material: Factory-assembled combination of mesh drainage material and metal lath.
 1. Diamond Mesh Metal Lath: ASTM C847, galvanized, self-furring.
 2. Rainscreen Drainage Mesh: 90 percent open non-woven polyester mesh.
 3. Manufacturers:
 - a. Mortar Net Solutions; LathNet: www.mortarnet.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Rainscreen Drainage Material:
 1. Rainscreen Drainage Mat: Polyester or polypropylene mesh.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
 - b. Seam Tape and Bug Screen: As recommended by rainscreen drainage mat manufacturer.
 - c. Manufacturers:
 - 1) Alabama Metal Industries Corporation; HydroDry Rainscreen: www.amicoglobal.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
 2. Rainscreen Drainage Accessories:
 - a. Material: PVC, open grid flanges or perforated with nailing holes.
 - b. Color: Gray.
 3. Rainscreen Drainage Panels: Ribbed, dimpled, or channeled polyethylene or extruded polystyrene sheets with polypropylene fabric mortar screen on one face.

- C. Cleaning Solution: Non-acidic, not harmful to AMSMV work or adjacent materials, approved by AMSMV manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that backup wall system construction complies with AMSMV manufacturer's instructions, MVMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51.
- B. Verify that substrates to receive mortar scratch coat or setting bed comply with AMSMV manufacturer's instructions, MVMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51:
 - 1. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for installation of AMSMV.

3.02 PREPARATION

- A. Dampen masonry surfaces to reduce excessive suction.

3.03 INSTALLATION - RAINSCREEN DRAINAGE MATERIAL

- A. Install rainscreen drainage material and metal lath with accessories over continuous insulation, sheathing material, and water-resistive barrier with fastening system in accordance with ASTM C1063 into wood or metal studs. Install drainage material with filter fabric mortar screen to exterior.
- B. Install metal lath and rainscreen drainage material with corrosion resistance fasteners sized per manufacturer's recommendation.
- C. Install metal lath with rainscreen drainage material in accordance with the manufacturer's instructions.

3.04 INSTALLATION - SCRATCH COAT

- A. Apply mortar scratch coat of 1/2 inch (12.5 mm) nominal to cover metal lath in accordance with ASTM C926. Scratch surface when somewhat firm. If scratch coat dries before applying setting bed mortar and AMSMV, moisten scratch coat by misting it with water.

3.05 INSTALLATION - AMSMV

- A. Install AMSMV with a cementitious mortar setting bed to a scratch coat backing surface, in accordance with AMSMV manufacturer's instructions, MVMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51.
- B. Mortar Joints: Concave.
 - 1. Style: Standard 1/2 inch tooled.
- C. Windows, Doors and Wall Openings: Install specified trim stones where located on drawings.
- D. Sills: Install sills where located on drawings.
- E. Caps: Install capstones where located on drawings.
- F. Seal all joints at wall openings and penetrations with sealant approved for use with AMSMV.

3.06 INSTALLATION - MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
- B. Extend metal flashings through exterior face of AMSMV and terminate in an angled drip with hemmed edge.
- C. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.07 CONTROL AND EXPANSION JOINTS

- A. Form joints as detailed on drawings, minimum spacing per manufacturer's specifications.

3.08 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m) and 1/2 inch in 20 feet (13 mm in 6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet (3 mm in 1 m).

3.09 CUTTING AND FITTING

- A. Cut and fit for pipes, conduit, and as indicated. Coordinate with other sections of work to provide correct size, shape, and location.

3.10 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean AMSMV in accordance with manufacturer's installation instructions.
- D. Clean soiled surfaces with cleaning solution.

3.11 PROTECTION

- A. Protect finished work from rain during and for 48 hours following installation.
- B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

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SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Shear stud connectors.
 - 3. Shrinkage-resistant grout.
- B. Related Requirements:
 - 1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
 - 2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
 - 3. Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" for painting requirements.
 - 4. Section 133419 "Metal Building Systems" for structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Shear stud connectors.
 - 4. Anchor rods.
 - 5. Threaded rods.
 - 6. Shop primer.
 - 7. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members not to be shop primed.
 - 6. Fabrication of materials prior to review of shop drawings shall be taken at the Contractor's risk.
 - 7. Review of shop drawings is for member sizes, spacings, details and general compliance only.
 - 8. Material quantities, lengths, fit-up, verification of job site conditions and coordination with other trades are the responsibility of the Contractor.
- C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer licensed in the State of Oklahoma and responsible for their preparation.
 - 1. Calculations shall include comprehensive engineering analysis by qualified professional engineer based on code referenced AISC *Steel Construction Manual*.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.

- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.8 ALLOWANCE

- A. Include an allowance in the bid price for an additional ten (10) percent of the total structural steel to be fabricated and placed as directed by Architect or Engineer. Allowance is to include, but not limited to, material, detailing, fabrication, shipping, installation, overhead and profit.

1.9 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- D. Quality Control Welding Inspector Qualifications: Qualified to the satisfaction of the fabricator's or erector's Quality Control Program, as applicable, and in accordance with either of the following:
 - 1. Associate welding inspectors (AWI) or higher as defined in AWS B5.1, Standard for the Qualification of Welding Inspectors.
 - 2. Qualified under the provisions of AWS D1.1 subclause 6.1.4.
- E. Quality Control Bolting Inspector Qualifications: Qualified on the basis of documented training and experience in structural bolting inspection.
- F. Quality Assurance Welding Inspector Qualifications: Qualified to the satisfaction of the quality assurance agency's written practice, the requirements of the Authority Having Jurisdiction, and either of the following:
 - 1. Welding inspectors (WIs) or senior welding inspectors (SWIs) as defined in AWS B5.1, Standard for the Qualification of Welding Inspectors, except associate welding inspectors (AWIs) are permitted to be used under the direct supervision of WIs, who are on the premises and available when weld inspection is being conducted.
 - 2. Qualified under the provisions of AWS D1.1, subclause 6.1.4.
- G. Quality Assurance Bolting Inspector Qualifications: Qualified on the basis of documented training and experience in structural bolting inspections.

- H. Nondestructive Testing (NDT) Personnel Qualifications: Qualified in accordance with their employer's written practice, which shall meet or exceed the criteria of AWS D1.1 Structural Welding Code – Steel, subclause 6.14.6 and:
 - 1. American Society of Nondestructive Testing (ASNT) SNT-TC-1A, Personnel Qualification and Certification In Nondestructive Testing.
 - 2. ASNT CP-189, Standard for the Qualification and Certification of Nondestructive Testing Personnel.
- I. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 3 and 3A: For structural steel connections not design on the Contract Drawings, submit design calculations and connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer licensed in the State of Oklahoma. Member reinforcement at connections is indicated on Drawings.

- a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.
- C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
 - 1. Studs shall be of uniform diameter, heads concentric and normal to shaft, and weld end chamfered and solid flux.
 - 2. For shear stud connectors thru composite deck:
 - a. Provide shear stud connectors with proper ferrules and accessories especially designed to create composite deck action by mating of shear connectors, concrete deck and supporting beam, and capable of providing shear forces shown on Contract Drawings when welded through deck used on the project.
 - b. Height: At least 1-1/2 inch above top of deck after installation, with at least 3/4 inch clear concrete cover above top of stud, unless noted otherwise on Contract Drawings.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- B. Threaded Rods: ASTM A36/A36M.
 - 1. Nuts: ASTM A63 heavy-hex carbon steel.
 - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 3. Finish: Plain.

2.5 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."
 - 2. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces unless indicated to be painted.
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
 - 8. Top flanges of beams with shear connectors to support metal deck.

- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 2.
- C. Prepare faying surfaces of slip critical connections in accordance with RCSC.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 - 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 - 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect and Structural Engineer of Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Cleaning and touchup painting are specified in Section 09 9113 "Exterior Painting." and Section 09 9123 "Interior Painting."

3.6 FIELD QUALITY CONTROL AND ASSURANCE

- A. Contractor shall retain a duly designated person who acts for, and in behalf of, the Contractor on all inspection and quality matters within the scope of AISC 360-16, AWS D1.1 and of the Contract Documents.
- B. Special Inspections: Owner will engage a special inspector to perform testing and verification inspections as noted below along with inspection schedule items included in the Contract Drawings. Testing Agency shall prepare test and inspection reports and submit in writing to Owner, Authority Having Jurisdiction, Engineer of Record, and Owner's consultants within 48 hours of testing or inspections. Reports shall contain Project identification name and number, date of inspection, name of testing and inspecting agency and location of inspected or tested work. In addition, reports shall include verification of compliance or deviations from the Contract Documents.
- C. The special inspector shall submit the following to the fabricator and erector:
 - 1. Inspection reports.
 - a. Verify structural-steel materials and inspect steel frame joint details.
 - b. Verify weld materials and inspect welds.
 - c. Verify connection materials and inspect high-strength bolted connections.
 - 2. Nondestructive testing reports
 - 3. Nonconformance reports
 - 4. Reports of repair, replacement or acceptance of nonconforming items
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 - b. In addition to visual inspections, field complete penetration groove welds shall be tested by either of the following, at testing agency's option or as specified on the Contract Documents:
 - 1) Ultrasonic Inspection: ASTM E 164
 - 2) Radiographic Inspection: ASTM E 94
 - c. In addition to visual inspections, ultrasonic testing (UT) of welds shall be performed as specified on the Contract Documents.

- 1) The ultrasonic testing (UT) rejection rate shall be determined as the number of welds containing defects divided by the number of welds completed. Welds that contain acceptable discontinuities shall not be considered as having defects when the rejection rate is determined. For evaluating the rejection rate of continuous welds over 3 feet in length where the effective throat is 1 inch or less, each 12 inch increment of fraction thereof shall be considered as one weld. For evaluating the reject rate on continuous welds over 3 feet in length where the effective throat is greater than 1 inch, each 6 inches of length or fraction thereof shall be considered one weld
- 2) The percentage of required testing may be reduced or shall be increased according to the following:
 - a) For projects that contain 40 or fewer welds, there shall be no reduction in the ultrasonic testing rate. The rate of UT is permitted to be reduced if approved by the Engineer of Record and the Authority Having Jurisdiction. Where the initial rate of UT is 100%, the nondestructive testing (NDT) rate for an individual welder or welding operator is permitted to be reduced to 25%, provided the reject rate, the number of welds containing unacceptable defects divided by the number of welds completed, is demonstrated to be 5% or less of the welds tested for the welder or welding operator. A sampling of at least 40 completed welds shall be made for such reduced evaluation on each project.
 - b) For structures in Risk Category II and higher, where the initial rate for UT is 10%, the NDT rate for an individual welder or welding operator shall be increased to 100% should the rejection rate, the number of welds containing unacceptable defects divided by the number of welds completed, exceeds 5% of the welds tested for the welder or welding operator. A sampling of at least 20 completed welds on each project shall be made prior to implementing such an increase. In the rejection rate for the welder or welding operator falls to 5% or less on the basis of at least 40 completed welds, the rate of UT may be to 10%. For evaluation the reject rate of continuous welds over 3 feet in length where the effective throat is 1 inch or less each 12 inch increment or fraction thereof shall be considered as one weld. For evaluating the reject rate on continuous welds over 3 feet in length where the effective throat is greater than 1 inch, each 6 inches of length or fraction thereof shall be considered one weld.

F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Initial testing of shear studs at start of work period: Test weld on at least 2 shear studs at start of each work period to determine proper generator control unit, and stud welder settings. Bend studs 45 degrees from vertical by striking with hammer. Inspect weld. Do not include these studs in required total number of studs required on beam. Contractor shall add replacement studs to supplement studs tested by bending 45 degrees.
2. Visually inspect welds at shear studs: Visually inspect all studs. Test studs that do not appear to have full sound 360 degrees fillet weld at base. Test by bending 15 degrees from vertical toward nearest end of beam by striking with hammer. Contractor shall replace studs that fail this test.
 - a. Periodic field testing of shear studs: Test one stud on each beam or girder after weld cools. Test by bending 15 degrees from vertical toward nearest end of beam by striking with hammer. If a tested stud fails at weld, all studs on the same beam

or girder shall be tested by same procedure. Contractor shall replace studs that fail this test.

END OF SECTION

SECTION 05 2100
STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. LH-series long-span steel joists.
 - 3. DLH-series long-span steel joists.
 - 4. Steel joist accessories.
- B. Related Requirements:
 - 1. Section 03 3000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
 - 2. Section 04 2200 "Concrete Unit Masonry" for installing bearing plates in unit masonry.
 - 3. Section 05 1200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Include safe load carrying capacity of each joist or girder by standard joist designations or by special loads in accordance with the requirements on the Documents.
 - a. Indicate all special special loadings, axial loads and concentrated loads on shop and erection drawings.
 - 4. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer licensed in the State of Oklahoma responsible for its preparation.
- F. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
 - 1. Use LRFD; data are given at factored-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/240 of the span.
 - 3. Design special joists to withstand design loads with total-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/180 of the span.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists.
 - 2. Provide holes in chord members for connecting and securing other construction to joists.
 - 3. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
 - 4. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
 - 5. Camber joists according to SJI's "Specifications."
 - 6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
 - 1. Provide holes in chord members for connecting and securing other construction to joists.
 - 2. Camber long-span steel joists according to SJI's "Specifications."
 - 3. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Primer:
 - 1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
 - 1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
 - 1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
 - 2. Finish: Plain.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.

- D. Welding Electrodes: Comply with AWS standards.
- E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Shop priming of joists and joist accessories is specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Replace bent or warped joists damaged during handling and erection.
- B. Do not install joists until supporting construction is in place and secured.
- C. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- D. Field weld joists to supporting steel framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, abutting structural steel, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.
 - 2. Cleaning and touchup painting are specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. In addition, the testing agency shall perform field tests and inspections as noted below along with the inspection schedule items included in the Contract Drawings. The testing agency shall prepare test and inspection reports and submit to the Owner and the Owner's consultants.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709.
 - c. Ultrasonic Testing: ASTM E164.
 - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 05 3100

STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck
 - 2. Composite floor deck.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for normal-weight structural concrete fill over steel deck.
 - 2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 4. Section 09 9113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
 - 5. Section 09 9123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Roof deck
 - 2. Composite floor deck.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.

1. Certify that all deck, shear studs, and deck accessories provided meet or exceed specified requirements.
 2. Certify that product and coatings conform to UL, FM or other agency rated assembly noted on the Drawings.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
1. Power-actuated mechanical fasteners.
- D. Research Reports: For steel deck, from ICC-ES.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its RoofNav for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Do not overload deck during construction by workers or storage of materials.
- C. Rusted, crimped or bent deck shall not be installed in the work. Replace damaged deck with new material at no additional cost to the owner.
- D. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
 - 2. Deck Profile: As indicated.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, **G60** zinc coating.
 - 2. Profile Depth: As indicated.
 - 3. Design Uncoated-Steel Thickness: As indicated.
 - 4. Span Condition: Triple span or more.

2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- J. Galvanizing Repair Paint: ASTM A780/A780M.
- K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
- B. Mechanical Fasteners: Deck shall be attached to supporting members as noted on the Contract Drawings.
1. Spacing of fasteners shall not exceed 12 inches along each support, unless noted otherwise on the Contract Drawings.
 2. Attachment shall be done immediately after the deck units are aligned.
 3. Deck units shall have side laps fastened at 36 inches on center or at midspan (whichever is smaller) for spans greater than 5 feet unless otherwise specified on the Contract Drawings.
 4. Fasten deck to perimeter members parallel to deck span at 36 inches on center maximum for spans greater than 5 feet unless otherwise specified on the Contract Drawings.
- C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches and as noted on the Contract Drawings.
- D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped 2 inches minimum.
- E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.
- H. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified."

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 5/8 inch, nominal.
 2. Weld Spacing: Space and locate welds as indicated.
- B. Mechanical Fasteners: Deck shall be attached to supporting members as noted on the Contract Drawings.

1. Spacing of fasteners shall not exceed 12 inches along each support, unless noted otherwise on the Contract Drawings.
 2. Attachment shall be done immediately after the deck units are aligned.
 3. Deck units shall have side laps fastened at 36 inches on center or at midspan (whichever is smaller) for spans greater than 5 feet unless otherwise specified on the Contract Drawings.
 4. Fasten deck to perimeter members parallel to deck span at 36 inches on center maximum for spans greater than 5 feet unless otherwise specified on the Contract Drawings.
- C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches and as noted on the Contract Drawings.
- D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Butted.
- E. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- F. Wet concrete stops at slab edge shall be upturned to top surface of slab to contain wet concrete. Provide stops of sufficient strength to remain stationary under wet concrete and construction work without distortion.
- G. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- H. Unless noted otherwise on Contract Drawings, reinforce steel deck openings less than 10 inches in size with 2x2x1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- I. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Mechanically attach at 6 inches on center maximum.

3.5 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Repair blow-holes at welds with 18 gage plates welded in place. Replace entire sections of deck where holes cannot be satisfactorily repaired

3.6 HANGERS FOR MISCELLANEOUS EQUIPMENT

- A. Do not attach hangers for ductwork, mechanical piping, or ceilings directly to metal deck.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform tests and inspections as noted below along with inspection schedule items included in the Contract Drawings. Testing agency shall prepare test and inspection reports and submit to the Owner and the Owner's consultants.
- B. Inspect condition of deck units for damage and corrosion. Report deficiencies.
- C. Inspect size, spacing, and quality of connections of deck to structure and at side laps for conformance with Contract Drawings. Report deficiencies.
- D. Deck: Inspect deck at welded connections. Connections do not conform to specifications where deck is not intact after welding and where blow holes occurred.
- E. Field welds will be subject to inspection.
- F. Prepare test and inspection reports.
- G. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

END OF SECTION

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SECTION 05 4000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Ceiling joist framing.
 - 3. Soffit framing.
 - 4. Any other cold-formed framing system noted on Structural Contract Drawings.
- B. Related Requirements:
 - 1. Section 053100 – Steel Decking
 - 2. Section 055000 – Metal Fabrications

1.3 SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory indicated on the Contract Drawings, provide the following:
 - 1. Section Properties: Submit section properties, material strengths and ASTM specification compliance verification for each size member, strap or brace of each gage used.
 - 2. Connections: Submit manufacturer's data for each type of manufactured connector, screw, or fastener verifying conformance with the Contract Drawings.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. Submit shop drawings and calculation electronically in PDF format via email for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will review the shop drawings and forward stamped electronic documents to the contractor through the Architect via email. The contractor shall be responsible for transmitting the reviewed set to the fabricator for corrections. The printing of shop drawings as required for review is considered a reimbursable expense and will be billed at cost.
 - 2. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.
 - 3. For cold-formed steel framing indicated to comply with design loads, include complete structural analysis data signed and sealed by the qualified professional engineer

responsible for their preparation and licensed in the state where the project is located. Design calculations will be reviewed by the Engineer-of-Record.

- C. Qualification Data: For testing agency.
- D. Welding certificates.
- E. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Powder-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Adhesive anchors.
 - 6. Vertical deflection clips.
 - 7. Horizontal drift deflection clips
 - 8. Miscellaneous structural clips and accessories.
- F. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.4 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer licensed in the state where the project is located.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated on this Project in material, design and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 for testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed steel framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. Comply with current AISI Specifications and Standards.
- H. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. During construction, adequately distribute all loads applied to framing members so as not to exceed the carrying capacity of any one member.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkDietrich Building Systems, Inc.
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Craco Mfg., Inc.
 - 6. Custom Stud Inc.
 - 7. Design Shapes in Steel.
 - 8. Formetal Co. Inc. (The).
 - 9. MarinoWARE.
 - 10. Nuconsteel; a Nucor Company.
 - 11. Olmar Supply, Inc.
 - 12. Quail Run Building Materials, Inc.
 - 13. SCAFCO Corporation.
 - 14. Southeastern Stud & Components, Inc.
 - 15. State Building Products, Inc.
 - 16. Steel Construction Systems.
 - 17. Steel Network, Inc. (The).
 - 18. Steel Structural Systems.
 - 19. Steeler, Inc.
 - 20. Super Stud Building Products, Inc.
 - 21. Telling Industries, LLC.
 - 22. United Metal Products, Inc.
 - 23. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Contract Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads with deflections not exceeding the following limits:
 - a. Exterior Load-Bearing Wall Framing – Horizontal deflections:
 - 1) Masonry Veneer: 1/600 of the wall height.
 - 2) Brittle Finishes: 1/360 of the wall height.
 - 3) Flexible Finishes: 1/240 of the wall height.

- b. Interior Load-Bearing Wall Framing – Horizontal deflections under a minimum horizontal load of 5 lbf/sq. ft.:
 - 1) Masonry Veneer: $1/600$ of the wall height.
 - 2) Brittle Finishes: $1/360$ of the wall height.
 - 3) Flexible Finishes: $1/240$ of the wall height.
 - c. Exterior Non-Load-Bearing Framing – Horizontal deflections:
 - 1) Masonry Veneer: $1/600$ of the wall height.
 - 2) Brittle Finishes: $1/360$ of the wall height.
 - 3) Flexible Finishes: $1/240$ of the wall height.
 - d. Floor Joist Framing: Vertical deflection of $1/360$ for live loads and $1/240$ for total loads of the span.
 - e. Roof Rafter Framing: Vertical deflection of $1/360$ for live loads and $1/240$ for total loads of the span.
 - f. Ceiling Joist Framing: Vertical deflection of $1/360$ of the span for live loads and $1/240$ for total loads of the span.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Roof Framing: Downward movement of $3/4$ inch and upward movement of $1/2$ inch, unless noted otherwise on Contract Documents.
 - b. Floor Framing: Downward movement of $3/4$ inch, unless noted otherwise on Contract Documents.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Comply with current AISI Specifications and Standards, unless more stringent requirements are indicated.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Manufacturing Standard: All cold form framing shall be equivalent to SSMA (Steel Stud Manufacturers Association) published standards and installation recommendations, which will be used as a quality standard reference in the event the Contractor furnishes materials in which the submitted manufacturer does not have a published installation manual.
- B. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H or ST50H as indicated or as required by structural performance
 - 2. Coating: G60.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1.
 - 2. Coating: G90.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
 - 2. Minimum Flange Width: 1-5/8 inches.
 - 3. Minimum Lip Length: 1/2 inch.
- B. Steel Track: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings, but shall match wall stud thickness when heavier than 0.0329 inch.
 - 2. Minimum Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips as noted on Contract Drawings, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkDietrich Building Systems, Inc.
 - c. MarinoWARE.
 - d. SCAFCO Corporation.
 - e. Steel Network, Inc. (The).
 - f. Steeler, Inc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track as noted on the Contract Drawings; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
 - 2. Minimum Flange Width: 3/4 inch plus the design gap.
 - 3. Row of bridging to be located 12 inches from top of studs.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
 - b. Minimum Flange Width: 3/4 inch plus the design gap.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
 - b. Minimum Flange Width: Equal to sum of outer deflection track flange width plus 1 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
 2. Minimum Flange Width: 1-5/8 inches.
 3. Minimum Lip Width: 1/2 inch.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
 2. Minimum Flange Width: 1-5/8 inches.
 3. Minimum Lip Width: 1/2 inch.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.
- B. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 5. Finish: Plain, except where indicated to be galvanized.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

- D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
 - 5. Do not begin fabrication of work prior to receiving approval of shop drawings and calculations. Fabricate per manufacturer's current printed instructions.
 - 6. Shop Fabrication: Fabricate items in shop to greatest extent possible so as to minimize field assembly of units at project site. Clearly mark units for assembly and coordinated installation.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. All structural joists and studs shall have a minimum of 10 inches of unpunched steel at bearing or support points.
- K. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Contract Drawings or Shop Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 2. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.

3. Connect drift clips to cold-formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Contract Drawings or Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at 96-inch centers.
 2. Bridging:
 - a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - c. Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

- A. Testing: Contractor will retain a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor, owner and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 5000 METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
 - 1. Miscellaneous steel or aluminum framing, supports, reinforcement, loose bearing and leveling plates, shelf angles and other steel or aluminum members or fabrications for applications as required for project and where they are not specified in other Sections.
- B. Downspout boots.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 09 9113 - Exterior Painting: Paint finish.
- C. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2021).
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- E. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- H. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- I. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- J. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- K. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- L. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- M. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- N. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- P. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014, with Amendment (2015).
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
- R. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata 2020.

- S. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gauges.
 - 4) Details of connections.
 - 5) Support reactions.
 - 6) Bracing requirements.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Design metal fabrications under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Stainless Steel, General: ASTM A666, Type 304.
- F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch (1.59 mm) minimum metal thickness, 1-1/2 inch (38 mm) diameter.
- G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- H. Slotted Channel Fittings: ASTM A1011/A1011M.
- I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- K. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- M. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. As required for project.

2.05 DOWNSPOUT BOOTS

- A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.
 - 1. Configuration: Angular.
 - 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
 - 3. Color: Final finish color to match gutter and downspout.

2.06 FINISHES - STEEL

- A. Prime Painting: One coat.

2.07 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I color anodized.
- B. Interior Aluminum Surfaces: Class II color anodized.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

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**SECTION 05 7311
DECORATIVE METAL RAILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Railing and handrail assemblies.
- B. Metal panel railings.

1.02 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2018.
- J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
- L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's product data, including description of materials, components, and finishes.
- C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, transitions, and terminations.
- D. Samples: Submit one (1) of each item below for each type and condition shown.
 - 1. Cladding: 6-inch by 6-inch (152 mm by 152 mm) sample of each type of cladding, showing finish.
- E. Manufacturer's qualification statement.
- F. Single-source qualification statement.
- G. Installer's qualification statement.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than fifteen years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Replace damaged items.
- D. Prior to installation, store materials and components under cover in a dry location.

1.06 WARRANTY

- A. Warranty: Manufacturer's standard one-year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Viva Railings, LLC: 151 W. Vista Ridge Mall Drive, Lewisville, TX 75067. 972-353-8482. www.vivarailings.com/#sle.
- B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- C. Substitutions: See Section 01 6000-Product Requirements.

2.02 RAILING SYSTEMS, GENERAL

- A. Factory- or shop-fabricate to suit project conditions, for proper connection to building structure, and in largest practical sizes for delivery to site.
- B. Handrails: Comply with applicable accessibility requirements of ADA Standards.
- C. Joints: Tightly fitted and secured, machined smooth with hairline seams.
- D. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.
- E. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

2.03 METAL PANEL RAILINGS

- A. Metal Panel Railing System: Engineered railing system of metal panels with integral vertical and horizontal supports; panels mechanically fastened to each other and to mounting stanchions.
 - 1. Product:
 - a. Viva Railings, LLC; FOLD: www.vivarailings.com/#sle.
 - 2. Mounting Stanchions: Steel with factory-applied finish.
 - 3. Grip Rail: Round, stainless steel, 1-1/2-inch (38 mm) diameter.
 - 4. Panel Pattern: Dageraad
 - 5. Panel Finish: Selected by Architect from manufacturer's standard range.

2.04 MATERIALS AND FINISHES

- A. Steel Components:
 - 1. Sections, Shapes, Plates, and Bars: ASTM A36/A36M.
 - 2. Tubing: ASTM A501/A501M structural tubing; round, and shapes as indicated.
 - 3. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
 - 4. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
 - 5. Powder Coat Finish: Manufacturer's recommended system.

2.05 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed

fasteners are unavoidable, provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to cast into concrete for bolt anchors.
2. Exposed Fasteners: No exposed bolts or screws.

B. Carbon Steel Bolts and Nuts: ASTM A307.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.02 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
- C. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Anchor securely to structure.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, noncumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.04 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.05 PROTECTION

- A. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

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SECTION 06 1000 ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Sheathing.
- C. Roof-mounted curbs.
- D. Roofing nailers.
- E. Preservative treated wood materials.
- F. Fire retardant treated wood materials.
- G. Miscellaneous framing and sheathing.
- H. Communications and electrical room mounting boards.
- I. Concealed wood blocking, nailers, and supports.
- J. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07411 – Metal Roof Panels.
- E. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.
- F. Section 07 7200 - Roof Accessories: Prefabricated roof curbs.
- G. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.
- H. Section 31 3116 - Termite Control: Field-applied termiticide and mildewcide for wood materials.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2016.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- D. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. AWWA U1 - Use Category System: User Specification for Treated Wood; 2018.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. PS 1 - Structural Plywood; 2009 (Revised 2019).
- K. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- L. PS 20 - American Softwood Lumber Standard; 2020.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Provide sustainably harvested wood; see Section 01 6000 - Product Requirements for requirements.
- C. Provide wood harvested within a 500 mile (805 km) radius of the project site, where possible.
- D. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source.
- E. Lumber fabricated from recovered timber (abandoned in transit) is permitted, unless otherwise noted, provided it meets the specified requirements for new lumber and is free of contamination; identify source.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings and as required for Project, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. At Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers.
- B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.04 CONSTRUCTION PANELS

- A. Wall Sheathing: Any PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 16.
 - 4. Performance Category: 3/4 PERF CAT.
 - 5. Edge Profile: Contractor's option to suite application.
- B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- C. Other Applications:
 - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 3. Other Locations: PS 1, C-D Plugged or better.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - a. Not allowed at exterior applications.
- B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
- C. Water-Resistive Barrier: As specified in Section 07 2500.
- D. Building Paper: Water resistant Kraft paper.
 - 1. Asphalt felt is not allowed.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat all exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.
 - 2. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated;

capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.

- a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- b. Treat rough carpentry items as indicated .
- c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:

1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.
 - d. Treat lumber in contact with masonry or concrete.
 - e. Treat lumber less than 18 inches (450 mm) above grade.
2. Preservative Pressure Treatment of Plywood Above Grade: AWWA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
 - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
 - b. Treat plywood in contact with roofing, flashing, or waterproofing.
 - c. Treat plywood in contact with masonry or concrete.
 - d. Treat plywood less than 18 inches (450 mm) above grade.
3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWWA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
 - b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific non-structural framing and blocking:
 1. Cabinets and shelf supports.

2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Additional locations as indicated on Drawings or as required for project.
9. Wall paneling and trim.
10. Joints of rigid wall coverings that occur between studs.

3.03 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.
 4. Size: 48 by 96 inches (2440 by 4880 mm), installed horizontally at ceiling height.
 - a. Unless otherwise indicated on drawings.

3.05 CLEANING

- A. Waste Disposal:
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

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SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Specially fabricated built-in elements.
 - 1. Locations and types are indicated on drawings.
- C. Hardware.
- D. Factory finishing.
- E. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 12 3600 - Countertops: Countertops and, support brackets.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware; 2020.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 3. Show all material joint locations on Shop Drawings.
 - 4. Show all material grain or pattern direction and orientation on Shop Drawings.
 - 5. Show support framing where indicated as part of assembly on Shop Drawings.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, locksets, and edge banding, demonstrating hardware design, quality, and finish.
 - 1. Submit 8 inch by 10 inch samples of all specified plastic laminate colors and finishes, including standard and custom colors and finishes.
 - 2. Submit sample of edge banding applied to cabinet door, 12 inches by 12 inches.
- E. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.
- F. Show locations and sizes of cutouts and items installed in architectural wood casework.
- G. Show interface with adjacent work, including mechanical, electrical and plumbing work.
 - 1. Show under-cabinet lighting, where indicated.
 - a. Show methods to conceal under-cabinet lighting from view.

2. Show appliances or equipment integral or within casework or where openings in casework are required.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum ten years of documented experience.
 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. See Section 01 4000 - Quality Requirements for additional requirements.
- C. Locate as indicated on drawings or where directed.
- D. Mock-up may not remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
 1. Types, profiles and finishes are indicated on drawings.
 2. Provide PLAM closure panels flush with face of upper cabinet door(s) to underside of ceiling.
- C. Cabinets:
 1. Finish - Exposed Exterior Surfaces: Wood Decorative laminate.
 2. Finish - Exposed Interior Surfaces: White melamine.
 3. Finish - Semi-Exposed Surfaces: White melamine.
 4. Finish - Concealed Surfaces: Manufacturer's option.
 5. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
 - a. Design intent is to match exposed exterior surface color, unless otherwise indicated.
 - b. Edge band thickness: 3mm.
 - c. Edge band material: ABS.
 - 1) PVC is not allowed.
 6. Adjustable Shelving Inside Cabinets: Square edge with thick applied band.
 - a. Design intent is to match exposed interior surface color, unless otherwise indicated.
 - b. Edge band thickness: 3mm at front face.
 - c. Edge band material: ABS.
 - 1) PVC is not allowed.
 7. Door and Drawer Front Retention Profiles: Fixed panel.
 - a. Unless otherwise indicated on drawings.
 8. Casework Construction Type: Type A - Frameless.
 9. Grained Face Layout for Cabinet and Door Fronts: Style and Rail, all Grades.
 - a. Doors: Vertical grain.
 10. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.

11. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
12. Cabinet Style: Flush overlay.
13. Cabinet Doors and Drawer Fronts: Flush style and as indicated.
14. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Medium Density Fiberboard:
 1. Sustainable Medium Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde (NAF), MR-10, FSC certified.
 - a. Basis-of-Design: "Arreis" MDF by Roseburg.
 2. Sustainable Moisture Resistant Medium Density Fiberboard: ANSI A208.2-2009, Grade 155, made with binder containing no urea formaldehyde (NAF), MR-50, FSC certified.
 - a. Basis-of-Design: "Medex" MDF by Roseburg.
 - b. Locations: Within 10 feet of any plumbing fixture.
- C. Medium Density Particleboard:
 1. Medium Density Particleboard: ANSI 208.1, Industrial Grade M3, made with binder containing no urea formaldehyde (NAF) or ultra low emitting formaldehyde (ULEF), MR-10, FSC certified.
 - a. Basis-of-Design: "Collins Pine Free-Form" by Collins Wood or "SkyBlend" particleboard by Roseburg.
 2. Medium Density Particleboard: ANSI 208.1, Industrial Grade M3, made with binder containing no urea formaldehyde (NAF), MR-50, FSC certified.
 - a. Basis-of-Design: "Collins Pine Free-Form MR50 Particleboard" by Collins Wood.
 - b. Locations: Within 10 feet of any plumbing fixture.
- D. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000.
- E. Provide wood harvested within a 500 mile (805 km) radius of the project site, where possible.
- F. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com/#sle.
 - b. Wilsonart LLC; ____: www.wilsonart.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
- C. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- D. Provide specific types as indicated.

2.04 COUNTERTOPS

- A. Countertops are specified in Section 12 3600.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
 1. Unless more stringent requirements are indicated or required for application.
- B. Fasteners: Size and type to suit application.

- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
 - 1. Satin or brushed finish, unless otherwise indicated.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard pre-finished grommets for cut-outs, in color as selected from manufacturer's full range.
 - 1. Basis-of-Design: One-piece, round, 2-1/2 inch diameter, metal grommet by Hafele, series 429.
 - 2. Located as required for mechanical, electrical or plumbing work and as required for IT / Data work by Owner and / or as directed by Owner.
- F. Additional accessories are indicated on drawings.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome or satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- C. Fixed Specialty Shelf Supports:
 - 1. Material: Steel.
 - 2. Manufacturer's standard, factory-applied, textured powder coat.
 - 3. Style: Low profile, hidden bracket.
 - 4. Color: Satin chrome.
 - a. Unless otherwise indicated on drawings.
- D. Fixed Specialty Workstation and Countertop Brackets: As specified in Section 123600 - Countertops.
- E. Fixed Americans with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets: As specified in section 123600 - Countertops.
- F. Fixed Specialty Vanity Brackets: As specified in Section 123600 – Countertops.
- G. Countertop Supports: As specified in Section 123600 – Countertops.
- H. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers ("U" shaped wire pull, steel with satin finish, 100 mm centers).
- I. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
- J. Catches: Magnetic Touch type.
- K. Drawer Systems: Integrated drawer slide and side.
 - 1. Side Type: Double Wall, metal.
 - a. Provide maximum lengths and heights possible in order to suit application and drawer face dimensions or profiles indicated on drawings.
 - 2. Extension Type: Extension types as required Extension types as indicated.
 - 3. Static Load Capacity: Heavy Duty grade.
 - a. 75-pounds minimum, unless more stringent requirements are indicated on drawings.
 - 4. Provide hanging file rails where indicated on drawings as a file drawer.
 - 5. Provide dividing system and inset drawers where indicated on drawings.
 - 6. Mounting: Bottom mounted.
 - 7. Stops: Integral type.
 - 8. Features: Provide self closing/stay closed and graphite finish type.
 - 9. Manufacturers:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Grass America Inc; Nova Pro Scala: www.grassusa.com/#sle.
 - c. Pride Industrial Llc; Mega Pro: www.proindustrial.com

- d. Other manufacturers are allowed subject to requirements indicated.
- e. Substitutions: See Section 01 6000 - Product Requirements.
- L. Hinges: European style concealed self-closing type, dark bronze with satin finish.
- M. Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper ; dark bronze with satin finish.

2.07 SHOP TREATMENT OF WOOD MATERIALS

- A. Provide UL (DIR) listed and approved identification on fire retardant treated material.
- B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- E. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, fixtures and fittings, and as indicated or required. Verify locations of cutouts from on-site dimensions. Seal cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

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**SECTION 06 8316
FIBERGLASS REINFORCED PANELING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

1.02 REFERENCE STANDARDS

- A. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor; 2013a.
- B. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- D. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 6"x6" in size illustrating material and surface design of panels.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Basis of Design: Marlite, Inc[<>]: www.marlite.com/#sle.
 - 2. Crane Composites, Inc: www.cranecomposites.com.
 - 3. Nudo Products, Inc: www.nudo.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
 - 2. Panel Thickness: 0.10 inch (2.5 mm).
 - 3. Surface Design: Embossed.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
 - 2. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
 - 3. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
- B. Trim: Vinyl; color coordinating with panel.
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

**SECTION 07 0553
FIRE AND SMOKE ASSEMBLY IDENTIFICATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
- C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.
- B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl sign with factory applied adhesive backing.
- C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See Section 09 9123 for products.
- D. Languages: Provide sign markings in English and Spanish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

- A. See Section 09 9123 for substrate preparation for painted markings.

3.03 INSTALLATION

- A. Locate markings as required by ICC (IBC).
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install applied markings in accordance with Section 09 9123.
- D. Install neatly, with horizontal edges level.

- E. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 1400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
 - 1. Polyurethane waterproofing.
 - 2. Cold-applied fiberglass reinforced vapor permeable waterproofing.
 - 3. Solvent-based asphalt waterproofing.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 05 1200-Structural Steel Framing: Below grade columns and baseplates to receive waterproofing.
- C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal copings and counterflashings.
- D. Section 07 9200 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not part of work in this section.
- E. Division 22 - Plumbing Piping Specialties: Roof drain and plumbing vent flashing flanges.

1.03 ABBREVIATIONS

- A. CSPE - Chlorosulfonated Polyethylene.
- B. HDPE - High-Density Polyethylene.
- C. NRCA - National Roofing Contractors Association.
- D. SBS - Styrene-Butadiene-Styrene.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018.
- C. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Warranty:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for the waterproofing membrane.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of documented experience.

1.07 MOCK-UP

- A. Construct mock-up consisting of 100 sq ft (10 sq m) of horizontal waterproofed panel; to represent finished work including internal and external corners, drainage panel, base flashings, control joints, expansion joints, counterflashings, and protective cover.
- B. See Section 01 4000 - Quality Requirements for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of this Work.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until cured.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. General: Provide waterproofing type at Contractor's option as appropriate and as recommended for application. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Polyurethane Waterproofing:
 - 1. AVM Industries, Inc: www.avmindustries.com/#sle.
 - 2. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/#sle.
 - 3. CETCO, a division of Minerals Technologies Inc: www.mineralstech.com/#sle.
 - 4. Gaco Western: www.gaco.com/#sle.
 - 5. Karnak Corporation: www.karnakcorp.com/#sle.
 - 6. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 - 7. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: www.tremcosealants.com/#sle.
- C. Cold-Applied Fiberglass Reinforced Vapor Permeable Waterproofing:
 - 1. Carlisle Coatings & Waterproofing, Inc; LiquiFiber: www.carlisleccw.com/#sle.
- D. Solvent-Based Asphalt Waterproofing:
 - 1. Carlisle Coatings & Waterproofing, Inc; LiquiFiber: www.carlisleccw.com/#sle.
 - 2. Mar-flex Waterproofing & Building Products; ArmorMembrane 363 Solvent-Based: www.mar-flex.com/#sle.

2.02 WATERPROOFING APPLICATIONS

- A. All below finish floor or below grade steel columns, base plates and anchor bolts.
- B. Penetrations in new or existing construction.
- C. As indicated on drawings.
- D. Polyurethane Waterproofing.
- E. Cold-Applied Fiberglass Reinforced Vapor Permeable Waterproofing.
- F. Solvent-Based Asphalt Waterproofing.

2.03 FLUID APPLIED WATERPROOFING MATERIALS

- A. Polyurethane Waterproofing: Cold-applied one or two component polyurethane, complying with ASTM C836/C836M.
 - 1. Cured Thickness: 60 mils, 0.060 inch (1.52 mm), minimum.
 - 2. VOC Content: None.
 - 3. Tensile Strength: 400 psi (2.758 MPa), minimum, measured in accordance with ASTM D412.
 - 4. Ultimate Elongation: 180 percent, minimum, measured in accordance with ASTM D412.
 - 5. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240.
 - 6. Adhesion: Greater than 150 psi (1.03 MPa), measured in accordance with ASTM D4541.
 - 7. Manufacturers:
 - a. Carlisle Coatings & Waterproofing, Inc; CCW 703 Liquiseal: www.carlisleccw.com/#sle.
 - b. Gaco Western; GacoFlex LM-60: www.gaco.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cold-Applied Fiberglass Reinforced Vapor Permeable Waterproofing: Two component system consisting of a water-soluble liquid membrane integrated with a randomly oriented glass strand reinforcing fabric.
 - 1. Cured Thickness: 60 mils, 0.060 inch (1.52 mm), minimum.
 - 2. Suitable for installation over exterior gypsum sheathing substrates.
 - 3. Puncture Resistance, Maximum Load: 23.9 lbs (10.84 kg), measured in accordance with ASTM E154/E154M.
 - 4. Puncture Resistance, Maximum Elongation: 171 percent, measured in accordance with ASTM E154/E154M.
 - 5. Elongation at Break, Cut Strip: 42.5 percent, measured in accordance with ASTM D751, Procedure A.
 - 6. Breaking Strength, Cut Strip: 26.6 lbs (12.06 kg), measured in accordance with ASTM D751, Procedure B.
 - 7. Elongation at Break, Grab Test: 30.4 percent, measured in accordance with ASTM D751, Procedure A.
 - 8. Breaking Strength, Grab Test: 81.5 lbs (36.96 kg), measured in accordance with ASTM D751, Procedure A.
 - 9. Resistance to Tear Propagation: 10 lbs (4.53 kg), measured in accordance with ASTM D751, Tongue Tear.
 - 10. Resistance to Tear Initiation: 47.9 lbs (21.72 kg), measured in accordance with ASTM D4073/D4073M.
 - 11. Water Vapor Permeance: 0.02 perms (1 ng/(Pa s sq m)), measured in accordance with ASTM E96/E96M.
 - 12. Manufacturers:
 - a. Liquid Membrane: Carlisle Coatings & Waterproofing, Inc; Barritech VP: www.carlisleccw.com/#sle.
 - b. Fiber Reinforcing Fabric: Carlisle Coatings & Waterproofing, Inc; Liquifiber - W: www.carlisleccw.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. Solvent-Based Asphalt Waterproofing: Rubber, latex, or polymer modified for increased flexibility.
 - 1. Cured Thickness: 60 mils, 0.060 inch (1.52 mm), minimum.

2.04 ACCESSORIES

- A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.

- B. Reinforcing Fabric for Between Liquid Applied Membranes (LAM): Polyester fabric, unsaturated spun bond and nonwoven, used as reinforcement between LAM waterproofing systems.
 - 1. Thickness: 9.5 mils, 0.0095 inch (0.241 mm), minimum.
- C. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
- D. Protection Mat: Polyester mat at 14 oz/sq yd (474 grams/sq m) to protect vertical or horizontal waterproofing membranes.
 - 1. Thickness: 100 mils, 0.10 inch (2.54 mm), minimum.
 - 2. Width: 40 inch (1.12 m).
- E. Drainage Panel: 1/4 inch (6 mm) thick formed plastic, hollowed sandwich.
- F. Cant Strips: Premolded composition material.
- G. Counterflashings: Galvanized steel type, 0.01 inch (0.25 mm) thick.
- H. Additional accessories as recommended by manufacturer to suite application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Install cant strips at inside corners.

3.03 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. At joints and cracks less than 1/2 inch (13 mm) in width including joints between horizontal and vertical surfaces, apply 12 inch (300 mm) wide strip of joint cover sheet.
- D. At joints from 1/2 inch to 1 inch (12.7 mm to 25.4 mm) in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch (31.8 mm to 44.5 mm), and extend sheet at least 6 inches (152 mm) on either side of expansion joint.
- E. Center joint cover sheet over joints, roll sheet into 1/8 inch (3.2 mm) thick coating of waterproofing material and apply second coat over sheet extending at least 6 inches (152 mm) beyond sheet edges.

- F. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- H. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to ensure clamp ring seal, and coordinate with drain installation requirements specified elsewhere.
- I. Seal membrane and flashings to adjoining surfaces.
 - 1. Install termination bar along edges.
 - 2. Install counterflashing over exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.
- C. Adhere protection board to substrate with compatible adhesive.

3.05 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

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SECTION 07 2100 THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at over roof deck and exterior walls behind finishes indicated on drawings.
- B. Batt insulation in exterior wall construction and as indicated or required.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- C. Section 07 2400 - Exterior Insulation and Finish Systems: Board insulation on exterior side of walls, finished with weatherproof coating.
- D. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- E. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Insulation Schedule: Indicate type of insulation for each required application.
 - 1. Submittals that do not identify each application for insulation type will be returned without review.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation, installation techniques, and as required for project..
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.
- B. Follow ABAA guidelines and recommendations.

1.06 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Expanded polystyrene (EPS) board.
 - 1. Where indicated on drawings.
- B. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) board.
- C. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
- D. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.
- E. Insulation Over Roof Deck: Polyisocyanurate board.
- F. As indicated on drawings.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Expanded Polystyrene (EPS) Board Insulation: ASTM C578, Type XIV; with the following characteristics:
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Compressive Resistance: Type XIV, 40 psi (276 kPa), minimum.
 - 4. Type and Water Absorption: Type XIV, 2.0 percent by volume, maximum, by total immersion.
 - 5. Type and Thermal Resistance, R-value (RSI-value): Type XIV, 4.2 (0.74) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
- B. Termite-Resistant Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578 with the following characteristics:
- C. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 - 5. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 - 6. Board Edges: Square.
 - 7. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
- D. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F (24 degrees C).
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Water Vapor Permeance: 1.2 perm (68 ng/(Pa s sqm)), maximum, at 1 inch (25 mm) thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
 - 5. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 - 6. Board Thickness: 1.5 inch (37.5 mm) or as required to meet R values indicated on drawings.
 - 7. Tapered Board: Slope as indicated; minimum thickness 1/2 inch (12.7 mm); fabricate of fewest layers possible.
 - 8. Board Edges: Square.

2.03 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Do not use glass fiber batts at locations subject to moisture or condensation.
 - 2. Do not use glass fiber batts at exterior perimeter and / or adjacent to steel framing.
 - 3. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 - 4. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 5. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 6. Formaldehyde Content: Zero.
 - 7. Thermal Resistance: Minimum R-value (RSI-value) of R-19.
 - 1) Unless more stringent requirements are indicated on drawings.
 - 8. Facing: Unfaced.
- B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Use mineral fiber at all exterior perimeter locations, including but not limited to:
 - a. Exterior metal stud cavity walls.
 - b. Infill at steel columns or beams adjacent to exterior perimeter of building.
 - c. Locations subject to moisture or condensation.
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 4. Thermal Resistance: Minimum R-value (RSI-value) of R-19.
 - a. Unless more stringent requirements are indicated on drawings.
- C. Flexible Blanket Insulation: Thin profile insulation that conforms to complex shapes, unfaced; flame spread index of 5 (five) and smoke development index of 10 (ten) when tested in accordance with ASTM E84.

2.04 ACCESSORIES

- A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 - 2. Width: As required for application.
- B. Flashing Tape: Special polyolefin film with high performance adhesive.
 - 1. Application: Interior window and door sill flashing tape.
 - 2. Width: As required for application.
- C. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- D. Insulation Fasteners: Lengths of unfinished, 13 gage, 0.072 inch (1.83 mm) high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
- E. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- F. Insulation Fasteners: Appropriate for purpose intended.
- G. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch (6 mm) thick.
- H. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inch (150 mm) wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
 - 1. Tape seal joints.
 - 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
- C. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- F. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere a 6 inch (150 mm) wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
 - 1. Tape seal joints between sheets.
 - 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
- C. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to wall on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- F. Tape insulation board joints.

3.04 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.05 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

- A. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
 - 3. Do not apply more insulation than can be covered with roofing in same day.

3.06 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall, roof, ceiling, and where indicated in spaces without gaps or voids. Do not compress insulation.
 - 1. Locations are indicated on drawings.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Provide pins, clips, anchors and attachment accessories as recommended and as required for application.
- F. Retain insulation batts in place with wire mesh secured to framing members.
- G. Coordinate work of this section with construction of air barrier seal specified in Section 07 2500.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

3.08 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

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**SECTION 07 2119
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior wall crevices.
 - 2. At junctions of dissimilar wall and roof materials.
 - 3. At locations as indicated on drawings.
 - 4. At locations where required to fill voids unable to be filled with other types of insulation, where continuous insulation is required or indicated.
- B. Foamed-in-place intumescent insulation.
- C. Protective intumescent coating.

1.02 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
- C. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
- D. ASTM D1623 - Standard Test Method for Tensile And Tensile Adhesion Properties of Rigid Cellular Plastics; 2017.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- H. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, and preparation requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
- D. ABAA Installer Qualification and participation in ABAA Quality Assurance Program (QAP) is recommended.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than ten years of documented experience.

- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum ten years of documented experience.
- C. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 MOCK-UP

- A. Provide field mock-up, 10 feet (3 m) long by 10 feet (3 m) wide; include insulation overcoat, wall construction, window and frame, and door frame in mock-up.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foamed-In-Place Insulation:
 - 1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation; SPRAYTITE 178 Closed Cell: www.spf.basf.com/#sle.
 - b. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
 - c. Vapor permeable closed cell spray polyurethane product subject to specified requirements.
 - 1) ASTM E 84: Class I.
 - 2) NFPA 285 Compliant.
 - 3) Air Leakage: ASTM E283: <0.005 @ 1.0 inch maximum.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Monolithic Foamed-In-Place Intumescent Insulation: Medium-density, semi-rigid, two-part, closed cell polyurethane foam; foamed on-site using blowing agent of non-ozone-depleting gas.
 - 1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and overcoat limitations.
 - 2. Thermal Resistance: R-value (RSI-value) of 6.7 (170.18), minimum, per 1 inch (25.4 mm) thickness at 140 degrees F (60 degrees C) mean temperature, at 90 days, when tested in accordance with ASTM C518.
 - 3. Water Vapor Permeance: 0.99 perms (56.64 ng/(Pa s sqm)), maximum, when tested at 2.4 inch (61 mm) thickness in accordance with ASTM E96/E96M.
 - 4. Air Permeance: 0.0014 cfm/sq ft (0.007 L/second sq meter), maximum, when tested at 1-1/4 inch (31.8 mm) thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf (75 Pa).
 - 5. Closed Cell Content: At least 90 percent.
 - 6. Density: 2.0 lbs/cu ft (32 kg/cu m), nominal, in accordance with ASTM D1622/D1622M.
 - 7. Tensile Strength: 28 psi (193 kPa), minimum, in accordance with ASTM D1623.
 - 8. Compressive Strength: 22 psi (152 kPa), minimum, in accordance with ASTM D1621.
 - 9. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, at 4 inch (102 mm) thick when tested in accordance with ASTM E84.
 - 10. Basis of Design:
 - a. BASF Corporation; SPRAYTITE 178 Closed Cell: www.spf.basf.com/#sle.
 - 11. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply overcoat monolithically, without voids to fully cover foam insulation, to achieve fire rating required.
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

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SECTION 07 2400
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating (Class PB).
 - 1. Drainage Type EPS EIFS system.
 - 2. Self-cleaning properties.
- B. Drainage and water-resistive barriers behind insulation board, compatible with EIFS system.

1.02 RELATED REQUIREMENTS

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Perimeter flashings.
- B. Section 07 9200 - Joint Sealants: Sealing joints between EIFS and adjacent construction and penetrations through EIFS.

1.03 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- C. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; 2016.
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
- E. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.
- F. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).
- G. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2017.
- H. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity; 2015 (Reapproved 2020).
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- N. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.
- O. ASTM E2485/E2485M - Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings; 2013 (Reapproved 2018).
- P. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS); 2013 (Reapproved 2018).
- Q. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

- R. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- S. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2014).
- T. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2009, with Editorial Revision (2012).
- U. ISO 9001 - Quality management systems -- Requirements; 2015.
- V. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2018.
- W. NFPA 268 - Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- X. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.04 OTHER REFERENCED DOCUMENTS

- A. American Association of Textile Chemists and Colorists AATCC-127 Water Resistance: Hydrostatic Pressure Test.
- B. EIFS Manufacturer Air/Moisture Barrier ICC Report.
- C. EIFS Manufacturer system ICC report.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
- C. Manufacturer's specifications and details.
- D. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.
 - 1. Include details of entire assembly. Prepare and submit project-specific details.
 - 2. Include installation instructions.
- E. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.
- F. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches (300 mm) square, illustrating project colors and textures.
- G. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.
- H. Manufacturer's code compliance report.
- I. Manufacturer's standard warranty.
- J. Sealant manufacturer's certificate of compliance with ASTM C 1382.
- K. Applicator's industry training credentials.

1.06 QUALITY ASSURANCE

- A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
- B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
 - 1. Member in good standing of EIMA (EIFS Industry Members Association).
 - 2. Manufacturer of EIFS products for not less than 20 years.
 - 3. Manufacturing facilities ISO 9001 certified.
- C. Insulation Manufacturer Qualifications:
 - 1. Comply with the following as required by EIFS Manufacturer:
 - a. Approved by manufacturer of EIFS and approved and labeled under third party quality program as required by applicable building code.

- b. Manufactured under EIFS Manufacturer and recognized EIFS Manufacturer as being capable of producing specified insulation board to meet EIFS requirements.
 - c. Insulation board labeled with information required by EIFS Manufacturer, the approved listing agency, and the applicable building code.
 - d. Insulation board listed by an approved agency.
- D. Installer Qualifications:
 - 1. Installer Qualifications: Company specializing in the type of work specified and with at least ten years of documented experience and approved by manufacturer.
 - a. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.
 - 2. Knowledgeable in the proper use and handling of EIFS Materials.
 - 3. Employ skilled mechanics who are experienced and knowledgeable in air/moisture barrier and EIFS application, and familiar with the requirements of the specified work.
 - 4. Provide the proper equipment, staffing and supervision on the job site to install the system in compliance with EIFS manufacturer's published specifications and details and the project plans and specifications.

1.07 MOCK-UP

- A. Construct mock-up of typical EIFS application on specified substrate, size as required to include examples of all key conditions, and including flashings, joints, and edge conditions.
- B. Locate mock-up at approved location convenient for comparison to finished work.
- C. Mock-up may not remain as part of the Work.
- D. Mock-up Testing:
 - 1. Construct full-scale mock-up of typical air/moisture barrier and EIFS/window wall assembly with specified tools and materials and test air and water infiltration and structural performance in accordance with ASTM E 283, ASTM E 331 and ASTM E 330, respectively, through independent laboratory. Where mock-up is tested at job site maintain approved mock-up at site as reference standard. If tested off-site accurately record construction detailing and sequencing of approved mock-up for replication during construction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
- B. Storage: Store materials as directed by manufacturer's written instructions.
 - 1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F (4 degrees C) and temperatures in excess of 90 degrees F (32 degrees C).
 - 2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
 - 3. Protect insulation materials from exposure to sunlight.

1.09 FIELD CONDITIONS

- A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.
- B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.
- C. Do not install coatings or sealants when ambient temperature is below 40 degrees F (5 degrees C).
 - 1. Maintain ambient and surface temperatures above 40°F (4°C) during application and drying period, minimum 24 hours after application of Air/Moisture barrier and EIFS products.
 - 2. Provide supplementary heat for installation in temperatures less than 40°F (4°C).
- D. Do not leave installed insulation board exposed to sunlight for extended periods of time.
- E. Provide protection of surrounding areas and adjacent surfaces from application of products.

F. Coordination:

1. Coordinate the following in accordance with EIFS manufacturer's specifications and as required for project:
 - a. Provide site grading such that the EIFS terminates above grade a minimum of 6 inches (150 mm) or as required by code.
 - b. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors, and other wall penetrations to provide a continuously connected air and moisture barrier.
 - c. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall.
 - d. Install window and door head flashing immediately after windows and doors are installed.
 - e. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
 - f. Install splices or tie-ins from air/moisture barrier over back leg of flashings, starter tracks, and similar details to form a shingle lap that directs incidental water to the exterior.
 - g. Install copings and sealant immediately after installation of the EIFS when coatings are dry, and such that, where sealant is applied against the EIFS surface, it is applied against the base coat or primed base coat surface.
 - h. Schedule work such that air-moisture barrier is exposed to weather no longer than the recommendation of the manufacturer.
 - i. Attach penetrations through the EIFS to structural support and provide water-tight seal at penetrations.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.
- C. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide Air and Moisture Barrier and EIFS coatings and accessories from single source manufacturer or approved supplier.
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Parex USA, Inc; www.parex.com/#sle.
 2. Sto Corp: www.stocorp.com/#sle.
 3. Dryvit: www.dryvit.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

- A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on flat-backed insulation board adhesive-applied directly to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.
- B. Provide air and moisture barrier and compatible EIFS for vertical above grade exterior walls.
- C. Moisture Control:
 1. Provide flashing to direct water to the exterior where it is likely to penetrate components in the wall assembly, including, above window and door heads, beneath window and door sills, at roof/wall intersections, decks, abutments of lower walls with higher walls, above projecting features, at floor lines (where indicated on drawings), and at the base of the wall.

2. Air Leakage Prevention – provide continuity of the air barrier system at foundation, roof, windows, doors, and other penetrations through the wall with connecting and compatible air barrier components to minimize condensation and leakage caused by air movement.
- D. Wind Load:
1. Design for maximum allowable system deflection, normal to the plane of the wall, of L/240.
 - a. Unless more stringent conditions are indicated on Structural drawings.
 2. Design for wind load in conformance with code requirements.
 3. Additional criteria is indicated on Structural drawings.
- E. Fire Characteristics:
1. Flammability: Pass, when tested in accordance with NFPA 285.
 2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
 3. Fire Resistance: Complies with fire resistance requirements indicated on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 4. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).
- F. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi (105 kPa), when tested in accordance with ASTM C297/C297M.
- G. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent unless flatwise tensile bond strength exceeds 15 psi (105 kPa) in all samples.
- H. Color:
1. Finish coat shall have a light reflectance value of 20 or greater.
 - a. Colors are indicated on drawings.
- I. Joints:
1. Provide minimum 3/4 inch (19 mm) wide joints in the EIFS where they exist in the substrate or supporting construction, where the cladding adjoins dissimilar construction or materials, at changes in building height, at expansion, control, and cold joints in construction. Terminate edges of EIFS with joint edges of through wall expansion joints and similar joints in construction.
 2. Provide minimum 1/2 inch (13 mm) wide perimeter sealant joints at all penetrations through the EIFS (windows, doors, mechanical, electrical, and plumbing penetrations, etc.). Follow manufacturer's specifications.
 3. Provide compatible backer rod and sealant that has been evaluated in accordance with ASTM C 1382, and that meets minimum 50% elongation after conditioning.
 4. Provide joints so that air barrier continuity is maintained across the joint, and drain joints to the exterior, or provide other means to prevent or control water infiltration at joints.
 5. Decorative reveal joint profiles and locations are indicated on drawings.
- J. Grade Condition:
1. Provide minimum 6 inch (152 mm) clearance above finished grade.
- K. Trim, Projecting Architectural Features and Reveals:
1. All trim and projecting architectural features must have a minimum 1:2 [27°] slope along their top surface. All reveals must have minimum 3/4 inch (19 mm) insulation thickness at the bottom of the reveal. All horizontal reveals must have a minimum 1:2 [27°] slope along their bottom surface. Where trim/feature or bottom surface of reveal projects more than 2 inches (51 mm) from the face of the EIFS wall plane, protect the top surface with waterproof base coat.
 2. Do not install EIFS on weather exposed projecting ledges, sills, or other projecting features unless supported by framing or other structural support and protected with metal coping or flashing.

- L. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.
- M. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.
- N. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches (100 by 150 mm) in size.
- O. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.
- P. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
- Q. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
- R. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
- S. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.
- T. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
 - 1. Standard: 25 to 49 in-lb (2.83 to 5.54 J), for areas not indicated as requiring higher impact resistance.
 - 2. High: 90 to 150 in-lb (10.2 to 17 J), for areas indicated on the drawings.

2.03 MATERIALS

- A. Finish Coating Top Coat: Water-based, air curing, acrylic finish with integral color and texture.
 - 1. Self-cleaning properties.
 - a. Texture: Fine.
 - b. Color: As indicated on drawings.
- B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with insulation board and reinforcing mesh, Class PB.
 - 1. Fiber reinforced acrylic based waterproof base coat mixed with portland cement (for use as a waterproof base coat for foundations, parapets, splash areas, trim, and other projecting architectural features and as required for project and in accordance with manufacturer's recommendations.
 - 2. Factory blended one component polymer modified portland cement based high build base coat
- C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.
- D. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
 - 1. Board Size Tolerance: Plus/minus 1/16 inch (1.5 mm) from square and dimension.
 - 2. Board Thickness: 2 inches (50 mm).
 - a. Unless thicker insulation is indicated or required for application.
 - 3. Board Edges: Square.

4. Type and Thermal Resistance, R-value (RSI-value): Type II, 4.0 (0.70) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature using ASTM C177 test method.
5. Manufacturers:
 - a. Substitutions: Not permitted.
- E. Drainage Layer or Spacers: Furnished or approved by EIFS manufacturer; capable of achieving specified drainage rate; not required to be water-resistive, air retarder, or vapor retarder.
- F. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.
 1. Vapor Permeable.
 2. Water Vapor Transmission: ASTM E96, > 10 perms.
 3. Joint Treatment, Rough Opening Protection, and Detail Components:
 - a. Rapid drying gun-applied treatment for sheathing joints, rough openings, seams, cracks, penetrations, and other transitions in above grade wall construction.
 - b. Transition Detail Components:
 - 1) Flexible air barrier membrane for continuity at static transitions.
- G. Fluid-Applied Flashing: Flexible water based polymer material suitable for use with reinforcing mesh and, if used with water-resistive barrier sheet, certified compatible with sheet material.
- H. Flashing Tape: Self-adhering rubberized asphalt tape with polyethylene backing or other material and surface conditioner furnished or approved by EIFS manufacturer.

2.04 ACCESSORY MATERIALS

- A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.
- B. Metal Flashings: As specified in Section 07 6200.
- C. Trim: EIFS manufacturer's standard galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.
 1. Galvanized steel trim where exposed to view is not allowed. Refer to drawings for colors where trim is exposed to view.
- D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.
 1. Inspect sheathing application for compliance with applicable requirement and installation in conformance with specification and manufacturer requirements:
 - a. Glass Mat Faced gypsum sheathing compliant with ASTM C 1177.
 - b. Cementitious sheathing – consult manufacturer.
 - c. Attachment into structural supports with adjoining sheets and fasteners at required spacing to resist design wind pressures.
 - d. Fasteners seated flush with sheathing surface and not over-driven.
- B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.
- C. Report deviations from the requirements of project specifications or other conditions that might adversely affect the Air/Moisture Barrier and the EIFS installation. Do not start work until deviations are corrected.

3.02 PREPARATION

- A. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

- B. Remove surface contaminants on concrete, concrete masonry, gypsum sheathing, or coated gypsum sheathing surfaces.
- C. Repair cracks, spalls or damage in concrete and concrete masonry surfaces and level concrete and masonry surfaces to comply with required tolerances.
- D. Apply conditioner by spray or roller to chalking or excessively absorptive surfaces or pressure wash to remove surface chalkiness.
- E. Remove fasteners that are not anchored into supporting construction and seal holes with air barrier material.
- F. Seal over-driven fasteners with air barrier material and install additional fasteners as needed to comply with fastener spacing requirement.
- G. Fill large gaps between sheathing or voids around pipe, conduit, scupper, and similar penetrations with spray foam and shave flush with surface.
- H. Replace weather-damaged sheathing and repair or replace damaged or cracked sheathing

3.03 INSTALLATION - GENERAL

- A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
 - 1. Where different requirements appear in either document, comply with the most stringent.
 - 2. Neither of these documents supersedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

- A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.
- B. Mechanically attach sheet materials to substrate using fasteners and fastener spacing recommended by EIFS manufacturer.
- C. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.
- D. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.
- E. At moving expansion joints, apply flexible flashing or flashing tape across and recessed into joint with U-loop forming continuous barrier but allowing movement.
- F. Lap flexible flashing or flashing tape at least 2 inches (50 mm) on each side of joint or transition.
- G. Install drainage layer or spacers after flashing tape has been completed.

3.05 INSTALLATION - INSULATION

- A. Install in accordance with manufacturer's instructions.
- B. Prior to installation of boards, install starter track and other trim level and plumb and securely fastened. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.
- C. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.
- D. On wall surfaces, install boards horizontally.
- E. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).
- F. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.
- G. Rasp irregularities off surface of installed insulation board.

- H. Mechanical Fastening: Space fasteners as recommended by EIFS manufacturer.
- I. Adhesive Attachment: Use method required by manufacturer to achieve drainage efficiency specified; do not close up drainage channels when placing insulation board.

3.06 INSTALLATION - CLASS PB FINISH

- A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of EIFS. Install reinforcing fabric as recommended by EIFS manufacturer.
 - 1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches (64 mm).
 - 2. Allow base coat to dry a minimum of 24 hours before next coating application.
- B. As required by impact resistance requirements, install second layer of reinforcing mesh embedded in second coat of base coating, tightly butting ends and edges of mesh.
- C. Install expansion joints at floor lines as recommended by EIFS manufacturer.
- D. Apply finish coat after base coat has dried not less than 24 hours and finish to a uniform texture and color.
- E. Finish Coat Thickness: As recommended by manufacturer.
- F. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.07 CLEANING, REPAIR AND MAINTENANCE

- A. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.
- B. Clean and maintain the EIFS for a fresh appearance and to prevent water entry into and behind the system. Repair cracks, impact damage, spalls or delamination promptly.
- C. Maintain adjacent components of construction such as sealants, windows, doors, and flashing, to prevent water entry into or behind the EIFS and anywhere into the wall assembly.
- D. Follow EIFS Manufacturer's recommendations for restoration, cleaning, repairs, recoating, resurfacing, and refinishing, or re-cladding.

3.08 PROTECTION

- A. Protect completed work from damage and soiling by subsequent work.
- B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION

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SECTION 07 2500 WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

1. Vapor permeable.
2. Locations are indicated on drawings: Air / Moisture Barrier.
3. Fluid applied.
 - a. Contractor may use membrane products where allowable by exterior material manufacturer in lieu of fluid applied.
 - 1) Required membrane locations include all outside corners, six inches on each side and as indicated on drawings.
 - b. Plastic sheet products, felt or building paper is not allowed.
 - c. High-Temperature (240 deg F, minimum) at metal walls or roof materials and where indicated or required by cladding manufacturer.

1.02 RELATED REQUIREMENTS

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 072400 - Exterior Insulation and Finish System: Air / Moisture Barrier behind EIFS.
- C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 9200 - Joint Sealants: Sealing building expansion joints.

1.04 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
 1. Water Vapor Permeance: For purposes of conversion, $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$.
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.05 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. AATCC Test Method 127 - Test Method for Water Resistance: Hydrostatic Pressure; 2018, with Editorial Revision (2019).
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

- H. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; 2016, with Editorial Revision (2019).
- I. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; 2017.
- J. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015.
- K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
 - 1. Provide project-specific details for all application types.
 - 2. Show interface with adjacent work.
 - 3. Clarify work as part of this Section and by other Sections.
- D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- E. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification; keep copies of each contractor accreditation and installer certification on site during and after installation, and present on-site documentation upon request.
- H. Testing Agency Qualification Statement.

1.07 QUALITY ASSURANCE

- A. Follow Air Barrier Association of America (ABAA) Quality Assurance Program (QAP) recommendations; www.airbarrier.org/#sle.
- B. Installer Qualification: Installer Qualifications: Company specializing in performing work of type specified and with at least ten years documented experience.
- C. Manufacturer Qualification: Use materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.08 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Air / Moisture Barrier: Provide on exterior walls under exterior cladding and where indicated in other sections.
 - 1. Provide continuous air / moisture barrier throughout entire building envelope, including horizontal to vertical transitions and under different finish materials. Seal all penetrations air and water tight.
 - 2. Continuous air / moisture barrier is required at all locations whether or not shown on drawings.

- B. Contractor to coordinate the compatibility of all system components with insulation and other materials. Provide accessory materials as required for a complete assembly.
- C. Seal all building envelope seams, gaps and material transitions air-tight.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Sheet, Self-Adhered:
 - 1. Air Permeance: 0.004 cubic feet per minute per square foot (0.02 L/s/sq m), maximum, when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 10 perms (572 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
 - 3. Water Penetration Resistance Around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).
 - 4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure.
 - 5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
 - 6. Complies with NFPA 285 wall assembly requirements.
 - 7. Water Resistance: Comply with applicable water-resistive requirements of ICC-ES AC38.
 - 8. Seam and Perimeter Tape: As recommended by sheet manufacturer.
 - 9. Required locations are indicated on drawings.
 - 10. Manufacturers:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GCP Applied Technologies; Perm-A-Barrier VPS: www.gcpat.com/#sle.
 - 2) Henry Company; Blueskin VP160: www.henry.com/#sle.
 - 3) Soprema; www.soprema.us.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.
- B. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
- C. High performance, spunbonded polyolefin, non-woven, non-perforated, weather barrier.
 - 1. Material: Polyether-based polymer.
 - 2. Dry Film Thickness (DFT): 20 mil, 0.020 inch (0.508 mm), minimum.
 - 3. Air Permeance: 0.001 cubic feet per minute per square foot (0.005 L/s/sq m), maximum, when tested in accordance with ASTM E2178.
 - 4. Water Vapor Permeance: 18 perms (1030 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M, Procedure B.
 - 5. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to six months of weather exposure after application.
 - 6. Dry Film Thickness: 40 mils (0.040 inch (1 mm)), minimum.
 - 7. Air Permeance: 0.004 cubic feet per square foot (0.02 liters per second per square meter), maximum, when tested in accordance with ASTM E2178.
 - 8. Water Vapor Permeance: 10 perms (574 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M.
 - 9. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 - 10. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 11. Complies with NFPA 285 wall assembly requirements.
 - 12. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
 - 13. VOC Content: 100 g per L or less.
 - 14. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
 - 15. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 - 16. Products:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Sto Corp; Sto Gold Coat: www.stocorp.com.

- 2) Dryvit; Backstop NT: www.dryvit.com.
- 3) Soprema: www.soprema.us
- 4) Henry Company: www.henry.com
- 5) Substitutions: See Section 01 6000 - Product Requirements.

2.03 SEALANTS

- A. All sealants to comply with ASTM C920, elastomeric polymer sealant to maintain watertight condition.
- B. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

2.04 ADHESIVES

- A. Provide adhesive recommended by manufacturer.

2.05 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970.
- C. Flexible Flashing: Sheathing fabric saturated with air barrier coating and complying with the applicable requirements of ICC-ES AC148.
- D. Pre-formed Transition Membrane: Semi-rigid silicone or polyester composition, tapered edges, tear resistant.
- E. Liquid Flashing: One part, fast curing, non-sag elastomeric STPU (Silyl-Terminated Polyurethane) gun grade, trowelable liquid flashing.
- F. Stainless Steel Flashing: Flexible flashing with 8 mil, 0.008 inch (0.203 mm) thick sheet of Type 304 stainless steel, 8 mil, 0.008 inch (0.203 mm) of butyl adhesive and a siliconized release liner.
- G. Sheet Membrane Mounting Tape: Double-sided strip of pressure-sensitive, acrylic adhesive reinforced with embedded fiber-strand carrier layer and plastic backing.
 1. Width: 3/4 inch (19 mm).
 2. Roll Length: 164 feet (50 m).
 3. Thickness: 14 mil, 0.014 inch (0.356 mm).
- H. Liquid Flashing: One part, fast curing, non-sag, gun grade, trowelable liquid flashing.
- I. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Self-Adhered Sheets:

1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
 2. Lap sheets shingle-fashion to shed water and seal laps air tight.
 3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
 4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
 5. At wide joints, provide extra flexible membrane allowing joint movement.
- E. Coatings:
1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
 2. Mastic Coating: Install by trowel or roller to minimum thickness of 1/4 inch (6 mm); use sheet seal to join to adjacent construction, seal air tight with sealant.
 3. Use flashing to seal to adjacent construction and to bridge joints.
- F. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches (100 mm) wide; do not seal sill flange.
 3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
 4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Coordination of ABAA Tests and Inspections:
1. Provide testing and inspection required by ABAA QAP.
 2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
 3. Cooperate with ABAA testing agency.
 4. Allow access to air barrier work areas and staging.
 5. Do not cover air barrier work until tested, inspected, and accepted.
- C. Do not cover installed weather barriers until required inspections have been completed.
- D. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- E. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

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SECTION 07 4113 METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Standing Seam Metal Roof Panels.
 - 1. Architectural roofing system of preformed steel panels.
 - 2. Flashing and trim adjacent to or part of architectural preformed steel panel roofing system.
 - 3. Refer to locations shown on drawings.
- B. Accessories and underlayment as required for complete installation.
- C. Gutters and downspouts adjacent to or part of architectural preformed steel panel roofing system.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Roof sheathing.
- B. Section 07 2100 - Thermal Insulation: Rigid roof insulation.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2021a.
- D. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- E. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2018.
- H. ICC-ES AC188 - Acceptance Criteria for Roof Underlayments; 2012, with Editorial Revision (2015).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - a. Include installation instructions.
 - 3. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Include accessories.
 - 2. Include project-specific details.
 - 3. Show work to be field-fabricated or field-assembled.
 - 4. Show interface with other work.
 - 5. Show all proposed seam and joint locations.
 - 6. Do not use architect's drawings as shop drawings.
 - 7. Scale of shop drawing details not less than 1-1/2" = 1'-0".

8. Show drawings, text and dimensions in black and white at a clear legible scale and size.
 - a. Color drawings that are not clearly legible will be returned without review.
9. Include structural analysis signed and sealed by qualified structural engineer, indicating compliance of roofing system to specified loading conditions.
10. Show roof panel layout on shop drawings. Include full panels and dimensions of cut panels. Comply with layout as indicated on drawings or as specified.
- D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
 1. Include typical panel joint in sample.
 2. Include typical fastening detail.
- F. Manufacturer Qualification Statement: Provide documentation showing metal roof panel fabricator is accredited under IAS AC472.
- G. Qualification Data: For Installer.
- H. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than twenty years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of documented experience.
 1. Contractor shall be authorized by the manufacturer to install specified materials 5 years prior to the bidding period through satisfactory project completion.
 2. Applicators shall have completed projects of similar scope using same or similar materials specified for a minimum of 10 years.
 3. Contractor shall provide full time, on-site superintendent or foreman experienced with the specified roofing from beginning through satisfactory project completion.
 4. Documentation stating that Project Manager, Job Site Superintendent and all other roofing applicators are employed directly by the Installer (no subcontracting of roofing installation will be permitted).
 5. Evidence of compliance with Oklahoma Bill #2180 "Roofing Contractor Registration Act", and current Commercial Endorsement with Oklahoma Construction Industries Board (CIB)
 6. Applicators shall be skilled in the application methods for all materials.
 7. Contractor shall maintain a daily record, on-site, documenting material installation and related project conditions.
 8. Contractor shall maintain a copy of all submittal documents, on-site, available at all times for reference.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty years from Date of Substantial Completion.
- C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within

specified warranty period of twenty years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design:
 - 1. Metal Roof Panels: Tee-Lock Panel manufactured by Berridge Manufacturing Co..
 - 2. Substitutions: See Section 016000-Product Requirements.

2.02 ARCHITECTURAL METAL ROOF PANELS

- A. Architectural Metal Roofing: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed or Field Formed panels with factory-applied finish.
 - 1. Steel Panels:
 - a. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 (AZM150) coating.
 - b. Steel Thickness: Minimum 22 gage.
 - 2. Profile: Standing seam, with minimum 2.0 inch (51 mm) seam height; concealed fastener system for field seaming with special tool.
 - 3. Texture: Smooth, with intermediate ribs for added stiffness.
 - 4. Length: Full length of roof slope, without lapped horizontal joints.
 - 5. Width: Maximum panel coverage of 18 inches (457 mm).

2.03 ATTACHMENT SYSTEM

- A. Concealed System: Provide manufacturer's standard 0.064-inc nominal thickness, aluminum-zinc alloy coated steel concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 SECONDARY FRAMING

- A. Miscellaneous Secondary Framing: Light gage steel framing incidental to structural supports; fabricated from steel sheet.
- B. Framing Material: ASTM A 1011/A 1011M, Designation SS steel sheet.
 - 1. Profile: Manufacturer's standard cee, zee, asymmetrical zee, hat channel, plain channel, single slope eave strut, double slope eave strut, and angle.
 - 2. Thickness: 12 gage, 0.1046 inch (2.657 mm).
 - 3. Finish: Galvanized per ASTM A653/A653M, G90.
- C. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

2.05 FABRICATION

- A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.06 FINISHES

- A. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat applied by panel manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.75 ± 0.05 mil over 0.2 ± 0.05 mil primer coat, to provide a total dry film thickness of 0.95 ± 0.10 mil. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat applied by panel manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.75 ± 0.05

mil over 0.2± 0.05 mil primer coat, to provide a total dry film thickness of 0.95± 0.10 mil. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- C. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.35 mil.

2.07 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, trim, moldings, closure strips, preformed crickets, caps, as indicated or as required for project, and similar sheet metal items of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
 - 1. Flashing and Trim: Provide flashing and trim, formed from same material and manufacturers run as metal roof panels, required to seal against weather and provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascia, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
 - 2. Gutters: Formed from same material and manufacturer's run as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches on center, fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
 - a. Gutter Profile: Square.
 - b. Provide continuous exterior-grade perforated gutter guard, concealed from view.
 - 3. Downspouts: Formed from same material and manufacturer's run as roof panels unless indicated otherwise on drawings. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters. Furnish gutter supports spaced a maximum of 36 inches on center, fabricated from same metal as gutters.
 - 4. Roof Curbs: Fabricated from same material as roof panels, 22 Ga nominal thickness; galvalume or stainless steel; supply an integral full-length cricket for curbs wider than 24 inches supported by a structural metal deck. Fabricate curb flashing from 22 Ga. On open framing, provide roof underlayment and decking at and about roof curb per roofing manufacturer's requirements. Maintain a minimum of 1/2 of roofing panel width on each side of roof curb, and start panels a minimum of 9 inches up slope of roof curb, flashing roofing panels to roof curb per roofing manufacturer's requirements.. Fabricate curb and sub framing to withstand indicated loads of size and height of roof top equipment. Where required insulate roof curbs with rigid insulation.
- B. Panel Fasteners: Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size as approved for the applicable loading requirements.
- C. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- D. Weatherseal: Manufacturer's standard as required for watertight warranty.
- E. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
 - 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.
- F. Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mil (1 mm) total thickness; with strippable release film and woven polyolefin top surface.
 - 1. Minimum Requirements: Comply with requirements of ICC-ES AC188 for non-self-adhesive sheet.
 - 2. Sheet Thickness: 40 mil, 0.040 inch (1.02 mm) minimum total thickness.

3. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
4. Adhesion to plywood at 40 deg F, lbf/ft: 10 lbf/ft in ASTM D1970
5. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
6. Water Vapor Permeance: 0.1 perm (5.72 ng/Pa s sq m), maximum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).
7. Minimum Thermal Stability:
 - a. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 - b. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
8. Building paper or felt is not allowed.
9. Manufacturers:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Henry Company; Blueskin PE200HT: www.henry.com/#sle.
 - 2) Polyglass USA, Inc; Polystick MTS Self-Adhered High Temperature Roof Underlayment: www.polyglass.us/#sle.
 - 3) Soprema Lastobond Shield HT.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Broom clean wood sheathing prior to installation of roofing system.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.
- C. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.
- D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.
- E. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using factory set, non-adjustable portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
3. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

3.04 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.
 - a. Install panels with alignment as indicated on drawings.
 - 1) If layout is not indicated, center panels in area. Provide equally cut panels along perimeter as required for a centered layout. Do not use full panels at one side and work towards the other side resulting in a randomly cut panel.
- B. Accessories: Install all components required for a complete roofing assembly, including flashings, trim, moldings, closure strips, preformed crickets, caps, rib closures, ridge closures, and similar roof accessory items.
- C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
 1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.
 2. Incorporate concealed clips at panel joints, and apply snap-on battens to provide weathertight joints.
 3. Provide sealant tape or other approved joint sealer at lapped panel joints.
 4. Install sealant or sealant tape, as recommended by panel manufacturer, at end laps and side joints.

3.05 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.06 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

**SECTION 07 4213
METAL WALL PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured metal panels for exterior wall panels, soffit panels, and subgirt framing assembly, with insulation, related flashings, and accessory components.
 - 1. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

1.02 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 07 2100 - Thermal Insulation.
- C. Section 07 2500 - Weather Barriers: Weather barrier under wall panels.
- D. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Include installation instructions.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, details of edge and penetration conditions, spacing and type of connections, flashings and special conditions, and methods of anchorage.
 - 1. Include downspouts.
 - 2. Include accessories.
 - 3. Include project-specific details.
 - 4. Show work to be field-fabricated or field-assembled.
 - 5. Show interface with other work.
 - 6. Show all proposed seam and joint locations.
 - 7. Do not use architect's drawings as shop drawings.
 - 8. Scale of shop drawing details not less than 3" = 1'-0".
 - 9. Show drawings, text and dimensions in black and white at a clear legible scale and size.
 - a. Color drawings that are not clearly legible will be returned without review.
- D. Samples: Submit two samples of wall panel and soffit panel, 12 inch by 12 inch (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

- G. Calculations:
 - 1. Include calculations with registered engineer seal, verifying panel and attachment methods resist wind pressures imposed on it pursuant to applicable building codes.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum ten years of documented experience.

1.06 MOCK-UP

- A. Construct mock-up, 12 feet (3.6 m) long by 12 feet (3.6 m) wide; include panel trim to adjacent materials system, glazing, attachments to building frame, associated air / moisture barrier materials, weep drainage system, sealants and seals, related insulation, and as indicated on drawings and integrated exterior material mock-up requirements specified in Section 014000 in mock-up.
- B. Locate where directed by Architect.
- C. Mock-up may not remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefabricated material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a ten year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
- C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Wall Panels:
 - 1. Metal Wall Panels - Standard with grooves-Profile, Concealed Fasteners; Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels: FW-12 Panel manufactured by Berridge Manufacturing Company: www.berridge.com/#sle..
 - 2. Substitutions: See Section 01 6000-Product Requirements.
- B. Metal Soffit Panels:
 - 1. Metal Soffit Panels - Concealed Fasteners: 6" Smooth V-Groove Soffit and 6" Vented V-Groove Soffit manufactured by Lux: www.luxarpro.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MANUFACTURED METAL PANELS

- A. Soffit Panel Systems: Factory fabricated prefabricated metal panel system, site assembled.
 - 1. Vented soffit panels to match. Locate as indicated on drawings.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on drawings.
- C. Provide exterior wall panels, soffit panels, and subgirt framing assembly.
 - 1. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.

2. Design Pressure: In accordance with applicable codes.
 - a. And as indicated on drawings.
 3. Maximum Allowable Deflection of Panel: $L/180$ for length(L) of span.
 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.
 8. Provide continuity of air / moisture barrier seal at building enclosure elements in accordance with materials specified in Section 07 2500.
 9. Exterior Wall Panels:
 - a. Profile: Vertical; style as indicated.
 - b. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
 - c. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
 - d. Panel Width: Maximum provided by manufacturer.
 - e. Color: As indicated on drawings.
 10. Soffit Panels:
 - a. Profile: Style as indicated.
 11. Subgirt Framing Assembly:
 - a. Provide a thermally broken attachment system for attachment of exterior cladding installed over continuous exterior-insulation.
 - b. 16 gage, 0.0598 inch (1.52 mm) thick formed non-precoated steel sheet.
 - c. Unless more stringent conditions are indicated on drawings.
 12. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
 13. Expansion Joints: Same material, thickness and finish as exterior sheets; thick; manufacturer's standard brake formed type, of profile to suit system.
 14. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
 15. Anchors: Galvanized steel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
- E. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

2.03 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Concealed Sealants: Non-curing butyl sealant or tape sealant.
- C. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
- D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
- E. Field Touch-up Paint: As recommended by panel manufacturer.
- F. Bituminous Paint: Asphalt base.

- G. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fascia, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
1. Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 2. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at 24 inches on center, maximum (at 610 mm on center, maximum).
 1. Unless more stringent conditions as indicated on drawings.

3.03 INSTALLATION

- A. Install panels on soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Locate joints over supports.
- E. Lap panel ends minimum 2 inches (51 mm).
- F. Provide expansion and control joints where indicated or where required by manufacturer.
- G. Use concealed fasteners unless otherwise approved by Architect.
- H. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.05 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.
- D. Upon completion of installation, thoroughly clean prefinished aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION

**SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic roofing membrane.
- B. Deck sheathing.
- C. Cover boards.
- D. Flashings.
- E. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets and Formed metal flashing and trim items associated with roofing.
- C. Section 07 7100 - Roof Specialties: Prefabricated roofing expansion joint flashing.
- D. Section 07 7200 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.03 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- B. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. FM (AG) - FM Approval Guide; current edition.
- F. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2022).
- G. NRCA (RM) - The NRCA Roofing Manual; 2022.
- H. NRCA (WM) - The NRCA Waterproofing Manual; 2021.
- I. UL (DIR) - Online Certifications Directory; Current Edition.
- J. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, surfacing, and fasteners.
 - 1. Provide membrane manufacturer's printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer's requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.
- C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions and conditions of interface with other materials.
 - 1. The roof membrane manufacturer's standard details customized for this project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion

joints, penetrations, and drains.

- D. Samples for Verification: Submit two samples ____ by ____ inches (____ by ____ mm) in size illustrating system.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least ten years of documented experience.
- C. Manufacturer shall have trained technical service representatives employed by the manufacturer, independent of sales.
- D. Installer shall provide full time, on-site superintendent or foreman experienced with the specified roofing from beginning through satisfactory project completion.
- E. Installer shall maintain a daily record, on-site, documenting material installation and related project conditions.
- F. Evidence of compliance with Oklahoma Bill #2180 "Roofing Contractor Registration Act.
- G. Documentation stating that all project personnel including roofing applicators are employed directly by installer (no subcontracting of roofing installation will be permitted).

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below or above manufacturer's specifications.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within five years after installation.
- C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years.
 - 2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
 - 1. Basis of Design: Versico Roofing Systems; 60 mil fleece back TPO, adhered.
 - 2. Carlisle Roofing Systems, Inc; FleeceBACK Fully Adhered TPO: www.carlisle-syntec.com/#sle.
 - 3. Firestone Building Products, LLC: www.firestonebpco.com/#sle.
 - 4. Johns Manville: www.jm.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:
 - 1. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.
 - 2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
- C. Acceptable Insulation Types: Any type that meets requirements and is approved by membrane manufacturer for application.
 - 1. As specified in Section 03 5216 - Light Weight Insulating Concrete.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 - 1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrim.
 - a. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
 - b. Fleece-back.
 - 2. Sheet Width: Factory fabricated into largest sheets possible.
 - 3. Color: To be selected by Architect from manufacturer's full color range.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane.

2.04 DECK SHEATHING

- A. Deck Sheathing: Gypsum sheathing complying with ASTM C1396/C1396M and ASTM C1177/C1177M, paper faced.
 - 1. Thickness: 5/8 inch (15.9 mm), Type X, fire resistant.

2.05 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 - 1. Thickness: 5/8 inch (15.9 mm), Type X, fire resistant.

2.06 ACCESSORIES

- A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.
- B. Sheathing Joint Tape: Paper type, ____ inch (____ mm) wide, self adhering.
- C. Membrane Adhesive: As recommended by membrane manufacturer.
- D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

- E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- F. Sealants: As recommended by membrane manufacturer.
- G. Walkway Pads: Suitable for maintenance traffic, visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Size: Manufacturers standard size.
 - a. No piece shall be smaller than 18 inches by 18 inches.
 - 3. Locations: Provide the following, unless more stringent conditions are indicated on drawings.
 - a. Service side of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. As required by roof membrane manufacturer's warranty requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips, nailing strips, and reglets are in place.

3.02 METAL DECK PREPARATION

- A. Install deck sheathing on metal deck:
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 - 3. Tape joints.

3.03 INSTALLATION - GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.04 VAPOR RETARDER AND INSULATION - UNDER MEMBRANE

- A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.

1. Extend vapor retarder under cant strips and blocking to deck edge.
 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
 - C. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.
 - D. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
 - E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
 - F. Do not apply more insulation than can be covered with membrane in same day.

3.05 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate in accordance with manufacturer's specifications. Fully embed membrane in adhesive except in areas directly over or within 3 inches (75 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (75 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
 1. Extend membrane over cant strips and up a minimum of 8 inches (200 mm) onto vertical surfaces.
 2. Extend membrane up and 6" over top of parapet walls where no other vertical material is indicated.
 3. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints. Make joints watertight.
 1. Install prefabricated joint components in accordance with manufacturer's instructions.
- H. Coordinate installation of roof drains and sumps and related flashings.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing material manufacturers daily during installation of the Work.

3.07 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

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SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts and other items indicated or required for project.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 07 4113 - Metal Roof Panels: Gutters and downspouts adjacent to or part of architectural preformed steel panel roofing system.
- C. Section 07 7100 - Roof Specialties: Manufactured copings, flashings, and expansion joint covers.
- D. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- H. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- I. CDA A4050 - Copper in Architecture - Handbook; current edition.
- J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
 - 1. Include accessories.
 - 2. Include project-specific details.
 - 3. Show work to be field-fabricated or field-assembled.
 - 4. Show interface with other work.
 - 5. Show all proposed seam and joint locations.
 - 6. Do not use architect's drawings as shop drawings.
 - 7. Scale of shop drawing details not less than 1-1/2" = 1'-0".
 - 8. Show drawings, text and dimensions in black and white at a clear legible scale and size.
 - 9. Color drawings that are not clearly legible will be returned without review.
 - 10. Show Work covered by this section and clarify Work furnished by other sections.

- C. Samples: For each exposed product and for each color and texture specified.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ten years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) (0.61 mm) thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
 - 1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
 - 2. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 3. Color: As selected by Architect from manufacturer's standard colors.
 - a. Unless indicated on drawings.
- C. Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) (0.81 mm) thick; anodized finish of color as selected.
- D. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) (0.81 mm) thick; plain finish shop pre-coated with fluoropolymer coating.
- E. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.03 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Underlayment: Polyethylene, 6 mils (0.15 mm) thick.
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc chromate type.

- E. Protective Backing Paint: Zinc molybdate alkyd.
- F. Concealed Sealants: Non-curing butyl sealant.
- G. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- H. Plastic Cement: ASTM D4586/D4586M, Type I.
- I. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.03 INSTALLATION

- A. Conform to drawing details.
 - 1. SMACNA (ASMM), Details, as applicable to project.
- B. Secure flashings in place using concealed fasteners.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

END OF SECTION

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SECTION 07 7100 ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings, fascias, gravel stops, and work as indicated on drawings and as required for project not specified elsewhere.
- B. Roof control and expansion joint covers.

1.02 RELATED REQUIREMENTS

- A. Section 07 4113 - Metal Roof Panels: Gutters and downspouts adjacent to or part of architectural preformed steel panel roofing system.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Fabricated sheet metal items.
- C. Section 07 7200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- E. NRCA (RM) - The NRCA Roofing Manual; 2022.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
 - 1. Include accessories.
 - 2. Include project-specific details.
 - 3. Show work to be field-fabricated or field-assembled.
 - 4. Show interface with other work.
 - 5. Show all proposed seam and joint locations.
 - 6. Do not use architect's drawings as shop drawings.
 - 7. Scale of shop drawing details not less than 1-1/2" = 1'-0".
 - 8. Show drawings, text and dimensions in black and white at a clear legible scale and size.
 - 9. Color drawings that are not clearly legible will be returned without review.
 - 10. Show Work covered by this section and clarify Work furnished by other sections.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following indicated below.

- B. Roof Edge Flashings and Copings:
 - 1. ATAS International, Inc: www.atas.com/#sle.
 - 2. Drexel Metals Inc: www.drexmet.com/#sle.
 - 3. Metal-Era Inc: www.metalera.com/#sle.
 - 4. Metal Roofing Systems, Inc: www.metalroofingsystems.biz/#sle.
 - 5. OMG Roofing Products: www.omgroofing.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- C. Control and Expansion Joint Covers:
 - 1. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 2. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
 - 3. GAF: www.gaf.com/#sle.
 - 4. Johns Manville: www.jm.com/#sle.
 - 5. MM Systems Corp: www.mmsystemscorp.com/#sle.
 - 6. Inpro Architectural Specialties; www.inprocorp.com.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.
- D. Louvered Vents:
 - 1. CopperCraft; ____: www.coppercraft.com/#sle.
 - 2. Vulcan Supply Corp; ____: www.vulcansupply.com/#sle.
- E. Pipe and Penetration Flashings:
 - 1. Portals Plus: www.portalsplus.com/#sle.
- F. Counterflashings:
 - 1. ATAS International, Inc: www.atas.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- G. Pipe Penetration Wall Seal:
 - 1. Airex Manufacturing, Inc; Airex Titan Outlet: www.airexmfg.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- H. Pipe Penetration Wall Seal and Insulation Protection System:
 - 1. Airex Manufacturing, Inc; Airex Pro-System Kit: www.airexmfg.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
 - 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
- B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
 - 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
- C. Pipe and Penetration Flashing: Base of galvanized steel, compatible with specified roof systems, and capable of accomodating pipes sized between 3/8 inch (9.5 mm) and 12 inch (305 mm).
 - 1. Caps: EPDM.
 - 2. Color: Manufacturer's standard or Contractor's options where concealed from view.
 - a. Architect to select from Manufacturer's full range of colors where exposed to view.

- D. Roof Penetration Sealing Systems: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- E. Pipe Penetration Wall Seal: Seal for HVAC piping wall penetrations with wall mounted rigid plastic outlet cover and elastomeric wall seal gasket.
 - 1. Outlet Cover Color: Match color of adjacent finish.
- F. Pipe Penetration Wall Seal and Insulated Piping Protection System: Seal for HVAC piping wall penetrations with wall mounted rigid plastic outlet cover and elastomeric wall seal gasket and having mechanical line insulation with PVC protective cover.
 - 1. Outlet Cover Color: Match color of adjacent finish.
 - 2. PVC Insulation Cover Color: Black with full-length velcro fastener.

2.03 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color to match adjacent roofing finish.
- B. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color to match adjacent roofing finish.

2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
- C. Roof Cement: ASTM D4586/D4586M, Type I.
 - 1. Unless otherwise required for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
 - 1. Refer to Section 07 7200 for information on roofing related accessories.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
- F. Coordinate installation of flashing flanges into reglets.

END OF SECTION

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SECTION 07 7200 ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Snow guards.

1.02 RELATED REQUIREMENTS

- A. Section 07 4113 - Metal Roof Panels.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.
- C. Section 07 7100 - Roof Specialties: Other manufactured roof items.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SNOW GUARDS

- A. Unit Snow Guards: Individual projecting polycarbonate shapes, attached between standing seams of roof panel, and mechanically fastened to roof deck.
- B. Fence Type Snow Guard: Continuous snow guard; manufacturer's standard dual pipe, bar, channel, or solid rod, set in brackets or posts, with optional plates and metal trim to match roof.
 - 1. Supplemental Plates and Clips: Attached to horizontal component; match finish of pipe, tube, rod, or channel.
 - 2. Clamps for Standing Seam Roof: Aluminum clamps attached to standing seams of roof panels; for attachment of fence type snow guard.
 - a. Seam Profile: Selected by Architect from manufacturer's standard range; match profile of metal roof.
 - 3. Manufacturers:
 - a. Sno Gem; Gem Clamp with MEC Bracket; www.snogem.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

- A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 8400 FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
- C. Penetration for all trades, including but not limited to fire protection, plumbing, mechanical and electrical.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.
- C. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2020.
- E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- G. ITS (DIR) - Directory of Listed Products; current edition.
- H. FM (AG) - FM Approval Guide; current edition.
- I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- K. UL (DIR) - Online Certifications Directory; Current Edition.
- L. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated, ASTM E119, and ASTM E814.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
1. Trained by manufacturer.
 2. Verification of minimum five years documented experience installing work of this type.

1.06 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
- B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
- C. If accepted, mock-up will represent minimum standard for the Work.
- D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Obtain penetration firestopping from single source or producer.
- C. For penetration firestopping, obtain each color, grade, finish, type, and variety from single source with resources to provide products of consistent quality in appearance and physical properties.
1. Use colors to match adjacent material color to the fullest extent possible, where allowed by local AHJ.
- D. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- E. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- F. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
 2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

- B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 - 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 - 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.03 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 07 9200 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 07 2500 - Weather Barriers: Sealants required on junction with Air / Moisture Barriers.
- C. Section 07 8400 - Firestopping: Firestopping sealants.
- D. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- E. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- D. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- E. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2019.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- I. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
- J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- L. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- M. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- N. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2015.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.
 5. Substrates for which use of primer is required.
 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 8. Sample product warranty.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
 - D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
 - E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
 - F. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 - a. Include name of adjacent material(s).
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.
 5. Provide drawing(s) or matrix to clearly indicate locations for each type of sealant. Identify sealants as part of this Section and where included in the Work of another Section.
 - G. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01 6116.
 - H. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
 - I. Installation Plan: Submit at least four weeks prior to start of installation.
 - J. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
 - K. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
 - L. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
 - M. Installation Log: Submit filled out log for each length or instance of sealant installed.
 - N. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
 - O. Manufacturer's Qualification Statement.
 - P. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience and approved by manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 1. Adhesion Testing: In accordance with ASTM C794.
 2. Compatibility Testing: In accordance with ASTM C1087.

3. Stain Testing: In accordance with ASTM C1248.
 4. Allow sufficient time for testing to avoid delaying the work.
 5. Deliver to manufacturer sufficient samples for testing.
 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- E. Installation Plan: Include schedule of sealed joints, including the following.
1. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 2. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.
 - c. Substrates.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Primer to be used, or indicate as "No primer" used.
 - g. Size and actual backing material used.
 - h. Date of installation.
 - i. Name of installer.
 - j. Actual joint width; provide space to indicate maximum and minimum width.
 - k. Actual joint depth to face of backing material at centerline of joint.
 - l. Air temperature.
- F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
 2. Name(s) of sealant manufacturers' field representatives who will be observing
 3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Test method used.
 - g. Date of installation of field sample to be tested.
 - h. Date of test.
 - i. Copy of test method documents.
 - j. Age of sealant upon date of testing.
 - k. Test results, modeled after the sample form in the test method document.
 - l. Indicate use of photographic record of test.
- G. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet (30 meters) in the first 1000 linear feet (305 linear meters), and one test per 1000 linear feet (305 meters) thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 linear feet (305 linear meters), continue testing at frequency of one test per 500 linear feet (152 linear meters) at no extra cost to

Owner.

4. Field testing agency's qualifications.
 5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- H. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
 2. Have a copy of the test method document available during tests.
 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
1. Record results on Field Quality Control Log.
 2. Repair failed portions of joints.
- J. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inch (457 mm) long.
 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
 4. Record results on Field Quality Control Log.
 5. Repair failed portions of joints.
- K. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 2. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 3. Pecora Corporation: www.pecora.com/#sle.
 4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 7. Substitutions: See Section 01 6000 - Product Requirements.

- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 2. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 3. Pecora Corporation: www.pecora.com/#sle.
 4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 5. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope: Extent of joint sealants are indicated on drawings.
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings.
 - 2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 3. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".
- F. Areas Where Tamper-Resistance is Required: As indicated on drawings.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.
- B. Colors: As indicated on drawings.

2.04 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 3. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 4. Color: Match adjacent finished surfaces.
 - a. Unless otherwise indicated.
- B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent finished surfaces.
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 - 1. Color: Match adjacent finish, unless otherwise indicated.
- D. Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
 - 1. Color: Match adjacent finish, unless otherwise indicated.
- E. Hybrid Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 20 to 40, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent finished surfaces.
- F. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 - 2. Color: Match adjacent finished surfaces.
- G. Tamper-Resistant Polyurethane Sealant: ASTM C920, Grade NS, Uses M, G, and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
 - 2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent finished surfaces.
- H. Epoxy Sealant: ASTM C881/C881M, Type I and III, Grade 3, Class B and C; two-component.
 - 1. Hardness Range: 65 to 75, Shore D, when tested in accordance with ASTM C661.
 - 2. Compressive Strength: 11,000 psi (76 MPa), when tested in accordance with ASTM D695.
 - 3. Color: Match adjacent finished surfaces.
- I. Acrylic-Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
 - 2. Hardness Range: 15 to 40, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent finish, unless otherwise indicated.
- J. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

1. Color: Match adjacent finish, unless otherwise indicated, Type OP (opaque).
2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).

2.05 SELF-LEVELING SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
 3. Color: Gray.
 - a. Unless otherwise indicated.
- B. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: Gray.
 - a. Unless otherwise indicated.
- C. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T, M and O; multi-component; explicitly approved by manufacturer for horizontal expansion joints.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: Gray.
 - a. Unless otherwise indicated.
 4. Tensile Strength: 200 to 250 psi (1.38 to 1.72 MPa) in accordance with ASTM D412.
- D. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: Gray.
 - a. Unless otherwise indicated.
- E. Self-Leveling Silyl-Terminated Polyether/Polyurethane (STPE/STPU) Sealant: ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus and minus 35 percent.
 2. Hardness Range: 30 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: Gray.
 - a. Unless otherwise indicated.
- F. Rigid Self-Leveling Polyurethane Joint Filler: Two part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.
 1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.
- G. Flexible Polyurethane Foam: Single-component, gun grade, and low-expanding.
 1. Color: White.
 - a. Unless otherwise indicated.
- H. High Quality Latex-Based Sound Sealant: ASTM C834, Type OP an opaque sealant, and Grade 0 Degrees C (32 Degrees F) meets requirements for low-temperature flexibility.
 1. Color: White.
 - a. Unless otherwise indicated.
- I. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support

concrete edges under traffic.

1. Composition: Multi-component, 100 percent solids by weight.
 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 3. Color: Concrete gray.
 4. Joint Width, Minimum: 1/8 inch (3 mm).
 5. Joint Width, Maximum: 1/4 inch (6 mm).
- J. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
 2. Color: Concrete gray.
 3. Joint Width, Minimum: 1/8 inch (3 mm).
 4. Joint Width, Maximum: 3/4 inch (19 mm).

2.06 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Overlay Extrusion for Glazing System Joint Protection: Rubber profiled extrusions placed over joints in glazing system and provided with watertight seal.
1. Profile: As required to match existing metal glazing cap requirements.
 2. Color: As required to match existing conditions.
- C. Preformed Extruded Silicone Joint Seal: Pre-cured low-modulus silicone extrusion, in sizes to fit applications indicated on drawings, combined with a neutral-curing liquid silicone sealant for bonding joint seal to substrates.
1. Size: 1 inch (25.4 mm) wide, in rolls 100 feet (30.5 m) long.
 - a. Unless otherwise indicated or required.
 2. Thickness: 0.78 inch (19.8 mm), with ridges along outside bottom edges for bonding area.
 3. Color: As selected by Architect..
- D. Preformed Extruded Polyurethane Joint Seal: Medium-modulus, preformed polyurethane extrusion used to bridge joints under elastomeric wall coatings, in sizes to fit applications indicated on drawings, combined with polyurethane sealant for bonding joint seal to substrates.
1. Size: 1-1/2 inch (38 mm) wide, in rolls 100 feet (30.5 m) long.
 - a. Unless otherwise indicated or required.
 2. Thickness: 0.051 inch (1.3 mm), with ridges along outside bottom edges for bonding area.
 3. Color: Light gray.
 - a. Unless otherwise indicated or required.
- E. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- F. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- G. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- H. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
 - 3. Arrange for sealant manufacturer's technical representative to be present during tests.
 - 4. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet (30 linear m), notify Architect immediately.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet (300 linear m), notify Architect immediately.

- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with thermal break frames.
- E. Tornado-resistant hollow metal doors and frames.
- F. Hollow metal borrowed lites glazing frames.
- G. Accessories, including glazing, louvers, matching panels, and as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9113 - Exterior Painting: Field painting.
- D. Section 09 9123 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SDI: Steel Door Institute.
- G. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2015.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

- J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- K. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames; 2016.
- L. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms; 2021.
- M. FLA (PAD) - Florida Building Code Online - Product Approval Directory; Current Edition.
- N. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; National Storm Shelter Association; 2014.
- O. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- P. ITS (DIR) - Directory of Listed Products; current edition.
- Q. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.
- R. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- S. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- T. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.
- U. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- V. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- W. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- X. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- Y. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- Z. UL (DIR) - Online Certifications Directory; Current Edition.
- AA. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- BB. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- CC. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
 - 1. Show thermal break frames on Shop Drawings.
 - 2. Include the following for all types:
 - a. Elevations of each door design.
 - b. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - c. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - d. Locations of reinforcement and preparations for hardware.
 - e. Details of anchorages, joints, field splices, and connections.
 - f. Details of accessories.
 - g. Details of moldings, removable stops, and glazing.
 - h. Details of conduit and preparations for power, signal, and control systems.
 - i. Show proposed field splice locations when shipping limitations dictate large openings need to be fabricated in sections.

- D. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- E. Door schedule indicating door and frame location, type, size and swing.
 - 1. Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.
- F. Samples: Submit two samples of metal, 2 inch by 2 inch in size (50 mm by 50 mm in size) showing factory finishes, colors, and surface texture.
- G. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- H. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: www.steeldoor.org/sdicertified.php/#sle.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.
- D. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40 inches above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- F. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- G. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.
 - 1. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.37, R-Value 2.7, including insulated door, thermal-break frame and threshold.
 - 2. Unless more stringent requirements are indicated on drawings or required by code.
- H. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
 - 1. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).
 - 2. Unless more stringent requirements are indicated on drawings.

- I. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
 - 1. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- C. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- D. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.09 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
- B. Subject to compliance with requirements, available SDI certified manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 2. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Hinged edge square, and lock edge beveled.
 - 5. Typical Door Face Sheets: Flush.

6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush, square, low-profile .
 - a. Glazing Stop Fasteners: Pre-finished. Design intent is to match specified frame paint color. Style: Flush.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
 - e. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam.
 - f. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 - 1) Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - g. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4 inch by 9 inch.
 - h. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 - i. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 2. Door Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density Polyisocyanurate, 2 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - b. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
 - c. NAUF.
 - d. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5 inches on center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
 3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate.
 4. Door Thickness: 1-3/4 inch (44.5 mm), nominal.

5. Weatherstripping: Refer to Section 08 7100.
 6. Weep Holes: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
- C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch (1.0 mm), minimum.
 - e. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 - f. Hinge Reinforcement: Minimum 7 gauge (3/16 inch) plate 1-1/4 inch by 9 inch or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - g. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - a. NAUF.
 3. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
- D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch (1.0 mm) 18 gage, 0.042 inch (1.0 mm), minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 5. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
 - a. Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 - b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 - c. Label: Include the "S" label on fire-rating label of door.
 6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 - a. NAUF.
 7. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
- E. Tornado-Resistant Doors:
1. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
 - a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
 - b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval, Miami (APD) approval, or UL (DIR) approval for Large and Small Missile impact and pressure cycling at design wind loads.
 2. Tornado Shelter Application: Comply with ICC 500 standard.

- a. Commercial: Designed and tested to comply with FEMA P-361 community shelter door assembly guidelines.
- 3. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: Gauges to be in accordance with manufacturers tested assemblies.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 - 2. Frame Metal Thickness: 14 gage, 0.067 inch (1.7 mm), minimum.
 - 3. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 4. Weatherstripping: Integral, recessed into frame edge.
 - 5. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16 inch positive thermal break and integral vinyl weatherstripping.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
 - 2. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
 - 1. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
 - 2. Fire Rating: Same as door, labeled.
 - 3. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
- F. Tornado-Resistant Door Frames: With same tornado resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
 - 1. Provide complete tornado or hurricane resistant door and frame assemblies, for both single doors and paired openings, tested and labeled as complying with ICC 500 - 2014 and FEMA P-361 (2015) and supported by third party test results.
- G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- H. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.
- I. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
 - 1. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
 - a. Provide flush, countersunk fasteners. Fastener finish to match specified frame paint colors, as indicated on drawings. Provide security screws at exterior locations.
 - 2. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are

- installed.
3. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
 4. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.
- J. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
1. Profile: Same as jamb and head.
- K. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
1. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.
- L. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.
1. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
- M. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
- N. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
1. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.06 ACCESSORIES

- A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

- 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick. Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - C. Storm Shelter Openings: Provide jamb, head, and sill anchors in accordance with manufacturer's tested and approved assemblies.
 - D. Louvers: Roll formed steel with concealed frame; finish same as door components ; factory-installed.
 1. Blade Type: Vision proof inverted V or inverted Y.
 - a. Locations as indicated on drawings.
 - 1) In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
 - 2) Fasteners: Concealed fasteners.
 - E. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 - F. Glazing: As specified in Section 08 8000, factory installed.
 - G. Removable Stops: Formed sheet steel, Flush, low-profile , mitered corners; prepared for countersink style tamper proof screws.
 - H. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
 1. UL listed products in compliance with requirements of authorities having jurisdiction.
 2. Provide recessed astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 3. Astragal Type: Split, two parts, and with automatic locking, cutouts for other door hardware, horizontal adjustment option, sealing gasket, snap cover to hide fasteners, and thermal break.
 4. Edge Type: Beveled edge
 5. Material: Manufacturers standard.
 6. Metal Finish: Match door color, powder coat.
 7. Provide non-corroding fasteners at exterior locations.
 8. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - I. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
 - J. Grout for Frames: Portland cement grout with maximum 4 inch (102 mm) slump for hand troweling; thinner pumpable grout is prohibited.
 - K. Silencers: Resilient rubber or vinyl, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
 1. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 - L. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
 - M. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

- N. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.
- D. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- E. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
- B. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- C. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch (1.6 mm).
- D. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- E. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- F. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- G. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
 - 1. Do not grout thermal frames, unless otherwise recommended by manufacturer.
- E. Install door hardware as specified in Section 08 7100.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- F. Comply with glazing installation requirements of Section 08 8000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING AND CLEANING

- A. Adjust for smooth and balanced door movement.
- B. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- C. Remove grout and other bonding material from hollow metal work immediately after installation.
- D. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

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**SECTION 08 1416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, and special function.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 08 1113 - Hollow Metal Doors and Frames.
- C. Section 08 7100 - Door Hardware.
- D. Section 08 8000 - Glazing.
- E. Section 09 9123 - Interior Painting: Field finishing of door trim / glass stops.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. AWI (QCP) - Quality Certification Program; Current Edition.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
 - 1. Include statement of compliance with NAUF (no added urea formaldehyde) requirement.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Door schedule indicating door location, type, size and swing.
 - 1. Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.
 - a. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS)
- E. Samples: Submit two samples of Plastic Laminate door facing, 8 inch by 10 inch in size for each specified color and texture.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Manufacturer's Installation Instructions: Indicate special installation instructions.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Specimen warranty.

- K. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than ten years of documented experience.
 - 1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than five years of documented experience.
- C. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. High Pressure Decorative Laminate (HPDL) Faced Doors:
 - 1. Ampco Products, Inc: www.ampco.com/#sle.
 - 2. Oregon Door: www.oregondoor.com/#sle.
 - 3. Poncraft Door Co: www.poncraft.com/#sle.
 - 4. VT Industries, Inc: www.vtindustries.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
 - 2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
 - 3. Where plastic laminate (PLAM) is indicated on door schedule, use high pressure decorative laminate (HPDL) faced doors in compliance with AWI/AWMAC/WI (AWS),

AWMAC/WI (NAAWS)

- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch wg (24.9 Pa) pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.
 - 4. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide flush wood door assemblies in compliance with WDMA I.S. 1A requirements for "S" label; no additional gasketing or edge sealing allowed.
 - 5. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
 - 1. Containing NAUF (no added urea formaldehyde).
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; color(s) as indicated; textured, low gloss finish.
 - 1. Containing NAUF (no added urea formaldehyde).
- B. Cross Banding Behind High Pressure Laminate Finish: 1 ply; of HDF material.
- C. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge, top of door for closer, and where required for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- G. Provide edge clearances in accordance with the quality standard specified.

2.06 ACCESSORIES

- A. Hollow Metal Door Frames: As specified in Section 08 1113.
- B. Glazing: As specified in Section 08 8000.
- C. Glazing Stops: Wood, to match HPDL door facing, mitered corners; prepared for countersink style tamper proof screws.
 - 1. Flush wood stops.

2. Concealed fasteners. Provide filler to match stops where required.
 3. Stain wood to match door finish.
- D. Door Hardware: As specified in Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

**SECTION 08 3323
OVERHEAD COILING DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead coiling doors, operating hardware, non-fire-rated and exterior; electrically operated.
- B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 7100 - Door Hardware: Cylinder cores and keys.
- C. Division 26 - Electrical: Power, conduit and wiring.
- D. Section 26 0583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. ITS (DIR) - Directory of Listed Products; current edition.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- H. NEMA MG 1 - Motors and Generators; 2018.
- I. UL (DIR) - Online Certifications Directory; Current Edition.
- J. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, component connections and details, and information related to application.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
 - 1. Show project specific details and interface with adjacent work.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- E. Installer's Qualification Statement.
- F. Maintenance Data: Include lubrication requirements and frequency, periodic adjustments required and other recommendations.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years documented experience and approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide lifetime manufacturer limited warranty for counterweights and tension springs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Alpine Overhead Doors, Inc: www.alpinedoors.com/#sle.
 - a. Basis-of-Design: IMB-V5.
 - 2. C.H.I. Overhead Doors: www.chiohd.com/#sle.
 - 3. Clopay Building Products; Model CERD20: www.clopaydoor.com/#sle.
 - 4. Overhaddoor: www.overhaddoor.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COILING DOORS

- A. Exterior Coiling Doors: Steel slat curtain.
 - 1. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1 (RSI-value of 1.43).
 - 2. Nominal Slat Size: 2 inches (50 mm) wide by required length.
 - 3. Finish: Factory painted, color as selected.
 - 4. Hood Enclosure: Manufacturer's standard; primed steel.
 - 5. Electric operation.
 - 6. Mounting: Surface mounted.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 - 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 - 2. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 - 3. Weatherstripping for Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of all doors.
 - 4. Steel Slats: Minimum thickness, 22 gauge; ASTM A653/A653M galvanized steel sheet.
- B. Sliding Door Construction: Manufacturer's standard insulated panels for door type and model selected.
 - 1. Perimeter Seals: Manufacturer's standard flexible and abrasion-resistant polyurethane extrusions.
- C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
 - 1. Prime paint.
- E. Lock Hardware:
 - 1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 08 7100.
 - 2. For motor operated units, additional lock or latching mechanisms are not required.

2.04 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 - 1. Provide interlock switches on motor operated units.

2. Provide tamperproof operation cycle counter.
- B. Electric Operators:
 1. Mounting: Side mounted.
 2. Motor Enclosure:
 - a. Interior Coiling Doors: NEMA MG 1, Type 1; open drip proof.
 3. Motor Rating: 1 HP (750 W); continuous duty.
 - a. Unless otherwise indicated on electrical drawings or required for application.
 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - a. Unless otherwise indicated on electrical drawings or required for application.
 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 6. Controller Enclosure: NEMA 250, Type 4.
 7. Opening Speed: 12 inches per second (300 mm/sec).
 8. Brake: Manufacturer's standard type, activated by motor controller.
 9. Manual override in case of power failure.
 10. Refer to Section 26 0583 for electrical connections.
- C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
 1. 24 volt circuit.
 2. Surface mounted, at interior door jamb.
 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
- D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 26 0583.
- F. Complete wiring from disconnect to unit components.
- G. Install enclosure and perimeter trim.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).
- C. Maximum Variation From Level: 1/16 inch (1.6 mm).
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet (3.2 mm per 3 m) straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of metal and glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Steel attachment members.
- B. Section 05 5000 - Metal Fabrications: Steel attachment devices.
- C. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- D. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- E. Section 08 8000 - Glazing: Glass and glazing accessories.
- F. Division 12 - Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- M. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- O. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- P. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

- Q. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
- R. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
 - 1. VOC Content: For sealants used inside of the weatherproofing system, include printed statement of VOC content.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Show connection to and continuity with adjacent thermal, weather, and air barriers.
 - 2. Include point-to-point wiring diagrams.
 - 3. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
 - 4. Include details of conduit and preparations for power, signal, and control systems.
 - 5. Include glass manufacturer's documentation of review and approval of glass application and installation configuration.
 - 6. Include sealant color on shop drawings for each location.
 - 7. Include flashing and drip ledge colors, where exposed to view.
 - 8. Provide sealant manufacturer's documentation of review and approval of structural and typical sealant joint sizing and application. Provide sealant manufacturer's report of material compatibility and adhesion.
 - 9. Use same frame designations and naming as indicated on drawings.
- D. Manufacturer's Installation Instructions: Provide installation instructions specific to the components and conditions on this project. Provide manufacture's re-glaze instructions.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Designer's Qualification Statement.
- J. Manufacturer's Qualification Statement.
- K. Installer's Qualification Statement.
- L. Engineer's Qualification Statement.
- M. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least twenty years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum framed storefront system and are based on the specific system indicated. Do not modify size and dimensional requirements.
- F. Design Criteria: Drawings indicate sizes, spacing of members, profiles and dimensional requirements of entrance and storefront work. Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Minor deviations will be acceptable in order to utilize manufacturer's standard products when such deviations do not materially detract from the design concept of intended performances.
 - 1. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
 - 2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's written review and acceptance.
- G. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- H. Pre-installation Conference: Approximately two weeks prior to scheduled commencement of storefront installation, meet at project site with Installer, installers of substrate construction to receive work, installers of other work in and around storefront work which must precede, follow or interact with storefront work, Contractor and storefront manufacturer's representative. Review methods and procedures related to work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 SOURCE LIMITATION

- A. Obtain aluminum-framed entrances from a single source or producer.

2.02 SYSTEM REQUIREMENTS

- A. Design Requirements:
 - 1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage, or moisture disposal.
 - 2. Requirements shown by details are intended to establish basic dimension of units, sight

- lines and profiles of members.
- 3. Provide concealed fastening.
- 4. Provide entrance systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
- 5. Attachment considerations are to take into account project peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
- 6. Provide for expansion and contraction due to structural movement without detriment to appearance or performance.
- 7. Provide framed systems to fit within openings provided without the use of excessive sealant joints.

2.03 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Front-Set Style, Thermally-Broken:
 - 1. Basis of Design: Kawneer:
 - a. Trifab Versaglaze 450.
 - b. Trifab 451T.
 - 2. Oldcastle Building Envelope:
 - a. Series 3000 Thermal MultiPlane.
 - b. Series 6000 Thermal MultiPlane.
 - 3. Manko Window Systems Inc.; www.mankowindows.com.
 - a. Manko 2450FS.
 - b. Manko 2600xpt.
 - 4. Interior locations to match exterior frame profiles and sight lines. Thermally-Broken frames not required at interior locations.
- B. Substitutions: See Section 01 6000 - Product Requirements.
 - 1. For any product not identified, submit information as specified for substitutions.

2.04 BASIS OF DESIGN -- SWINGING DOORS

- A. Wide Stile, Insulating Glazing, Thermally-Broken:
 - 1. Thermally-Broken doors are required at all exterior locations.
 - a. Basis of Design: Kawneer.
 - 1) 500T Insulpour Thermal Entrance.
 - b. Oldcastle Building Envelope.
 - 1) WS-500 TC Thermal Composite Door and Frame.
 - c. Manko Window Systems Inc.; www.mankowindows.com.
 - 1) Manko 150xpt.
 - d. Interior locations to match exterior door style and configuration. Thermally-Broken frames not required at interior locations.
- B. Substitutions: See Section 01 6000 - Product Requirements.
 - 1. For any product not identified, submit information as specified for substitutions.

2.05 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Unitized, shop assembly.
 - a. 1 inch insulated glazing at exterior locations.
 - 2. Glazing Rabbet: For 1/4 inch (6 mm) monolithic glazing.
 - a. At interior locations.
 - 1) Unless otherwise indicated.
 - 3. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 4. Finish Color: Dark Bronze.

- a. Unless otherwise indicated on drawings.
 - 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - a. Excessive sealant joints are not allowed.
 - 11. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
 - 12. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
 - a. Where required for window shades.
- B. Performance Requirements:
- 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: As indicated on drawings.
 - b. Other Design Loads: As indicated on drawings.
 - c. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 - 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf (480 Pa).
 - 3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.
 - 4. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
 - 5. Overall Maximum U-Value Including Glazing. Comply with IECC 2018, Table C402.4, Climate Zone 3:
 - a. Fixed Fenestration: U-0.46 Maximum.
 - b. Operable Fenestration: U-0.60 Maximum.
 - c. Entrance Doors: U-0.77 Maximum.
 - d. Unless more stringent conditions are required by local AHJ or specified elsewhere.
 - 6. Sub-sill: Full height sub-sill, to match specified mullion sight line. Partial height sub-sills are not allowed.
 - a. Anchoring through the back of the sub-sill is not allowed.

2.06 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
 - 3. Cross-Section: As indicated on drawings.

4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - a. Provide reinforcing as required for application.
- B. Glazing: As specified in Section 08 8000.
- C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
 1. Core: Rigid polyisocyanurate foam insulation core with LTTR-Value of 5 per inch, minimum.
 2. Provide additional infill insulation where indicated on drawings.
 3. Finish: Same as storefront.
 - a. Smooth finish. Textured panels are not allowed.
- D. Swing Doors: Glazed aluminum.
 1. Thickness: 2-1/4 inches (57.1 mm).
 - a. Exterior Thermal Doors.
 2. Thickness: 2 inches (50 mm).
 - a. Interior Doors.
 3. Top Rail: 4 inches (100 mm) wide, minimum.
 - a. Provide 8 inch top rail where door closer exceeds manufacturer's standard top rail. Seams are allowed.
 4. Vertical Stiles: 4 inches (100 mm) wide, minimum.
 5. Bottom Rail: 12 inches (304 mm) wide.
 - a. One-piece, seamless.
 6. Glazing Stops: Extruded Aluminum; Square.
 7. Finish: Same as storefront.
 8. Door Jambs: Tubular.
 9. Frames: Fabricate with mechanical joints using internal steel reinforcing plates, shear blocked and fastened as recommended by manufacturer for application.
 - a. Spline Screws: #10, minimum.
 - 1) Unless more stringent sizes are recommended by manufacturer for application.

2.07 SHOP FABRICATE TO THE GREATEST EXTENT POSSIBLE; DISASSEMBLE IF NECESSARY FOR SHIPPING.

2.08 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Structural Supporting Anchors: See Section 05 1200.
- E. Structural Supporting Anchors Attached to Structural Steel: Design for welded attachment.
- F. Fasteners: Stainless steel.
- G. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
 1. Material thickness shall be as required, suitable to condition, without deflection or "oil-canning".
- H. Concealed Flashings: Galvanized steel, 26 gage, 0.0179 inch (0.45 mm) minimum base metal thickness.
- I. Concealed Flashings: Stainless steel, 26 gage, 0.0187 inch (0.48 mm) minimum thickness.
- J. Concealed Flashings: Sheet aluminum, 26 gage, 0.017 inch (0.43 mm) minimum thickness.
- K. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- L. Sealant for Setting Thresholds: Non-curing butyl type.

- M. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- N. Glazing Accessories: As specified in Section 08 8000.
- O. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- P. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.09 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: Dark bronze.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.10 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, threshold, and as indicated or required for project.
- B. Other Door Hardware: As specified in Section 08 7100.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, non-slip surface; provide on all exterior doors and where required by floor finish transitions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Provide foamed in place insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in continuous bed of sealant and secure.
- J. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

1. Unless more stringent conditions are recommended by manufacturer for application.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 4000 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 1. Perform a minimum of three tests in each designated area as directed by Architect.
 2. Conduct tests in each area prior to 10 percent, 35 percent, 50 percent, and 70 percent completion of this work.
 - a. Unless otherwise recommended by manufacturer for project.
- D. Provide field testing of installed storefront system by AAMA accredited independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 1. Perform a minimum of three tests in each designated area as indicated on drawings.
 2. Conduct tests in each area prior to 35 percent, 50 percent, and 70 percent completion of this work.
 - a. Unless otherwise recommended by manufacturer for project.
 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf (200 Pa).
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.20 psf (300 Pa).
- E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 7100 DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
- 4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
- 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
 - 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 - 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
- b. Catalog pages for each product.
- c. Final approved hardware schedule edited to reflect conditions as installed.
- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

- 1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

- 1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
- 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
- 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
- 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

- 1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage ND Series: 10 years
 - b) Falcon: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - 4) Automatic Operators
 - a) LCN: 2 years
 - b. Electrical Warranty
 - 1) Locks
 - a) Schlage: 3 years
 - 2) Exit Devices
 - a) Von Duprin: 3 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. No Substitute
 - b. Hager BB1191/1279 series
 - c. McKinney TB series
 - d. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin EPT-10

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
 - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.

- b. Lever Design: RHO

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.

2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage Everest 29 SL
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Restricted 7-Pin: cylinder with permanent 7-pin core with keys capable of working in full size key-in-lever/knob, and small format interchangeable core.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.12 KEYING

A. Scheduled System:

1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
 - 1) Telephone:

B. Requirements:

1. Construction Keying:
 - a. Temporary Construction Cylinder Keying.
 - 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
 - a) Split Key or Lost Ball Construction Keying System.
 - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
 - c) 12 construction change (day) keys.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Telkee
2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Zero International

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Schlage

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.22 FINISHES

A. Finish: BHMA 643e/716 (US11); except:

1. Door Closers: Powder Coat to Match.
2. Weatherstripping: Dark Bronze Anodized Aluminum.
3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
 2. Connections to and from power supplies to electrified hardware.
 3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Connections to panel interface modules, controllers, and gateways.
 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

109414 OPT0371682 Version 3

HARDWARE GROUP NO. 002

126.2 126.3 127B

Provide each SGL door(s) with the following:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
EA	BALANCE OF HARDWARE BY DR MF			

HARDWARE GROUP NO. 103

105	126.4	128	134A	135	136
137	138	139			

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD RHO (VERIFY CORE SYSTEM. VERIFY KEY SYSTEM.)	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 103SH

113A	113B	117A	117B	144A	144B
149A	149A	149B	149B	154A	154B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD RHO (VERIFY CORE SYSTEM. VERIFY KEY SYSTEM.)	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	OH STOP	90S SERIES X SIZE & MTG AS REQ	613	GLY
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 201

104	121.3	121.4	131A	132	140
156.1					

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 201C

130 156.2

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	641	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 203S

112.1 114.1 116.1 118.1 143.1 145.1
148.1 150.1 153.1 155.1

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	OH STOP	90S SERIES X SIZE & MTG AS REQ	613	GLY
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	FINGER GUARD	Safe Guard Length as Req.		

HARDWARE GROUP NO. 301G

110 121.2 129 156.3 156.4

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PRIVACY LOCK	ND40S RHO	643e	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
2	EA	GASKETING	488S PSA H & J (PROVIDE A DOUBLE ROW)	BK	ZER
1	EA	DOOR BOTTOM	355A	AA	ZER
1	EA	THRESHOLD	164A (OMIT @ NON-CARPETED LOCATIONS)	A	ZER

HARDWARE GROUP NO. 301GSH

121.1

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PRIVACY LOCK	ND40S RHO	643e	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
2	EA	GASKETING	488S PSA H & J (PROVIDE A DOUBLE ROW)	BK	ZER
1	EA	DOOR BOTTOM	355A	AA	ZER
1	EA	THRESHOLD	164A (OMIT @ NON-CARPETED LOCATIONS)	A	ZER

HARDWARE GROUP NO. 307G

111.1

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PRIVACY LOCK	ND40S RHO	643e	SCH
1	EA	OH STOP	90S SERIES X SIZE & MTG AS REQ	613	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
2	EA	GASKETING	488S PSA H & J (PROVIDE A DOUBLE ROW)	BK	ZER
1	EA	DOOR BOTTOM	355A	AA	ZER
1	EA	THRESHOLD	164A (OMIT @ NON-CARPETED LOCATIONS)	A	ZER

HARDWARE GROUP NO. 341G

122 124

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	643e	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
2	EA	GASKETING	488S PSA H & J (PROVIDE A DOUBLE ROW)	BK	ZER
1	EA	DOOR BOTTOM	355A	AA	ZER
1	EA	THRESHOLD	164A (OMIT @ NON-CARPETED LOCATIONS)	A	ZER

HARDWARE GROUP NO. 401C

123

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PASSAGE SET	ND10S RHO	643e	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 407

126.1

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	PASSAGE SET	ND10S RHO	643e	SCH
1	EA	OH STOP	90S SERIES X SIZE & MTG AS REQ	613	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 501

106 111 153A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 501C

126A 126B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HARDWARE GROUP NO. 501S

112A	112A	114A	114A	116A	116A
118A	118A	143A	143A	145A	145A
148A	148A	150A	150A	153A	155A
155A					

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	FINGER GUARD	Safe Guard Length as Req.		

HARDWARE GROUP NO. 503

107	133
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Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 700ACM

115 119 142 147 152

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
2	EA	PANIC HARDWARE	33A-L-06 LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
3	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR		

HARDWARE GROUP NO. 700CM

127A

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	641	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
2	EA	PANIC HARDWARE	99-L-06 LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
3	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
2	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 714AM

101A 101A 101B 101B

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
1	EA	PANIC HARDWARE	33A-EO LENGTH AS REQ	643E	VON
1	EA	PANIC HARDWARE	33A-NL-OP LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR		
2	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER
	EA	DOOR BELL	SUPPLIED BY SECURITY CONTRACTOR		

HARDWARE GROUP NO. 714M

131B

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	F643E/ 716	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
1	EA	PANIC HARDWARE	99-DT LENGTH AS REQ	710	VON
1	EA	PANIC HARDWARE	99-NL LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER

HARDWARE GROUP NO. 715

127C

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	F643E/ 716	IVE
1	EA	PANIC HARDWARE	99-NL LENGTH AS REQ	643E	VON
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER

HARDWARE GROUP NO. 715A

126C

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	33A-NL-OP LENGTH AS REQ	643E	VON
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER

HARDWARE GROUP NO. 801C

108

109

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	641	IVE
1	EA	PUSH PLATE	8200 4" X 16"	695	IVE
1	EA	PULL PLATE	8303 10" 4" X 16" F	695	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. AC710AM

102A

102B

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-EO-CON LENGTH AS REQ	710	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
1	EA	AUTO OPERATOR	AUTO OPERATOR BY RELATED SECTION		
1	EA	ACTUATOR	ACTUATOR(S) BY RELATED SECTION		
2	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR		
2	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		
	EA	DOOR BELL	SUPPLIED BY SECURITY CONTRACTOR		

- INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.
- FREE EGRESS BY THE ACTUATOR OR THE PUSH PAD.
- THE ELECTRIFIED LATCH BOLTS WILL BE SEQUENCED WITH THE AUTOMATIC OPENER AND RETRACT PRIOR TO THE AUTOMATIC OPENER ACTIVATING.
- COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.
- OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. C201

001 003A 103 134B 134C 141

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	HINGE	5BB1 4.5 X 4.5	641	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	641	IVE
1	EA	EU STOREROOM LOCK	ND80HDEU RHO CON 12V/24V DC	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
2	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY LEVER.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. C201A

003B 102C 102C 102D 102D

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU STOREROOM LOCK	ND80HDEU RHO CON 12V/24V DC	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	695	LCN
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		

- INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.
- FREE EGRESS BY LEVER.
- VERIFY ALUMINUM DOOR IS WIDE STILE.
- 5" STILE IS REQUIRED FOR THE SPECIFIED HARDWARE, COORDINATE WITH DOOR MFR./SUPPLIER.
- COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.
- OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. C710ACM

002B

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-EO-CON LENGTH AS REQ	710	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR		
2	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PADS.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. C714AM

002A 002A 004A 004B

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	622	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-EO-CON LENGTH AS REQ	710	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON LENGTH AS REQ	643E	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR		
2	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER
2	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PADS.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. C715A

112B	114B	116B	118B	143B	145B
148B	150B	153B	155B		

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON LENGTH AS REQ	643E	VON
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	90 DEG OFFSET PULL	8190-O 10"	695	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	RAIN DRIP	142AA DW + 4"	D	ZER
		(OMIT @ COVERED OPENINGS)			
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		
1	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER
2	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY DIV 28		

- INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.
- FREE EGRESS BY THE PUSH PAD.
- COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.
- OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. D204

120 146 151

Provide each PR door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	F643E/ 716	IVE
1	EA	AUTO FLUSH BOLT	FB31P/FB41P AS REQ	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	COORDINATOR	COR X FL X MB X HW PREPS	628	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	695	IVE
1	EA	RAIN DRIP	142AA DW + 4"	D	ZER
			(OMIT @ COVERED OPENINGS)		
1	SET	GASKETING	328AA H & J	D	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)	D	ZER
2	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER
2	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE

HARDWARE GROUP NO. D205

120A 120B 146A 146B 151A 151B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	F643E/ 716	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	643e	SCH
1	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	695	IVE
1	EA	RAIN DRIP	142AA DW + 4"	AA	ZER
			(OMIT @ COVERED OPENINGS)		
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	65A	A	ZER

HARDWARE GROUP NO. T751R

102E 102F 121A 156A 156B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	641	IVE
1	EA	FIRE EXIT HARDWARE	WS-T-9957-L-BE-F-06-2SI-377T-KC-SNB LENGTH & HEIGHT AS REQ	643E	VON
1	EA	ROD AND LATCH GUARD	WS-LGO LENGTH AS REQ	630	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT 1 3/4"	695	LCN
1	EA	WALL STOP	WS406/407CCV	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER

-FOR USE WITH STEELCRAFT PALADIN DOOR ASSEMBLY.

-MEETS ICC 500-2020 AND FEMA 320/361.

-MAXIMUM DOOR SIZE 4'0 X 8'0 (SINGLE) AND 8'0 X 8'0 (PAIR).

-IF ANOTHER DOOR MFR. IS USED CONSULT WITH THEM FOR APPROVED HARDWARE, DOORS AND HARDWARE ARE SOLD AS A COMPLETE TESTED ASSEMBLY.

-GC TO PROVIDE SIGNAGE THAT MEETS ICC 500-2020 REQUIREMENTS, AS NEEDED.

-2SI "UNLOCKED":

-OUTSIDE LEVER IS ACTIVE WHEN -2SI IS SET TO "UNLOCKED" STATE.

-INGRESS BY OUTSIDE LEVER.

-FREE EGRESS BY THE PUSH PAD.

-2SI "LOCKED":

-OUTSIDE LEVER IS RIGID WHEN -2SI IS SET TO "LOCKED" STATE.

-THUMBTURN IS RIGID.

-INGRESS BY KEY OVERRIDE.

-TURN KEY TO ACTIVATE CYLINDER CONTROL.

-ROTATE CYLINDER CONTROL THUMBTURN TO RETRACT LATCHBOLTS.

-PULL RIGID LEVER TO OPEN DOOR.

-CANNOT REMOVE KEY IN 377T-KC (KEY CAPTURE) CYLINDER CONTROL WHILE ACTIVATED.

-FREE EGRESS BY THE PUSH PAD.

HARDWARE GROUP NO. TC785R

121B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	F643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-ESL-WS-T-9957-L-KC-06- CON-SNB LENGTH & HEIGHT AS REQ	643E	VON
1	EA	ROD AND LATCH GUARD	WS-LGO LENGTH AS REQ	630	VON
1	EA	SFIC MORTISE CYL.	80-132 W/ KEYED CONST CORE	613	SCH
1	EA	SFIC RIM CYLINDER	80-159 W/ KEYED CONST CORE	613	SCH
2	EA	SFIC EVEREST CORE	SFIC EVEREST 29SL.	613	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC	695	LCN
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	8198AA	D	ZER
1	EA	THRESHOLD	656A (COORDINATE WITH SILL DETAIL)	A	ZER
1	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC (OMIT 2RS BOARD WHERE NOT REQ)		VON

-FOR USE WITH STEELCRAFT PALADIN DOOR ASSEMBLY.

-MEETS ICC 500-2020 AND FEMA 320/361.

-MAXIMUM DOOR SIZE 4'0 X 8'0 (SINGLE) AND 8'0 X 8'0 (PAIR).

-IF ANOTHER DOOR MFR. IS USED CONSULT WITH THEM FOR APPROVED HARDWARE, DOORS
AND HARDWARE ARE SOLD AS A COMPLETE TESTED ASSEMBLY.

-GC TO PROVIDE SIGNAGE THAT MEETS ICC 500-2020 REQUIREMENTS, AS NEEDED.

-INGRESS BY CREDENTIAL READER OR KEY OVERRIDE.

-CREDENTIAL READER IS DISABLED WHEN ESL IS SET TO "LOCKED" STATE. EMERGENCY KEY
OVERRIDE BY L-KC (KEY CAPTURE).

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

END OF SECTION

109414 OPT0371682

V3 8/8/2024 vs. V3 8/8/2024

Legend:

✂ Electrified Opening

Door#	HwSet#
001 ✂	C201
002A ✂	C714AM
002A ✂	C714AM
002B ✂	C710ACM
003A ✂	C201
003B ✂	C201A
004A ✂	C714AM
004B ✂	C714AM
101A	714AM
101A	714AM
101B	714AM
101B	714AM
102A ✂	AC710AM
102B ✂	AC710AM
102C ✂	C201A
102C ✂	C201A
102D ✂	C201A
102D ✂	C201A
102E	T751R
102F	T751R
103 ✂	C201
104	201
105	103
106	501
107	503
108	801C
109	801C
110	301G
111	501
111.1	307G
112.1	203S
112A	501S
112A	501S
112B ✂	C715A
113A	103SH
113B	103SH
114.1	203S
114A	501S
114A	501S
114B ✂	C715A
115	700ACM

Door#	HwSet#
116.1	203S
116A	501S
116A	501S
116B ✂	C715A
117A	103SH
117B	103SH
118.1	203S
118A	501S
118A	501S
118B ✂	C715A
119	700ACM
120 ✂	D204
120A	D205
120B	D205
121.1	301GSH
121.2	301G
121.3	201
121.4	201
121A	T751R
121B ✂	TC785R
122	341G
123	401C
124	341G
126.1	407
126.2	002
126.3	002
126.4	103
126A	501C
126B	501C
126C	715A
127A	700CM
127B	002
127C	715
128	103
129	301G
130	201C
131A	201
131B	714M
132	201
133	503
134A	103

Door#	HwSet#
134B ✂	C201
134C ✂	C201
135	103
136	103
137	103
138	103
139	103
140	201
141 ✂	C201
142	700ACM
143.1	203S
143A	501S
143A	501S
143B ✂	C715A
144A	103SH
144B	103SH
145.1	203S
145A	501S
145A	501S
145B ✂	C715A
146 ✂	D204
146A	D205
146B	D205
147	700ACM
148.1	203S
148A	501S
148A	501S
148B ✂	C715A
149A	103SH
149A	103SH
149B	103SH
149B	103SH
150.1	203S
150A	501S
150A	501S
150B ✂	C715A
151 ✂	D204
151A	D205
151B	D205
152	700ACM
153.1	203S

Door#	HwSet#
153A	501
153A	501S
153B ✎	C715A
154A	103SH
154B	103SH
155.1	203S
155A	501S
155A	501S
155B ✎	C715A
156.1	201
156.2	201C
156.3	301G
156.4	301G
156A	T751R
156B	T751R

SECTION 08 8000 GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Locations and glazing types are indicated on drawings.
- D. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
- D. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- L. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2020.
- M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- N. ASTM F1233 - Standard Test Method for Security Glazing Materials And Systems; 2008 (Reapproved 2019).
- O. GANA (GM) - GANA Glazing Manual; 2008.
- P. GANA (SM) - GANA Sealant Manual; 2008.
- Q. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
- S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).

- T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.
- U. 2018 International Energy Conservation Code (IECC).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on drawings.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Initial Samples: Submit two samples 12 by 12 inch (305 by 305 mm) in size of glass units.
 - 1. For each type of clear glass specified.
- G. Certificate: Certify that products of this section meet or exceed specified requirements.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- L. See Section 01 6000 - Product Requirements, for additional provisions.
- M. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM) and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years documented experience.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- E. Provide fully tempered and / or safety glazing at locations as required by code.

1.07 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
- B. Provide on-site glazing mock-up with the specified glazing components.

- C. Locate where directed.
- D. Clear glass Mock-ups may not remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Laminated Glass: Provide a ten (10) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.
- D. Heat Soaked Tempered Glass: Provide a ten (10) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Basis-of-design: Vitro Architectural Glass (formerly PPG Glass):
www.vitroglazings.com/#sle.
 - a. Solarban 90.
 - 2. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Viracon: www.viracon.com..
 - 1) VNE1-53.
 - 3. Substitutions: Refer to Section 01 6000 - Product Requirements.
 - a. For any product not identified, submit information as specified for substitutions.
- B. Mirrored Glass Manufacturers:
 - 1. Pilkington North America Inc; Pilkington Mirropane Transparent Mirror:
www.pilkington.com/na/#sle.
 - 2. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Comply with 2018 International Energy Conservation Code (IECC), unless more stringent conditions are indicated.
- B. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
 - 4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 5. Glass thicknesses listed are minimum.
- C. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - 2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.

3. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- D. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 - a. Provide heat strengthened glass at all locations, except where tempered / safety glass is indicated or required for safety based on application or as required by code.
 - b. Maximum peak to valley rollerwave 0.005" (0.127mm) in the central area.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 - a. Provide as required for application and as required by code.
 - b. Maximum peak to valley rollerwave 0.005" (0.127mm) in the central area.
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 - a. Provide as required for application and as required by code, whether or not shown on drawings. It is the Contractor's responsibility to confirm and provide safety glass as required by code.
 5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.
 6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 2. Provide as required for application and as required by code.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
 1. Any of the manufacturers specified for float glass.
- B. Insulating Glass Units: Types as indicated.
 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 - b. Color: Black.
 6. Purge interpane space with dry air, hermetically sealed.

7. Capillary Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet (762 m) between point of fabrication and point of installation to permit pressure equalization of air space.
 - a. Capillary Tubes: Tubes to remain open and be of length and material type in accordance with insulating glass fabricator's requirements.
 - b. Inert gas may be installed in the field into air space in accordance with insulating glass fabricator's and installer's requirements.
- C. Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (solar control type), on #2 surface.
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: None, unless indicated as ceramic frit glass.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24 (argon), nominal.
 7. Visible Light Transmittance (VLT): 51 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 0.23, nominal.

2.05 GLAZING UNITS

- A. Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6.4 mm), nominal.
- B. Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; ASTM C1376.
 1. Applications: Locations as indicated on drawings.
 2. Thickness: 1/4 inch (6 mm).
 3. Glass Tint: Grey.
 4. Glass Type: Annealed.

2.06 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 1. Width: As required for application.
 2. Thickness: As required for application.
 3. Spacer Rod Diameter: As required for application.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; color black.
- E. Glazing Clips: Manufacturer's standard type.
- F. Smoke Removal Window/Glazing Unit Markings: Adhesive backed markings affixed to manually operable or fixed windows of high-rise buildings to identify units intended for post-fire smoke removal in compliance with ICC (IBC) and local building officials.

2.07 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide shop inspection and testing for glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

- D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- F. Carefully trim protruding tape with knife.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.08 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.09 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

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**SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set tile.
 - 4. Finishes that require preparation not specified in other sections.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Patching compound.
- F. Remedial floor coatings.
- G. Remedial floor sheet membrane.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements: Additional requirements relating to testing agencies and testing.
- B. Section 03 3000 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
- C. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 2020.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.

2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 1. Manufacturer's qualification statement.
 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 4. Manufacturer's installation instructions.
 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- C. Testing Agency's Report:
 1. Description of areas tested; include floor plans and photographs if helpful.
 2. Summary of conditions encountered.
 3. Moisture and alkalinity (pH) test reports.
 4. Copies of specified test methods.
 5. Recommendations for remediation of unsatisfactory surfaces.
 6. Product data for recommended remedial coating.
 7. Include certification of accuracy by authorized official of testing agency.
 8. Submit report to Architect.
 9. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.
- F. Copy of RFCI (RWP).

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 1. Provide access for and cooperate with testing agency.
 2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Use product recommended by testing agency.
- D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.
 - 7. Other preparation specified.
 - 8. Adhesive bond and compatibility test.
 - 9. Protection.
- C. Remediations:
 - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that

adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.

3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.09 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.10 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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**SECTION 09 2116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Resilient sound isolation clips.
- E. Acoustic insulation.
- F. Gypsum sheathing.
- G. Cementitious backing board.
- H. Gypsum wallboard.
- I. Joint treatment and accessories.
- J. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 4000 - Cold-Formed Metal Framing: Structural steel stud framing.
- C. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- D. Section 07 2100 - Thermal Insulation: Acoustic insulation.
- E. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- F. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- G. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- H. Section 31 3116 - Termite Control: Field-applied termiticide and mildewcide for metal framing.

1.03 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- G. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- H. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

- L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- M. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- N. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
- O. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.
- P. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2017.
- Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.
- R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- S. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- V. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- W. GA-216 - Application and Finishing of Gypsum Panel Products; 2016, with Errata.
- X. GA-600 - Fire Resistance Design Manual Sound Control; 2021.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing, acoustic seals, and control joints, cove lighting and interface with specialty casework and finish carpentry.
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
 - 3. Show locations for each type of gypsum board on shop drawings.
 - 4. Include corner guard detail.
- C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and tile backer panels.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Manufacturer's installation instructions.
- F. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum ten years of documented experience.

1.06 MOCK-UP

- A. Provide mock-up of stud wall, ceiling, and soffit framing including insulation, sheathing, window frame, and door frame and finish specified in other sections. Coordinate with installation of associated Work specified in other sections.

- B. Provide mock-up of gypsum board corner trim.
- C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.

2.02 METAL FRAMING MATERIALS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Manufacturers - Metal Framing, Connectors, and Accessories:
 - a. ClarkDietrich: www.clarkdietrich.com.
 - b. Jaimes Industries: www.jaimesind.com.
 - c. Marino: www.marinoware.com.
 - d. R-stud, LLC: www.rstud.com.
 - e. Phillips Manufacturing Co: www.phillipsmfg.com.
 - f. SCAFCO Corporation: www.scafco.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.
- B. Structural Steel Framing for Application of Gypsum Board: As specified in Section 05 4000.
- C. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 5 psf (L/360 at 240 Pa).
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
 - 5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (12 mm) channel depth.
 - a. Unless other sizes are required for applications indicated on drawings.
 - 6. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
- D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Products:
 - a. Same manufacturer as other framing materials.
- E. Area Separation Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.
- F. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.
 - 1. Unless more stringent conditions are indicated on drawings.
- G. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- H. Preformed Top Track Firestop Seal:
 - 1. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
- I. Non-structural Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

- a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
- 3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
- J. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Manufacturers - Gypsum-Based Board:
 - a. American Gypsum Company: www.americangypsum.com.
 - b. CertainTeed Corporation: www.certainteed.com.
 - c. Continental Building Products: www.continental-bp.com.
 - d. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - e. National Gypsum Company: www.nationalgypsum.com.
 - f. PABCO Gypsum: www.pabco gypsum.com.
 - g. USG Corporation: www.usg.com.
 - h. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces, unless otherwise indicated.
 - 2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - 3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - 4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required:
 - 1) Toilet Rooms.
 - 2) Utility or mechanical rooms.
 - 3) Laundry rooms.
 - 4) Kitchens.
 - 5) Janitor / Custodian rooms.
 - 5. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 6. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - 1) Unless otherwise indicated for direct adhesion over CMU.
 - b. Horizontal Surfaces: 5/8 inch (16 mm).
 - c. Ceilings: 1/2 inch (13 mm).
 - d. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- C. Backing Board For Wet Areas: One of the following products:
 - 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings, and within 10 feet of any plumbing fixture.
 - 2. Application: Horizontal surfaces behind tile in wet areas including countertops and within 10 feet of any plumbing fixture.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 1/2 inch (12.7 mm) unless otherwise indicated.

5. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
 - a. Thickness: 1/2 inch (12.7 mm).
6. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Regular Type: Thickness 1/2 inch (12.7 mm).
 - b. Fire Resistant Type: Type X core, thickness 5/8 inch (16 mm).
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Type: Regular and Type X, in locations indicated.
 5. Type X Thickness: 5/8 inch (16 mm).
 6. Type C Thickness: 1/2 inch (13 mm).
 7. Regular Board Thickness: 1/2 inch (13 mm).
 8. Edges: Tapered.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 1/2 inch (13 mm).
 3. Edges: Tapered.
- F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
 1. Application: Exterior sheathing, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
 4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 5. Interior edge of parapet walls: Sheathing type recommended by roof manufacturer.
 6. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 7. Core Type: Type X.
 8. Type X Thickness: 5/8 inch (16 mm).
 9. Regular Board Thickness: 5/8 inch (16 mm).
 10. Edges: Square.
 11. Glass Mat Faced Products:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. American Gypsum Company; M-Glass Exterior Sheathing Type X.
 - c. American Gypsum Company; M-Glass Exterior Sheathing.
 - d. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - e. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing.
 - f. National Gypsum Company; Gold Bond eXP Sheathing.
 - g. Substitutions: See Section 01 6000 - Product Requirements.
- G. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (610 mm) wide, beveled long edges, ends square cut.
 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 2. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Paper-Faced Products:

- a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Gypsum Company; M-Bloc Shaft Liner.
 - 2) American Gypsum Company; Shaft Liner.
 - 3) CertainTeed Corporation; M2Tech Type X Shaftliner.
 - 4) Georgia-Pacific Gypsum; ToughRock Shaftliner.
 - 5) National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
 - 6) Substitutions: See Section 01 6000 - Product Requirements.
- 5. Glass Mat Faced Products:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Gypsum Company; M-Glass Shaft Liner.
 - 2) CertainTeed Corporation; GlasRoc Shaftliner Type X.
 - 3) Continental Building Products; Shaftliner Type X.
 - 4) Continental Building Products; Mold Defense Shaftliner Type X.
 - 5) Continental Building Products; Weather Defense Platinum Shaftliner Type X.
 - 6) Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
 - 7) National Gypsum Company; Gold Bond Brand eXP Shaftliner.
 - 8) National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
 - 9) Substitutions: See Section 01 6000 - Product Requirements.

2.04 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
 - 1. Thickness:
 - a. 3-1/2" at 3-5/8" studs.
 - b. 5-1/2" at 6" studs.
 - c. Unless more stringent requirements are indicated on drawings.
- B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
 - 1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Tape Thickness: 1/4 inch (6 mm).
- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- D. Water-Resistive Barrier: As specified in Section 07 2500.
- E. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel, rolled zinc, or extruded aluminum, unless noted otherwise.
 - 1. Corner Trim: Low profile, for 90 degree outside corners.
 - a. Products:
 - 1) Fry Reglet DMCT-1250: www.fryreglet.com.
 - (a) Locations: All outside corners, full height of wall from finish floor to at least 2" above finish ceiling so that trim edge is fully concealed by ceiling finish.
 - (1) Where tile is indicated: Do not install at tile or above tile, where tile is up to 5'-0" above finish floor.
 - (b) Finish: Manufacturer's standard paint-grip finish. Paint to match adjacent wall.
 - (1) Unless otherwise indicated on drawings.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
 - 2. L-Trim with Tear-Away Strip: Sized to fit 1/2 inch (13 mm) or 5/8" thick gypsum wallboard.
 - 3. Architectural Reveal Beads:
 - a. Shapes: As indicated on drawings.
 - 4. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8 inch (29 mm) flange.
 - a. Unless more stringent deflection requirements are indicated on drawings.
 - 5. Expansion Joints:

- a. Type: V-shaped metal with factory-installed protective tape.
 - 1) Unless otherwise indicated on drawings.
 - b. Products:
 - c. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Phillips Manufacturing Co; 093 Expansion Control Joint: www.phillipsmfg.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- F. Decorative Metal Trim:
 - 1. Material: Extruded aluminum alloy 6063-T5 temper.
 - 2. Finish: Factory primed for field painting, unless otherwise indicated.
 - 3. Type: Profile as selected from manufacturer's standard range, unless otherwise indicated.
- G. Moisture Guard Trim: ASTM C1047, rigid plastic, 48 inch (1219.2 mm) length, applied to bottom edge of gypsum board.
 - 1. Height: 1-3/4 inch (44.5 mm).
 - 2. Depth: 5/8 inch (15.9 mm) or as required for application.
 - 3. Locations:
 - a. Walls adjacent to wet areas not scheduled to receive tile.
 - b. Utility or mechanical rooms.
 - c. Laundry rooms.
 - d. Kitchens.
 - e. Janitor / Custodian rooms.
 - 4. Products:
 - a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Watertight USA; Watertight: www.watertight-usa.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs as indicated.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Resilient Sound Isolation Clips: Install resilient sound isolation clips, and where applicable, associated furring sections and channels, in accordance with clip manufacturer's written instructions.
- F. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
- G. Blocking: Install mechanically fastened steel sheet blocking for support of:
 1. Framed openings.
 2. Wall mounted cabinets.
 3. Plumbing fixtures.
 4. Toilet partitions.
 5. Toilet accessories.
 6. Wall mounted door hardware.
 7. Equipment as indicated and as required
 8. Other items as required for project
 9. Provide channel blocking where required for application.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.
 2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
 1. Seal joints, cut edges, and holes with water resistant sealant.
- G. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
 - 2. Align wall and ceiling control joints.
 - 3. At one side of window and / or door openings or at 30 feet maximum spacing.
 - 4. At dissimilar materials.
 - 5. Contractor shall coordinate control joint locations with Architect in walls exceeding 30 feet in length and ceilings exceeding 50 feet.
 - 6. Contractor shall coordinate control joint locations with Architect in walls with wall covering or graphics.
 - 7. Refer to additional information as indicated on drawings.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.
- E. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

3.07 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 4. Level 0: Temporary partitions.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TEXTURE FINISH

- A. Texture finishes are not allowed.

3.09 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

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SECTION 09 3000 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Coated glass mat backer board as tile substrate.
- E. Non-ceramic trim.
- F. Tile types and locations are indicated on drawings.
- G. Waterproof and crack isolation membrane.
- H. Elastomeric joints at tile work (Control joints and soft joints).

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Division 22 - Plumbing: Prefabricated Showers.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- C. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

- N. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- O. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2010 (Reaffirmed 2016).
- P. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- R. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- S. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile; 2008 (Reaffirmed 2013).
- T. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- U. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- V. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- W. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2017.
- X. ICC-ES AC308 - Acceptance Criteria for Termite Physical Barrier Systems; 2014, with Editorial Revision (2017).
- Y. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
 - 1. For adhesives and sealants, include printed statement of VOC content.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and ceramic accessories.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Samples: Provide samples of actual tile.
- F. Full-size units of each type of trim and accessory for each color required.
- G. Manufacturer's Installation instructions: For each type of tile specified.
- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 5 percent of each size, color, and surface finish combination, but not less than ten of each type.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum ten years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of ten years of documented experience.
- D. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Except where multiple sources supplied original tile, which are to match.
- E. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- F. TCNA Installation Guidelines: Tile Council of North America (TCNA) "Handbook for Ceramic Tile Installation" current edition; comply with TCNA methods indicated.

1.07 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location. Contractor may choose location, if not indicated on drawings.
 - 1. Minimum size of mock-up is 5 ft x 5 ft, unless otherwise indicated on drawings.
 - 2. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings. Tile shall also be provided in accordance with the following:
 - 1. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.
 - 2. Factory Applied Temporary Protective Coatings: Where required by tile type and manufacturer's specifications, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.
- B. Manufacturers: As indicated on drawings .
 - 1. Substitutions: See Section 01 6000 - Product Requirements.
- C. Glazed Wall Tile: ANSI A137.1, standard grade.
- D. Porcelain Tile: ANSI A137.1, standard grade.

2.02 TRIM AND ACCESSORIES

- A. Trim: Satin nickel anodized aluminum extruded, style and dimensions to suit application, unless more stringent conditions are indicated on drawings, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.

- b. Open edges of floor tile.
 - c. Wall corners, outside and inside.
 - d. Transition between floor finishes of different heights.
 - e. Thresholds at door openings.
 - f. Expansion and control joints, floor and wall.
 - g. Floor to wall joints.
 - h. Borders and other trim as indicated on drawings.
 - i. As indicated on drawings and as required for application.
2. Manufacturers:
- a. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Schluter-Systems: www.schluter.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SETTING MATERIALS

- A. Manufacturers:
- 1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products: www.custombuildingproducts.com/#sle.
 - b. LATICRETE International, Inc: www.laticrete.com.
 - c. Mapei; www.mapei.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
- 1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
- C. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
- 1. Applications: Wet locations.
- D. Organic Adhesive: ANSI A136.1, thinset mastic type.
- 1. Applications: Dry locations.
- E. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.

2.04 GROUTS

- A. Standard Grout: ANSI A118.6 standard cement grout.
- 1. Applications: All tile locations unless otherwise indicated as wet location.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As indicated on drawings.
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
- 1. Applications: Kitchens and Wet Locations and as required for application.
 - 2. Color(s): As indicated.
- C. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
- 1. Applications: Kitchen and Restroom Floors.

2.05 MAINTENANCE MATERIALS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
- B. Sealant / soft joint color: Match grout color unless otherwise indicated on drawings.
- C. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
- 1. Applications:
 - a. Between tile and plumbing fixtures.

- b. Between tile and all adjacent materials.
- c. Inside tile corners.
- d. At wall to floor and wall to ceiling transitions.
- e. Control joint locations as recommended by TCNA EJ171 and where indicated on drawings. If not indicated on drawings, follow TCNA recommendations.
 - 1) Tile control joints adjacent to gypsum board wall control joints: Provide tile soft joint / control joint to follow tile installation pattern. Do not cut tile. Install tile soft joint / control joint as close as possible to adjacent gypsum board wall control joint.
 - 2. Color(s): Match grout color.
 - a. Unless otherwise indicated.
- D. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Type: As required for application.
 - 2. Thickness: 40 mils (1 mm), minimum.
 - 3. Crack Resistance: No failure at 3/8 inch (9.5 mm) gap, minimum.
- B. Waterproofing Membrane at floors and walls: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum; comply with ANSI A118.12.
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 40 mils (1 mm), minimum, dry film thickness.
- C. Waterproofing Membrane at Showers and wet locations: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber.
 - b. Material: Acrylic.
 - c. Thickness: 40 mils (1 mm), minimum, dry film thickness.
- D. Waterproofing Membrane Under Thick Mortar Bed at showers and wet locations:
 - 1. Material: Chlorinated polyethylene sheet, 40 mils (1.0 mm) thick, minimum; complying with ASTM D4068.
- E. Reinforcing Mesh: 2 by 2 inch (51 by 51 mm) size weave of 16/16 wire size; welded fabric, galvanized.
- F. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.
- G. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
 - 1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E2179, ASTM E492, ANSI A118.13 bonded membrane, ASTM E2179, ASTM E492, ANSI A118.13 bonded membrane, ASTM E2179, and ASTM E492.
 - 2. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
 - 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 - 4. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
 - 5. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
 - 6. Suitable for installation over green concrete.
 - 7. Suitable for installation over wood-based substrates.

- 8. Type: Fluid or Trowel Applied.
- H. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch (12.7 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.
- I. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - 1. Standard Type: Thickness 1/2 inch (12.7 mm).
- J. Backer Board: High density polystyrene with reinforced cementitious coating on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
 - 1. Thickness: 1/2 inch (12.7 mm).
- K. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on drawings and where required by TCNA Installation Details. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- G. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and accessories and grout in accordance with applicable requirements of ANSI A108.1A thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
 - 1. If tile pattern is not indicated, request tile pattern from Architect prior to installation. Random tile placement is not allowed.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align joints as indicated
 - 1. If alignment is not indicated, request from Architect prior to installation.

- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles square.
 - 1. Unless otherwise indicated.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- M. Exposed unfinished tile edges are not allowed.
- N. Do not install defective tile.
- O. Cutting: Saw cut only.
- P. Provide uniform soft joint and spacing between tile and floor drains, cleanout covers and other floor or wall devices. Jagged or cracked tile is not allowed.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with specified grout.
- B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.
 - 3. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.
- C. Over wood substrates, install in accordance with TCNA (HB) Method F142, with standard grout, unless otherwise indicated.
 - 1. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F143.
- D. Over wood substrate with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with epoxy grout.
- E. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F101, bonded, with epoxy grout.
- B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F112, bonded, unless otherwise indicated.
 - 1. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F132, bonded.
 - 2. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F114, with cleavage membrane.
- C. Over wood substrates, install in accordance with TCNA (HB) Method F141, with standard grout, unless otherwise indicated.
- D. Cleavage Membrane: Lap edges and ends.

- E. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.
- F. Mortar Bed Thickness: 5/8 inch (15.9 mm), unless otherwise indicated.

3.06 INSTALLATION - WALL TILE

- A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
- B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
- C. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
- D. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.
 - 1. Where mortar bed is indicated, install in accordance with TCNA (HB) Method W222, one coat method.
 - 2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCNA (HB) Method W222, one coat method.
- E. Over metal studs without backer install in accordance with TCNA (HB) Method W241, mortar bed, with membrane where indicated.
- F. Wall Tile: Center wall tile within room or space, unless specifically noted otherwise.

3.07 CLEANING

- A. Clean tile and grout surfaces.

3.08 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

**SECTION 09 5100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Division 21 - Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
- C. Division 23 - Air Outlets and Inlets: Air diffusion devices in ceiling system.
- D. Division 26 - Interior Lighting: Light fixtures in ceiling system.
- E. Division 28 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, mechanical and electrical items installed in the ceiling, and locations where removable grid is required for access.
 - 1. Submit component and project specific installation drawings, cut sheets, and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation.
 - 2. Include fabrication and installation details. Distinguish between factory and field work.
 - 3. Include plans, elevations, sections, attachments, and work by other trades.
 - 4. Include wiring diagrams when applicable.
 - 5. Indicate seismic bracing and fastening requirements as applicable.
 - 6. Indicate compliance with design intent and layout, as specified on drawings.
- C. Product Data: Provide data on suspension system components and acoustical units.

- D. Samples: Submit two samples 12 by 12 inches in size illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance instructions and recommendations.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc; Types as indicated on drawings: www.armstrong.com/#sle.
 - 2. TURF; Types as indicated on drawings: www.turf.design
 - 3. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems:
 - 1. Same as for acoustical units.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category as indicated on Structural drawings and complying with the following:
 - 1. Local authorities having jurisdiction.
- C. Removable Grids: Provide removable grids for ceiling access where indicated on drawings.

2.03 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
 - 1. VOC Content: As specified in Section 01 6116.
- B. Acoustical Tiles: Painted mineral fiber, with the following characteristics:
 - 1. Application(s): as indicated on drawings.
 - 2. Classification: ASTM E1264 Type III.
 - a. Form: 1 and 2.
 - b. Pattern: C and E.
 - 3. Sizes: 24 by 24 inches.
 - a. Locations are indicated on drawings.
 - 4. Thickness: 3/4 inch (19 mm).

5. Tile Edge: Square.
 - a. Joint: Kerfed and rabbeted.
 6. Color: As indicated on drawings.
 7. Suspension System: Exposed grid.
 - a. Match tile color indicated.
- C. Acoustical Tiles: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Application(s): As indicated on drawings.
 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 3. Size: 24 by 24 inches (610 by 610 mm).
 4. Thickness: 1 inches (24.5 mm).
 5. Tile Edge: Square.
 - a. Joint: Kerfed and rabbeted.
 6. Color: As indicated on drawings.
 7. Suspension System: Exposed grid.
 - a. Match tile color indicated.
- D. Acoustical Tiles: Mineral fiber with scrubbable finish, with the following characteristics:
1. Application(s): Kitchens. Refer to locations on drawings..
 2. Classification: ASTM E1264 Type IX.
 - a. Form: 2, water felted.
 - b. Pattern: "G" - smooth.
 3. Size: 24 by 24 inches (610 by 610 mm).
 4. Thickness: 5/8 inches (16 mm).
 5. Panel Edge: Square.
 6. Color: White.
 7. Suspension System: Exposed grid.

2.04 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, splices, and grip clips (at removable grid locations) as required.
1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; 15/16 inch (24 mm) face width.
 3. Color: As indicated on drawings.
 4. Finish: Baked enamel.
- C. Exposed Suspension System for "Cloud" Applications: Galvanized steel grid and cap; trim as specified under Accessories.
1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; 15/16 inch (24 mm) face width.
 3. Finish: Baked enamel.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

- E. Grip Clips: Manufacturer's standard for joining main beams to cross tees with locking barbs without the use of pop rivets or screws. Provide cross tee adapter clips where required. Provide custom accessories if manufacturer's standard does not accommodate access requirements indicated on drawings.
- F. Perimeter Moldings: Same material and finish as grid or aluminum with matching finish.
 - 1. Size: As required for installation conditions and specified Seismic Design Category.
 - 2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
 - 3. Shadow Molding: Shaped to create a perimeter reveal.
 - 4. Channel Molding: U-shaped, for hold-down type installations.
 - 5. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
 - 6. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
- G. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 - 1. Trim Height: As indicated on drawings or required for transition applications.
 - 2. Finish: Baked enamel.
 - 3. Color: As indicated on drawings.
- H. Gypsum Board: Fire rated type; 5/8 inch (16 mm) thick, ends and edges square, paper faced.
- I. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
 - 1. Center system in room, unless otherwise specifically noted on drawings. Follow guidelines for placement as indicated on drawings. If not indicated, request layout from Architect prior to beginning installation.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Install in bed of acoustical sealant.
 - 2. Use longest practical lengths.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

- H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.
- K. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units as indicated.
- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

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SECTION 09 6500.1
RESILIENT FLOORING WATERJET CUTTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Custom waterjet cutting of resilient tile flooring: LVT.
 - 1. Includes cutting and assembly of designs and surrounding field area.
 - 2. Locations are indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- B. Section 09 6500 - Resilient Flooring.

1.03 REFERENCE STANDARDS

- A. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile 2018a.
- B. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submit request for electronic file at least four weeks prior to scheduled submittal date to Architect.
- C. Shop Drawings: Include the following:
 - 1. Design.
 - 2. Color Specifications.
 - 3. Tolerance.
 - 4. Revisions to line integrity.
 - 5. Area for review signature and date.
 - 6. Installation plan to include contact information of the waterjet company.
 - 7. Installation plan to include the following statement:
 - a. Removal of low tack tape is to take place prior to the drying of the adhesive.
- D. Certification: Prior to installation of flooring, submit written certification by waterjet cutting company and installer that condition of subfloor is acceptable.
- E. Installer's Qualification Statement.
 - 1. Include confirmation that waterjet company has a design department.
 - 2. Include (5) similar project references.
 - a. Include project image(s), name, location and dated completed.
- F. Waterjet cutting company's installation instructions.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

- A. Basis of Design Manufacturer: Waterjet Works: www.waterjetworks.com.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.
 - 1. Employer of workers for this Project who are competent in techniques required by manufacturer for resilient flooring cutting and installation indicated.
- C. Cutting: All cutting is to be done with waterjet technology.
 - 1. Use "water only" cutting process.
 - a. Abrasives are not allowed.

2. Hand cutting is not allowed.
- D. Tolerance: 0.002 inches (0.0508 mm).
- E. Electronic File: Use Architect's electronic file for logo design.
- F. Single Source: Obtain all resilient flooring for waterjet cutting from a single manufacturer.
 1. Refer to Section 096500 – Resilient Flooring.

1.06 MOCK-UP

- A. Provide 1 mock-up for each design layout of resilient flooring.
- B. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Shipping:
 1. Each design to be reassembled back into sections.
 2. Entire project to be checked for accuracy prior to boxing which includes verifying that each assembled piece fits correctly.
 3. Tiles to be packed in box with padding of types recommended by waterjet cutting company.
 - a. Loose tile packing is not allowed.
 4. Include content labels and sequence numbering as recommended by waterjet cutting company.
 5. Boxes to be palletized and shrink wrapped.
- B. Upon receipt, immediately remove packaging and check materials for damage and the correct style, color, quantity and run numbers.
- C. Store all materials off of the floor in an acclimatized, weather-tight space.
- D. Maintain temperatures recommended by Manufacturer.

1.08 FIELD CONDITIONS

- A. Follow manufacturer's recommendations.
- B. Install flooring only after all other trades, including painting and overhead work, has been completed.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer and waterjet cutting company, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.
- F. Dry lay all waterjet designs prior to final installation.
- G. Notify waterjet cutting company of any unsatisfactory conditions.
 1. Correct unsatisfactory conditions prior to final installation.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with flooring manufacturer's and waterjet cutting company's written instructions.

3.04 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.05 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

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SECTION 09 6500 RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- C. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- D. Section 096500.1 - Resilient Flooring Waterjet Cutting

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
- B. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2021).
- C. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 - 1. Finishing: Include manufacturer's finish instructions and recommendations.
- C. Shop Drawings: Indicate seaming plans, floor patterns, and transition details.
- D. Verification Samples: Submit two samples, actual size illustrating color and pattern for each resilient flooring product specified.
- E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
 - 1. Submit evidence of compliance with flooring manufacturer's specifications.
- G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 200 square feet (18.5 square meters) of each type and color.
 - 3. Extra Wall Base: 20 linear feet (6 linear meters) of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum twenty years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.
 - 1. Employer of workers for this Project who are competent in techniques required by manufacturer for resilient flooring installation indicated.
- C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.06 MOCK-UP

- A. Provide 10 ft x 10 ft minimum mock-up for each type of resilient flooring.
- B. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperatures recommended by Manufacturer.
- D. Do not double stack pallets.

1.08 FIELD CONDITIONS

- A. Follow manufacturer's recommendations.
- B. Install flooring only after all other trades, including painting and overhead work, has been completed.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Monolithic Solid Vinyl Tile (LVT) - Homogeneous Tile, ASTM F1700 Class I - Monolithic Solid Vinyl Tile, Type A (Smooth): Solid vinyl with color and pattern throughout thickness.
 - 1. Manufacturers:
 - a. Basis-of-Design: Patcraft; www.patcraft.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 3. VOC Content Limits: As specified in Section 01 6116.
 - 4. Size: As indicated on drawings.
 - 5. Total Thickness: As indicated on drawings.
 - 6. Pattern: As indicated on drawings.
 - 7. Color: As indicated on drawings.

2.02 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Basis-of-Design: Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Height: 4 inch (100 mm).
 - a. Unless otherwise indicated on drawings.
 - 3. Thickness: 0.080 inch (2.0 mm).
 - 4. Finish: Satin.
 - 5. Length: Roll.
 - 6. Color: As indicated on drawings.
 - 7. Accessories: Premolded external corners, internal corners, and end stops.

2.03 ACCESSORIES

- A. Subfloor Filler: Portland-based patching and leveling compounds; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Use premolded corners.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and wax in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

**SECTION 09 6700
FLUID-APPLIED FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-applied flooring and base.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 9200 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. ANSI/ESD STM7.1 - The Protection of Electrostatic Discharge Susceptible Items Flooring Systems Resistive Characterization; 2021.
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).
- C. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Samples: Submit two samples, 3" x 3" in size illustrating color and pattern for each floor material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.
 - 1. Minimum 5 years of documented experience.

1.06 MOCK-UP

- A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
 - 1. Number of Mock-Ups to be Prepared: One.
 - 2. Use same materials and methods for use in the work.
 - 3. Locate where directed.
 - 4. Minimum Size: 48 inches by 48 inches (1220 mm by 1220 mm).
- B. Obtain approval of mock-up by Architect before proceeding with work.
- C. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.08 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.

- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring: Epoxy base coat(s), with broadcast aggregate.
 - 1. Aggregate: Vinyl flakes.
 - 2. Top Coat: Polyurethane.
 - 3. System Thickness: 1/4 inch (6.4 mm), nominal, dry film thickness (DFT).
 - 4. Texture: Slip resistant.
 - 5. Color: As indicated on drawings.
 - 6. Integral Cove Base
 - 7. Basis of Design Product: Sherwin Williams; Resuflor Deco

2.02 ACCESSORIES

- A. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- B. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

3.03 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness required by manufacturer.
- C. Finish to smooth level surface.
- D. Cove at vertical surfaces.

3.04 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

END OF SECTION

SECTION 09 6813 TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- C. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
- B. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- C. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
 - 1. Include statement of VOC compliance.
- C. Shop Drawings: Indicate layout of joints, direction of carpet pile, location of edge moldings, and interface with adjacent materials.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Sustainable Design Submittal: Submit VOC content documentation for adhesives.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Installer's Qualification Statement.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum five years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Basis-of-design: Shaw Contract: www.shawcontract.com/en-us.

2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Tile Carpeting: Tufted or fusion bonded, as specified by basis-of-design product type, manufactured in one color dye lot.
 1. Products, colors, styles and patterns as indicated on drawings.
 - a. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - b. VOC Content: Comply with Section 01 6116.
 - c. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 - d. PVC, phthalates or PBD / PBDE ingredients are not allowed.

2.03 ACCESSORIES

- A. Edge Strips: Manufacturer's standard.
 1. Unless otherwise indicated on drawings.
- B. Adhesives:
 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Conduct tests by an independent testing agency acceptable to Owner.
 - a. See Section 09 0561.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
 3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile as indicated on drawings.

1. If layout is not indicated on drawings, request pattern and / or layout from Architect prior to installation.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
 1. Adhere carpet in accordance with manufacturer's instructions and recommendations.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

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SECTION 09 8430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing panels: Acoustical wall panels.
- B. Sound-absorbing ceiling baffles.
- C. Mounting accessories.

1.02 RELATED REQUIREMENTS

- A. Section 095100 – Acoustical Ceilings: Pyramidal Ceiling Diffuser Panels.
- B. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
 - 1. Submit component and project specific installation drawings, cut sheets, and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. Submit for approval before beginning any fabrication, installation, or erection.
 - 2. Include fabrication and installation details. Distinguish between factory and field work.
 - 3. Include plans, elevations, sections, attachments, and work by other trades.
 - 4. Indicate seismic bracing and fastening requirements as applicable.
 - 5. Show proposed seam locations and maximum panel sizes, where applicable.
- D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- E. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch (305 by 305 mm), showing construction, edge details, and fabric covering.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed, of each type.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than ten years of experience in manufacturing acoustical products similar to those specified.
- B. Source Limitations: Obtain all products from a single manufacturer through one source providing a comprehensive material and installation package.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

1.07 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
- B. Construct mock-up of acoustical units at location as indicated by Architect.
 - 1. Minimum mock-up dimensions; 96 by 96 inches (2440 by 2440 mm).
 - 2. Approved mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

- A. Manufacturers:
 - 1. Basis-of-Design: Turf Design, Inc.; www.turf.design.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:
 - 1. Prefinished, factory assembled fabric-covered panels.
 - 2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- C. Fabric-Covered Acoustical Panels for Walls and Ceilings:
 - 1. Panel Core: Manufacturer's standard rigid glass-fiber board, with chemically hardened edges core.
 - 2. Panel Size: As indicated on drawings.
 - 3. Panel Thickness: As required to meet required acoustical performance.
 - a. Unless otherwise indicated on drawings.
 - 4. Edges: Perimeter edges reinforced by a formulated resin hardener.
 - 5. Corners: As detailed.
 - 6. Fabric: Woven polyester.
 - a. Light Fastness: AATCC 16, Option 3: 40 hours.
 - b. Fastness to Crocking: AATCC 8: #4 Wet and Dry.
 - c. Flammability: ASTM E 84, Class A or 1.
 - d. Basis of design product: Guilford of Maine, FR701, Style 2100 series.
 - 7. Color: As selected by Architect from manufacturer's full range.
 - 8. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
 - 9. Wall Panel Mounting Method: Metal wall bracket with panel-mounted z-bracket.

2.02 FABRICATION

- A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
 - 1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
 - 2. For panels suspended from ceiling, provide fabric covering both sides, with seams only at panel edges.
- B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch (1.6 mm) for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

- A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
 - 1. Two-part clip and base-support bracket system; brackets designed to support full weight of panels and clips designed for lateral support, with one part mechanically attached to back of panel and the other attached to substrate.
- B. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.
- C. Fixing Clips: Manufacturers standard for application as indicated.
- D. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.

3.02 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- C. Suspend ceiling baffles at locations and heights as indicated.
- D. Install acoustical units to construction tolerances of plus or minus 1/16 inch (1.6 mm) for the following:
 - 1. Plumb and level.
 - 2. Flatness.
 - 3. Width of joints.

3.03 CLEANING

- A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

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SECTION 09 9113 EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Mechanical and Electrical: As indicated on drawings.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Non-metallic roofing and flashing.
 - 6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
 - 7. Marble, granite, slate, and other natural stones.
 - 8. Floors, unless specifically indicated.
 - 9. Ceramic and other types of tiles.
 - 10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
 - a. Unless otherwise indicated at existing materials to remain on drawings.
 - 11. Exterior insulation and finish system (EIFS).
 - 12. Glass.
 - 13. Concrete masonry units in utility, mechanical, electrical, and concealed spaces.
 - 14. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5000 - Metal Fabrications: Shop-primed items.
- C. Section 09 9123 - Interior Painting.

1.03 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2019.
- E. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- G. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

- H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- I. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
 - 6. Confirmation that top coat is compatible with primer used for steel fabrications.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, submit each color in each sheen available.
 - 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and factory finished metals, have been approved.
- D. Samples: Submit two paper "draw down" samples, 8-1/2 x 11 inch (216 x 279 mm) in size illustrating range of colors and textures available for each surface finishing product scheduled.
- E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- G. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 5 gallons (19 L) of each color and type; from the same product run, store where directed.
 - 3. Label each container with color, type, and location in addition to the manufacturer's label.
 - a. Match paint type designations indicated on drawings for each paint type.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.
- C. The Contractor shall receive written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator / supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work. Coordinate all shop and / or field-applied primers with topcoat.

1.07 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 10 feet (3 m) long by 10 feet (3 m) wide, illustrating paint color, texture, and finish.

- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Primer Sealers: Same manufacturer as top coats.
- C. Block Fillers: Same manufacturer as top coats.
- D. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 2. PPG Paints: www.ppgpaints.com/#sle.
 - 3. Tnemec Protective Coatings: www.tnemec.com
- E. Stains:
- F. Primer Sealers: Same manufacturer as top coats.
- G. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

5. Supply each paint material in quantity required to complete entire project's work from a single production run.
 6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
 7. All materials used shall be lead and mercury free.
- B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.
 - C. Flammability: Comply with applicable code for surface burning characteristics.
 - D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
 - E. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including .
 1. Two top coats and one coat primer.
- B. Ferrous Metals, (doors, frames, & handrails), Primed, Latex, 2 Coat:
 1. Touch-up with SW B66-310 Series, Pro-Cryl Universal Water Based Primer.
 2. Semi-gloss: Two coats of B53-1150 Series, WB Alkyd Urethane Enamel Semi-Gloss.
 3. One coat of PPG Pitt-Tech Plus DTM Primer, 4029 PF.
 4. Semi-gloss: Two coats of PPG Pitt-Flex Plus S/G 4216 HP or Speedhide WB Alkyd S/G, 6-1510XI.
- C. Galvanized Metals, Latex, 3 Coat:
 1. One coat of SW B66-310 Series, Pro-Cryl Universal Water Based Primer.
 2. Gloss: Two coats of of B66-600 Series, Pro Industrial Acrylic Gloss.
 3. One coat of PPG Pitt-Tech Plus DTM Primer, 4020 PF.
 4. Gloss: Two coats of PPG Pitt-Tech Gloss 90-374 or Pitt-Tech Plus Gloss 90-1310.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
 1. Unless otherwise recommended by manufacturer.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Exterior Plaster and Stucco: 12 percent.
 2. Fiber Cement Siding: 12 percent.
 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 5. Concrete Floors and Traffic Surfaces: 8 percent.
 6. Unless otherwise recommended by manufacturer.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- G. Asphalt, Creosote, or Bituminous Surfaces: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.
- H. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- I. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- J. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- D. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Apply each coat to uniform appearance.
- G. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- H. Sand wood and metal surfaces lightly between coats to achieve required finish.
- I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- J. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

- B. Inspect and test questionable coated areas in accordance with Manufacturer's recommendations.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.07 COLOR SCHEDULE

- A. As indicated on drawings.

END OF SECTION

SECTION 09 9123 INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In all areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 10. Glass.
 - 11. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 12. Acoustical materials, unless specifically indicated.
 - 13. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5000 - Metal Fabrications: Shop-primed items.
- C. Section 078123 - Intumescent Fire Protection.
- D. Section 09 9113 - Exterior Painting.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.

- C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2019.
- F. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- G. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- H. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- J. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- K. SSPC-SP 3 - Power Tool Cleaning; 2018.
- L. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- M. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
 - 6. Confirmation that top coat is compatible with primer used for steel fabrications.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, submit each color in each sheen available.
 - 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as wood cabinets, have been approved.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
 - 1. Match schedule indicated on drawings.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 5 gallons (19 L) of each color and type; from the same product run, store where directed.
 - 3. Label each container with color, type, and room locations in addition to the manufacturer's label.
 - a. Match paint type designations indicated on drawings for each paint type.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.
- C. The Contractor shall receive written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator / supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work. Coordinate all shop and / of field-applied primers with topcoat.

1.07 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 10 feet long by 10 feet wide, illustrating paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 2. PPG Paints: www.ppgpaints.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Block Fillers: Same manufacturer as top coats.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 5. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
 - a. Unless otherwise indicated on drawings.
 - 2. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.
- B. Wood, Opaque, Latex, 3 Coat:
 - 1. One coat of SW B28W8111, Premium Wall & Wood Interior Latex Primer
 - 2. Semi-Gloss: Two coats of SW B34W8251, ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss.
 - 3. One Coat: PPG 68000 Rhino Grip Interior Wall & Wood Primer.
 - 4. Two Coats: PPG 6-1510XI Speedhide WB Acrylic Alkyd Semi- Gloss Enamel.
- C. Ferrous Metals (doors, frames, & handrails), Unprimed, Latex, 3 Coat:
 - 1. One coat of SW B66-310 Series, Pro-Cryl Universal Water Based Primer.
 - 2. Semi-gloss: Two coats of B53-1150 Series, WB Alkyd Urethane Enamel Semi-Gloss.
 - 3. One Coat: PPG 4020 Pitt- Tech Plus DTM Acrylic Universal Primer.
 - 4. Three Coats: PPG 6-1510XI Speedhide WB Acrylic Alkyd Semi- Gloss Enamel.
- D. Galvanized Metals, Latex, 3 Coat:
 - 1. One coat of SW B66-310 Series, Pro-Cryl Universal Water Based Primer.
 - 2. Semi-gloss: Two coats of B66-650 Series, Pro Industrial Acrylic Semi-Gloss.
 - 3. One Coat: PPG 4020 Pitt- Tech Plus DTM Acrylic Universal Primer.
 - 4. Two Coats: PPG 4216 Pitt- Tech Plus DTM Acrylic Semi- Gloss Enamel.
- E. Gypsum Board/Plaster, Latex Flat Finish, 3 Coat:
 - 1. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 - 2. Flat: Two coats of B30-2600 Series, ProMar 200 Zero VOC Interior Latex Flat.
 - 3. One Coat: PPG 6-4900XI Speedhide Zero Voc Interior Latex Wall Primer.

4. Two Coats: PPG 6-4110XI Speedhide Zero Voc Interior Latex Flat.
- F. Gypsum Board/Plaster, Latex Egg-Shell Finish, 3 Coat:
 1. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 2. Eggshell: Two coats of K45W01151, Pro Industrial Pre-Catalyzed Epoxy Latex Eg-Shell.
 3. One Coat: PPG 6-4900XI Speedhide Zero Voc Interior Latex Primer.
 4. Two Coats: PPG 16-310 Pitt- Glaze Precatalyzed Water Based Epoxy Eggshell.
- G. Gypsum Board/Plaster, Latex-Acrylic Semi-Gloss Finish, 3 Coat:
 1. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 2. Semi-gloss: Two coats of B31-2600 Series, ProMar 200 Zero VOC Interior Latex Semi-Gloss.
 3. One Coat: PPG 6-4900XI Speedhide Zero Voc Interior Latex Wall Primer
 4. Two Coats: PPG 6-4310XI Speedhide Zero Voc Interior Latex Eggshell OR
 - a. Alternate: Two Coats: PPG 6-4510XI Speedhide Zero Voc Interior Latex Semi- Gloss
- H. Metal Decking DryFall Finish, Latex Flat, 2 Coat:
 1. Flat: Two coats of B42W181, Pro Industrial Waterborne Acrylic DryFall Flat.
 2. Two Coats: PPG 6-725XI Speedhide Super Tech Interior Latex Flat Dryfall.
- I. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
 1. Two top coats and one coat primer.
- J. Dry Fall: Metals; exposed structure and overhead-mounted services, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
 1. Shop primer by others.
 2. One top coat.
- K. Transparent Finish on Concrete Floors.
 1. 2 coats sealer.
 2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
 3. Sealer Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen at all locations.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
 1. Unless otherwise recommended by manufacturer.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Plaster and Stucco: 12 percent.
 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors and Traffic Surfaces: 8 percent.
6. Unless otherwise recommended by manufacturer.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
 3. Clean concrete according to ASTM D4258. Allow to dry.
 4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- L. Copper: Remove contamination by steam, high pressure water, or solvent washing.
- M. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 2. Prepare surface according to SSPC-SP 2.
- N. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- O. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- P. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- Q. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
- B. Inspect and test questionable coated areas in accordance with Manufacturer's recommendations.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.07 COLOR SCHEDULE

- A. As indicated on drawings.

END OF SECTION

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SECTION 10 1100 VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards
- B. Tackable wall panels

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.
- B. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (R2020).
- B. ANSI A208.1 - American National Standard for Particleboard; 2016.
- C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard and trim.
- E. Manufacturer's printed installation instructions.
- F. Manufacturer's Qualification Statement.
- G. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Product Certification: UL Greenguard Gold for low chemical emissions.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. ADP Lemco, Inc: www.adplemco.com/#sle.
- C. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
- D. MooreCo, Inc: www.moorecoinc.com/#sle.
- E. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
- F. Polyvision Corporation: www.polyvision.com/#sle.

- G. ASI: www.asi-visualdisplayproducts.com.
- H. Substitutions: See Section 01 6000 - Product Requirements.

2.02 VISUAL DISPLAY UNITS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
 - 3. Core: Class A fire rated hardboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Galvanized steel sheet or aluminum sheet, laminated to core.
 - 5. Height: 48 inches (1220 mm).
 - a. Unless otherwise indicated on drawings.
 - 6. Length: 6 feet (1830 mm) , in one piece.
 - a. Unless otherwise indicated on drawings.
 - 7. Frame: Extruded aluminum , with concealed fasteners.
 - 8. Frame Profile: Manufacturer's standard flat profile.
 - 9. Frame Finish: Anodized, natural.
 - 10. Accessories: Provide marker tray and map rail.
- B. Tackable Wall Panels: Fabric laminated to fiberboard; Factory-fabricated.
 - 1. Fabric: Vinyl coated fabric.
 - 2. Color, Pattern, and Texture: As selected from manufacturer's full range.
 - 3. Backing: Fiber board, 1/2 inch (13 mm) thick, laminated to tack surface.
 - a. Unless otherwise indicated on drawings or required for specified application.
 - 4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 - 5. Size: As indicated on drawings.
 - 6. Height: As indicated on drawings; No horizontal seams.
 - 7. Edge Treatment: Square edge unless detailed otherwise.
 - 8. Edge Molding: Provide metal "J-mold" type edge trim for exposed edges at door and window openings and similar conditions.
 - a. Unless otherwise indicated on drawings.
 - 9. Adhesives: Provide manufacturer's recommended adhesive, primer, and sealer, produced for use on substrate shown on drawings. Provide materials which are mildew-resistant and non staining to wallcovering.
 - 10. Manufacturers:
 - a. Claridge Products; Claridge Cork: www.Claridge.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Fiber Board: ASTM C208, cellulosic fiber board.
- E. Adhesives: Type used by manufacturer.

2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
- B. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- C. Cleaning Instruction Plate: Provide instructions for markerboard cleaning on a metal plate fastened to perimeter frame near marker rail.

- D. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- E. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Provide wall backing as required.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 36 inches (914 mm) above finished floor.
 - 1. Unless otherwise indicated on drawings or directed by Owner.
- C. Secure units level and plumb.
- D. Butt Joints: Install with tight hairline joints.
- E. Do not install over mechanical, electrical or life safety devices.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

3.05 SCHEDULE

- A. Markerboards: Locations are indicated on drawings.
- B. Tackboards: Locations are indicated on drawings.

END OF SECTION

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SECTION 10 1400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.
 - 1. Interior and exterior illuminated and non-illuminated signage.
- E. Other signage as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Division 5 - Metals: Support framing and backing and delegated design engineering for signage attachment to building.
- B. Division 26 - Electrical: Power for sign lighting.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Shop Drawings: For each type of sign. Include attachment details, materials, finishes, seam locations, methods for drainage for exterior signs, power feed and lighting types.
- D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- E. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- F. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- G. Verification Samples: Submit samples showing colors specified.
- H. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- I. Qualification Statement: For Manufacturer and Installer.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.05 COORDINATION

- A. Confirm Room Names and Numbers.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.
- B. Installer Qualification: Same as or approved by Manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.08 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 0.625 inch (15.875 mm) unless otherwise indicated.
 - 4. Sign Height: 6 inches (150 mm), unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN", "WOMEN" and "UNISEX" room numbers to be determined later, and braille.
 - 9. As indicated on drawings.
- C. Interior Directional and Informational Signs:
 - 1. Sign Type: Same as room and door signs.
- D. Emergency Evacuation Maps:
 - 1. Provide a minimum of (5) five unless more stringent conditions are indicated on drawings.
 - 2. Map content to be provided by Owner.
 - a. Unless otherwise indicated.
 - 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- E. Building Identification Signs:
 - 1. Use individual metal letters, unless otherwise indicated.
 - 2. Mount on outside wall in location indicated on drawings.
 - 3. Provide manufacturer's recommended drainage system.
 - 4. Conceal all fasteners. Exposed fasteners and anchors are not allowed.
- F. Other Dimensional Letter Signs: Wall-mounted.
 - 1. Locations and types are indicated on drawings.

2.02 SIGN TYPES

- A. Color and Font: Unless otherwise indicated:
 - 1. Character Font: As indicated on drawings.
 - 2. Character Case: As indicated on drawings.
 - 3. Background Color: As indicated on drawings.
 - 4. Character Color: Contrasting color.

2.03 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/4" (6mm)

2.04 DIMENSIONAL LETTERS

- A. Metal Letters: Exterior Building Address Numbers and facility name.
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch minimum (3 mm).
 - a. Unless otherwise required for application.
 - b. Unless indicated differently in drawings.
 - 3. Letter Height: As indicated on drawings.
 - a. Address Numbers: 8" minimum.
 - 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - 1) Unless otherwise indicated on drawings.
 - b. Character Case: Upper case only.
 - 5. Finish: Brushed, satin.
 - 6. Mounting: Concealed screws.

2.05 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Stainless steel.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed stickers or labels are not allowed. If UL stickers are required by AHJ, install where concealed from view.
- C. Install neatly, with horizontal edges level.
- D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- E. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

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**SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Concealed steel support members.
- B. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.
- D. Samples: Submit two samples of partition panels, 6 by 6 inch (152 by 152 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Scranton Products; Eclipse Partitions: www.scrantonproducts.com/#sle.
 - 2. ASI Global Partitions: www.globalpartitions.com.
 - a. Accurate Partitions.
 - 3. Substitutions: Section 01 6000 - Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
 - 1. Color: Single color as selected.
 - 2. Texture: Orange Peel.
 - 3. Doors:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: 24 inch (610 mm).
 - c. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
 - d. Height: 72 inch (1829 mm).
 - 4. Panels:

- a. Thickness: 1 inch (25 mm).
 - b. Height: 72 inch (1829 mm).
 - c. Depth: As indicated on drawings.
- 5. Pilasters:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: As required to fit space; minimum 3 inch (76 mm).
- 6. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Head Rails: Extruded aluminum, anti-grip profile.
 - 1. Size: Manufacturer's standard size.
- C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hinges: Stainless steel; satin finish.
- F. Door Hardware: Stainless steel; satin finish.
 - 1. Door Latch: Slide type with exterior emergency access feature.
 - a. Occupancy indicator.
 - 2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 - 3. Provide door pull for outswinging doors.
- G. Coat Hook with Rubber Bumper: One per compartment, mounted on door.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as instructed by the manufacturer.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
 - 1. Unless smaller clearances are allowed by manufacturer.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

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**SECTION 10 2600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protective wall covering.

1.02 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).
- C. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2014.
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, anchorage details, rough-in measurements, and trim and size limitations.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two samples of protective wall covering and trim, 6 by 6 inches (152 by 152 mm) square.
- E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention, and Installation instructions.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Stock Materials: 100 square feet (9 square meters) of each kind of protective wall covering and door surface protection.
- H. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations

for each type of item.

- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Protective Wall Covering:
 - 1. Basis of Design: Inpro: www.inprocorp.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

- A. Protective Wall Covering:
 - 1. Material: Rigid High-impact sheet.
 - 2. Thickness: 0.040 inch (1.02 mm).
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Color: As indicated on drawings.
 - 5. Accessories: Provide manufacturer's standard color-matched trim and moldings.
 - 6. Mounting: Adhesive.
- B. Adhesives and Primers: As recommended by manufacturer.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as instructed by the manufacturer.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position protective wall covering no less than 1 inch (25.4 mm) above finished floor to allow for floor level variation.
 - 1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
 - a. Center wall covering panels on each wall. Provide equal spacing at each end. Random placement is not allowed.
 - 2. Apply adhesive with 1/8 inch (3.2 mm) V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
 - 3. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
 - 4. At joints indicated to be caulked, allow for a minimum 1/16 inch (1.6 mm) wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project.
 - 5. Use a roller to ensure maximum contact with adhesive.
 - 6. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

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SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Under-lavatory pipe supply covers.
 - 1. Where not specified in other Sections.
- D. Diaper changing stations.
- E. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 10 2113.19 - Plastic Toilet Compartments.
- B. Division 22 - Plumbing: Automatic Soap Dispensers.

1.03 ABBREVIATIONS AND ACRONYMS

- A. PPE: Personal Protective Equipment.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a (Reapproved 2019).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2018, with Editorial Revision (2021).
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
- I. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, reinforcement of toilet partitions, and Work by Owner to receive anchor attachments.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:

1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ASI American Specialties, Inc.: www.americanspecialties.com.
 - b. AJW Architectural Products: www.ajw.com/#sle.
 - c. American Specialties, Inc: www.americanspecialties.com/#sle.
 - d. Bradley Corporation: www.bradleycorp.com/#sle.
 - e. Georgia-Pacific Professional: www.blue-connect.com/#sle.
 - f. Koala Kare Products: www.koalabear.com.
 - g. Kohler: www.us.kohler.com.
 - h. Bobrick: www.bobrick.com
 - i. Gamco: www.gamcousa.com
 - j. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 1. Grind welded joints smooth.
 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Zinc Alloy: Die cast, ASTM B86.
- G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- H. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- I. Adhesive: Two component epoxy type, waterproof.
- J. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- K. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Basis of design as indicated on drawings.
- B. Grab Bars: Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Basis of design as indicated on drawings.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:

1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
3. Construction: 1/8 inch (3.2 mm) flexible PVC.
4. Color: White.
5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.07 DIAPER CHANGING STATIONS

- A. Horizontal Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Material: Stainless steel.
 2. Mounting: Recessed.
 3. Color: As selected.
 4. Minimum Rated Load: 250 pounds (113.4 kg).
 5. Products:
 - a. Substitutions: 01 6000 - Product Requirements.

2.08 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
 1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
 2. Hooks: 3 to 5 as space allows, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 4. Length: Manufacturer's standard length for number of holders/hooks.
 5. Products:
 - a. As indicated in drawings.
 - b. Substitutions: 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Coordinate Owner furnished and installed items and locations with Owner.
- D. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- E. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 1. Other Accessories: As indicated on drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ansul, a Tyco Business: www.ansul.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Nystrom, Inc: www.nystrom.com/#sle.
 - 4. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle.
 - 5. Potter-Roemer: www.potterroemer.com/#sle.
 - 6. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.
- C. Fire Extinguisher Cabinets and Accessories:
 - D. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
 - 4. Nystrom, Inc: www.nystrom.com/#sle.

5. Oval Brand Fire Products; Cabinets for Low Profile Extinguishers:
www.ovalfireproducts.com/#sle.
6. Potter-Roemer: www.potterroemer.com/#sle.
7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 1. Cartridge Operated: Spun shell.
 2. Class: A:B:C type.
 3. Size: 20 pound (9.1 kg).
 - a. Unless larger sizes are required by AHJ.
 4. Size and classification as scheduled.
 5. Finish: Baked polyester powder coat, color as selected.
 6. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 175 degrees F (79.5 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 1. Unless otherwise required for application and location.
 - a. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
 1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
- D. Cabinet Configuration: Semi-recessed type.
 1. Size to accommodate accessories.
 2. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- F. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.
- C. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

3.03 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

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SECTION 10 5129 PHENOLIC LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic lockers.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and project specific details.
- D. Samples: Submit two samples 4 by 4 inches (100 by 100 mm) in size, of each color scheduled.
- E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Phenolic Lockers:
 - 1. Basis-of-design: ASI Storage Solutions; www.asistorage.com.
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Columbia Lockers, a division of PSISC: www.psisc.com/#sle.
 - 2. Scranton Products; www.scrantonproducts.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Student Lockers: Phenolic lockers, free-standing with matching closed base.
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Locker Configuration: Five tier.
 - 3. Fittings: Size and configuration as indicated on drawings.
 - 4. Ventilation: By open space between the back of the door and locker body.
 - 5. Locking: Built-in combination locks.
 - 6. Provide sloped top.

2.03 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 - 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 - 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
 - 4. Provide filler strips where indicated or required for application, securely attached to lockers.
 - 5. Colors: Match Architect's control sample for each type of locker door, body and panel.

6. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
 1. Doors: 1/2 inch (13 mm) minimum thickness.
 2. Locker Body: One of the following combinations:
 - a. Tops, bottoms, and shelves 1/2 inch (13 mm); sides 3/8 inch (10 mm); backs 1/4 inch (6 mm); minimum.
 3. End Panels and Filler Panels: 1/2 inch (13 mm) minimum thickness.
 4. Sloped Tops: 1/2 inch (13 mm) minimum thickness.
 5. Toe Kick Plates: 1/2 inch (13 mm) minimum thickness.
- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
 1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.
- D. Hinges: Stainless steel, black powder coat finish; minimum of 180 degree opening; either exposed barrel 5-knuckle hinge attached to back of door and inside of body with tamperproof screws, or concealed cabinet style hinge attached with tamperproof screws.
- E. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- F. Locks: Locker manufacturer's standard type indicated above.
- G. Lock Strike: Stainless steel, or black high impact ABS plastic strike plate attached to locker body with throughbolts.
- H. Locker Base: Manufacturer's standard base constructed of the same material as locker body..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, sloped tops, and miscellaneous panels.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 7313 AWNINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal awnings.

1.02 RELATED REQUIREMENTS

- A. Section 07 6100 - Sheet Metal Roofing.
- B. Section 07 6200 - Sheet Metal Flashing and Trim.
- C. Section 09 9113 - Exterior Painting: Paint finish on framing members.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Indicate awning profiles, sizes, connection attachments, anchorage, size and type of fasteners, accessories, locations, and transverse cross sections, covering and trim details, and optional installation details to clearly indicate proper assembly of components, sealed by a State Registered Structural Engineer registered in the state in which the work is being performed..
 - 1. Shall include plans and / or elevations and details of the system and its installation. Flashing sealants and anchorage shall be clearly indicated.
 - 2. Shall note gauges of brake metal, the finish on the framing and any other information required to properly describe and install the system.
- D. Selection Samples: Manufacturer's color charts for metal framing and awning panel colors and finishes.
- E. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer registered in the state in which the work is being performed.
- F. Designer's qualification statement.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Executed warranty.
- J. Specimen warranty.

1.05 QUALITY ASSURANCE

- A. Codes and standards: Comply with provisions of the following except as otherwise indicated: Local building codes including the IBC/ASCE 7-10, latest addition with amendments, if any. AWS (American Welding Society) standards for structural aluminum welding.
- B. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- E. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work.
- F. E. Coordination: Coordinate work of this section with work of other sections which interface with covered walkway system (sidewalk, curbs, building fascias, etc.).

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 1 manufacturer warranty for coverage for structural, water tightness and finish beginning the day of Substantial Completion of Installation.. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Awnings:
 - 1. Basis of Design: Duo-Gard Inc: www.duo-gard.com.
 - 2. CEAS+: www.ceasplus.com.
 - 3. Mapes Architectural Canopies: www.mapescanopies.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 AWNINGS - GENERAL

- A. Design Criteria: Design and fabricate to resist the following loads without failure, damage, or permanent deflection:
 - 1. As indicated on drawings
 - 2. Thermal Movement: Plus/minus 1/8 inch (3.175 mm), maximum.
- B. Configuration: As indicated on drawings.
- C. Provide a complete system ready for erection at project site.
- D. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.03 METAL AWNINGS

- A. Description: Flat, sloped, or gabled metal framework with metal covering attached to building exterior over a door or window to protect from sun or rain.
- B. Type: Face-mounted.
- C. Size: As indicated on drawings.
- D. Framework: Aluminum.
- E. Covering Materials:
- F. Internal weep system

2.04 COMPONENTS

- A. Aluminum Framing System:
 - 1. Aluminum Outriggers, Front Bars, Diagonal Supports, Hinged Arms, Mounting Brackets, Shapes, and Plates: ASTM B211/B211M, 6061 alloy, T6 temper.
 - 2. Perimeter framing, bracing and diagonal support arms shall be minimum extruded aluminum, alloy 6063-T5. In profile and thickness as determined by engineering requirements.
- B. Deck: Deck shall be standing seam panels in the thickness specified on the drawings.
- C. Flashing: Flashing shall be .032" aluminum (min.). All thru-wall flashing is completed by others.
- D. E. Fasteners: All exposed fasteners shall be stainless steel.

2.05 FABRICATION - FRAMING

- A. Fit and shop assemble components in largest practical sizes, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Perform welding in accordance with AWS D1.1/D1.1M
- D. All framework connections shall be MIG or TIG welded. Mechanical connections shall be used for panel integration and support members.

2.06 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Finish Color: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Erection shall be performed after all concrete, masonry, and roofing work in the vicinity is complete and cleaned.
- B. Verify that wall substrate anchors are acceptable and are ready to receive work.

3.02 INSTALLATION - FRAMING

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.
- C. Protective cover shall be erected true to line with adequate slope for drainage. Adequate framing members and/or blocking shall be provided in the wall structure (by others) to safely support the canopy.
- D. Provide anchors required for connecting framing to structure. Anchor framing to structure.
- E. Do not field cut or alter structural members without approval.

3.03 INSTALLATION - CANOPY COVERING

- A. Install in accordance with manufacturer's instructions.
- B. Fasten metal covering panels to metal support members, aligned level and plumb.
- C. Install fascia panels, trim, and flashing.
- D. Separate dissimilar metals using concealed bituminous paint.
- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.04 CLEANING

- A. clean all surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

END OF SECTION

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SECTION 10 7500 FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete for flagpole foundation.

1.03 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.
- F. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, and anchor requirements.
- D. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.
- B. Substitutions shall meet or exceed use and material product data of specified products.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flagpoles:
 - 1. Concord American Flagpole: www.concordamericanflagpole.com
 - a. Titan Series - IWW, Internal with Winch - Wire Halyard
 - 2. Approved equal.

2.02 FLAGPOLES

- A. Flagpole, 35 ft Height: Designed in accordance with NAAMM FP 1001
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.
 - 3. Mounting: Ground mounted type.
 - 4. Outside Butt Diameter: 7 inches.
 - 5. Outside Tip Diameter: 3.5 inches.

6. Nominal Wall Thickness: 0.188 inches.
 7. Nominal Height: 35 feet; measured from nominal ground elevation.
 8. Halyard: Interior type.
 9. 1 section.
- B. Performance Requirements:
1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 117 miles/hour wind speed (with flag), in accordance with NAAMM FP 1001.

2.03 ACCESSORIES

- A. Finial Ball:
1. Sized to accommodate specified pole.
- B. Truck Assembly: Stainless steel; revolving, stainless steel ball bearings, non-fouling.
- C. Flags: at 35 ft pole:
1. State of Oklahoma, 6 ft by 10 ft size, 2-ply polyester fabric, brass grommets, hemmed edges.
 2. Cherokee Nation, 6 ft by 10 ft size, 2-ply polyester fabric, brass grommets, hemmed edges.
- D. Flush access door with keyed lock, continuous piano hinge, manually operated winch (positive locking at any position), and removable winch handle.
- E. Halyard: stainless steel aircraft cable.
- F. Counterweights: size and quantity as recommended by the manufacturer to accommodate pole and flag.
- G. Flagsnaps: stainless steel, size and quantity as recommended by the manufacturer to accommodate flag.
- H. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.
- I. Collar: Heavy duty cast aluminum flash collar; finish to match pole.

2.04 OPERATORS

- A. Stainless steel winch assembly with handle and lockable door.

2.05 MOUNTING COMPONENTS

- A. Ground Sleeve and Galvanized Steel Base Plate with Ground Spike per manufacturer's requirements.

2.06 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Aluminum: Anodized clear, dark bronze, or black - submit samples for review.
- C. Finial: to be selected from manufacturer's full range of finish options.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper execution of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

- A. Coordinate as required with other trades to assume proper interface with the work of this Section.
- B. Install concrete foundation per manufacturer's instructions.

- C. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- D. Upon completion of the installation, touch-up all scratches and abrasions to be completely invisible to the unaided eye.

3.04 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

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SECTION 11 3013 RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Kitchen appliances.
- B. Laundry appliances.

1.02 RELATED REQUIREMENTS

- A. Division 22 - Plumbing: Plumbing connections for appliances.
- B. Division 23 - Mechanical: Mechanical connections and exhaust hoods for appliances.
- C. Division 26 - Electrical: Electrical connections for appliances.

1.03 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard warranty.
- C. Provide five (5) year manufacturer warranty on laundry appliances.
- D. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- E. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refrigerator, Type Full Size: Free-standing, bottom-mounted freezer, and cycle-defrost.
 - 1. Capacity: Total minimum storage of 18 cubic ft (0.51 cu m); minimum 20 percent freezer capacity.
 - 2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
 - 3. Features: Include glass shelves, light in freezer compartment, and LED lighting.
 - 4. Exterior Finish: Stainless steel, color as indicated.
 - 5. Manufacturers:
 - a. As indicated on drawings.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Under-Counter Refrigerator, Type ADA-Compliant: Free-standing.
 - 1. Size: 24" wide.
 - 2. Capacity: 4.8 cubic ft.
 - 3. Style: Solid Door Model.

4. Exterior Finish: stainless steel.
5. Manufacturers:
 - a. As indicated on drawings
 - b. Substitutions: See Section 016000-Product Requirements.
- D. Under-Counter Ice Machine
 1. Size: 15" wide
 2. Capacity: 30 lbs
 3. Production: 90lbs per 24 hours
 4. Manufacturers:
 - a. As indicated on drawings
 - b. Substitutions: See Section 016000-Product Requirements.
- E. Microwave: Integral with casework as indicated on drawings at accessible mounting height.
 1. Capacity: 2 cubic ft (0.05 cu m).
 2. Power: 1000 watts.
 3. Features: Include turntable and as accessories as required for application.
 4. Exterior Finish: Stainless steel.
 5. Manufacturers:
 - a. As indicated on drawings.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- F. Waste Disposer: Standard type, overload protection, direct wired, dishwasher connection, drain elbow, drain connector, and sound reduction features.
- G. Provide the following, unless otherwise indicated on Plumbing and / or Electrical drawings:
 1. Power: 1 HP.
 2. Capacity: Large.
 3. Height: 14-1/2 inch (368 mm).
 4. Depth: 8-1/2 inch (216 mm).
 5. Controls: Wall switch.
 - a. Voltage: 115 volts, 60 Hz, 4 amps.

2.02 LAUNDRY APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Clothes Washer, Type Free standing: Front-loading.
 1. Size: Large capacity.
 2. Controls: Solid state electronic.
 3. Cycles: Include normal, permanent press, delicate, soak, and automatic soak.
 4. Motor Speed: Single-speed.
 5. Features: Include optional second rinse, bleach dispenser, fabric softener dispenser, self-cleaning lint filter, sound insulation, and end of cycle signal.
 6. Finish: Painted steel, color as selected.
 7. Manufacturers:
 - a. As indicated on drawings.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Clothes Dryer, Type Free standing: Front-loading: Electric, stationary.
 1. Size: Large capacity.
 2. Controls: Solid state electronic, with temperature-sensing dry control.
 3. Temperature Selections: Three.
 4. Cycles: Include normal, permanent press, knit/delicate, and air only.
 5. Features: Include interior light, reversible door, stationary rack, sound insulation, and end of cycle signal.
 6. Finish: Painted steel, color as selected.
 7. Manufacturers:
 - a. As indicated on drawings.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.03 ADJUSTING

- A. Adjust equipment to provide efficient operation.

3.04 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

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FOODSERVICE DESIGN PROFESSIONALS

SECTION 11 40 00 FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Documents, apply to the Work specified in this Section.

1.2 SUMMARY OF THE WORK

- A. Project Name and Location: CN Catoosa Child Development Center (CDC)
Catoosa, OK
- B. Approval of Working Surface: any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory conditions. Beginning of work by any contractor shall constitute acceptance of the previous work.
- C. Checking Dimensions at Site: before ordering any materials or doing any work, verify all measurements of the building and be responsible for the accuracy of them. No extras will be allowed for variations from drawings in existing conditions or for work performed under this contract. Any discrepancies found shall be submitted to the Architect or Foodservice Consultant for instructions before proceeding.
- D. Cutting and Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the written approval of the Architect. Each Contractor shall leave all chases and openings straight, true and of the proper size in his work as may be necessary for the proper installation of his and other contractors' work. After such work has been installed, he shall carefully fit around, close up, repair, patch and point up same as directed, to the entire satisfaction of the Architect.
- E. Cooperation: The General Contractor, all other contractors and all subcontractors shall coordinate their work with all adjacent work and shall cooperate with all other trades to facilitate the general progress of the work. Each trade shall afford all the other trades every reasonable opportunity for installation of their work and storage of their material.
- F. Inspection and Tests: Architect, Owner, Foodservice Consultant and their representative shall at all times have access to the work whether it is in preparation or progress. Provide proper and safe facilities for such access and inspection.
- G. Fees, Permits and Inspections: secure and pay fees for all permits, licenses and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, codes, rules, regulations and contract requirements bearing on the work.

1.3 SCOPE

- A. Include the Work specified, shown or reasonably inferable as part of Foodservice Equipment. Portions of this Work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.
- B. The General Contractor is responsible for Related Work specified in other Sections: i.e. final plumbing, electrical and mechanical connections. The Foodservice Equipment Contractor is responsible for all internal connections when specified.

- C. Specifications and drawings have been prepared to form the basis for procurement, erection, startup and adjustment of all equipment in this contract. Plans and specifications shall be considered as mutually explanatory and work required by one, but not by the other, shall be performed as though required by both. Items required by one, but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings, so that all items of equipment shall be completely functional for purpose for which they were designed. Provide all necessary material, tools, equipment and labor required for the complete installation. When there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Architect/Consultant prior to bidding.
- D. Should the drawings disagree in themselves, or the specifications with the drawings, the better quality, more stringent, and/or greater quantity of the work or materials shall be completed without additional costs to the Owner.

1.4 OTHER DIVISIONS/CONTRACTORS RELATED WORK

A. Division 03 (Concrete) is responsible for but not limited to:

- 1. Slab depressions reinforced concrete wearing bed at prefabricated cold storage assemblies.
- 2. Concrete or masonry platforms (with a finished top and coved base at the perimeter) for the raised setting of food service equipment.
- 3. Slab depressions to receive stainless steel drain trench liner/grate assemblies (provided under this Section).

B. Division 09 (Finishes) responsible for but not limited to:

- 1. Interior finished floor with a coved base at prefabricated cold storage assemblies.

C. Division 10 (Specialties) responsible for but not limited to:

- 1. S/S Corner Guards throughout the kitchen (unless specified otherwise).
- 2. Lockers.

D. Division 22 (Plumbing) is responsible for but not limited to:

- 1. All connections shall follow local codes and national standards, except where plans and specifications exceed those codes and standards.
- 2. Empty PVC and wide-sweep bends for refrigerant piping to beverage lines, Co2 lines, and remote food service equipment refrigeration systems.
- 3. Rough-in and final connection of plumbing systems to food service equipment and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 22. This includes but is not limited to the installation of all faucets (water fill faucets, pre-rinse faucets, etc.), hoses, gas disconnects, and drains from the equipment point of connection to building plumbing systems.
 - a. Kitchen Equipment Contractor is responsible for providing all faucets (water fill faucets, pre-rinse faucets, etc.), drain fittings, mixing valves, control valves, water pressure regulators, vacuum breakers, and all accessories for equipment specified under 11 40 00. Division 22 is responsible for installation.
- 4. Indirect drain line runs from the equipment to the nearest drain or floor sink—lines to be type 'K' Copper.

FOODSERVICE DESIGN PROFESSIONALS

5. If any plumbing accessories or fittings are provided loose with equipment by 11 40 00, Div. 22 is to attach to equipment and provide final connection.
6. Gas Supply Systems with all components and fittings required for a complete system.
7. Water Supply Systems with all components and fittings required for a complete system.
8. Compressed Air Systems with all components and fittings required for a complete system.
9. Piping and Drainage Systems (Sanitary and grease laden). Systems are to be cleaned before the final connection with food service equipment.
10. Floor Sinks (Provide and Install). Flange and grates to be flush with the finished floor.
11. Floor Drains (Provide and Install). Flange and grates to be flush with the finished floor.
12. Trench Drains (Provide and Install). Trench Liners provided by 11 40 00. Flange and liners to be flush with the finished floor.
13. Grease Traps as required (Size, Provide, Locate, and Install). Verify with local codes to bypass or pipe thru Grease Trap and/or Interceptor.
14. P-Traps as required (including all disposers).
15. Interconnect water thru Water Filter (Filter provided by 11 40 00 unless otherwise specified) to equipment.
16. Gas Quick Disconnect Installation (Quick Disconnect provided by 11 40 00).
17. Safety Restraint Cable Installation (Safety Restraint Cable Provided by 11 40 00).
18. Specified couplings and piping to all equipment furnished by 11 40 00.
19. Air Compressors (Size, Provide, and Install unless otherwise specified).
20. Water Softeners (Size, Provide, and Install unless otherwise specified).
21. Pressure Boilers (Size, Provide, and Install unless otherwise specified).
22. Hand Sinks (Provide (unless otherwise specified) and Install). Provide a hot water tempering valve if required. Water temperature to be at least 100 degrees and flow for at least 20 seconds.
23. Ice Bin Drain Insulation (Provide and Install).
24. Unions at disposer solenoid valves (Provide and Install).
25. Back Flow Prevention as required (Provide and Install - including all disposers). Back- Siphonage shall be installed at all fixtures and equipment where backflow and/or back-siphonage may occur and where a minimum air gap cannot be provided between the water to the fixture or equipment at its flood/level rim. When furnished with equipment, vacuum breakers shall override the above if acceptable with applicable codes. Division 22 is responsible for verifying requirements with local codes.
26. Janitor Sink with Faucet (Provide and Install).
27. Freeze Proof Hose Bibb at the exterior of the building by receiving door (Provide and Install - unless otherwise specified).
28. Reverse Osmosis Systems (Size, Provide (unless otherwise specified), Locate, and Install).
29. All piping within the counter body or under fabricated counters must be run to a connection point below the counter body by Section 11 40 00—final connection by Division 22.
30. Exhaust Hood condensate drain connections (Provide and Install).
31. Interconnection of ½" CW to Pre-Rinse and Disposers cone/body inlets piped through the solenoid and vacuum breaker.
32. Fire System Piping. The exposed piping is to be chrome plated.
33. Pipe ½" cold water to swirl inlets at disposers.
34. Water Treatment for Ice Builders (Non-Chlorinated water with a PH Level of 10 or Higher) and any drains and overflows. Piping from Ice Builders to Tumble Chillers by Div. 23.
35. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

E. Division 23 (Mechanical) responsible for but not limited to:

1. All connections shall follow local codes and national standards, except where plans and specifications exceed those codes and standards.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Rough-in and final connection of mechanical systems to food service equipment, cold storage assemblies, and between components (including materials and labor).
4. A mechanical contractor will test and balance rooms and exhaust hoods. **Balance report for food service Exhaust Hoods to be provided to Foodservice Design Professionals (FDP) immediately upon completion (send to Dallas.Submittal@fdp.org) and must be submitted with O&M manuals.**
5. Exhaust Hoods, Condensate Hoods, Fire Suppression Systems, connections, and controls (Provide and Install – unless otherwise specified). Provide tempered air at all supply ducts.
 - a. If Exhaust/Condensate Hoods and Fire Suppression Systems are specified under Section 11 40 00, Division 23 is responsible for all Exhaust and Condensate Hood connections (Provide and Install).
6. VFD System and controllers when required by code (Provide and Install).
7. Provide and install all ventilation (direct or indirect), air conditioning, and heating systems (unless otherwise specified).
8. Coordinate Supply and Return ducts above Serving Counters. Cold air is not to blow directly on hot food counters or open-air refrigerated merchandisers.
9. Coordinate Supply and Return ducts away from equipment with top-mounted refrigeration. Air is not to blow directly on compressors.
10. Mechanical Contractor to locate temperature monitors within return ducts.
11. Circulating air above cold storage assemblies (Provide and Install).
12. Circulating air above and in air gaps at Warehouse cold storage assemblies (Provide and Install).
13. Water Chillers as required (Provide, Size, and Locate).
14. Piping from Ice Builders to Tumble Chillers (Size, Provide and Install).
15. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

F. Division 26 (Electrical) responsible for but not limited to:

1. Rough-in and final connection of electrical systems to food service equipment, cold storage assemblies, and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 26.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Empty EMT Conduit with pull-wire and wide-sweep bends for interconnect cables between LAN and POS terminals, change-makers, pre-check units, printers, CPUs, etc. Division 26 to verify where the conduit will run for POS System (i.e., Manager's Office or IDF Room).
4. Empty EMT Conduit with pull-wire and wide-sweep bends for fire suppression systems. Interconnect the Fire Protection System to panel box shunt trips and building alarms.
5. Cold Storage Assembly Light Fixture Installation (Provided loose by Section 11 40 00).
6. Table Limit Switch Installation (Provided loose by Section 11 40 00).
7. Electrical Materials and Devices (Shunt-trip breakers, surge protectors, lighting control devices, conduit, wire, etc.).
8. Switches and Stainless Steel Disconnects as required (Provide, Locate, and Install – to be in an accessible location).

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9. Charging Stations for Forklifts, Pallet Stackers, and Pallet Jacks (Size, Provide, Locate, and Install).
10. Interconnection between Condensate Fan and Dishmachine control panel.
11. Interconnection between Exhaust Hood fans and switch.
12. Interconnection between Exhaust Hood lights and switch.
13. Door Heaters, Lights, Coils, and Heated Pressure Relief Ports pre-wired to the junction box at the top of cold storage assemblies provided by Section 11 40 00— final connection by Div. 26.
14. If any electrical accessories, fittings, and cord/plugs are provided loose with equipment by 11 40 00, Div. 26 is to attach to equipment and provide final connection.
15. Provide waterproof receptacles in wet areas.
16. All electrical connections beneath Exhaust Hoods to extend to shunt trip breakers with electrical panel box for shutdown during fire mode.
17. Receptacles will be pre-wired to Junction Box or Load Center for final connection by Division 26.
18. All electrical lighting, power, and distribution systems.
19. Do not interconnect more than three (3) convenience outlets on one (1) breaker.
20. Other than convenience outlets, all electrical connections on food service plans are dedicated breakers.
21. Doorbell at receiving door (Provide and Install –audible throughout Kitchen, Office, and Dry Storage room).
22. Adequate lighting at receiving door.
23. Dedicated circuit for heated drain line connection in Walk-In Freezer (120/1/16.0 Amp) at each coil.
24. Provide and install (2) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. One (1) to be located in the Kitchen above Walk-In Freezer door (or Cooler door when Freezer is within Cooler in an 'inline' assembly), and One (1) to be located in the Cafetorium (Coordinate location with Owners). Provide all conduit and wiring required, and interconnect the illuminated Push Button Panic Alarm in the Walk-In Freezer to both Strobe Beacons (Critical). Coordinate with Division 27.
25. Refer to Section 2.5, ELECTRICAL REQUIREMENTS, for additional information.

G. Division 27 (Communication) responsible for but not limited to:

1. Data line coordination for food service equipment.
2. Time clocks.
3. Video cameras for learning assistance in food service areas as required (Provide, Locate, and Install).
4. Provide conduit, data line, and interconnect the illuminated Push Button Panic Alarm inside the Walk-In Freezer to the Building Automation System (BAS). When activated, facility personnel are to be notified - coordinate notification requirements with the Owner (Critical). Coordinate with Division 26.

H. Division 28 (Electronic Safety and Security) is responsible for but not limited to:

1. Security Cameras as required (Provide, Locate, and Install).
2. Interconnection of Entrapment Panic Alarm for Cold Storage Assembly to the main Building Alarm System that will notify the person designated by the Owner that the Entrapment Panic Alarm has been activated (**Critical**).

I. General Contractor responsible for but not limited to:

1. Any wall penetration required for food service equipment utilities. Escutcheon plates or S/S sleeves are to be provided and installed as needed.

2. Bulk Freezer Ventilation Pipe (Provide and Install unless otherwise specified).
3. Core drilling for Guide Rails.
4. Refrigeration Roof Curbs / Roof Jack.
5. Interior Bollards – to be epoxy painted per local codes (Provide and Install).
6. Provide and Install ¾" Plywood blocking in the wall for mounting equipment furnished by Section 11 40 00 as required.
7. Cold Storage Assembly Depressions (to be dead level) and sand leveling bed.
8. Structural bracing for Bulk Cold Storage Assembly ceiling panels if required.
9. Menu System Video Monitors in Server (unless otherwise specified).
10. Structural bracing for Menu System Video Monitors if required.
11. Interior/Exterior refrigeration penetrations and sleeves at building penetrations.
12. Door Scope viewer (peephole) with wide viewing angle at receiving door.
13. Canopy at receiving door. Coordinate height with the height of Receiving Door (8') and the mounting height of Air Screen above the door.
14. Soap and towel dispenser provided by Owner. G.C. is responsible for installation.
15. Washer and Dryer (Provide and Install, unless otherwise specified).
16. Dwarf wall at exposed front/ends of cafeteria serving counters with the finish as selected by the Architect.
17. Final cleaning of all equipment before demonstrations.

1.5 QUALITY ASSURANCE

- A. In addition to complying with all applicable laws, statutes, building codes and regulations of public authorities, comply with the following:
 1. National Sanitation Foundation (all equipment to bear label).
 2. National Electric Code.
 3. Underwriters' Laboratories, Inc. (all applicable equipment to bear label).
 4. CSA certified (all applicable equipment to bear label)
 5. American Gas Association Laboratories.
 6. National Fire Protection Association.
 7. Americans with Disabilities Act.
 8. Food and Drug Administration HACCP Guidelines.
 9. International Energy Conservation Code(IECC).
 10. Department of Energy.
 11. Environmental Protection Agency
- B. Furnish certification of regularly manufactured equipment listing or classification by Underwriter's Laboratories, Inc. with initial submittal.
- C. Furnish list of equipment and components (internal and external) that are not of domestic origin. All equipment and components (internal and external) should be of domestic origin when possible. This information should be provided with the initial submittal.
- D. Projects outside the continental United States shall adhere to all local authorities having jurisdiction over that project.

1.6 SUBSTITUTIONS

- A. Equipment items or components specified are intended to be the Basis of Bid. All other brands, including any additional names, which may be listed as "Alternates" or "Approved Equal," must conform with the specifications, size, accessories, function, etc. of the first-named brand and be subject to Paragraph C-03 of this Article.
- B. Proposed Substitutions:

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1. Submitted no less than 14 calendar days prior to Bid Date.
2. Submit proposed substitutions with catalog data and/or manufacturer's shop details indicating all modifications required to conform with specified brand.
3. List of deviations must include listing of equipment name, model number, accessories and features with deviation(s) noted for both specified and proposed alternate equipment. Equipment without listed deviation(s) will be considered to be furnished as specified.

C. Substitutions with prior approval:

1. Submitted on Bidder's letterhead attached to Proposal Form with individual additive/deductive amounts stipulated and the documentation required in Paragraph B02.
 2. Owner reserves the right to accept or reject any or all substitution proposals before execution of Contract.
 3. Provide all design/engineering services required to make adjustments in space, systems, utilities, etc. and pay all additional costs of utilities, construction or professional services that may be incurred due to the acceptance of any substitution.
- D. All appliances within common group or category (e.g., refrigerators, kettles, ovens, etc.): same manufacturer.

1.7 INTERPRETATION OF DOCUMENTS

- A. During Bidding: contractor's, supplier's or vendor's questions and comments pertaining to Construction Document's clarity or intent will be addressed by addendum.
- B. Subsequent to Award:
1. Confirmation of Construction Document requirements will be provided by Clarification Bulletin.
 2. Request for Information Bulletins submitted by Contractor: contain Contractor's proposed resolution.

1.8 WARRANTY

- A. Provide a written warranty for a period of one year from the date of Substantial Completion, including extended four-year replacement warranty on compressor bodies.
- B. Components of equipment subject to replacement prior to one-year's use (such as refrigerator door gaskets) and those items which may fail due to improper or inadequate periodic maintenance by the Owner/Operator (such as an uncleaned refrigeration system condenser) are not intended to be included within the scope of the Warranty.
- C. Refrigeration Systems/Equipment: one-year free service available within twenty-four hours of notification.
- D. Furnish three copies of a list of all equipment and their respective local service agencies, indicating the address, telephone number and name of person to contact. Whenever possible, the service agencies selected shall be factory-authorized for the equipment assigned.
- E. Provide following for refrigeration systems/equipment, unless specified otherwise:
1. One (1) year free service available within twenty-four hours of notification, for refrigeration systems.

2. Provide five (5) year manufacturer's registered written replacement, warranty certificate, covering compressor bodies. Warranty to cover labor costs for first year.
3. Provide ten (10) year manufacturer's registered written replacement/repair, warranty certificate, covering walk-in panels. Warranty to cover defects in material and workmanship. Warranty to cover labor costs for first year.
4. Provide two (2) year parts and labor warranty for **all parts/components (including third-party components that may be utilized)** of the refrigeration system(s) **(including freon)**, cold storage cooler(s), and freezer(s) not otherwise covered herein.

F. **All above-stated warranty periods are from the date of Substantial Completion.** All replacement parts due to a warranty call should be the same quality as the original, or better if the original were defective. Replacement parts should be of a domestic origin where possible.

1.9 SUBMITTAL DATA

A. Special Requirements: the following are in addition to any general requirements given elsewhere in the Documents.

B. Submittal Requirements:

1. Kitchen Equipment Contractor to furnish all submittals via PDF, drawings to be scaled per General Specifications and provided in Three (3) submittal packages.
2. Foodservice Design Professionals requires the below listed business days for each package submitted. Packages to be submitted with 14 days between each issued package.
 - a. Package One: 10 Business Days
 - i. Equipment rough-in
 - ii. Equipment Brochure
 - b. Package Two: 10 Business Days
 - i. Exhaust Hood
 - ii. Cold Storage Assembly
 - iii. Refrigeration
 - c. Package Three: 15 Business Days
 - i. Custom Fabrication
 - ii. Serving Counter
 - iii. Merchandising Equipment
 - iv. Miscellaneous submittals

C. Submittals to be identified with the below listed file name structure:

- i. 11 4000-1 EQUIPMENT BROCHURE
- ii. 11 4000-2 EQUIPMENT ROUGH-IN PLANS
- iii. 11 4000-3 CUSTOM FABRICATION
- iv. 11 4000-4 SERVING COUNTER
- v. 11 4000-5 EXHAUST HOODS
- vi. 11 4000-6 COLD STORAGE ASSEMBLY
- vii. 11 4000-7 REFRIGERATION
- viii. 11 4000-8 BEVERAGE MERCHANDISER

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- D. Package One (1) requires both submittals-Brochure and Rough-in plans. If not sent together, submittal will be rejected.
- E. All submittals will be notated in RED, architect, and general contractor to be colored per their direction.
- F. If hard copy submittals are required, kitchen contractor to furnish all hard copies as required to the specified trades.
- G. If discrepancies, missing information, or incorrect information occur within the documents, kitchen contractor to seek clarification or clearly notate on submittals the need for further direction. Kitchen contractor is to bid the higher of the discrepancy. Per General specifications (Section 1.3. Scope subparagraph D)..
- H. Brochure Format (for regularly-manufactured equipment and components):
 - 1. Front and rear protective cover with labeled project name.
 - 2. Brochure index: indicate functional Area/Room number, item number, quantity, description and manufacturer.
 - 3. A separate flysheet for each component or item of equipment, indicating: item number, name, quantity, manufacturer, optional equipment, modifications, special instructions and utility requirements. An item of equipment or assembly containing more than one buyout sub-assembly or component shall have the secondary item listed in parenthesis beside the primary item name. For example: Serving Counter (hot food well).
 - 4. Catalog specification sheet and manufacturer's drawing.
- I. Shop Drawings (Rough-In Drawings):
 - 1. Separate drawing sheets: same size as Contract Drawings (Contract Drawings are not to be traced or reproduced). Submittal drawings are to be provided by Kitchen Equipment Contractor and not reproduced from Contract Documents. Any reproduced submittal drawings will be rejected.
 - 2. 1/4" scale drawing of fixed/movable Foodservice Equipment and pre-fabricated Cold Storage Assemblies with itemized schedules.
 - 3. Special Conditions Drawings, sizing and locating the following conditions:
 - a. Slab depressions, cores, sleeves or block-outs (cold storage assemblies, drain trenches, piping, etc.).
 - b. Concrete or masonry platforms.
 - c. Pipe sleeves or roof jacks.
 - d. Wall-openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.
 - e. Blocking grounds or anchor plates required in walls for equipment support/attachment.
 - f. Above-ceiling hanger assemblies for support of exhaust hoods, utensil-racks, etc.
 - g. Access panels in walls or ceiling for service of equipment.
 - h. Ceiling pockets or recesses for unusually high equipment.
 - i. In-wall carriers for wall-hung or cantilevered equipment.
 - 4. Electrical rough-in drawing.
 - 5. Plumbing/mechanical rough-in drawing.
 - 6. Required information:
 - a. All fixed and movable Foodservice Equipment shown on Contract Drawings.

- b. All prefabricated Cold Storage Assemblies and Conveyor/Dishtable Assemblies shown on Contract Drawings.
- c. All general-use and convenience utilities or services indicated on Contract Drawings, including those required by or connected to equipment or devices not in this Section.
- d. All rough-in drawings: fully dimensioned from engineering benchmark (column lines, when provided) and finished-room surface to point of stub-up through floor and stub-out through wall or ceiling for all mechanical, electrical and plumbing services.
- e. Connection number/tag system and symbols: identical to Contract Drawings.

J. Shop Drawings (Manufacturer's and Fabricator's):

- 1. Sheet Size: identical to Contract Drawings, drawn or plotted at $\frac{3}{4}$ " scale for plan view and elevations; $1\frac{1}{2}$ " scale for sections and construction details.
- 2. Included information: item number, name and quantity.
- 3. Construction details, sections and elevations to reflect requirements of the Specifications and Drawings.
- 2. Indicate adjacent walls, columns and equipment.
- 3. Indicate plumbing and electrical schematic drawings for equipment such as: conveyors, waste systems, self-cleaning exhaust hoods, exhaust hood fire protection systems and fabricated fixtures with single electrical or plumbing connection.
- 4. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer, including panel size and location to permit easy lubrication, adjustment or replacement of all moving parts.

- K. All equipment and engineering rough-in plans sheet numbers are to match the contract documents. All equipment item no.'s and engineer item no.'s located on the schedules are to match the contract documents. All engineering requirements are to be updated as required to accommodate the provided equipment and/or match the contract documents. The Kitchen Contractor is responsible for the coordination of any MEP revisions to accommodate the provided and proposed equipment. The kitchen contractor is responsible for any costs associated with equipment substitution.
- L. FDP drawings and schedules are not to be copied in anyway. Any replicated drawings of FDP will be rejected.

1.10 SERVICE MANUAL

- A. Three copies bound in $1\frac{1}{2}$ " hardback, three-ring binders (as many volumes as required by scope of project) with same data as brochure at completion of installation (Refer to "Submittal Data"). Provide separate service manuals as required for each independent area within the project scope (Main Kitchen, Culinary, Concession, etc.).
- B. Each Volume: section for maintenance of finish materials (e.g., stainless steel, plastic laminates, FRP, Plexiglas, etc.).
- C. Catalog specification sheet and/or manufacturer's shop drawings.
- D. Each Volume: index of items, manufacturer's operating/maintenance information, replacement parts data and price lists. Provide the name, title and address of personnel at each respective manufacturer to be contacted for spare/replacement parts after warranty period.

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- E. To the extent possible, provide two copies of manufacturer's video instructional cassettes for operating, maintenance and service of equipment.
- F. Internally subdivide binder contents with permanent page dividers, logically organized by equipment item number or manufacturer name, with tab titling clearly printed under reinforced laminated plastic tabs.
- G. Electronically submitted manuals are required to follow the same formatting requirements listed above.

1.11 VERIFICATION AND COORDINATION OF PROJECT / DATA

- A. Utilities Rough-in Drawings and Field-Services within four weeks after receipt of notice-to-proceed, review Contract Drawings and Submittal Data for accuracy and completeness and notify Architect of conflicts and proposed adjustments. Coordinate work with other sub-contractors.
 - a. KEC to provide on-site field verification of all underground utilities prior to pouring of concrete for capacity and location, coordinate with General Contractor. Submit review to Architect and General Contractor.
 - b. KEC to provide on-site field verification of all other utility connections and locations, coordinate with General Contractor. Submit review to Architect and General Contractor.
- B. ON-SITE INSPECTION REPORTS
 - a. Prior to concrete pour. (KEC to submit a copy of the report below to the Architect, General Contractor and Foodservice Consultant within 24 hours of the inspection.)
 - b. Prior to delivery of equipment. (KEC to submit a copy of the report below to the Architect, General Contractor, and Foodservice Consultant with-in 24 hours of the inspection.)



On - Site Inspection Report
Prior to Concrete Pour

Inspection Date _____ Project Name _____

Project Location _____

Inspector's Name _____ Company _____

Inspector's Contact Number _____ Email _____

Architectural Firm _____ Project Architect _____

Architect's Contact Number _____ Email _____

General Contractor _____ Project Manager _____

G.C. Contact Number _____ Email _____

Foodservice Consultant **FDP**
Consultant Number - Dallas 972-245-5300
Consultant Number - Houston 281-350-2323

Project Manager _____
Email _____

An on-site inspection to verify the location of underground utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory. Neither the Architect nor the Kitchen Consultant need to be present at any of the inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE CONSULTANT.

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On - Site Inspection Report Prior to Delivery of Equipment

Inspection Date _____ Project Name _____

Project Location _____

Inspector's Name _____ Company _____

Inspector's Contact Number _____ Email _____

Architectural Firm _____ Project Architect _____

Architect's Contact Number _____ Email _____

General Contractor _____ Project Manager _____

G.C. Contact Number _____ Email _____

Foodservice Consultant **FDP** Project Manager _____

Consultant Number - Dallas **972-245-5300**

Consultant Number - Houston **281-350-2323**

Email _____

An on-site Inspection to verify the location of installed utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory. Neither the Architect nor the Kitchen Consultant need to be present at any of the inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE CONSULTANT.

- C. Review critical systems/components for application, performance and capacity and submit calculation worksheets with initial submission of brochure/rough-in drawings, with all proposed adjustments noted, including:
 1. Exhaust hood removal/supply air volume, velocity, static pressure, duct collar sizes and locations.
 2. Refrigeration Systems (compressor, condenser and evaporator) capacities/sizes, quantities and refrigerant piping distances/sizes.
 3. Exhaust Hood Fire Suppression Systems (nozzle locations, air handler and fuel interlocks, piping/distance limitations).
 4. Locations of Vacuum Breakers.
 5. Conformance of Refrigerated Components/Equipment with HACCP Guidelines (e.g., salad/sandwich pans, upright/open refrigerator cabinets, salad bars) with HACCP Guidelines.
 6. Gas, water line sizes and manifold configurations.
 7. Diameter and length of flexible connector lines for fixed/movable gas appliances.
 8. Fabricated Equipment load center panels (individual and total amperage calculations and circuit balance).
 9. ADA compliance of workstations, service positions, passageways, etc.
- D. Ceiling mounted appliances/fixtures: verify and coordinate dimensions/location of support framing/hangers with General Contractor. All material and installation below 12'-0" aff.: Section 11 4000.
- E. Dimension Responsibility: obtain actual or guaranteed measurements for proper fit of equipment. All dimensions indicated in Contract Documents are approximate and are as accurate as can be determined at the time. Field-check all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment and notify the Architect of all conflicts or deviation from the dimensions shown.
- F. Checking Dimensions at Site: before ordering any materials or doing any work, verify all measurements of the building and be responsible for the correctness of them. No extras will be allowed for variations from drawings in existing conditions or for work performed under this contract. Any discrepancies found shall be submitted to the Architect for instructions before proceeding.
- G. Scheduling to Fit Openings: Should it become necessary to schedule the construction of walls or partitions before delivery of fixed equipment, the equipment must be fabricated for passage through finished openings. Maintain close contact with the project and be cognizant of all conditions, including vertical handling limitations within the building (elevator cabs or openings, stairs, etc.) and possible hoisting requirements. Coordinate all procedures with General Contractor and Project Team.
- H. Refrigerated and Dry Storage Areas: verify and coordinate dimensions to accommodate scheduled modular shelf sections. Notify Architect of variance between the Contract Documents and actual conditions.
- I. Color/Pattern Selections: submit selection samples of solid polymer products, plastic laminate, paint or stain finishes and vinyl-coated surface material of equipment as selected by Owner.
- J. Movable Equipment Interface: rolling stock (pan racks, carts, dollies, dish/tray/rack dispensers) required to fit through or into fixed equipment (roll-in refrigerators, counter bodies, etc.) is to be reviewed and coordinated for compatibility at time initial of shop drawing submittal. Indicate conflicts and proposed adjustments.

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- K. Relocation of Work: relocate or re-route work as required to coordinate related items free of charge if no extra work is involved.
- L. Contractor must provide an Itemized Schedule of Values that correlates with the foodservice equipment item numbers for verification prior to submittals being submitted.

1.12 EQUIPMENT FURNISHED / INSTALLED BY OTHERS

- A. Obtain and coordinate utility requirements of Owner-Furnished/Owner-Installed (OF/OI) equipment with the building utilities and roughing-in drawings/provisions.
- B. Coordinate physical data of OF/OI appliances or equipment and incorporate information into Submittal Drawings. Vendor- or Purveyor-Furnished equipment (e.g., coffee/tea equipment): same as OF/OI.

1.13 WORK INSTALLED BUT FURNISHED BY OTHERS

- A. Coordinate delivery/installation schedule of Owner-Furnished/Contractor-Installed (OF/CI) equipment with Owner not less than ninety (90) days before equipment requirement.
- B. Obtain and coordinate utility requirements of OF/CI equipment with the building utilities and roughing-in drawings/provisions.
- C. Receive at job-site and fully incorporate into installation procedures as if furnished under this Section.

PART 2 - PRODUCTS

2.1 FABRICATED FIXTURES MATERIAL / COMPONENTS

- A. Stainless steel sheets or shapes: 18-8, Type 302, polished to 180 grit No. 4 finish.
 - 1. Stainless steel joints and seams: heli-arc welded, free of pits and flaws, ground smooth and polished to No. 4 finish.
 - 2. The "grain" direction of horizontal stainless-steel surfaces: longitudinal, including the backsplash. The polishing procedure at right-angle corners of fixtures shall provide a mitered appearance.
- B. Galvanized Iron Sheets: Armco copper bearing Zinc Grip or Zinc Grip/Paint Grip.
 - 1. Galvanized iron joints and seams: arc-welded, free of pits and flaws and ground smooth.
 - 2. Galvanized sheets or shapes: washed with mineral spirits and painted with Rustoleum gray semi-gloss enamel.
- C. Sound Deadening: Schnee Butyl Sealant ½" wide rope positioned continuously between all frame-members or contact material and underside of stainless steel surface (sinks, table tops, food wells, overshelves and undershelves). Tighten stud-bolts for maximum compression of sealant and trim excess.
- D. Plastic Laminates: color/pattern selected by Architect, in 1/16" thickness for flat surfaces: 1/32" thickness for radiused surfaces. Plastic laminates and adhesives must be N.S.F. approved (Standard No. 35).

- E. Solid Polymer products: color/pattern/material as selected by Architect in thickness as specified. Solid Polymer and adhesives must be N.S.F. approved (Standard No. 51).
- F. Casters.
 - 1. Fabricated fixtures with "Open Base" construction: Jarvis and Jarvis Model No. 5-405-113P-NSF swivel casters with grease seals on forks and wheels; Zerk fitting in swivel; two casters: Model No. E-75 Vertilock brakes. All casters: B-7" rolling bumpers with stainless steel top discs.
- G. Cutting Boards: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated.
- H. Identification Plates, Labels, Tags:
 - 1. Prohibited Information: names of suppliers, fabricators and contractors.
 - 3. NSF Labels: required on all pieces of equipment.
 - 4. Required Information: function or purpose of controls such as display light switches, food warmer controls, etc.
 - 5. Plate Construction: engraved phenolic plastic, secured to equipment with epoxy cement or stainless-steel screws. Furnish samples.

2.2 PLUMBING / MECHANICAL REQUIREMENTS

- A. Plumbing Fittings and Components: furnished under this Section as follows:

Note: Fitting and components described in Items 1, 2, 3, 4 and 5 are furnished loose for installation by Division 22.

- 1. Control valves, appliance pressure regulators for water, gas and steam, and vacuum breakers: wherever required on Foodservice Equipment (chrome-plated where exposed).
- 2. Faucets and drains without connected overflows (unless otherwise indicated) for all sinks.
- 3. Specialty Foodservice water-fill faucets or hose assemblies indicated in drawings/specifications.
- 4. Wade Model No. W-10 Shock-Stop shock absorbers for all Foodservice Equipment with quick-opening or solenoid-operated water valves.
- 5. Dormont Stainless Steel Water Quick Disconnect hose, diameter per water connection size requirements, with SafetyQuick safety fitting, w/coiled restraining device, full port ball valve, antimicrobial coating, lifetime warranty.
- 6. Extensions of indirect waste fittings to open-sight floor sink or floor drains from sinks, under bar equipment, and food-holding components of serving counters (e.g. cold pans, hot food wells, refrigerator/freezer coils not equipped with condensate evaporators) furnished and installed by Division 22. Drains: painted with aluminum paint where exposed, type "K" copper where concealed.
- 7. Piping brackets and supports beneath/within fabricated equipment.
- 8. Closed Base Bodies: removable 18-gauge stainless steel closure panel at plumbing penetrations, under top.
- 9. Control valves on Open Base fixtures: mounted on 14-gauge stainless steel gusset-shaped panel with 3 1/2" setback from counter top edge/rim to face of control handle.
- 10. Fill hose/faucet at support pedestals or Closed Base Body: installed in a 15" x 18" x 5" deep recessed mounting panel. Panel bottom: sloped on a 60o angle, with 3/8" stainless steel rod hanger-bracket for hose.
- 11. In-line water filter system:

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- a. 3M or Everpure System filters for coffee/tea brewers, icemakers, water chillers, convection steamers and beverage systems. Sized per manufacturer recommendation.
- B. Gas-Heated Equipment Fittings and Components: furnished under this Section as follows:
 1. Fixed Equipment: Dormont MFG brand "KITCF" Series gas hose kit with Quick Disconnect fitting at appliance. Approved equal: T&S Brass. Diameter per fuel volume/connection size requirements. Gas valve diameter size per fuel volume/connection size requirements.
 - a. Restraining device: heavy duty steel cable, fastened to equipment and walls, 3" to 6" shorter than equipment connector length.
- C. Final Plumbing Connections Provisions.
 1. Fabricated equipment containing components, fittings and/or devices indicated on Foodservice Connection Drawings to be connected to the building systems: each component, fitting or group thereof pre-piped to a utility compartment for final connection by Division 22. Refer to drawings for capacities.
 2. Field-assembled equipment (e.g., prefabricated walk-in refrigerator/freezers, exhaust hoods, warewash machines, convection ovens, etc.): plumbing components completely interconnected under this Section for final connection arrangements indicated on Utility Connection Drawings.
 3. All plumbing final connection points of equipment shall be tagged, indicating:
 - a. Item number.
 - b. Name of devices or components.
 - c. Type of utility (water, gas, steam, drain, chilled water).
- D. Ducts and Vents.
 1. Exhaust hoods which are furred-in to ceiling: 2" high duct collar for final connection to duct system.
 2. Warewash machines equipped with integral vent cowls or extended hoods: furnished with 18-gauge stainless steel seamless duct risers to 6" above finish ceiling for final connection. The duct: trimmed at ceiling with 16-gauge stainless steel angle flange with all corners welded.

2.3 FOODSERVICE EQUIPMENT REFRIGERATION SYSTEMS

- A. Install complete with all refrigerant, oil, dials, dehydrators, gauges, controls required for the proper operation of the system.
- B. Self-contained or factory-installed compressors: check and adjust to proper operating temperature prescribed by FDA/HACCP.

2.4 PLUMBING TRIM

- A. Faucets: furnished for all sinks or equipment requiring open water supply.
- B. Fill Faucets: furnished for appliances requiring open water supply.
- C. Drain Fittings: furnished for all sinks or equipment requiring removal of liquids. Install specified chrome-plated or stainless-steel fittings in die-stamped openings with washers

and locknuts. Solder may be used as a sealer but shall not be applied to the top surface of the drain fittings.

2.5 ELECTRICAL REQUIREMENTS

- A. All electrical systems, components and accessories within the work of this Section: certified to be in accordance with NEC 70.
- B. Electrical Fittings and Components: furnished under this Section as follows. Coordinate foodservice equipment loads, voltage and phase with building system and confirm any existing or OF/OI equipment requirements.
- C. Cord and Caps.
 - 1. Coordinate all Foodservice Equipment cord/caps with related receptacles.
 - 2. All 120 volt "plug-in" equipment shall have Type SO or SJO cord and plug with ground wire fastened to frame/body of item.
 - 3. Cord lengths for fixed equipment: adjusted to eliminate loose-hanging excess.
 - 4. All non-fixed plug-in "buy-out" equipment: Hubbell configuration, ratings as required.
 - 5. All mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutters, toasters, coffee makers, microwave ovens, etc.): 8'-0" cord length with cord-hanger strap secured to rear of equipment or mobile stand.
- D. Switches and Controls.
 - 1. Each motor-driven appliance or electrically heated unit: equipped with control switch or starter per Underwriters' Laboratories, Inc. with low-voltage and overload protection.
 - 2. Disposer controls recess-mounted in wall: external fittings and accessories removed from enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 4'-0" aff to bottom of enclosure.
 - 3. Disposer controls recess-mounted in counter-splash risers: external fittings and accessories removed from NEMA 4 enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 3'-0" aff to bottom of enclosure. Provide panel with 60" long coil of Seal-Tite electrical conduit, from bottom of control panel for final field connections under Division 26.
 - 4. Equipment which is not provided with built-in circuit breakers or fused terminal block and is indicated on Utility Connections Drawings to be directly-connected to the building electrical system: a NEMA 4 stainless steel disconnect switch furnished and installed by Division 26.
 - 5. All remote manual starters, disconnect switches, magnetic contactors or starters and push-button stations: NEMA Type 4 enclosure; NEMA Type 1 enclosure only when installed in a Closed Base Body.
- E. Heating Elements.
 - 1. Electrically-heated equipment: thermostatic controls.
 - 2. Water heating equipment: equipped with positive low water shut-off.
 - a. Receptacles and Switches.
 - 3. Receptacles installed in vertical panels of support pedestals or Closed Base Bodies: installed in 12" x 8½" x 3" deep recessed mounting panel sloped on 60o angle and turned up to top of opening.

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4. Pre-wire receptacles in closed base fixtures to a junction box installed within 6" from bottom of utility or compressor compartments.
5. Receptacles mounted on Open Base fixtures: installed on 12" x 10½" x 4½" deep 14-gauge stainless steel panel with returned ends and sloping recess. Secure panel to underframe of fixture top.
6. Pre-wire receptacles on open base fixtures to a junction box secured to a leg or mounted on underside of lower shelf. Vertical runs of wiring: made in rigid conduit or within the tubular leg.
7. Receptacles installed in/on-fabricated equipment: Hubbell, Inc. assemblies horizontally-mounted in a metal box with stainless steel cover plate.
8. Switches installed in/on-fabricated equipment: Hubbell, Inc. with metal box and stainless-steel cover plate. Switches: pre-wired to the controlled device and to a junction box installed within 6" from bottom of utility or compressor compartment. All refrigeration system switches: installed within the compressor compartment near the door opening.
9. Load centers installed in/on fabricated equipment to have all fixture components pre-wired to load center with balanced phase loading. Load center: ready for final connection by Division 26 and flush-mounted within utility compartment rear panel, set back 8" from access door. All breaker/device information: typewritten on circuit schedule in load center door (number corresponding breaker/device) with enclosed schematic wiring diagram of fixture components.
10. All receptacles to be pre-wired to cord and plug assembly and routed through oversheaf post at all island equipment locations, unless specified otherwise.

F. Light Fixtures.

1. Light fixtures with lamps installed in/on fabricated or field-assembled equipment: pre-wired to a junction box for final connection (continuous-run fixtures when indicated).
2. LED Display Light: install light fixtures full-length of Display Stand and Serving Shelf with stud bolts and pre-wire through support posts to an apron-mounted switch.
3. Heat Lamps: installed to underside of serving shelf assemblies. When multiple 24" heat lamps are specified, provide maximum length heat lamp chassis. Install all switches remote from lamps.
4. Cold Storage Light Fixtures: Furnished by Section 11 4000 and installed by Div. 26. All electrical wiring and conduit provided by Div. 26. electrically connected through the Vapor proof light fixture base connection, located on the interior door header. Door frame wiring stubs out top of panels 8" in flexible conduit for final connection by electrical contractor. All horizontal conduit: above ceiling panels. Install plastic sleeve through ceiling panels for electrical conduit. Seal sleeved penetrations airtight at both sides of panel. All penetrations to be sealed by Kitchen Equipment Contractor. All Cold Storage light fixtures to be LED.

G. Final Electrical Connection Provisions.

1. Fabricated equipment containing electrically-operated components or fittings indicated on Utility Connections Drawings: direct-connected, with each component, fitting or group pre-wired to a junction box for final connection by Division 26. Refer to drawings for circuit loading.
2. Fabricated equipment containing electrically-operated components and/or devices indicated: circuit-breaker load center with each component or device pre-wired to a separate circuit breaker for balanced phase loading and single final connection by Division 26.
3. Field-assembled equipment (e.g., prefabricated cold storage assemblies, exhaust hoods, warewash machines, etc.) shall have electrical components completely

interconnected in this Section for final connection arrangements as indicated on Utility Connection Drawings by Division 26.

4. Pre-wire the following groups of cold storage assembly electrical devices to a top-mounted junction box for final connection by Division 26 per compartment grouping (unless otherwise indicated).
 - b. Light fixtures and switches; heated pressure-relief vent.
 - c. Door/jamb heaters.
 - d. Evaporator fans, defrost elements and drain line heaters.
 2. All electrical final connection points of equipment shall be tagged, indicating:
 - a. Item number.
 - b. Name of devices on circuit.
 - c. Total electrical load.
 - d. Voltage and phase.
- H. Lamps: in all Foodservice Equipment containing light fixtures. Refrigerator or heated cabinets: All exposed LED lamps above or within a food zone: Shat-R-Shield lamps or standard lamps, sleeved with end caps.

2.6 CUSTOM - FABRICATED / ASSEMBLED UNITS

- A. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer. The service access panel(s) size and placement is to permit easy lubrication, adjustment or replacement of all moving parts and is to be indicated on fabrication shop drawings.

2.7 BAKER TABLE TOPS (Unless specified otherwise)

- A. 14-gauge 304 S/S top with 2" square turn down at front, 6" high enclosed splash at three (3) sides and rear. Brace same as "Counter/Table tops".
- B. 1¼" x 6" high integral coved riser at rear and ends unless indicated otherwise on drawings.
- C. 16-gauge stainless steel flour-trough at free long sides, secured to underside of top. Trough: 3" diameter with eased edges/corners.

2.8 COUNTER / TABLE TOPS

- A. 14-gauge stainless steel; all free edges turned down 2" with ¾" tight hem at bottom. Free corners: rounded on ¾" radius.
- B. Marine edges: turned up ½" on 45° angle and turned down 2" with ¾" tight hem at bottom.
- C. Cafeteria serving counter tops at hot food stations: full-length x 3½" x ½" high raised rail at (customer's) front side with 45° integral turndown to counter surface.
- D. Tops abutting high fixtures or walls: cove up specified height and slope back 1½" at top on 45° angle; 2½" slope where piping occurs. Turn down 1" at rear of splash and close ends to bottom of top turndown. Secure splash turndown to wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall, 36" o.c.
- E. Freestanding tables and all serving counter splash-risers: turned back on 90° angle with 1" turndown at rear.
- F. Brace tops with rigid-welded 1½" x 1½" x 1/8" galvanized steel angle frame at perimeter with cross bracing 2'-0" o.c. maximum. Provide 4" x 4" x 12-gauge stainless steel triangular pads where leg gusset welds to frame. Paint entire frame with Rustoleum gray

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semi-gloss enamel. Angle frames: secured to underside of top surfaces with $\frac{1}{4}$ " studs welded 9" o.c. maximum with chrome-plated washer, lock washer and capnut. Studs: such length that cap nuts can be made-up tight, bringing top down snugly on angle frame eliminating all vibrations or "oil-canning".

- G. Tops: $1\frac{1}{2}$ " overhang at free sides of underframe or Closed Base Body.
- H. Mockett Model No. SG5-26 chrome-plated/plastic grommet assembly or integrally-welded stainless-steel flange or inverted gusset where service utilities or support posts penetrate or abut tops, ground and polished to match top. When conditions permit, provide a 1" x $1\frac{1}{2}$ " rectangular opening in the backsplash for service utilities in lieu of piercing the horizontal surface. Install stainless steel split-tubing at raw-edge of opening.
- I. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on leg/bracket assembly.
- J. All openings in tops: $\frac{3}{16}$ " high raised die-formed edges.
- K. All top openings for pans or inserts: 20-gauge stainless steel, watertight liners, $8\frac{1}{2}$ " deep, secured to underside of counter top.
- L. All "built-in" and "drop-in" counter equipment/appliances: with framing members at perimeter of opening.
- M. Scrap Container: 18-gauge stainless steel construction $6\frac{1}{2}$ " x $6\frac{1}{2}$ " x $21\frac{3}{4}$ " long. Top of container: $\frac{5}{8}$ " wide x $\frac{1}{4}$ " high full perimeter flange with $\frac{1}{4}$ " diameter stainless steel rod bail handle. Interior vertical corners coved on $\frac{1}{2}$ " radius. Counter top: fitted with $6\frac{3}{4}$ " square die-stamped opening.

2.9 COLD PANS

- A. 14-gauge stainless steel with $\frac{3}{4}$ " coved interior welded integrally to counter top with $\frac{3}{16}$ " raised edge at perimeter of opening. Depth of Cold Pan: NSF 7 compliance.
- B. Slope bottom to required quantity of Component Hardware Model No. E16-4021 drain fittings at 48" o.c. maximum. Sleeve through insulation at drain fittings and extend common drain line into utility compartment for indirect waste connection.
- C. $\frac{1}{2}$ " o.d. copper refrigerant lines in serpentine pattern, $1\frac{1}{2}$ " o.c. flattened for maximum contact. Secure tubing to underside of $\frac{1}{4}$ " thick aluminum "distribution plate" installed tight to underside of frost plate area and apply cold-conductive mastic to all surfaces.
- D. Component Hardware Model No. E16-4021 drain fittings at 48" o.c. maximum, sleeved through insulation with common drain line extended into utility compartment.
- E. Heat Cable: low-wattage, full-perimeter, below counter top at edge of depression. Secure with "Z" clips, 9" o.c. and interwire with compressor switch for simultaneous operation.
- F. Enclose sides and bottom of pans with airtight 18-gauge galvanized jacket and pack with 2" fiberglass insulation set in mastic.
- G. Compressor: size as indicated or required to accommodate size of cold pan. Locate compressor in compressor compartment below unit or as indicated on drawings.

- H. Sectional 16-gauge stainless steel perforated false bottom ($\frac{1}{4}$ " holes, @ $\frac{3}{4}$ " o.c.). Turn down $1\frac{1}{2}$ " all sides, weld corners and provide finger rings. False bottom sections: 24" long maximum.

2.10 DRAWERS

- A. Liners: Component Hardware Model No. S81-2020C (20" x 20") S/S liner, easily removable with drawer in fully extended position.
- B. Drawer Frame: 16-gauge stainless steel flanged out at top. Weld the frame to double-paneled 16-gauge stainless steel drawer front with full-length recessed pull at top (similar profile as Garco Model No. R-1060) with closed ends.
- C. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at front and ends with $\frac{1}{2}$ " tight hem. Front edge of pull: flush with face of drawer. Recess behind pull: sloped up on 60° angle, terminating 1" below bottom edge of pull.
- D. Mount drawer frame on Component Hardware Model No. S52-2020 self-closing slides, with Delrin bearings, full-depth of fixture. Secure slides to body or brackets to eliminate lateral movement in extended position. Refrigerator drawers: Component Hardware Model No. S52-2024 stainless steel slides with Delrin bearings.
- E. Drawer enclosure in an Open Base Fixture: 18-gauge stainless steel flanged out at top for attachment to underside of table top. Lower edge of enclosure is flanged in toward open bottom. Mount drawer slides to enclosure and brace as required. Face of enclosure is to be same length and height of drawer face. Provide $\frac{3}{4}$ " deep offset in front of enclosure and $2\frac{1}{2}$ " from underside of table top for flush-fitting appearance. Drawer enclosure on freestanding fixture: full-depth of table framing.
- F. Drawer enclosure in a Closed Base Fixture: completely partitioned from adjoining area. Drawer front: flush-fitting with face of body.
- G. Drawer Liners other than tool/utility: **Bread Drawer:** S/S drawer liners sized to fit drawer; **Refrigerated Drawer:** S/S drawer liners sized to fit drawer.
- H. Cash Drawer: integral stainless steel body, 3" deep.

2.11 FOOD WELLS (UNLESS SPECIFIED OTHERWISE)

- A. Food Warmer Controls: remote-mounted in sloping recessed apron panel. Control panel is recessed $2\frac{1}{2}$ " from bodyline at top of 60° slope, 1" at lower edge. Terminate slope angle $2\frac{1}{2}$ " below counter top. Mount panel on concealed piano hinge at bottom edge; secure with screws at upper corners.
- B. Manifold all warmer drains and extend to within utility compartment for indirect waste connection. Install valve in drain line and extend handle through compartment door.
- C. Removable 18-gauge stainless steel closure panel at underside of warmers.
- D. 14-gauge stainless steel plate/utensil shelf full-length of hot food station unless noted otherwise: 10" below counter top x 9" deep, with rear panel coved up to underside of counter top; end panels turned up square. Front of shelf: turned down $1\frac{1}{2}$ " and returned under for closure panel attachment.

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- E. Food wells: Hatco Model No. HWBIBRT-FULD insulated food warmer (1200 watts, 208 volts, single phase) secured to underside of 12" x 20" die-stamped counter top openings with thermal breaker mastic rope applied at perimeter of food well flange.
- F. F. Soup Warmers: Hatco Model No. HWB-11QTD soup warmer secured to underside of 11" diameter die stamped counter top opening with thermal breaker mastic rope applied at perimeter of soup well flange. Maximum allowable temperature of counter top at contact surface: 120oF. Each warmer: equipped with one 11-quart stainless steel round insert and slotted cover.
- G. When specified: 5/8" deep recess in counter top full-length of pan-opening or as shown, with equal-length removable 3/4" thick Read Products "Richlite" cutting board sections, 42" long maximum. Recess and board: spaced 2" from front edge of pan opening and extended to leading edge of counter top.

2.12 SINKS

- A. 14-gauge stainless steel; all interior corners (horizontal/vertical) coved on 3/4" radius. 1 1/2" wide double-walled partitions with flat tops between compartments.
- B. Continuous exterior panels of multiple-compartment sinks: 14-gauge stainless steel filler panel welded, ground and polished between compartments.
- C. Sinks (with overflow): score and slope sink bottom 1/2" to die-stamped opening fitted with Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. 14-gauge stainless steel bracket: welded to sink bottom for drain stem with 1 1/2" handle clearance.
- D. Where sinks are installed in fixture with Closed Base Body, provide a Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. (Sinks with dimension larger than 20" x 20" in Closed Base Body will not have overflow fitting.) 14-gauge stainless steel bracket: welded to sink bottom with T & S Model No. BL-4740-1 guide bushing. Install on shortened drain stem, one T & S Model No. BL-4710-1 remote control stem assembly only (length as required) with Model No. 113-L universal joint and white blank button. Set drain control handle in Cambro Model PSB-6 bowl with bottom omitted (dress raw edge) to permit passage of drain handle. Secure bowl in utility compartment door or body panel with clear silicone.
- E. When single-hole deck-mounted faucets are specified, install overflow fitting in sidewall of sink compartment and provide ell-fitting in connecting tubing.
- F. Flush Covers when specified: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated. Support clips: 1/4" stainless steel rod 2" long, formed at 45° with two 3/4" leg ends (1/4" long threaded ends). Insert rod-clips through tight-clearance holes in sink, seal watertight and secure with stainless steel acorn-nuts or tack-weld at exterior of sink wall. Set support clips 1/2" below top. Provide 14-gauge stainless steel channel or angle support frame to store covers when not in use. Cover holder: adjacent to sink compartment, below counter top or under drawer assembly.

2.13 TRAYSLIDES (UNLESS OTHERWISE SPECIFIED)

- A. Trayslides: 12" wide, solid 16-gauge stainless steel turned up 2" at rear behind counter top turndown; turned down 4" at front and free ends, unless otherwise indicated.
- B. Three 1/4" high die-formed inverted "vee" ridges at 4" o.c., 2" from leading edge, terminating 2" from ends of trayslide with tapered ridge-ends.

- C. Ridges formed on radius: equal-length segments with 2" separation between chords.
- D. Secure trayslides to counter-top/body frame, same as "Counter Tops." Enclose exposed underside of trayslide with 18-gauge stainless steel.
- E. When indicated, project trayslides 2" beyond serving counter top and return the full-width of serving counter at free ends.
- F. All trayslides to be provided and mounted per ADA requirements.

2.14 DISHTABLES

- A. Soiled/clean dishtable: 14-gauge stainless steel; free edges coved up 3" with 1½" diameter rolled rim and bullnosed corners.
- B. Edge of dishtables next to high fixtures or walls: coved up 10" and sloped back 1½" on 45° angle; 2½" slope where piping occurs. Turn down 1" at rear of splash and secure to wall with 4" long 14-gauge stainless steel "Z" clips anchored to wall, @ 36" o.c.
- C. Exposed rear splash: 16-gauge stainless steel finish panel from top of splash to bottom edge of rolled rim with welded vertical joint at end. Secure panel with concealed attachment and install bracing 24" o.c.
- D. Cove all interior corners (horizontal/vertical) on ¾" radius and slope tables 1/8" per foot to sinks, scuppers or warewash machines, maintaining level crown/splash.
- E. Brace dishtables with 1" x 4" 12-gauge stainless steel channels down centerline of top and between each pair of legs, with closed ends. Bracing: secured to underside of dishtable with ¼" studs welded 6" o.c. maximum, with chrome-plated washer, lock washer and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel-members, eliminating all vibration and "oil-canning."
- F. Integrally-welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops; ground and polished to match top.
- G. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.
- H. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on leg/bracket assembly.
- I. Paper-Drop Opening: 9" square with 4" integral chute having hemmed bottom edge. Slope dishtable top 1" toward opening, forming a 16" square tapered deposit point.
- J. Accessible Tray-Drop Opening: 10" x 18" with integral 16-gauge stainless steel seamless chute sloped on 45° angle toward center of mobile soak sink position.

2.15 DISH / TRAY DEPOSIT ASSEMBLY

- A. 14-gauge stainless steel deposit shelf, size as indicated. Extend shelf through opening, flush with public side of partition, height as required by local code authorities. Turn shelf down 1" at front with ¾" return at bottom (either scribed into partition or forming reveal). Shelf: 1" square turndown at rear long side, integral with conveyor slider pan, tray-accumulator or dishtable. Extend rear/end splash to align with head of deposit station

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opening. Modify rolled rim at the operator's side of the tray drop window to have a 3" rolled rim.

- B. 18-gauge stainless steel window frame with perimeter flange channel-formed 1" x 3/4" at both sides of wall. Weld all corners of frame and install with concealed attachment. Align/about one jamb of frame with end splash of conveyor slider pan or dishtable whenever adjacent.

2.16 UTENSIL - WASH COUNTERS

- A. 14-gauge stainless steel; all free edges coved up 3" with 1 1/2" diameter rolled rim and bullnosed corners.
- B. Edges of utensil-wash counters next to high fixtures or walls: coved up 10" and sloped back 1 1/2" on 45° angle; 2 1/2" slope where piping occurs. Turn down 1" at rear of splash and secure back splash to wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall @ 36" o.c. Vacuum breaker pockets: 4" long square turnback sections, aligned with slope breakline.
- C. Exposed Rear Splash: 16-gauge stainless steel finished panel from top of splash to bottom edge of rolled rim with welded vertical joint at end of splash and 1/2" turnback at bottom of panel. Secure panel with concealed attachment and install bracing 24" o.c.
- D. Cove all interior corners (horizontal/vertical) on 3/4" radius and slope tables 1/8" per foot, maintaining level crown.
- E. Brace utensil-wash counters with 1" x 4" 12-gauge stainless steel channels down centerline of top and between each pair of legs, with closed ends. Bracing: secured to underside of dishtable with 1/4" studs welded 6" o.c. maximum, with chrome-plated washer, lock washer and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel-members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops: ground and polished to match top.
- G. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on a leg/bracket assembly.
- H. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose-hanger.

2.17 DOORS

- A. 18-gauge x 1" stainless steel double pan-formed welded construction, insulated with 1" thick polyurethane boards. Seal perimeter joint of pans. Offset lower horizontal framing member of Closed Base Body to align flush access door with bottom of Body.
- B. Channel-formed full-length horizontal recessed pull: 3/4" turndown at front and ends with 1/2" tight hem. Front edge of pull: flush with face of door. Recess behind pull: sloped up on 60° angle and terminated 1" below bottom edge of pull.
- C. Door Hardware:
 - 1. Two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge location).
 - 2. Component Hardware Model No. 35-2000 concealed Magnetic Catch.

3. Component Hardware Model No. D30-4780 lock in upper free corner of door.
- D. Louvered opening: cutout opening size as indicated, turn in 1" and weld. All corners: ground and polished.
1. Full-height 18-gauge stainless steel louver with 1" vanes at 45°, ½" spacing. Perimeter channel-formed frame: 1½" x 1".
 2. 45° x 1" x ½" x opening width plus ½" 18-gauge stainless steel louver.
 3. Tack weld tab of louver flange to back panel of door.
- E. Drain handle opening: 6" diameter hole through double pan to accommodate Cambro Model No. PSB-6 Bowl.
1. Secure bowl to door panel with clear silicone.
 2. Omit bottom of bowl. Dress raw edges of opening for passage of drain handle.
 3. Exposed insulation at penetration of door pan: painted black.
- F. Sliding Doors: fabricate same as Paragraph "A."
1. Aluminum Sliding Door Track: Component Hardware Model No. B57-0000 Series, length as required. Secure to angle frame at top of underside.
 2. Front/rear door sheaves: stainless steel ¾" side mounted door hangers; two (2) required per door.
 4. Recessed Vertical Pull at Upper Corner of Door: Component Hardware Model No. P63-1012.
 5. By-Passing Door Guides secured to bottom shelf: Component Hardware Model No. B62-1093.
 6. Door Stop at bottom edge of door: Component Hardware Model No. B60-1086.
- G. Offset lower horizontal framing member of Closed Base Body/utility compressor compartment to align door flush with bottom of Body.

2.18 CLOSED BASE BODIES

- A. Frame: rigid-welded 1½" x 1½" x 1/8" galvanized steel angle forming a continuous structure around the top and bottom perimeters of the fixture, a post at each corner, studs spaced 48" o.c. maximum. Top of frame is cross-braced with 1½" angles, 2'-0" o.c. maximum.
- B. 18-gauge stainless steel panels and trim with concealed attachment. All seams: welded, ground and polished.
- C. Exposed Vertical Corners: rounded on ¾" radius. Closed Base Bodies adjacent to walls or fixtures: square corners.
- D. Vertical and horizontal channel members at shelf interior or drawer enclosures, such as corners and center mullions: closed and sealed
- E. Closed Base Bodies set on finished masonry platforms: closed and caulked at underside of equipment overhang and bolted to platform. Body overhang of platform: 1" at free ends 2" at front and exposed rear sides.
- F. Closed Base Bodies not set on platform: Component Hardware Model No. A54-2-6, 6" legs spaced 5'-0" o.c. maximum.

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2.19 COMPRESSOR COMPARTMENTS

- A. Same material as Closed Base Bodies with back and end partitions; omit bottoms only.
- B. 10-gauge steel slide out support: channel frame on full extension slides with 125 lb. minimum capacity secured to fixture frame with anti-vibration mountings for maximum sound deadening. Closed Base Body on solid platform: front-to-back slide out support channels set 4" above bottom for air circulation.
- C. Access Door: 18-gauge stainless steel double-pan type with channel formed horizontal recessed pull full length of top (similar profile as Garco Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at front and face of door. Recess behind pull slopes up on 60° angle, terminating 1" below bottom edge of pull. Offset lower horizontal framing member of Closed Base Body to align flush access door with bottom of body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. Access Doors Louver: full-height, with $1\frac{1}{2}$ " x 1" x 18-gauge stainless steel channel-formed frame with welded corners. 18-gauge stainless steel louver. Submit sample of design for approval.

2.20 UTILITY COMPARTMENTS

- A. Closed Base Bodies or Pedestal Supports: fitted with utility compartments wherever piping or wiring is required in/on the fixture.
- B. Same material as Closed Base Bodies with full-height back and end partitions. Omit bottoms except at hose-reel locations.
- C. Access Doors: 18-gauge stainless steel double-pan type with channel formed horizontal recessed pull full-length of top (similar profile to Garco Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turn down at front of door, recess behind pull slopes up on 60° angle, terminating 1" below bottom edge of pull. Offset the lower horizontal framing member of the Closed Base Fixture to permit flush alignment of door with face and bottom edge of body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and one Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. No shelves of Closed Base Fixtures are to be penetrated.

2.21 UTENSIL RACKS

- A. Rack: $\frac{1}{4}$ " x 2" 300 series stainless steel flat bar with No. 4 finish, fully welded and formed to match shape shown on drawings. Lowest band: 7-6 aff, unless otherwise indicated.
- B. Ceiling Mount Supports: 1-5/8" diameter 16-gauge stainless steel tubing from band to 18" above ceiling. Anti-sway bracing above ceiling: $1\frac{1}{2}$ " unistrut members. Tubing penetrations at ceiling: Component Hardware Model No. A16-0206 stainless steel gussets.
- C. Table Mount Supports: 1-5/8" diameter 16-gauge stainless steel tubing extended thru counter top. Secure to closed base framing or crossrail/undershelf on open base fixture. Tubing penetrations of counter tops: integrally welded stainless steel inverted gusset.

- D. Utensil Rack Hooks: Component Hardware Model No. J77-4401 stainless steel hooks spaced 8" o.c. maximum.
- E. Electrical Receptacle: NEMA No. 5-20-R or as noted. Mount in fully welded 3½" x 5½" x 3" 14-gauge stainless steel enclosure with ½" radius corners. Stainless steel cover plate to fit specified receptacle. Pre-wire thru tubular support for final connection above ceiling by Division 26.

2.22 CASHIER / SERVING COUNTERS

- A. Exterior Body Panels when specified: ¾" thick marine grade hardwood plywood with plastic laminate or solid polymer in Architect's selection of color/pattern at all exposed surfaces; backing sheet where concealed.
- B. Position, size and finish horizontal or vertical reveal as directed by Architect.
- C. Secure panels to counter body framing in concealed manner. Install removable panels with "Z" clips overlapping body framing members.
- D. Hinged doors in exterior body panel(s): Grass Model No. 1200VZ or 1200VZ8 self-closing hinges. Three (3) required per door; Grass Model No. G/HRZ base plate at each hinge; Ives Model No. TM820 concealed push latch at each door. Confirm Model No. and provide samples with submittal.
- F. Cashier counter to have 16-gauge s/s intermediate shelf, turned down 1 1/2" with tight hem at front. Cove up 2" at rear and sides. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at longitudinal centerline. Provide outlet for power/data within body located above intermediate shelf. Provide cash drawer inserts per district standards.

2.23 OPEN BASE STRUCTURES

- A. 1-5/8" o.d. x 16-gauge seamless stainless-steel tubing legs beveled at bottom. 1¼" o.d. crossrails fully-welded (360o smooth and polished) to legs at 10" aff, o.c.
- B. Top of Leg: inserted in Component Hardware Model No. A20-0206 gusset fully-welded to table frame or sink bottom.
- C. Bullet Foot: Component Hardware Model No. A10-0851.
- D. Freestanding fixtures requiring utility connections: Component Hardware Model No. A10-0854 flanged feet at the fixture corners, anchored to floor with non-corrosive bolts.
- E. Table Bases: maximum leg spacing of 6'-0" o.c.; dishtable and utensil wash counter bases at 5'-0" o.c.
- G. Open Base equipment specified to be supported by brackets at the rear side only (not completely cantilevered): tubular legs at front side only with Component Hardware Model No. A10-0854 flanged feet anchored to floor with non-corrosive bolts. Front-to-back crossrail: fitted into Component Hardware Model No. A20-0406 circular gusset secured to wall with non-corrosive bolts.

2.24 UNDERSHELVES

- A. Open Base Structures: 16-gauge stainless steel turned down 1½" with tight hem at bottom. Notch all corners to fit tubular legs and weld from underside to completely fill gap; grind and polish. Cove up 2" at rear or ends adjacent to wall, columns, refrigerators, etc. The

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turn up at freestanding fixtures is to be hemmed tight to bottom of turndown. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at longitudinal centerline and at each intermediate pair of legs.

- B. Open Base Structure specified to be supported by brackets at rear side only (not completely cantilevered): 16-gauge stainless steel turned down 1 ½" at free sides with tight hem at bottom edge. Notch all corners to fit tubular legs as required and weld from underside to completely fill gap; grind and polish. Cove up 2" at rear ends, as indicated. Fill gap at front to back rail, grind and polish. Brace undershelf with 1" x 4" x 1" 14-gauge stainless steel channel at longitudinal centerline between front to back rails.
- C. Closed Base Fixtures: 16-gauge stainless steel turned down 1 ½" at front. Front edge of bottom shelf: turned back and sealed to finished masonry platform or boxed for leg application. Center shelf has ¾" tight hem.
 - 1. Shelves: turn up square at ends (coved up at rear only) to the shelf above or counter top flanged out for attachment with no open spaces at interior.
 - 2. All shelf partitions at exposed ends of cabinet bodies or interiors: free of exposed framing members.
 - 3. Reinforce shelves with full-length 1" x 4" x 14-gauge stainless steel closed hat channel.
 - 4. Unless otherwise noted, all closed base undershelves are to be 22" deep, clear.
 - 5. Fully weld smooth and polish, the vertical seam of shelf turndown/turn up with face of body partition.
 - 6. Seal the vertical seam of square turn-in at exposed interior of open shelf sections.

2.25 ANCHOR PLATES / WOOD GROUNDS

- A. Behind finish surface wherever building wall, partitions or ceiling construction will not accommodate direct attachment of equipment such as overshelves, wall cabinets, hose reels, utensil racks, exhaust hoods, display cases, etc. Material and installation by General Contractor. Location and coordination with trades by Section 11 4000.
- B. Anchor Plates: not less than 12" x 12" x ¼" thick steel, secured to the structure above or behind the finished surface, positioned at attachment points.
- D. Wood Grounds: length required by fixture, component or device, 24" wide x ¾" thick plywood secured to partition system prior to gypsum board installation.
- E. Above ceiling supports: structural shapes (4" x 8.0 lb. channel) suspended from structure. Maximum height 15'-0" aff. size: width of equipment x length of equipment plus 6'-0". Cross bracing at 6'-0" on center maximum.

2.26 OVERSHELVES

- A. 16-gauge stainless steel with free edges turned down 1" with ½" tight hem at bottom. ¾" radius at free corners.
- B. Turn up 2" raw at walls and sides with horizontal coved corner at rear. Round front corners of turn up on ¾" radius.
- C. Where shelf width exceeds 12" width, reinforce with ½" x 4" x 14-gauge stainless steel closed hat channel full-length of shelf.
- D. Wall-Mounted Shelves: 16-gauge stainless steel brackets 48" o.c. maximum, set in 6" from ends.

- E. Freestanding Shelves: where splash is required at free overshelves, turn up square 2" at ends, cove up at rear and hem tight to lower edge of front turndown. Weld exposed corners.
 - 1. Freestanding overshelves: 16-gauge stainless steel cantilevered brackets at rear of table; double-cantilevered brackets at center of table. Posts for cantilevered overshelves are 1-5/8" o.d. x 16-gauge stainless steel secured to underframe, 4'-0" o.c. Ends of shelves: secured to adjacent wall/fixture or mounted on 1 1/4" diameter stainless steel posts.
 - 2. Freestanding overshelves not on cantilevered brackets: 1 1/4" o.d. x 16-gauge stainless steel posts, each pair at 4'-0" o.c., maximum.
- F. Baker Table Overshelves: supported at 18" above top with 1 1/4" o.d. stainless steel tubular supports with channel shoe secured to risers.
- G. Glass/Cup Rack Overshelf at Dishtables: 14-gauge stainless steel with 1 1/2" deep "vee" trough at free long sides with 1" tight hem at inside of trough. Provide a 1/2" marine edge at free ends; 4" splash at wall. Suspend shelf at 18" above dishtable surface on posts/brackets anchored to dishtable frame/wall at rear; 1" o.d. stainless steel tubing supports from structure above ceiling at front edge, 60" o.c./each end.
 - 1. Install at both ends, 1/2" stainless steel drain-tube (connecting both vee-troughs) extended to dishtable surface through splash turnback.
 - 2. Rack-rest: horizontal full-length 1-5/8" o.d. stainless steel tubing supported at 10" o.c. above shelf (8" o.c. for double service shelf) by 1 1/4" o.d. stainless steel tubing with closed ends. Support tubing: welded, ground and polished, spaced 60" o.c.
 - 3. Rack-rest supports to wall: 4" x 4" x 10-gauge stainless steel flange plates welded to support tubing. Anchor flanged plates to blocking ground with non-corrosive bolts.

2.27 DRAIN TRENCH LINER / GRATING

- A. Liners: 14-gauge stainless steel in sizes as indicated.
- B. Interior of liners: 6" deep with all interior corners (horizontal/vertical) coved on 3/4" radius; sloped and scored 1" to integrally welded Component Hardware Model No. D34-Y011 basket drain assemblies @ 48" o.c., fitted with 6" long welded tailpiece. Stainless steel safety chain: connected to basket strainer assembly and top of liner wall.
- C. Liners: 1" wide perimeter shoulder at the top, turned up flush with finished floor, tight-hemmed back down to the shoulder level and flanged out 2" for attachment to the slab.
- D. Underside of sloping portion of liner: 2" long "Z" clips.
- F. Grating: IMC-TEDDY PFG-ADA removable fiberglass grating.
 - 1. 1" deep "I" bearing bars with 0.6" wide top flange.
 - 2. Full perimeter frame, section quantities and sizes indicated.
 - 3. Maximum of 2'-0" sections.
 - 4. Grating bars to be spaced 0.4" apart per ADA requirements.
 - 5. Grating to be two (2) equal sizes.

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2.28 WALL PANELS

- A. Wall Panels: 18-gauge stainless steel, double pan-formed ½" thick with internal stiffener members. Fill with USDA approved thermal insulation, full height and width of panels, attach to interior with mastic. Maximum allowable temperature at rear side of panel: 120oF.
 - 1. Height of panels as required: top of tile base to underside of hood, top of tile base to top cap of stub wall or top of splash to underside of hood.
 - 2. Level and square lower edge and sides.
 - 3. Butt joint all panels.

2.29 EXHAUST HOOD (Surface - Mounted Condensate)

- A. Hoods: size/shape as indicated: 18" high at interior.
- B. Body: 16-gauge stainless steel, with all seams welded, ground and polished.
- C. Continuous condensate trough at perimeter: 3" x 1".
- D. Frame top of hood with ½" angle iron assembly and suspend from structure above ceiling by ½" diameter steel rods, drawn tight against finished ceiling surface.
- E. Duct opening/collar as specified with stainless steel louvered grille over opening.
- G. Div. 22 to extend drain line to floor sink. Drain line to be silver painted.
- H. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.

2.30 EXHAUST HOOD (UNLESS SPECIFIED OTHERWISE)

- A. Exhaust to be provided to meet local jurisdiction code requirements. Kitchen Equipment Contractor to verify code requirements and coordinate with Division 23 and 26. Hoods over production equipment to be Type 1 with continuous capture. All Type 1 hoods to be 6' deep to ensure smoke/steam capture unless notated otherwise
- B. Install fire suppression system(s) in all ventilators, specified in this section. Install in accordance with manufacturer's recommendations and applicable codes or standards. Submit installation certification form to Architect.
- C. Locate chemical cylinders as indicated on drawings and install piping to exhaust hood(s) in totally-concealed manner. Set cylinders and cabinets at 7"-0" clear AFF unless noted otherwise. Provide polished chrome plated tubing piping/fittings, where exposed at cylinder location and at interior of exhaust ventilator. Exposed pipe threads in/above food zone not allowed. Submit schematic diagram of installation and confirm critical distances from cylinders to nozzles.
- D. Remote manual release located in path of egress from protected exhaust hood area. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.

- E. Provide one (1) handheld Type 'K' 6-liter fire extinguisher per Ansul system, surface wall mounted.
- F. Required quantity and sizes of mechanically-operated gas valves.
- G. Confirm interconnection of all equipment as required to ensure exhaust hood and fire suppression systems are completely operational and meet local jurisdiction code requirements.
- H. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
- I. Provide appropriate quantity of fire suppression systems as required by local jurisdiction code requirements.

2.31 HIGHLIGHTING

- A. Polish the following vertical surfaces to a No. 8 finish:
 - 1. Serving and display shelf turndowns.
 - 2. Conveyor and dish/tray deposit station turndowns/frame.
 - 3. Trayslide turndowns.

2.32 SHOP / FIELD JOINTS

- A. Field joints: least possible number, used only when equipment size must be limited for access into building or interior space.
- B. Stainless steel tops (including edges and splashes): fully welded, ground and polished to match adjacent surface.
- C. Vertical field joints of fixture backsplashes that are inaccessible from the back: terminate 1" above the horizontal coved corner. The remaining height of field joint: hairline butt joint with offset draw-angle behind. All horizontal/vertical draw-joints: located and noted on shop drawings.
- D. Hairline butt joint: 1½" x 1½" x 1/8" steel angles welded to back/underside of counter top/shelf. Offset angle beyond joining metal edge ½" (min.) to provide flat backing surface for joint with angle of other joining metal edge, set for ½" space between vertical legs of angles. Bolt sections together with 5/16" machine bolts, lock washers, acorn head cap nuts, set 3" o.c.
- E. Closed Base Bodies: draw-type with hairline seam fully field-welded.
- F. Millwork: plastic laminated material joints shall be doweled, glued and draw-bolted with fasteners.
- G. Solid Polymer: surfaces drawn tight, filled, sanded and finished to match adjacent surface.

2.33 PREFABRICATED COLD STORAGE ASSEMBLIES

- A. Assembly to be installed by Factory Authorized Installers only.
- B. KEC to provide a 1-year walk-in panel installation warranty. Panel installation warranty to cover labor and part replacement issues resulting from a failure to adequately complete the following during installation:

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1. Walk-in panels to be installed in a square, plumb and level manner.
 2. Ceiling panels to be installed flush and tight to wall panels with the gasket material undamaged and to create a proper seal. Any signs of condensation at joints or walk-in walls should be reported to FDP and addressed immediately. Caulk at panel seams will not be an acceptable solution.
 3. All cam-locks should be engaged and button holes in place.
 4. Any gaps under floor angle (due to shimming) must be sealed completely to the slab.
 5. All penetrations in ceiling or wall panels should be insulated and sealed.
 6. Proper installation of the door systems should allow for the door to self-close and seal around the perimeter of the door opening and at the floor threshold.
 7. Final operation of the IC/IC+ control, door heaters and light switches should be confirmed upon completion of the electrical connections.
 8. Service issues, resulting from faulty installation will be covered under the walk-in panel installation warranty.
- C. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install verifying that all items above have been inspected by the KEC for completeness. This letter will be required as part of the completion of the contract.
- D. Sectional Assemblies: size/shape indicated on drawings; 9'-6" interior clearance unless otherwise specified. Door locations/size: exactly as shown.
- E. Sandwich Panel Insulation: Class 1 Urethane with a vapor barrier, 4" thickness (unless specified otherwise) with mature "U" factor of .030 or lower. Finished panels shall be UL-listed and demonstrate a flame spread rating of 20 or less. Panels must meet performance standards as outlined in U.S. Government legislation.
- F. Wherever compartment dimension exceeds clear-span ability of ceiling panels, provide I-beam support on exterior of ceiling or spline-hangers. Install ½" diameter steel rods through beam/hangers and secure to structure above. Beams or posts within compartments are not acceptable.
- G. Reinforce prefabricated wall panels to rigidly support the door assemblies. The perimeter of the door and frame shall be built of a fiberglass reinforced polymer (FRP) pultrusion. All pultrusions shall be non-conductive, non-corrosive, rust proof and NSF listed. All doors shall be furnished with a replaceable aluminum braided heater wire, electronically monitored, and controlled as to initiation temperature, termination temperature and percentage of operation time as required. Install 2" x 4" 16-gauge stainless steel hat-channel full-width of the jamb with 1/8" stainless steel removable flush sill, secured with stainless steel screws and sealed watertight to channel.
- H. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side – interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob. Emergency Strobe Beacons are by Division 26.
- I. Provide aluminum cove base at interior and exterior of exposed panels for all floor assemblies.
- J. Floor Installations:
1. **4" Recessed Exposed Factory Floor Installation (if required):**

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.

2. 8-1/2" Recessed Floor Installation (if required):

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" manufacturer's floor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.
- f. Concrete flooring and tile over insulation by Divisions 03/09.

3. 12" Recessed Floor Installation (if required):

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" manufacturer's floor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.
- f. Concrete flooring over insulation by Division 03:
 - i. Concrete mix: 5000 psi @ Freezers and 3000 psi @ Coolers.
 - ii. No limestone or fly ash; fiberglass reinforced.
 - iii. #3 rebar, set on 12" centers in both directions.
 - iv. Center rebar vertically in wearing bed.
 - v. 10" high concrete 45° angled wall curb at interior perimeter per food service details.
- g. Diamond treadplate wall panels on the interior and exposed exterior by 11 40 00. Refer to drawings for height. Coordinate diamond treadplate wall covering at the interior with angled wall curb.
- h. Ventilation Pipe Requirements by G.C.:
 - i. Bottom perforated vent pipes to be #40 PVC on six ft. max centers open on both ends with the thermostatically controlled fan on (1) end and perforated mesh on the opposite end of the fan at the exterior of the building.
 - ii. Vent pipes to turn parallel with exterior wall - 180° turn down.
 - iii. Vent pipe openings to be held at 24" above grade or roof per design.
 - iv. Fans to be Grainger Manufacturer and sized per airflow needs. Airflow is to be sized based on the length and number of bends.
 - v. If no exterior wall is adjacent, vent pipes will route up and extend past the roof. Roof penetrations by Division 07.

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4. Surface Mounted Factory Floor Installation (if required):

- a. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
 - b. 36" reinforced diamond treadplate internal ramp.
 - c. 10-gauge stainless steel threshold to provide a smooth transition to the interior cold storage assembly floor.
- K. Integrated, flush-mounted temperature monitor/alarm with sensor and probe-cord length required to extend from the exterior front of the assembly to a mounting position of the sensor within the evaporator return airstream. System to have an easy-to-read LCD with high and low alarm set points with audible and visual alerts for alarm conditions. System to include Adaptive Programming for automatic set point control. Wi-Fi connectivity is included for remote notifications of alarms such as power failure, high and low temperatures, entrapment, and door open. System to include a built-in panic alarm. The system is to be interconnected to the Building Automation System (BAS) or the Owner's Network (by Division 27) and to notify facility personnel of the district/owner choosing when activated.
- L. Heated and illuminated Push Button Panic Alarm with protective cover located inside Walk-In Freezer on panel next to door (handle side) – ADA mounting height. Pre-pipe conduit in panels from Panic Alarm to above the freezer door (or Cooler door if 'inline' assembly) for installation of strobes. Panic Alarm to interconnect to external Strobe Lights by Division 26 and BAS by Division 27. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsections F. Division 26 (**Electrical**) and G. Division 27 (**Communication**) for additional information.
- M. KE2 Smart Access (unless otherwise specified). Confirm all component model numbers for complete installation and operation.
- N. LED surface-mounted light fixture, in quantity/arrangement shown on drawings—light fixtures to be perpendicular to coils. Light fixtures wired to interior and exterior temperature control panel. Light fixtures are to be provided by Section 11 40 00 and installed by Division 26. Division 26 is to seal all conduit penetrations at light fixtures. KEC to verify that penetrations are sealed.
- O. Penetrations of Panels: To be sealed by factory installer and appropriate trade contractors, with Dow Corning 3-6548 silicone RTV foam, total depth of the panel. Trim excess flush. KEC to verify that all penetrations are sealed.
- P. Install closure panels and trim strips to building walls and ceiling with concealed attachment. Closure material: same as wall panels unless noted otherwise.
- Q. Compartment Entrance Doors: 36" x 78" nominal clearance unless otherwise noted.
1. Mount hinged doors on two Kason Model No. 1346; polished chrome-plated nylon cam-lift hinges.
 2. Hinge doors as indicated on drawings.
 3. Defrost heater: Thermostatically controlled and replaceable at the entire perimeter of all doors, except when using clear Lexan doors (in addition to door jambs). Defrost heaters to be wired for continuous service.
 4. 36" high x full-length diamond aluminum treadplate at front and rear of all hinged doors.
 5. 12" x 2" engraved phenolic plastic compartment identification sign in Architect's color selection with 1" letters, mounted above door window.

6. 14" x 24" four-panel glass view window with heater and molded non-metallic inner and outer frame. The heater is to be wired and controlled via the door monitor for continuous service.
 7. Padlock/key provisions in the door latch with safety release mechanisms as listed below.
 8. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate One (1) 12" below ceiling on Cooler/Freezer common wall panel and One (1) 12" below ceiling on Cooler wall panel. If Cooler and Freezer are separate units, locate one on the Freezer wall panel as well, 12" below ceiling and mounted in the door frame assembly. All ports to have separate dedicated electrical connections and be wired for continuous service. Located and installed by Manufacturer.
 9. Kason Model No. 0487 (unless specified otherwise) Frost Free inside release with fiberglass rod and plastic flange with safety flow plastic knob – ADA compliant.
 10. Manual backup vacuum release mechanism to punch hole in Freezer door panel assembly to release vacuum within Freezer assembly. Mechanism to include a pull-down handle with freeze- proof hand grip. Handle to have the ability to penetrate and/or punch hole in panel accordingly to assist with opening of door in the event of entrapment (and failure of frost-free inside release button). Door panel to include knock-out section to assist with requirements. Release mechanism assembly to be built-in/mounted to the door assembly structural frame to minimize mechanism tear-out and/or failure. Handle to be painted yellow with phenolic label "Vacuum Pressure Release."
- R. Provide refrigeration calculations and refrigeration alarm to meet local jurisdiction code requirements.
- S. If air screens or air shields are specified above doors or on the interior of the assembly, the manufacturer must provide adequate blocking in panels to support these components and pre-wired electrical connections. Installer to coordinate location of door closure to not interfere with air screens or air shields. Clear-VU swinging door assemblies are not required if air shields are specified.
- T. S/S trim above cold storage assembly to conceal manufacturers ceiling grid.
- U. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment.
- V. Cold Storage Assemblies to be installed by Manufacturer pre-approved installers.
- W. Installer to seal all holes in Cold Storage Assembly.

2.34 COLD STORAGE REFRIGERATION SYSTEMS

- A. Unit Coolers: specified quantity and model, ceiling-hung by ½" o.d. nylon bolts with stainless steel washers and nuts. Insert hanger bolts through plastic sleeve and seal penetration airtight.
1. Unit cooler drain fittings: positioned as indicated on drawings. Installation of cast tee-fittings on drain pan outlet with union and cleanout plug and extension of 1" Type K copper drain line through wall panel to air-gap fitting or floor drain under this Section.
 2. Slope drain line ½" per foot, trap at exterior of assembly and turn down into drain. Manifold drain lines of adjacent compartments wherever possible.

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3. Install drain line plastic sleeve through compartment wall, seal around drain line and install stainless steel escutcheon with setscrews.
4. Electric drain line heater cable (self-regulating 7 watts): on all unit coolers operating below 36°F., installed from coil drain line fitting to wall penetration under this Section. Heater cables: minimum rating of 15 watts/lineal foot, 208 volts, single phase. Wrap drain line with maximum 2" loop spacing and interwire to unit cooler for continuous operation.
5. Mounted, pre-piped and pre-wired evaporator components:
 - a. Sporlan thermostatic expansion valve with external equalizer.
 - b. Shut-off valve at evaporator suction and liquid lines.
 - c. Sporlan "Catch-All" refrigerant filter/dehydrator on liquid line.
 - d. White Rogers 1609-101 adjustable thermostat with remote bulb positioned in return air-stream of evaporator.
 - e. Electrical disconnect switch in NEMA 4 enclosure.
 - f. **For any facility within 20 miles of a salt air environment:** Condenser and Evaporators to be built with Electrofin coating to retard salt air deterioration. Coils are to be coated with Technicoat 10-2 coating for protection against a salt air environment.

B. Refrigerant System Installation.

1. Refrigerant Lines; Type "L" hard copper tubing. Fittings: wrought copper or brass designed for use with high temperature solder. Piping joints: made with silver solder (Sil-Fos). Piping: properly suspended from and anchored to the structure with adjustable hangers 6' o.c. maximum. Suction lines: sized to have maximum pressure drop of two pounds in medium temperature systems; one pound in low temperature system. Liquid lines: sized to give maximum pressure to prevent trapping of oil. Insulation on all suction lines: Armaflex insulation by Armstrong. ¾" thick at medium temp 1" thick at low-temp. Refrigerant lines in PVC or EMT conduit: sealed at both ends with Dow Corning 3-6548 silicone RTV foam. Exterior Refrigerant Lines to be wrapped by refrigeration system installer in self-fastening jacket of Type 3003-H14 aluminum alloy 0.016-inch thick. Provide aluminum strapping and seals for applying aluminum jacket and covers according to manufacturer's recommendations to provide completely weather-tight covering.

C. Evacuation and Charging.

1. After completion of the pressure test, the system shall be evacuated using an approved auxiliary vacuum pump. Connections for evacuation: in accordance with manufacturer's recommendations.
2. Charging subsequent to the initial charge, which is contained in the condensing unit (Type of Refrigerant to meet District Standards, Industry Standards and Codes.) - Non- CFC Ozone Depletion Refrigerant on low temp units) – (Refrigerant must meet local codes): given through the charging valve in the high side passing all of the liquid refrigerant through a charging dehydrator. All charging lines and gauges: purged of air prior to connection with system. Refrigerant: unused and shall be delivered in clean containers. After the system is fully charged: start and place in full operation.

2.35 PRE-APPROVED KITCHEN SUPPLIERS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid.
- B. **Any supplier requesting for inclusion within this bid will be required to submit AIA form 305 minimum 14 days prior to bid date for review, or as required by Architect.**

1. Ed Don & Company, Mr. Scott Jost, 3501 Plano Parkway, The Colony, Texas 75056, Phone: (972) 624-7460, Fax: (972) 624-7762, E-mail: scottjost@don.com
2. Kirby Restaurant Supply, Mr. Brian Kernan, 809 S. Eastman Road, Longview, Texas 75602, Phone: (903) 757-2723, Fax: (903) 757-9519, Email: briank@kirbyrestaurantsup.com
3. Oswalt Restaurant Supply, Mrs. Lindsay Reece, 4532 Enterprise Dr, Oklahoma City, OK 73128, Phone: (405) 843-9000, Email: lindsay.reece@oswalt.biz
4. Supreme Fixture Co. Inc., Mr. Tim Hampel, 11900 Vinny Ridge Road, P.O. Box 193655 Little Rock, Arkansas 72219, Phone (501) 455-2552, Fax: (501) 455-0802, Email: tim@supremefixture.com

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

- A. Supervision: provide a competent foreman or supervisor who shall remain on the job during the entire installation.
- B. Delivery: coordinate with progress of construction and Owner's operation schedules. Unless otherwise instructed and documented by Owner or General Contractor, the following procedures apply:
 1. Field-Assembled Fixed Equipment integrated into the structure (e.g., cold storage assemblies, exhaust hoods, drain trench/grate assemblies, conveyor systems, ceiling-mounted utensil racks, etc.) are to be sent to the jobsite when directed by the General Contractor and installed/protected accordingly.
 2. All other Fixed Equipment: delivered after completion of work on adjacent finished ceilings, lighting, finished floor and wall systems, including painting.
 3. Major Movable Equipment: delivered when possible to inventory in secured area for interim job-site storage or, if secured area is not available, when fixed equipment installation/clean-up has been completed.
 4. Minor appliances and loose items (e.g., pans, covers, flatware containers, etc.) delivered only when Owner is prepared to receive and inventory such items.
- C. Installation: performed by manufacturer of custom fabricated fixtures.
 1. Assemble, square, level and make ready all items for the final utility's connections.
 2. Cut neatly around obstructions to provide sanitary conditions.
 3. Where gaps of 1/4" or less occur adjacent to or between equipment, insert rope backing and smoothly-applied General Electric construction sealant Series SE-1200 silicone mastic (white color). Mask both sides of gap for neat application of sealant and remove excess. If space exceeds 1/4", neatly install 18-gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "Z" clips wherever possible to secure stainless steel trim. Exposed edges or corners of trim: eased and smooth.
 4. Refrigeration coil drain line runs to indirect drain connection greater than 2" from face of wall or panel: either of the following field procedures.
 - a. Trench the floor and provide 6" wide x 2" deep 16-gauge stainless steel sloping (-1" to -2") trough from face of cooler/freezer wall to body of floor sink/floor drain. Trough: turned up 4" at wall; 3/4" flange with 1/2" turndown at both long sides. Set trough in waterproof mastic and seal 1" o.d. drain tube penetration into floor sink/floor drain at -2 1/2" bff. Patch the floor to match adjacent material/surface.
 - b. Provide 12" x 6" x 2" deep 16-gauge stainless steel condensate pan mounted to cooler/freezer wall at 6" aff clear. Trench the floor and install 1" o.d. drain line from

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bottom of pan to body of floor sink/drain. Slope drain line ¼" per foot and seal all connections watertight. Patch the floor to match adjacent material/surface.

D. Protection of Work:

1. Fabricated fixtures: fiberboard or plywood taped to tops and exposed body panels/components.
2. Manufactured Equipment: fiberboard or plywood taped as required by equipment shape and installation-access requirements.
3. Prohibited use of equipment: tool and materials storage, workbench, scaffold, stacking area, etc.
4. Damaged Equipment: immediately documented and submitted to Owner with Contractor's recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount, if any.

3.2 CLEAN AND ADJUST

- A. Clean up and remove from the job site, all debris resulting from this Work as the installation progresses.
- B. Thoroughly clean and polish interior/exterior of all Foodservice Equipment, prior to demonstration and final observation, ready for Owner's use.
- C. Lubricate and adjust drawer slides, hinges, casters.
- D. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
- E. Clean or replace faucet aerators, line strainers.
- F. Touch-up damage to painted finishes.
- G. G. Start up and check operation of all refrigeration systems for at least 72 hours prior to acceptance.

3.3 EQUIPMENT START-UP/DEMONSTRATION

- A. Carefully test, adjust and regulate all equipment in accordance with the manufacturer's instructions and certify in writing to the Owner that the installation, adjustments and performance are in full compliance.
- B. Provide the Owner or Foodservice Operators with a thorough operational demonstration of all equipment and furnish instructions for general and specific care and maintenance. Coordinate and schedule selected items of equipment and attendees with Owner at least two weeks in advance of demonstration periods.

3.4 FINAL OBSERVATION

- A. Final observation will be made when the Contractor will certify that he has completed his work, made a thorough review of the installation/operation of each item in the contract and found it to be in compliance with the Construction Documents.
- B. Repetitive final observations (more than two) and all costs associated thereto which may be incurred due to the Contractor's failure to comply with the requirements of this Article will be invoiced to this Contractor on a \$70.00/hr. and expense basis.

PART 4 - EQUIPMENT SCHEDULE

- 4.1 REGULARLY-MANUFACTURED EQUIPMENT/COMPONENTS:** Standard finishes and accessories unless specifically deleted or superseded by the Contract Documents.
- 4.2 FABRICATED AND FIELD-ASSEMBLED EQUIPMENT:** Arrangement and configuration as shown on Plans, Elevations, Detail Drawings and outlined in Specifications.
- 4.3 REFER TO DRAWINGS:** For unit quantities and electrical or mechanical provisions required, including manufacturer's optional voltages, wattages, burner capacities, etc.
- 4.4 REFER TO PART 2 – PRODUCTS:** For accessories, fittings, requirements and procedures related to the listed buy-out and fabricated equipment.
- 4.5 ALTERNATE MANUFACTURER REQUIREMENTS:** A specific product manufactured by the listed pre-approved equals shown under Section 4.7 Foodservice Equipment are acceptable only if the specific product can evidence compliance with the specified line items and the contract documents.
- 4.6 RE-USED EXISTING EQUIPMENT IF SHOWN**
- A. Existing equipment scheduled for re-use is to be inventoried and documented that equipment is in operating condition once Kitchen Contractor has taken ownership.
 - B. Provide pictures of all equipment once inventoried and issue to the architect to ensure that equipment has not been damaged.
 - C. Verify locations of all equipment with owner.
 - D. Existing equipment that is to be reused may be missing parts or accessories for proper and complete operation. Submit report listing all items with pricing for approval to allow complete installation.
 - E. Utility disconnection and re-connection: under Divisions 22 and 26. Kitchen Contractor to verify utility requirements of existing equipment and coordinate with Kitchen Consultant as required. All utilities not scheduled for re-use to be capped and covered by required disciplines.
 - F. Disassembly, removal, transportation and relocation: under this Section and scheduled with General Contractor. Owner's representative must be present, coordinate date / time with owner.
 - G. Thoroughly clean inside and out prior to relocation.
 - H. Review functional parts (e.g., doors, controls, heating elements, compressors, etc.) and submit report of required repairs and estimate of cost. Any finishes or equipment damaged due to construction to be repaired as required.
 - I. Existing equipment not scheduled for reuse is to be carefully removed/relocated by the Kitchen Contractor per the Owner's direction. Kitchen Contractor to coordinate date / time with General Contractor and Owner.
 - J. Removal or replacement of existing equipment is to be scheduled for times of least interruption and inconvenience to the foodservice operation. Submit proposed schedule of time frame, task sequence and operation for approval prior to starting work.

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- K. Kitchen Contractor to verify size and shape for all existing equipment being re-used and coordinate with Foodservice Consultant as required.
- L. Any modification(s) required/desired for re-used existing equipment to be verified by the Kitchen Contractor. All modifications must be approved by the Owner and Foodservice Consultant prior to the modifications being made.
- M. The KEC is to verify and coordinate all of the utility requirements with the construction documents as required. Refer to the general specifications re: conflicts.

4.7 FOODSERVICE EQUIPMENT

- A. All equipment to have a performance check from factory authorized personnel. Warranties will begin on the day of performance check.
- B. All equipment and internal components should be of domestic origin where possible.
- C. Architectural coordination items for potential Food Service color or material selections.
 - 1. Countertops: Stone (stainless steel is provided unless otherwise specified)
 - 2. Tray slides: Corian or Stone (stainless steel is provided unless otherwise specified)
 - 3. Counter fronts: Ceramic tile, 3 Form, Plastic Laminate
 - 4. Sneeze Guards: Stone insets.
 - 5. General color/graphic selections:
 - a. Display Air Screen Merchandisers - Color selection: Powder coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
 - b. Bakery Display Cases - Color selection: Powder coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
 - c. Pass Thru or Reach-in Holding Cabinets – Color selection: Powder coat (Mfg: True) or Plastic Laminate (Mfg: Traulsen). (Stainless steel is provided unless otherwise specified).
 - d. Hanging Heat Lamps, track and fixture colors.
 - e. Heated Merchandisers
 - f. Color of Portable Guide rails, stanchions and belt
 - g. Popcorn machine: signage
 - h. Bottle Cooler: signage
 - i. Graphic package information
 - j. Hot food well covers
- D. General Architectural finishes:
 - 1. Walls: Ceramic Tile, Flat FRP, Molded FRP, (as approved by local jurisdiction).
 - 2. Ceilings: Removable Vinyl Face Tile (easily cleanable as approved by local jurisdiction).
 - 3. Floors – Tile, Epoxy, Rubberized flooring system (coordinate floor tile transition at serving lines)
 - 4. Floors – Cold Storage assembly. Extend kitchen floor flush into walk-in assembly with coved base.
 - 6. Furr downs above Serving Counters

EQUIPMENT LIST

ITEM NO. 101 AIR SCREEN

QUANTITY 1

Manufacturer: Mars
Model: STD248-1UA-OB standard ext.
Size and Shape: Refer to drawings
Alternate: Berner

1. Air curtain, STD2 series model, unheated, obsidian black exterior. Size unit to fit door.
2. Air Curtain to include Model #J0023 Controller Kit. Controller kit to come complete with plastic magnetic reed switch, surface mounted, .50 HP max, 115v/1-ph limit switch. The magnet to be mounted on the surface of the door jamb and the door.
3. Confirm clearance above door prior to installation. Air Curtain to accommodate door width and height.
4. 114000 to provide magnetic reed switch kit loose to General Contractor for installation by Division 26. Division 26 to route flexible conduit to j-box on cabinet. Routing to be clean and secured to building.
5. Provide Harsh Weather Cover if no awning or recessed door is provided.

ITEM NO. 102 COLD STORAGE ASSEMBLY

QUANTITY 1

Manufacturer: American Panel
Model: ---
Size and Shape: Refer to drawings
Alternate: Thermokool, Kolpak

1. **Installation to be completed by Factory Approved / Authorized installer. Refer to Section 2.33 Submittal drawings to include factory approval letter or certificate.**
2. Manufacturer to review final installation and provide a letter confirming installation meets manufacturer requirements.
3. Assembly to have 9'-6" interior clearance.
4. 304 #3 finish 20 gauge stainless steel finish where exposed, 20 gauge galvanized steel where concealed.
5. Factory floor with smooth aluminum finish, recessed in slab 8 1/2". Secure floor to wall assembly with cam-lock assembly. KEC to ensure the floor assembly is level prior to the wearing bed installation. Kitchens finished floor to extend to walk-in.
6. Threshold to be smooth and level with finished floor. - **Critical.**
7. Interior walls to be .040" aluminum, white embossed texture on walls.
8. Ceiling to be embossed textured .040" aluminum baked white enamel.
9. Two (2) 36" doors. Doors to be 18-gauge stainless steel, type 304 (18-8), #3 finish, with heated perimeter / door jambs / windows and threshold heaters. Each door to be equipped with 3'-0" high diamond tread kick plate on both sides of doors. Mount hinged doors on two (2) Kason model no. 1346 (or equal); polished chrome plated nylon cam-lift hinges.
10. Provide heated illuminated Push Button Panic Alarm with protective cover and Phenolic Label "PANIC ALARM" for entrapment within Freezer (ADA mounting height). Panic Alarm Encasing is to be stainless steel (not plastic). Manufacturer to pre-run conduit within panel from Panic Alarm to panel above Freezer door (or Cooler door if 'inline' assembly) for installation of Emergency Strobe/Horn. Division 26 will provide (2) external Emergency Strobe/Horn Beacons and

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interconnect the Push Button Panic Alarm to external Beacons (One above the Freezer door and One in the Cafetorium). Division 27 will interconnect the Push Button Panic Alarm to the Building Automation System for Owner notification.

11. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side - interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob.
12. The Cooler will have the standard control panel with standard panic button tied into the Owner's network for notification.
13. Provide Kason model no. 0487 Frost Free Inside release (or equal) for each cold storage door assembly. Fiberglass rod and plastic flange, with safety glow plastic knob, ADA compliant.
14. Manual backup vacuum release mechanism to punch hole in wall assembly to release vacuum within freezer assembly. Mechanism to include a pull-down handle with freeze-proof hand grip. Handle to have the ability to penetrate and/or punch hole in wall accordingly to assist with opening of door assembly in the event of entrapment (and failure of Frost free inside release button). Wall panel to include a knockout section to assist with requirements. Release mechanism assembly to be built-in/mounted to the door assembly structural frame to minimize mechanism tear-out and/or failure. Handle to be painted yellow with phenolic label "Vacuum Pressure Release".
15. 18-gauge stainless steel, type 304 (18-8), #3 finish trim where adjacent to walls and enclosure panels that extend to 2" above finished ceiling.
16. Freezer One (1) lot LED light fixtures to operate in temperatures to -20 F. Lights to be installed perpendicular to coils.
17. Refrigerator- One (1) lot LED light fixtures. Lights to be installed perpendicular to coils.
18. 3'-0" high diamond tread plate at exposed exterior surfaces. Fasten to wall with stainless steel fasteners.
19. Provide door bumper at doors.
20. Compartments to have all electrical concealed within the walls or located above the ceiling.
21. Provide Manufacturers alarm/control system that includes hi/low limits . Route temperature sensor to be located to the side of evaporator coil
22. Doors to be provided with CCI Industries, Inc., Clear-VU swinging door assemblies, Alternate: Kason.
23. K.E.C. to provide aluminum coved base to interior of assembly. Provide sealant between floor and wall panels.
24. All holes in assembly to be sealed by factory installer.
25. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate One (1) 12" below ceiling on cooler/freezer common wall panel and One (1) 12" below ceiling on exterior cooler wall. All ports to have separate dedicated electrical circuits. Pressure relief ports to be wired for continuous service. Relief port to be located and installed by Walk-in Manufacturer.
26. KEC to field verify all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment.
27. KEC to provide 1-year walk-in panel installation warranty. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install.
28. Manufacturer to provide One Year Parts and Labor Warranty.
29. Interwiring of temperature monitor panel to master building alarm system or to the Owner's network. Technology department to provide all interfacing of alarm system and with the building alarm system. Conduit from refrigeration system to monitor by Division 26. Temperature Monitor

installation at 4'-0" above finished floor. All conduit to be located above walk-in cooler/freezer ceiling. Exposed electrical conduit is not acceptable.

30. Manufacturer Representative to provide training on controls and inside emergency release mechanisms.

ITEM NO. 103 COLD STORAGE REFRIGERATION SYSTEM

QUANTITY 1

Manufacturer: RDT
Model: ZS1-2 EcoSmart
Size and Shape: Refer to drawings
Alternate:

1. Air cooled system.
2. Cooler temperature to be +35 degrees.
3. Freezer temperature to be -10 degrees.
4. EcoSmart system on demand defrost.
5. KE2 Controllers located per districts requirements.
6. S/S covered housing.
7. All exterior piping to be aluminum wrapped.
8. System to accommodate Item No. 102 Cold Storage Assembly.
9. Mount condensing unit on common exterior rack. Refer to Architectural and Engineering drawings for exact location of remote unit. Coordinate routing of refrigeration lines and conduit with appropriate trades. Heat tape and insulate all drain lines. General Contractor to seal all building penetrations at refrigeration lines.

ITEM NO. 104 COLD STORAGE SHELVING

QUANTITY 2

Manufacturer: Metro
Model: Metro Max Q
Size and Shape: Refer to drawings
Alternate: Cambro

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" post per unit. Provide foot plates at all posts when assembly is supplied with walk-in floor.
3. Refer to drawings for size, width and lengths.
4. Quantity Two (2) to equal One (1) lot: all shelving shown within cold storage assembly.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 107 DRY STORAGE SHELVING

QUANTITY 2

Manufacturer: Metro
Model: MetroMax Q
Size and Shape: Refer to drawings
Alternate: Cambro

1. Each unit to be five (5) tiers high with open grid shelving.
2. Four (4) 86" posts per unit.
3. Quantity One (1) to equal One (1) Lot: all shelving shown within the dry storage room.

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4. Refer to drawings for size, width and lengths.
5. Verify shelving requirements with approved submittal prior to ordering.
6. Provide four (4) Can Storage Rack model CR24E, each accommodates (8) #10 cans or (12) #5 cans, corrosion-resistant, taupe epoxy finish, compatible with MetroMax® i, MetroMax® Q, & Super Erecta Pro shelves.

ITEM NO. 109 ICE MAKER W/ BIN

QUANTITY 1

Manufacturer: Scotsman
Model: C0530/B330S
Size and Shape: Refer to drawings
Alternate: Manitowoc

1. Stainless steel bin.
2. Stainless steel legs.
3. Provide bin adapter kit as required.
4. Provide Luminice II Virus and Bacteria Inhibitor.
5. Provide size and quantity as required: Dormont Model No. 73-3135-72 water quick disconnects installed between filter and ice machine.
6. Cord and plug assembly, coordinate NEMA configuration with electrician.
7. Coordinate cord and cap with receptacle. Water supply to filter to be hard copper plumbed. 72" long flex hose from filter to ice maker with 48" wall restraint cable. Interconnection thru water filter to ice machine and final connection by Division 22. Water filter overflow tube to be strapped to back side of ice machine and extend to 1" above floor sink.

ITEM NO. 110B STACKED WASHER & DRYER

QUANTITY 1

Manufacturer: Whirlpool
Model: Residential
Size and Shape: Refer to drawings
Alternate: GE

1. Washer:
2. 3.5 cubic ft. capacity.
3. Straight vane agitator.
4. 9 wash cycles
5. 4 water temperatures.
6. "Quick pak" sound insulation.
7. Color to be white.
8. Water and drain hoses.
9. Dryer:
10. 5.9 cubic ft. capacity.
11. 4 Drying cycles
12. Auto dry.
13. Color to be white.
14. To include dryer cord and vent kit.
15. Units to include model stationary assembly including: white stack stand, dryer wall mount kit, door latch kit.
16. Contractor to provide current model numbers at the time of delivery.

ITEM NO. 111 CHEMICAL SHELF**QUANTITY 1**

Manufacturer: Metro
Model: MetroMax Q
Size and Shape: Refer to drawings
Alternate:

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" posts per unit.

ITEM NO. 121 TWO COMPARTMENT SINK W. DISPOSER**QUANTITY 1**

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S marine edge with 2" turndown at free sides.
2. Open base construction.
3. 10" high splash where adjacent to walls/fixtures.
4. Two (2) 24" x 26" x 15" deep sink compartments.
5. One (1) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for ¾" hot and cold water connections.
6. Two (2) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. Provide One (1) T&S model no. B-0133-EE-CR-8C pre-rinse, **two (2)** B-0108-C spray head, two(2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
8. 16 gauge S/S undershelf per drawings.
9. Disposer - installed in top integrally welded disposer cone. Notch and punch splash turn back for vacuum breaker. 12 gauge S/S bracket mounted below counter top for disposer control panel ground and polished to match top.
10. 12" deep single post mounted overshelf at 18" above counter top, punched to accommodate spray rinse.
11. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
12. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray nozzle by owner.
13. Omit rear rail at sink compartments, disposer and front rail at hose bibb.
14. Two (2) "Richlite" ½" thick removable sink covers installed at each sink. Weld ¼" bar stock, set 5/8" below work surface at all four corners for support of sink covers. Two (2) finger holes per board.
15. Provide top and bottom c-channel support storage for sink covers at right or left end of counter.
16. One (1) Edlund model no. S-11 Manual can opener, mounted on raised platform.
17. Flanged feet at front only.
18. Seal at all splash penetrations.

ITEM NO. 123 DISPOSER-CONE MOUNT

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QUANTITY 2

Manufacturer: Salvajor
Model: 300-CA-18-ARSS -LD
Size and Shape: Refer to drawings
Alternate: In-Sink-Erator

1. Fixed nozzle.
2. Delete standard syphon breakers and provide T & S B-0456-04 vacuum breakers and mount 6" from tabletop to base of breaker.
3. Solenoid valve.
4. Flow control.
5. Model no. ARSS-LD control panel.
6. Auto-reverse.
7. Dejamming tool.
8. Install vacuum breaker in splash
9. S/S cone cover.
10. Perforated silver saver and disposer cone with scrap ring.
11. Two (2) Swirl inlet located in disposer cone at a 45 degree angle.
12. GC to pipe 1/2" cold water to disposer body and swirl inlets. Excess electrical cord to be secured to fabrication as required. Install into counter by section 114000.

ITEM NO. 124 WORKTABLE W/ OVERSHELF

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Top: 14 gauge type 304 S/S top with 6" high backslashat wall and 2" turndown at free sides.
2. Open base construction.
3. 16 gauge S/S overshef post mounted 18" above working surface.
4. 16 gauge S/S undershef.
5. Two (2) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S10-2020C drawer pan.
6. Close back of splash when exposed.

ITEM NO. 125 20 QT. MIXER W/STAND

QUANTITY 1

Manufacturer: Hobart
Model: HL200
Size and Shape: Refer to drawings
Alternate:

1. Food mixer, Bench Model, 1/2-HP motor, 20 qt. Capacity.
2. 115/60/1 ph.
3. 15 minute timer.
4. Epoxy enamel finish-bench model.
5. One (1) 20 qt. S/S bowl.
6. One (1) 20 qt. Aluminum "B" flat beater.

7. One (1) 20 qt. S/S "D" wire whip.
8. One (1) 20 qt. "ED" dough hook.
9. One (1) 20 qt. Lexan splash cover.
10. One (1) Caddy model no. T-242 mobile mixer stand, with casters, two (2) with brakes. Secure mixer to table with non-corrosive bolts. Alternate- New Age.
11. Stand to be Pre-Drilled to accommodate Mixer.

ITEM NO. 128 UTILITY CART

QUANTITY 6

Manufacturer: Lakeside
Model: 522
Size and Shape: Refer to drawings
Alternate: Piper

1. Four (4) N.S.F. approved non-marking casters, Two (2) with brakes.
2. Extended perimeter bumper.

ITEM NO. 138 PAN RACK

QUANTITY 2

Manufacturer: CresCor
Model: 207-UA-13A
Size and Shape: Refer to drawings
Alternate: Lakeside

1. Four (4) 5" casters.
2. Adjustable universal slides on 1-1/2" centers.
3. Corner bumpers.

ITEM NO. 139 INSUL MOBILE PROOFER

QUANTITY 2

Manufacturer: Cres Cor
Model: H-137-WSUA-12D
Size and Shape: Refer to drawings
Alternate: Metro, FWE

1. Insulated proofer/heated cabinet.
2. Field reversible doors.
3. Adjustable universal angles.
4. Four (4) 5" casters, two (2) with brakes.
5. Tempered glass door windows.
6. Key lock handle.
7. Corner bumpers.
8. Cord and plug. Coordinate NEMA configuration with Electrician.
9. Thermometer.
10. 1500 watt heater.

ITEM NO. 144 WORKTABLE W/DBL.BAR UT.RACK

QUANTITY 1

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Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S, 2" turn down at all sides.
2. Open base construction.
3. Full length 16 gauge S/S undershelf.
4. Four (4) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
5. Flanged feet.
6. Post mounted utensil rack, extend 1-5/8" diameter S/S post from cross rail, thru top to 78" A.F.F. and weld full length x 2" x 1/4" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with Owner. 48" max. upright post spacing.
7. Provide a duplex receptacle and housing mounted below countertop per drawings. Interconnect and prewire a 5'-0" cord and plug out of receptacle housing for plugging into ceiling drop cord receptacle. 114000 and Div. 26 to coordinate location of drop cord receptacle.

ITEM NO. 145 WORKTABLE W/SINK & S.BAR UT.RACK

QUANTITY 1

Manufacturer: Custom Fabricated
Model:
Size and Shape: Refer to drawings
Alternate:

1. Top: 14 gauge type 304 S/S, 2" turn down at all sides.
2. Provide table in two (2) sections-one (1) 27" and one (1) 33" section. Refer to detail.
3. Open base construction.
4. Full length 16 gauge S/S undershelf.
5. Two (2) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
6. One (1) 15" x 20" x 10" deep sink compartment. Coordinate location with drain overflow.
7. One (1) T&S model no. B-0320-BB-CR, rigid gooseneck, ceramic cartridges, deck faucet for 3/4" hot and cold water connections.
8. One (1) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
9. Post mounted utensil rack, extend 1-5/8" diameter S/S post from cross rail, thru top to 78" A.F.F. and weld full length x 2" x 1/4" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with Owner. 48" max. upright post spacing.
10. Provide a duplex receptacle and housing mounted below countertop per drawings. Interconnect and prewire a 5'-0" cord and plug out of receptacle housing for plugging into ceiling drop cord receptacle. 114000 and Div. 26 to coordinate location of drop cord receptacle.
11. Omit rear cross rail at sink section.
12. Flanged feet.

ITEM NO. 151 FIRE PROTECTION SYSTEM

QUANTITY 1

Manufacturer: Ansul
Model: R102

Size and Shape: Refer to drawings
Alternate:

1. Duct and plenum protection to exhaust hood.
2. Surface protection for cooking equipment.
3. Locate remote fire pulls as recommended by Fire Marshal.
4. One (1) lot Mechanical gas valve (maximum diameter as required). Size as required. Furnished by Section 114000, installed by Division 22. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.
5. System to meet U.L. 300 requirements.
6. Provide one (1) hand held Type 'K' and ABC 6 liter fire extinguisher per Ansul System, surface wall mounted.
7. Exposed pipe threads are unacceptable.
8. All exposed piping to be chrome plated.
9. All hood penetrations to have U.L. listed "Quick Seal".
10. Provide phenolic I.D. labels for exhaust hood, remote fire pull, light/fan switches and fire protection system.
11. Provide a manufacturer performance test and report that verifies this system is fully operational.
12. Provide s/s cabinet as shown on plan.
13. Installer to provide one (1) Ansul system per exhaust hood, review drawings and provide systems as required.
14. Install hand held extinguishers, maximum of 3'-2" A.F.F. to top of unit.

ITEM NO. 152 EXHAUST HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: W-cpb
Size and Shape: Refer to drawings
Alternate:

1. Hood to meet all local Mechanical and Energy Codes.
2. All 18 gauge S/S construction and s/s rear back at exposed surface.
3. Insulated hood ends.
4. Hood manufacturer to perform hood balance reports, to be sent directly to FDP prior to final project completion.
5. Continuous capture.
6. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required. **(W-cpb)**
7. Recess mounted LED light fixtures. All exposed fire control piping to be chrome plated and all hood penetrations sealed with S/S escutcheons.
8. 3" air space at rear of hood.
9. S/S filters and grease cup. Provide filter removal tool.
10. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
11. Ventilators to have adjustable make-up air damper which must remain accessible for adjustment
12. Make-up air fire dampers. Insulated make-up air plenum with 1" thick foil faced fiberglass insulation.
13. S/S filters and grease cup with filter removal tool.

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14. Provide 18 gauge stainless steel wall panel. "Stainless steel "Tee" type joining strips at panel joints and "C" type finishing strips at ends not protected full height with corner guards. Extend from top of coved base to underside of hood. Top of panel to be secured to wall with "Z" clips, bottom secured to wall with stainless steel overhead molly bolts. Wall panels to extend the full length of the hood wall.
15. S/S c-channel closure panel from top of hood to ceiling.
16. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
17. Provide pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 95° F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 95° F.
18. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.

ITEM NO. 161 CONVECTION OVEN

QUANTITY 1

Manufacturer: Blodgett
Model: DFG-200 DBL
Size and Shape: Refer to drawings
Alternate: Hobart, Vulcan

1. S/S front, top and sides.
2. Two (2) 1/2 HP 2-speed motors.
3. Natural gas.
4. SSI-M solid state infinite control with manual timer.
5. Electronic spark ignition.
6. Five (5) oven racks per compartment.
7. Dual pane thermal windows.
8. Simultaneous door operation.
9. Heavy duty casters, two (2) with brakes.
10. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
11. Dedicated gas connections, do not manifold.
12. Shunt trip breaker by Division 26.

ITEM NO. 162 CONVECTION STEAMER

QUANTITY 1

Manufacturer: Groen
Model: (2) GSSP-BL-5GS Double
Size and Shape: Refer to drawings
Alternate: Cleveland

1. Double stack ten (10) pan capacity.

2. Two (2) compartments.
3. Individual connections.
4. Stainless steel legs.
5. Field stacking kit.
6. Heat shield kits.
7. Water tempering kit.
8. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
9. Coordinate with Item No. 263 Remote filtration System.
10. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to steamer,color coded for filtered and non-filtered water.
11. KEC to coordinate filtered and unfiltered water with steamer, do not connect filtered water to unfiltered water connection.
12. Coordinate location with floor sink outside steam free zone. Division 26 to provide shunt trip breaker. General Contractor to interconnect equipment to the remote filter system.

ITEM NO. 172 COMBI OVEN- STACKED

QUANTITY 1

Manufacturer: Rational
Model: ICP 6-FULL/6 FULL N/G
Size and Shape: Refer to drawings
Alternate:

1. Six (6) 18" x 26" or twelve (12) 12" x 20" pan capacity, per unit.
2. 208/240V 1PH
3. Standard warranty: 2 year parts and labor, installation inspection/start up.
4. Doors hinged per drawings.
5. Cleaner Tablets.
6. Care Tablets.
7. KEC to coordinate pan accessories with Owner prior to ordering.
8. Four hour chef training.
9. Heat shield.
10. Water Tempering kit.
11. Installation Kit "10", per unit, article number 8720.1560US.
12. Rational offers Certified Installation of units by Commercial Kitchens.
13. System installation to be reviewed by an authorized factory installer, provide report confirming installation meets factory's requirements.
14. Coordinate with Item No. 263 Remote Filtration System.
15. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to steamer,color coded for filtered and non-filtered water.
16. KEC to coordinate filtered and unfiltered water with Combi Oven, do not connect filtered water to unfiltered water connection.
17. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
18. Water supply to have shut-off valve and back flow preventer furnished and installed by Division 22. Supply water to interconnect thru water filter and then to each oven. Indirect drain line to be ran outside of the footprint of the unit, coordinate location of the related floor sink.

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ITEM NO. 193 REACH-IN REFRIGERATOR - 2DR

QUANTITY 1

Manufacturer: Traulsen
Model: HT-232WUT
Size and Shape: Refer to drawings
Alternate: Utility

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Universal 18" x 26" and 12" x 20" pan files on 4" centers in all sections.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Omit plug. Unit to be Hard Wired.
10. Re-hinging feature.

ITEM NO. 249 THREE COMPARTMENT SINK

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Top: 14 gauge S/S 3" high 1-1/2" rolled rim at free sides, 10" high splash at walls.
2. Open base construction.
3. Omit rear rail at sink.
4. Three (3) 30" x 26" x 15" deep sink compartment. Coordinate location with drain overflow.
5. Two (2) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for 3/4" hot and cold water connections.
6. Three (3) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. 12" deep single post mounted over shelf mounted at 18" above counter top.
8. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x 1/4" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center.
9. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray rinse by owner.
10. Omit front rail at hose bibb.
11. 16 gauge S/S undershelf as per drawings.
12. Flanged feet at front only of counter.
13. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

ITEM NO. 250 DISHMACHINE WITH BUILT-IN BOOSTER

QUANTITY 1

Manufacturer: Hobart
Model: CL44eN-BAS
Size and Shape: Refer to drawings
Alternate: Champion

1. 44" Conveyor dishmachine with built-in water tempering kit and built-in booster heater.
2. Prewired 15 KW Electric tank heat.
3. Booster Heater built-in 30KW
4. Built-in water tempering kit.
5. Verify direction of dishmachine with drawings.
6. One (1) Year Extended warranty - One (1) Year parts and labor.
7. One (1) Year Extended warranty on booster heater - One (1) Year parts and labor.
8. Chamber to be standard height.
9. Dual point electrical connection. One (1) connection for Motors, Controls and Tank Heat, and one (1) Connection for Internal Booster Heater. Div. 26 to provide S/S disconnect switches located as per plans interconnected to dishmachine and booster heater.
10. Two (2) vent cowls with 4 x 16 vent and damper. Provide 18 gauge stainless steel seamless duct risers 6" above finish ceiling for final connection. The duct: trimmed at ceiling with 16 gauge stainless steel flange with all corners welded.
11. One (1) table limit switch with stainless steel cover to conceal back. Provided by Manufacturer / Installed by Div. 26.
12. Four (4) 20"x20" Peg racks.
13. Four (4) 20" x 20" sheet pan racks.
14. Two (2) 20" x 20" combination racks.
15. Vent fan controls.
16. Peak Rate of drain flow = 38 gpm. Division 22 to provide and install backflow preventor between booster heater and filter. Final connection by Division 22. Coordinate location of electrical disconnects on free wall.
17. Provide Scaltrol Filter for Booster Heater.

ITEM NO. 254 SOILED & CLEAN DISHTABLE

QUANTITY 2

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Top: 14 gauge type 304 S/S 3" high 1-1/2" rolled rim at free sides. 10" high splash at walls.
2. Install Disposer as shown. Notch and punch splash turn back for vacuum breaker. 12 gauge S/S bracket mounted below counter top and polished to match top for disposer control panel.
3. Provide One (1) T&S model no. B-0133-EE pre-rinse, B-0108-C spray head, two (2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
4. One (1) 18" disposer cone.
5. Provide 1/2" slope in top towards dishmachine per the general specifications.
6. S/S cover to conceal table limit switch.
7. 2 1/2" backsplash at dishmachine portion, single thickness of s/s will not be accepted.
8. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

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ITEM NO. 255 MOBILE UTENSIL SHELF

QUANTITY 2

Manufacturer: Metro
Model: PR48VX3
Size and Shape: Refer to drawings
Alternate: Cambro

1. Four (4) tier, includes two (2) drop-ins and (1) cutting board/tray drying rack, built in Microban antimicrobial product protection.
2. Two (2) no. 5MPX casters per unit.
3. Two (2) no. 5MPBX locking casters per unit.

ITEM NO. 262 HAND SINK

QUANTITY 3

Manufacturer: Aero
Model: HSF Modified
Size and Shape: Refer to drawings
Alternate: Advance Tabco, Eagle

1. Hand Sink, wall model, 14" wide x 10" front-to-back x 5" deep bowl.
2. 3 1/2" gooseneck splash mount faucet with wrist blade operation.
3. Basket drain and wall bracket.
4. P-Trap assembly, delete open/close drain valve.
5. Soap and Towel Dispensers by Owner.
6. Custom fabricated removable end splashes on sides as required by code. Height same as the rear splash.
7. Division 22 to provide temperature adjustment valves as required

ITEM NO. 263 REMOTE WATER FILTER SYSTEM

QUANTITY 1

Manufacturer: 3M
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Multiple filter assembly to serve all cold water equipment, including one (1) *double stack convection steamer*, (1) *double steak combi oven* and one (1) *ice machine*.
2. Provide two (2) sets of additional filters.
3. Shall have 20" coarse filter.
4. 1/2 micron Fiberdyne filtration technology with scale inhibition.
5. Inlet water shut off valve, flushing valve, inlet/outlet pressure gauges and dual outlets.
6. Manufacturer to size unit to accommodate equipment as required.
7. Manufacturer to provide shop drawings showing all water connections.
8. Manufacturer to make site visits to coordinate installation by G.C.
9. Factory to provide water testing of local area to confirm requirements to accommodate manufacturers recommendations. Provide as a complete operating system, no additional cost will be provided during the installation process.

ITEM NO. 264 REVERSE OSMOSIS SYSTEM & RACK ASSEMBLY

QUANTITY 1

Manufacturer: 3M/Metro
Model: SCALEGARD HP Reverse Osmosis/Super Erecta
Size and Shape: Refer to drawings
Alternate:

1. Manufacturer to size system to accommodate equipment as required.
2. Metro Super Erecta green epoxy-coated Microban, RO rack assembly 86" high posts.. Size as required. 24" x 30" (for 20 gallon) or 24" x 36" (for 40 gallon)
3. RO Rack assembly to include one (1) Super Erecta Dunnage shelf located at bottom and one (1) Super Erecta wire shelf located on the top of assembly. . Size as required. 24" x 30" (for 20 gallon) or 24" x 36" (for 40 gallon)
4. RO Rack to include hanger rail for mounting of filter assembly.
5. RO Rack assembly to include Smart wall wall grid on ends. Hardware for attaching wall grid to hanger rails by installer.
6. 3M Purification Model No. SCALEGARD HP 120V Reverse Osmosis System.
7. Four (4) 3M Purification Model No. CFS22
8. SCALEGARD Install Kit.
9. Provide two sets of replacement filters.
10. Factory to submit shop drawings for review and approval.
11. To be interconnected to any/all cold water equipment, including; Ice Machines, Combi Ovens, Convection Steamers or Beverage Equipment.
12. Factory to perform startup and confirm all equipment interconnections are piped correctly. Provide letter with warranty confirming installation meets manufacturer requirements.
13. Special Instructions: Division 22 to provide and install all interconnection tubing and components required by system.

ITEM NO. 601 HOT WATER DISPENSER**QUANTITY 1**

Manufacturer: Hatco
Model: AWD-12
Size and Shape: Refer to drawings
Alternate:

1. Water treatment system.
2. Cord and plug assembly, NEMA L6-30P.
3. Plumbing kit.
4. Stainless steel dormont water disconnect, sized to accommodate equipment. Run from filter to water connection.
5. Provide grommetted hole in countertop to accommodate utility requirements.

ITEM NO. 614 FILL FAUCET**QUANTITY 1**

Manufacturer: T & S
Model: B-0610
Size and Shape: Refer to drawings
Alternate:

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1. Pot Filler Faucet, splash-mounted, 8" centers, vacuum breaker, flexible S/S hose, 60" long, hooked nozzle with self-closing valve, ½" IPS female inlets, built-in check valves.
2. 12" square 12 ga. S/S wall plate with hose rack with radius corners.
3. Install at 48" A.F.F. by Division 22. Coordinate height of backflow preventor with highest water level of associated equipment.

ITEM NO. 632 SIX BURNER RANGE

QUANTITY 2

Manufacturer: Vulcan
Model: 36S-6B
Size and Shape: Refer to drawings
Alternate:

1. Standard oven with two (2) oven racks.
2. Stainless steel front, sides,
3. ¾" rear gas connection.
4. 10" high stainless steel backguard.
5. Heavy duty casters, two (2) with breaks.
6. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.

END OF EQUIPMENT LIST

**SECTION 11 6500
ATHLETIC EQUIPMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Technical Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following work: Contractor shall provide and install Athletic Equipment shown on the plans and listed in this Section.
 - 1. Basketball Equipment
 - a. outdoor goal

1.03 SUBMITTALS

- A. Product data in the form of manufacturer's technical data, specifications, and cut sheets for each product specified.
- B. For each product specified, the Contractor shall submit color samples of manufacturer's standard color range of finishes for review and approval.

1.04 SHOP DRAWINGS

- A. Provide drawings of the manufacturer's recommended installation and foundation requirements for review prior to actual field installation work.
 - 1. Contractor shall be responsible for retaining the services of a licensed structural engineer who shall work with the equipment manufacturer and the local geotechnical conditions to develop required shop drawings for equipment foundations.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has at least three years of experience and has completed at least five projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements. Report any discrepancies to the Architect prior to installation.

1.07 COORDINATION

- A. Contractor shall be solely responsible for ensuring items are properly coordinated and sequenced for the orderly completion of the Project including installation of Athletic Equipment.
- B. Installation of Athletic Equipment occurs in varying locations and configurations. Contractor shall familiarize himself with the manufacturers' installation requirements prior to beginning construction activities.
 - 1. Specific instances of coordination include (but are not limited to):
 - a. Coordinate construction of footings and installation of goals, corner flags, and covered player benches with construction of synthetic turf playing field.
- C. Equipment specified herein may have lengthy manufacturing lead times. Contractor is not entitled to relief from any other Conditions of the Contract due to product lead times.

1.08 REFERENCE

- A. ASTM International Standards

PART 2 PRODUCTS

2.01 BASKETBALL EQUIPMENT

- A. Basketball Goal:
 - 1. By: First Team, Inc., 800.649.3688, www.firstteaminc.com; or approved equal.
 - a. HydroSport II

- b. FT1103, HydroPost
- c. FT1150, Sport Extension Arm
- d. FT210, 36" x 48" Acrylic Backboard
- e. FT186ZC, Heavy Duty Flex Goal
- f. FT10, Nylon Basketball Net
- g. Backboard Padding
- h. FT404CLM-FO, Four-Sided Column Pad
 - 1) Color as selected from manufacturer's full range.
- i. Install per manufacturer's instructions

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide, assemble, place, and install equipment according to manufacturer's recommendations.

END OF SECTION

**SECTION 11 6813
PLAYGROUND EQUIPMENT**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide and install play equipment as shown on the drawings, specified herein, and per Manufacturer's instructions-including, but not limited to:
 - 1. Playground equipment.
 - 2. Playground equipment concrete footings.
- B. Related work:
 - 1. Section 03 3000: Cast-in-Place Concrete.
 - 2. Division 31 "Earthwork" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 3. Section 31 1813: Synthetic Turf Surfacing.
 - 4. Section 32 1817: Poured-In-Place Solid Safety Surfacing.

1.02 REFERENCE STANDARDS

- A. CPSC (current version) Handbook for Public Playground Safety.
- B. ASTM F1487-98 Standard Safety Performance Specification for Playground Equipment for Public use (or latest update)

1.03 QUALITY ASSURANCE

- A. Comply with Site Work requirements.
- B. Manufacturers shall be insured for both product and general liability of not less than one million dollars. The issuing underwriter shall be AA rated.
- C. Manufacturers shall be required to provide a Manufacturer's Certificate of Compliance with the Consumer Products Safety Commission's Playground Equipment Guidelines.
- D. All playground equipment shall be constructed to exceed the U. S. Consumer Products Safety Commission Handbook for Safety and ASTM F 1487-95 Standard Safety Performance Specification for Playground Equipment for Public use (or latest update).
- E. Natural play equipment manufacturers shall have fifteen years experience manufacturing natural play equipment compliant with safety and licensing standards.
- F. Installer's Qualifications:
 - 1. Minimum of five years experience installing play equipment of comparable size and type.
 - 2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the requirements and the methods needed for proper performance of the work of this section.
- G. Manufacturers authorized representative shall provide written certification that installation meets CPSC guidelines.

1.04 WARRANTY

- A. From the date of final acceptance, Manufacturers shall provide the following minimum warranties against corrosion, structural failure, or manufacturing defects.
 - 1. 25-year minimum warranty: Steel or aluminum posts, stainless steel fasteners, clamps, beams and caps
 - 2. 15-year minimum warranty: Plastic components, all steel components (except 25-year steel posts), decks, coatings
 - 3. 10-year minimum warranty: Concrete products
 - 4. 8-year minimum warranty: Climbing cables
 - 5. 3-year minimum warranty: All other equipment parts

1.05 SUBMITTALS

- A. Submit product data in accordance with project requirements.
- B. Submit manufacturer's plan view drawing of the equipment.

- C. Submit manufacturer's material data.
- D. Submit samples of manufacturer's standard colors for materials on suitable substrates.
 - 1. Provide 3D rendering of equipment following color selections, and modify per review comments.
- E. Submit manufacturer's verification that equipment is installed in accordance with manufacturer's requirements.
- F. Submit manufacturer's schedule of frequency for inspection and maintenance in relation to time and use.
- G. Submit touch-up paint of each color specified.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Equipment Substitutions: substitution must be equal to specified product and approved by Owner during bidding process.
- B. Substitution review criteria:
 - 1. Identify proposed substitution play elements and their corresponding element within the specified product. Corresponding play elements shall meet comparable acts, and size, of play to be considered equal.
 - 2. Proposed substitution shall meet or exceed quality data of specified product.
 - 3. Proposed substitution shall match design intent of specified product.
- C. Acceptable Products:
 - 1. Reference drawings for equipment items and layout.
 - a. Playmound by ForeverLawn, Phone: 866.992.7876, playgroundgrass.com
 - b. Bears Playgrounds. Phone: 585.624.5694, www.bearsplaygrounds.com
 - c. Eartheasy, Phone: 888.451.6752, www.eartheasy.com
 - d. Duncan & Grove, Phone: 888.571.9470, www.duncanandgrove.com
 - e. Approved equal.
- D. Equipment colors: equipment colors to be chosen by the Architect from manufacturer standards.
- E. Concrete footings: playground equipment concrete footings shall comply with Section 03 3000, and sized per Manufacturer's requirements.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that gradients and elevations of base are correct.

3.02 INSTALLATION

- A. Install play equipment with a minimum setback or use zone of six feet from low non-moving equipment and/or the edge of the playground curb. Install higher and moving equipment with setbacks per manufacturer's recommendations and the U. S. Consumer Products Safety Commission guidelines.
- B. Playground equipment concrete footing sizes to be installed per Manufacturer's recommendations.
- C. Tops of playground footings shall be smooth with a two-inch radius. Footings shall be covered with the same depth of playground surfacing material as the rest of the play area.
- D. Slide beds shall be oriented in accordance with the Consumer Product Safety Commission Guidelines, generally northeast facing unless otherwise approved by the Owner's Representative.
- E. Play equipment shall be configured so that children with hearing disability can see potential hazards and other children playing on the equipment.

- F. Playground surfacing materials and construction shall conform to the most current U.S. Consumer Products Safety Commission Guidelines.
- G. In the event the play equipment and the playground surfacing materials are not installed and completed on the same day, the play equipment shall be barricaded and signed sufficiently to prevent play or access by the public until the playground surfacing materials are completely installed.
- H. Following completion of playground equipment installation, the playground shall be inspected by a playground Safety Inspector certified by National Recreation and Park Association and a report filed to the Owner and Contractor. The Contractor, prior to final acceptance, shall correct safety concerns noted in the report.

END OF SECTION 116813

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SECTION 12 2400 WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior manual roller shades.
- B. Interior motorized roller shades.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
- D. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- E. WCMA A100.1 - Safety of Window Covering Products; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
 - 1. Provide project specific details. Include mounting details and installation methods.
- D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- E. Selection Samples: Include fabric samples in full range of available colors and patterns.
- F. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
- G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum ten years of documented experience with shading systems of similar size and type.
 - 1. Manufacturer's authorized representative.
 - 2. Factory training and demonstrated experience.
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- D. Mounting: Provide concealed mounting where possible. Provide fascia covers where recessed / concealed mounting is not possible. Exposed rollers are not allowed.

1.07 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams, batten pockets, and fascia / housing when applicable.
 - 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 - 2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SWFcontract, a division of Springs Window Fashions, LLC.; Pro Series Manual Solar Shade System: www.swfcontract.com/#sle.
 - 2. WT Shade; HeliaRise SoloMount Manual Roller Shade; www.wtshade.com.
 - 3. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
 - 4. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
 - 5. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
 - 6. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com/#sle.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.
- C. Interior Motorized Roller Shades, Motors and Motor Controls:
 - 1. Draper, Inc; Motorized FlexShade: www.draperinc.com/#sle.
 - 2. Hunter Douglas Architectural; RB500 Motorized Roller Shades: www.hunterdouglasarchitectural.com/#sle.
 - 3. Lutron Electronics Co., Inc; Contract Roller Motorized Roller Shades: www.lutron.com/#sle.
 - 4. MechoShade Systems LLC; IQ2 Motorized: www.mechoshade.com/#sle.
 - 5. SWFcontract, a division of Springs Window Fashions, LLC: www.swfcontract.com/#sle.

6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROLLER SHADES

- A. General:
1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 2. Provide shade system that operates smoothly when shades are raised or lowered.
 3. Provide UL Greenguard Gold Certification.
- B. Roller Shades for Storefront window locations as indicated:
1. Basis of Design: As indicated on drawings.
 2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: As required for application.
 - b. Roll Direction: Roll down, closed position is at window sill.
 - c. Mounting: Window jamb mounted - inside, between jambs.
 - 1) Use concealed mounting in ceiling where possible.
 - d. Size: As required for application.
 - e. Fabric: As indicated under Shade Fabric article.
 3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 4. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
 - d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
 5. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Exposed aluminum bottom bar, flat profile with closed ends; clear anodized finish.
 - b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
 6. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop beaded ball chain, 95 pounds (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
 - d. Chain Retainer:
 - 1) Chain tensioning device complying with WCMA A100.1.
 - 2) Manufacturer's standard clip.
 7. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
 - 1) Color: Dark Bronze. Design intent is to match window frame color.
 - 2) Profile: Square.
 - b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
 - c. Interior Side Channels: As required for light sealing room-darkening shade applications.
 - d. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

- A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Material: Vinyl coated polyester.
 - a. Fiberglass is not allowed.
 - 2. Material Certificates and Product Disclosures:
 - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
 - 3. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 - 4. Openness Factor: 3% unless otherwise indicated as blackout shade.
 - 5. Color: As selected by Architect from manufacturer's full range of colors.
 - 6. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
 - c. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: As recommended in writing by manufacturer.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.07 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

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SECTION 12 3600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid surface countertops for architectural cabinet work.
- B. Solid surface window sills.
- C. Solid surface work surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions
- B. Section 06 4100 - Architectural Wood Casework.
- C. Section 114000 - Foodservice Equipment: Other stainless steel counters and fabrications.
- D. Division 22 - Plumbing: Lavatories integral with solid surface countertops.

1.03 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2016.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- C. AWI (QCP) - Quality Certification Program; Current Edition.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- G. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- I. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections. Show all proposed seam locations on Shop Drawings.
 - 1. Show interface with adjacent work.
 - 2. Show sink cut outs and accessories.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Counter Edge Sample: Submit sample of edge banding applied to counter, 12 inches long.
- G. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.
- H. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- I. Installation Instructions: Manufacturer's installation instructions and recommendations.

- J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than ten years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS, WINDOW SILLS AND WORK SURFACES

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Formica Corporation; Solid Surfacing: www.formica.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 1/2 inch (12 mm), minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; edge profile as indicated on drawings.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 - a. Unless otherwise indicated on drawings.
 - 6. Skirts: As indicated on drawings.
 - 7. Window sills and work surfaces:
 - a. Same as countertops.
- C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Wilsonart; ____: www.wilsonart.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.

- b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
- c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
- d. Finish on Exposed Surfaces: Polished.
- e. Color and Pattern: As indicated on drawings.
- 3. Other Components Thickness: 3/4 inch (19 mm), minimum.
- 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

2.02 MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
 - 2. Provide wood products made with binder containing no urea formaldehyde (NAF) or ultra-low emitting formaldehyde (ULEF).
 - 3. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000 - Product Requirements.
 - 4. Provide wood harvested within a 500 mile (805 km) radius of the project site, when possible.
 - 5. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
 - 1. Sustainable Medium Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde (NAF), MR-10, FSC certified.
 - a. Basis-of-Design: "Arreis" MDF by Roseburg.
 - 2. Sustainable Moisture Resistant Medium Density Fiberboard: ANSI A208.2-2009, Grade 155, made with binder containing no urea formaldehyde (NAF), MR-50, FSC certified.
 - a. Basis-of-Design: "Medex" MDF by Roseburg.
 - b. Locations: Within 10 feet of any plumbing fixture.
- D. Medium Density Particleboard:
 - 1. Medium Density Particleboard: ANSI 208.1, Industrial Grade M3, made with binder containing no urea formaldehyde (NAF), MR-10, FSC certified.
 - a. Basis-of-Design: "Collins Pine Free-Form" by Collins Wood.
 - 2. Medium Density Particleboard: ANSI 208.1, Industrial Grade M3, made with binder containing no urea formaldehyde (NAF), MR-50, FSC certified.
 - a. Basis-of-Design: "Collins Pine Free-Form MR50 Particleboard" by Collins Wood.
 - b. Locations: Within 10 feet of any plumbing fixture.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- F. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.

1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 12 9300
SITE FURNISHINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Benches.
- B. Planter Bench.
- C. Waste Receptacle.
- D. Raised Garden.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: For product footings.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' specifications and descriptive literature, installation instructions, and maintenance information.
- C. Shop Drawings: Provide manufacturer details for product for approval, prior to fabrication.
- D. Samples: Submit manufacturer's available colors and finishes for each material type.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's requirements.
- B. Transport, store, and handle units in an upright position, avoiding rubbing, scratching, or dragging of unit base on concrete or substrate.
- C. Remove pallet/crate strapping and wrapping upon delivery of units to site to avoid marring of surface finish, unless stored in an interior, enclosed storage space free from moisture and excessive heat.
- D. Use equipment and methods for transportation, site handling and installation as recommended by manufacturer.
- E. Storage:
 - 1. Store units off ground, preferably on a wood pallet, and in manner to prevent physical damage, including rubbing, scratching, or denting of finished surface.
 - 2. Place stored units in a singular upright position and according to manufacturer specifications.
 - 3. Store so that singular units are accessible and undamaged.
- F. Handle products with care to prevent any damage to surface finish.

PART 2 PRODUCTS

2.01 BENCHES

- A. Manufactured by: Victor Stanley; <http://www.victorstanley.com>, or approved equal.
 - 1. Backed
 - a. Model STE-20
 - b. Length: 6'
 - c. Wood: Ipe or Wood grain recycled plastic: select from manufacturer's full range; submit finish samples for review.

- d. Steel Frame Finish: select from manufacturer's full range; submit finish samples for review.
- e. Surface Mount per manufacturer's requirements.
 - 1) Mounting hardware: non-corrosive tri-groove anti-theft type; cut bolt flush with the nut.
- 2. Backless
 - a. Model STE-23NA
 - b. Length: 6'
 - c. Wood: Ipe or Wood grain recycled plastic: select from manufacturer's full range; submit finish samples for review.
 - d. Steel Frame Finish: select from manufacturer's full range; submit finish samples for review.
 - e. Surface Mount per manufacturer's requirements.
 - 1) Mounting hardware: non-corrosive tri-groove anti-theft type; cut bolt flush with the nut.

2.02 PLANTER BENCH

- A. Manufactured by: Unique Garden Decor, Inc.; <https://www.uniquegardendecor.com/>; or approved equal.
 - 1. Curved Planter Bench
 - a. SKU: CVDB-SP
 - b. Size: L83" W36" H36" (with bench)
 - c. Aluminum Finish: color as selected from manufacturer's full range; submit finish samples for review.
 - d. Surface Mount per manufacturer's requirements.
 - e. Mounting hardware: non-corrosive tri-groove anti-theft type; cut bolt flush with the nut.

2.03 WASTE RECEPTACLE

- A. Manufactured by: Victor Stanley; <https://victorstanley.com/>; or approved equal.
 - 1. REN-45TD
 - a. 45 gallon
 - b. Solid steel panels and recycled plastic combination
 - c. Top-deposit
 - d. Side-door opening
 - e. Wide convex lid
 - f. Heavy steel latch
 - g. High-density plastic liner
 - h. Rubber-tipped leveling feet
 - i. Finish: as selected by architect from manufacturer's full range.
 - j. Surface Mount per manufacturer's requirements.
 - 1) Field verify locations with Owner and Architect prior to installation.
 - 2) Mounting hardware: non-corrosive tri-groove anti-theft type; bolt cut flush with the nut.

2.04 RAISED GARDEN

- A. Manufactured by: Eartheasy; <https://eartheasy.com>
 - 1. Composite Raised Garden Bed
 - a. 4' wide x 8' long
 - b. 16.5" tall
 - c. 2" thick boards
 - d. Composite plastic
 - e. 5 year warranty
 - f. Fill with Garden Mix soil by Gem Dirt

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine deliveries upon arrival at site to verify each unit is without damage.
 - 1. Replace damaged units.
- B. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.
- C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
- B. Provide level mounting surfaces for site furnishing items.
 - 1. Set units level, plumb, square and true within allowable tolerances.

3.03 ADJUSTING

- A. Adjust each system so that sectional units are in proper location and orientation.
- B. Holes cannot be added to units in the field and must be fabricated during manufacturing process, prior to finishing of units.

3.04 CLEANING

- A. Clean dirt or blemishes from surface of exposed units.
- B. Wash and rinse in accordance with manufacturer's recommendations.
- C. Protect adjacent surfaces from damage due to cleaning operations.
- D. Do not use cleaning materials or processes which could alter character of exposed finishes.

END OF SECTION

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**SECTION 13 3123
TENSIONED FABRIC STRUCTURE**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

- A. Fabric on steel frame shade structure.

1.03 REFERENCES

- A. Shade structures must comply with the latest revision of applicable codes and regulations including International Building Code (IBC), version adopted by authority having jurisdiction for this project.
- B. American Society for Testing Materials (ASTM)
- C. American Welding Society: Structural Welding Code AWS D1.1: Symbols for Welding and Nondestructive Testing AWS 2.3.
- D. International Accreditation Services (IAS)
- E. American Institute of Steel Construction (AISC): Specifications for the design, fabrication and erection of structural steel.

1.04 SUBMITTALS

- A. Contractor shall submit for permitting the approved shop drawings and calculations with the engineering seal and signature of a structural engineer licensed in the State of Oklahoma for deferred permit submittal.
- B. Materials list of items proposed to be provided under this Section.
- C. Shop drawings showing pertinent details of the units and their interface with other components of the structure, including concrete foundations.
- D. Manufacturer's installation requirements.
- E. Provide fabric samples to demonstrate fabric color range and powder coat color selections. Also, provide letter of authorization from fabric manufacturer for use of the specified fabric.
- F. Provide proof of quality assurance items including;
 - 1. Proof of General liability, Professional liability and umbrella insurance.
 - 2. Proof of IAS certification.
 - 3. Proof of an Annual Maintenance Inspection Program.

1.05 QUALITY ASSURANCE

- A. Fabrication and erection shall be by firms with proven experience in design and construction of fabric shade structures and such firms shall meet the following minimum requirements.
- B. Design Loads: Provide design as required by the International Building Code, version adopted by authority having jurisdiction for this project.
- C. Bidders shall be able to provide proof with bid submittal of a minimum of \$1,000,000 general/public liability insurance, \$3,000,000 professional liability (PL) insurance and additional \$5,000,000 umbrella/excess liability insurance.
- D. Manufacturer shall be accredited by the IAS (International Accreditation Service) for Structural Steel Fabrication under UBC 97 & 2000 Section 1701.7 and IBC (version adopted by authority having jurisdiction for this project) Section 1704.2.2.
- E. The shade contractor shall have a Corporate Quality Control program and manual describing their complete quality assurance program.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for shade structures shown on the Drawings in relation to adjacent structures, and verify locations by field measurements prior to construction.

1.07 WARRANTY

- A. The successful bidder shall provide a 12-month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years (prorated) on fabric and 10 years (non-prorated) on the structural integrity of the steel from date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 TYPE

- A. 3-point sail, reference Drawings for dimensions.

2.02 GENERAL

- A. Approved manufacturers:
 - 1. USA Shade: www.usa-shade.com
- B. To qualify as an approved equivalent, submit product documentation, fabric samples and all quality assurance criteria per this section and project requirements.
- C. The structures shall include the structural steel frame, fabric roof, steel cables, all fasteners, concrete foundations, and installation of structures.
- D. The shade structure shall conform to the International Building Code version adopted by authority having jurisdiction for this project, and local agency additions and amendments.
- E. Shade structures shall be engineered and designed to meet a minimum of 90 mph wind load, Exposure C and a live load of 10 lbs/sf². Shade structures shall be engineered with a zero wind pass-through factor on the fabric. When ASD Steel Design Method is used based on IBC (current adopted version) Section 1605.3.1 the Dead + 0.75 of Live + 0.75 of Wind Load cases must be combined.
- F. Steel:
 - 1. Steel members of the shade structure shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold Formed Members and manufactured in a IAS (International Accreditation Service) accredited facility for Structural Steel Fabrication as per IBC (current adopted version) Section 1704.2.2
 - 2. Connections shall have a maximum internal sleeving tolerance of .0625 inches using high tensile strength steel sections with a minimum sleeve length of 6 inches.
 - 3. Non-hollow structural steel members shall comply to ASTM A-36. All hollow structural steel members shall be cold formed, high strength steel and comply with ASTM A-500, Grade C. All steel plates shall comply to ASTM A-572, Grade 50. All galvanized steel tubing shall be triple coated for rust protection using an in-line electro-plating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.
- G. Bolts:
 - 1. Structural field connections of the shade structure shall be designed and made with high strength bolted connections using ASTM A-325 bolts.
 - 2. Stainless steel bolts shall comply with ASTM F-593, Alloy Group 1 or 2.
 - 3. Bolt fittings shall include rubber washer for watertight seal at joints. All nuts shall comply with ASTM F-594, Alloy Group 1 or 2.
- H. Welding:
 - 1. Shop-welded connections of the shade structure shall be designed and performed in strict accordance with the requirements of the "American Welding Society" (AWS)

Specifications. Structural welds shall be made in compliance with the requirements of the "Prequalified" welded joints where applicable and by certified welders. No onsite or field welding shall be permitted.

2. Full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirement of IBC (current adopted version) and local agency additions and amendments.
- I. Powder coating:
1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance to solvent cleaning SSPC-SP1. Solvent such as water, mineral spirits, xylol, toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning prior to surface preparation shall be executed according to Power Tool Cleaning SSPC-SP3 and utilizing wire brushes abrasive wheels and needle gun, etc.
 2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance to commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, products and other foreign material.
 3. Powder coating shall be sufficiently applied, with a minimum three mils thickness and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests as defined by the American Society of Testing Materials.
 4. Powder used in the powder coat process shall have the following characteristics:
 - a. Specific Gravity: 1.68 +/- 0.05
 - b. Theoretical coverage: 114 +/- 4ft²/lb/mil
 - c. Mass loss during cure: <1%
 - d. Maximum storage temperature: 75 deg F
 5. Rust Protection Powder Under Coat Primer will be required on all structures. Epoxy Powder Coating Primer shall be applied in accordance with the manufacturer's specifications. Primer should be fused only and then top coated with the selected powder coat to ensure proper intercoat adhesion.
- J. Tension Cable: Steel cable to be determined based on calculated engineering load.
- K. Fabric Roof Systems
1. UV Shade Fabric
 - a. UV shade fabric is made of a UV stabilized cloth and made of a UV stabilized high-density polyethylene mesh. Mesh shall be raschel knitted with monofilament and tape yarn filler to ensure that material will not unravel if cut. Panels to be 10ft wide.
 - b. Fire Testing: Fabric shall conform and pass the ASTM E84 testing standard.
 - c. The fabric knot is to be made using monofilament and tape filler, which has a weight of 195g per square meter.
 - d. Fabric Properties:
 - 1) Life Expectancy: A minimum of 10 years continuous exposure to the sun
 - 2) Fading: Minimum fading after 5 years (3 years for red)
 - 3) Fabric Mass: 2.43-2.58 oz/sqft (190-200g/sm)
 - 4) Fabric Width: 9.8425 (3m)
 - 5) Roll Length: 164.04 (50m)
 - 6) Roll Dimensions: 62.99"x16.5354" (160 cm x 42 cm)
 - 7) Roll Weight: +/- 66 lbs (=/-30 kg)
 - 8) Minimum Temperature: -13°F (-25° C)
 - 9) Maximum Temperature: +176°F (80° C)
 - e. Stitching & Thread:
 - 1) All sewing threads are to be double stitched.
 - 2) Thread shall be manufactured from 100% expanded PTFE (Teflon); mildew resistant exterior approved thread. Thread shall meet or exceed the following:
 - (a) Flexible temperature range
 - (b) Very low shrinkage factor

- (c) Extremely high strength, durable in outdoor climates
- (d) Resists flex and abrasion of fabric
- (e) Unaffected by cleaning agents; acid rain, mildew, salt water and rot resistant, unaffected by most industrial pollutants
- (f) Treated for prolonged exposure to the sun

2.03 SHIPPING AND HANDLING

- A. Steel surfaces touched by tie down straps are to be padded before final clinching. This can be accomplished by using carpet pads or factory manufactured padding.
- B. Dunnage must be padded before painted products are set in place. Smaller and loose pieces must be padded and totally separate from paint padding.
- C. Unloading: Lift forks to be covered with properly fitted padding. All dunnage must be padded vertically and horizontally to prevent damage to painted surfaces. When unloading, take care to prevent tools and other hard surface items from making contact with painted items.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install the work of this Section in strict accordance with the shop drawings and manufacturer's instructions as approved by the Owner's representative and with the requirements of governmental agencies having jurisdiction.
- B. Concrete
 - 1. Concrete for footings and piers shall meet a minimum 3,500 psi at 28-day strength.
 - 2. Concrete work is executed in strict accordance with the latest American Concrete Institute Building Code (ACI 318-99).
 - 3. Slump 4" maximum.
 - 4. Whenever daily ambient temperatures are below 80 degrees Fahrenheit, the contractor may have mix accelerators and hot water added at the batch plant.
 - a. temperature range between 75-80 degrees, 1% accelerator High Early (non-calcium)
 - b. temperature range between 70-75 degrees, 2% accelerator High Early (non-calcium)
 - c. temperature range below 70 degrees, 3% accelerator High Early (non-calcium)
 - 1) The contractor shall not pour any concrete when daily ambient temperature is below 55 degrees Fahrenheit.

5. TABLE 1

Temperature Range	% Accelerator	Type Accelerator
75-80 degrees	1%	High Early (non calcium)
70-75 degrees	2%	High Early (non calcium)
Below 70 degrees	3%	High Early (non calcium)

- C. Foundations:
 - 1. Anchor Bolts set in new concrete shall be ASTM A-325.
 - 2. Anchor Bolts shall be Hot Dipped Galvanized.
 - 3. Concrete footing requirements shall be included in the shop drawings.

END OF SECTION

**SECTION 13 3400
PRE-ENGINEERED STRUCTURES**

PART 1 GENERAL

1.01 SUMMARY

- A. Work to include:
 - 1. Shade Structure with concrete footings.
- B. QUALITY ASSURANCE
 - 1. Provide drawings signed and sealed by an Engineer registered to practice in the State of Oklahoma.
 - 2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are proficient with the specified requirements and methods necessary for proper performance of the work of this Section.
- C. SUBMITTALS
 - 1. Product data: Within 30 calendar days after the contractor has received the Owner's Notice to Proceed, submit:
 - a. Materials list of items proposed to be provided under this Section.
 - b. Shop drawings showing pertinent details of the units and their interface with other components of the structure.
 - c. Manufacturer's warranty (10-year, minimum).
 - d. Manufacturer's recommended installation procedures.
- D. DELIVERY, STORAGE AND HANDLING
 - 1. Deliver the units to the job site with adequate wrapping to prevent staining and other damage from moisture, per manufacturer's recommendations.
 - 2. Store materials in accordance with manufacturer's recommendation and as directed by the Owner's Representative.
 - 3. Maintain wrapping in proper condition until erection has started.
- E. DESIGN LOADS
 - 1. Provide design as required by the International Building Code, 2015 edition.
- F. COORDINATION
 - 1. Coordinate the work of this section with installation of any underground piping, conduit or wiring, and grading.
 - 2. Closely coordinate all work with grading, paving and other site work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coverworx: coverworx.com
- B. Approved equal.

2.02 SHADE STRUCTURE

- A. Steelworx Cantilever Shelter
 - 1. Size:
 - a. 10' X 178'
 - b. 10'x116'
 - 2. Frame: steel.
 - a. Steel finish: TGIC Polyester powder coat finish.
 - b. Color as selected from manufacturer's standards.
 - 3. Eave height: 9'-0" (low side).
 - 4. Roofing:
 - a. 2:12 roof pitch.
 - b. 24 gauge steel panels.
 - c. Colors as selected from manufacturer's standards.
 - 5. Hidden fasteners.

6. No field welding.
7. Provide factory touch up paint.

2.03 PART 3 EXECUTION

A. SURFACE CONDITIONS

1. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. INSTALLATION

1. Install the work of this Section, including concrete footings, in strict accordance with the shop drawings and manufacturer's requirements as approved by the Owner's representative and with the requirements of governmental agencies having jurisdiction.

END OF SECTION

**SECTION 13 3419
METAL BUILDING SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufacturer-engineered, shop-fabricated structural steel building frame.
 - 1. Design intent for Metal Building is indicated on Architectural and Structural Drawings.
 - 2. Extent of Metal Building Design shall include criteria indicated on drawings.
 - 3. It is the responsibility of the Metal Building System fabricator and installer to coordinate with design criteria as indicated.
 - 4. Metal Building system shall include additional framing and supports as required for the support and interface with Work specified in other Sections. Additional purlins or secondary framing members may be required to conform with ceiling features indicated on architectural drawings, support sprinkler system, duct runs, lighting and equipment. Required clearances at the perimeter of the building for toilets and other architectural features shall be included.
- B. Metal wall and roof panels including exterior and interior accessories as indicated on drawings and as required for project.
 - 1. Insulation system shall comply with IECC 2018: International energy conservation code: Thermal performance of opaque building assemblies.
- C. Exterior Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 042000 – Unit Masonry: Brick ties and anchors that attach to Metal building system framing.
- B. Section 051200 - Structural Steel Framing: Structural steel column anchor bolts.
- C. Section 054000 - Cold-Formed Metal Framing
- D. Section 07 9200 - Joint Sealants: Sealing joints between accessory components and wall system.
- E. Division 8: Overhead Coiling Grilles, Aluminum-Framed Storefronts, Glazed Aluminum Curtain Walls.
- F. Section 08 1113 - Hollow Metal Doors and Frames.
- G. Section 099123 - Interior Painting: Paint finish.
- H. IECC 2018: International energy conservation code: Thermal performance of opaque building assemblies.

1.03 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2016 (Revised 2021).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- G. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

- I. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2021a.
- J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- K. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- L. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2023.
- M. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- O. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- P. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
- S. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2018.
- T. MBMA (MBSM) - Metal Building Systems Manual; 2019.
- U. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- V. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on profiles, component dimensions, fasteners and insulation, building liner and thermally-broken attachment clips.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, openings, cambers, loads, and interface with adjacent work; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and interface with other structural framing, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
 - 1. Use grid lines indicated on drawings.
 - 2. Show adjacent structural framing and primary architectural features included in other Sections. Shop drawings that do not include these features will be returned without review.
 - 3. Show all exterior openings and use window frame designations indicated on architectural drawings.
 - a. Include openings for MEP systems.
 - 4. Shop drawings and notes shall be clearly legible and at a scale appropriate for the depicted level of detail.
 - 5. Show backing for brick ties specified in 042000 – Unit Masonry.
 - 6. Show steel markings and erection tabs to be removed and repaired prior to application of topcoat.

7. For metal building systems indicated to comply with performance requirements and design criteria, include analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement, and compliance with indicated design and installation requirements.
- E. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- F. Designer's Qualification Statement.
- G. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
- H. Erector's Qualification Statement.
- I. Statement of Compliance: For insulation system's compliance with performance requirements as indicated.
- J. Project Record Documents: Record actual locations of concealed components and utilities.
- K. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
 1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
 2. Comply with applicable code for submission of design calculations and reviewed shop and erection drawings as required for acquiring permits.
 3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 360 and MBMA (MBSM).
 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 1. Not less than ten years of documented experience.
 2. Accredited by IAS in accordance with IAS AC472.
- D. Erector Qualifications: Company specializing in performing the work of this section with minimum ten years documented experience and approved by manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- F. Coordination: Coordinate shop primers with topcoats:
 1. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- G. Thermal Performance: Comply with IECC 2018 - International energy conservation code: Thermal performance of opaque building assemblies.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

- C. Provide twenty year manufacturer warranty for Weathertightness and Exterior Finish.
 - 1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Buildings Systems:
 - 1. Subject to compliance with requirements and design intent, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Butler Manufacturing Company: www.butlermfg.com/#sle.
 - b. Ceco Building Systems: www.cecobuildings.com/#sle.
 - c. Metallic Building Company: www.metallic.com/#sle.
 - d. Nucor Building Systems: www.nucorbuildingsystems.com/#sle.
 - e. VP Buildings: www.vp.com/#sle.
 - f. Alliance Steel, Inc., www.allianceokc.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ASSEMBLIES

- A. Tapered beam.
 - 1. Drawings indicate additional framing at connections to achieve architectural aesthetics.
- B. Bay Spacing: As indicated in drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, braced end frames, end wall columns, and end wall corner columns, and wind bracing.
 - 1. Provide open-end frames at locations highlighted in drawings.
- D. Secondary Framing: Purlins, Girts, Eave struts, Flange bracing, Sill supports, Clips, and as required to support the Work of other sections, and as required for application, and other items detailed.
 - 1. Provide flush or bypass girts and framing, or both as required for application. Multiple girt system types may be required for project. Refer to design intent, as indicated on drawings.
- E. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, insulation, liner sheets, and cold form metal framing as required to support the Work of other sections, and as required for application, and accessory components.
 - 1. Finishes and materials are indicated on drawings.
- F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, liner panels, and exterior sheathing with high-temperature underlayment membrane, and accessory components.

2.03 PERFORMANCE REQUIREMENTS

- A. Installed thermal Resistance of Wall System: R-value of R-19 + R-11, minimum.
 - 1. Insulation system shall comply with IECC 2018: International energy conservation code: Thermal performance of opaque building assemblies.
- B. Insulating system shall have a continuous heavy-duty liner inside of building purlins, girts, and insulation to provide complete isolation from inside conditioned air.
- C. Design structural members to withstand dead and live loads, applicable snow load and drifts, and design loads due to wind pressure and suction as calculated in accordance with applicable code.
- D. Additional requirements are indicated on drawings.
- E. Design structural members to withstand Class 90 wind uplift in accordance with UL 580.
- F. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - 1. Purlins and Rafters: Vertical deflection of 1/240 of the span.

2. Girts: Horizontal deflection of 1/600 of the span. An additional load factor of 0.7 may be utilized with standard service load combinations when verifying member deflection due to wind loads.
 3. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
 4. Lateral Drift: Maximum of 1/240 of the building height.
- G. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
 - H. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 120 degrees F (48.8 degrees C).
 - I. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - J. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.
 - K. Design and fabricate supports required for brick ties specified in 042000 – Unit Masonry.

2.04 MATERIALS - FRAMING

- A. Structural Steel Members: ASTM A36/A36M.
- B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
- C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
- D. Anchor Bolts: ASTM A307, Grade A, with no preference for protective coatings.
- E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
- F. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.
- G. Primer: SSPC-Paint 20 zinc rich.
 1. Compatible with topcoat.
- H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
 3. Height Change, Plastic State: When tested in accordance with ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.

2.05 MATERIALS - WALLS AND ROOF

- A. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
- B. Insulation: ASTM C991 Type I; thickness as required to achieve specified R-Value.
 1. Formaldehyde-free.
 2. Thermally-broken attachment.
 3. Unfaced batt insulation.
 4. Refer to Paragraph 2.05C for manufacturer.
- C. Metal Building Type, Factory Applied, Vapor-Barrier Insulation Facings: Water vapor permeance no greater than 0.10 perm (5.7 ng/(Pa s sq m)) when tested in accordance with ASTM E96/E96M; flame spread index of 25 or less, and smoke developed index of 40 or less when tested in accordance with ASTM E84.
 1. Manufacturers:
 - a. Basis-of-design: Johns Manville Simple Saver System (R19+R11 with thermal block) with liner manufactured by Thermal Design; www.thermaldesign.com;
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Joint Seal Gaskets: Manufacturer's standard type.
 3. Fasteners: Thermally-broken.

4. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
5. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.06 COMPONENTS

- A. As required for application.

2.07 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Provide wall opening framing for doors, windows, and other accessory components.

2.08 FABRICATION - WALL AND ROOF PANELS

- A. Siding: Minimum 0.024 inch (.6096 mm) metal thickness, Wave Panel, Concealed fastener profile, 7/8 inch (22 mm) deep, male/female edges fitted with continuous gaskets.
- B. Roofing: Minimum 0.024 inch (.6096 mm) metal thickness, Maxima Standing Seam profile, male/female edges fitted with continuous gaskets.
- C. Soffit Panels: Minimum 0.024 inch (.6096 mm) metal thickness, flat profile indicated, perforated for ventilation.
- D. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- E. Internal and External Corners: Same material thickness and finish as adjacent material, profile shop cut and factory mitered to required angles. Back brace mitered internal corners with steel sheet, of size as recommended by manufacturer
- F. Expansion Joints: Same material and finish as adjacent material where exposed, manufacturer's standard brake formed type, of profile to suit system.
- G. Flashings, Closure Pieces, Fascia and Infills: Same material and finish as adjacent material, profile to suit system.
- H. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.
- I. Roof Fascia: Install metal roof fascia; Minimum [0.024] inch ([.6096] mm) metal thickness as indicated in the drawings.

2.09 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts and scuppers of profile to match rake trim and size according to SMACNA's "Architectural Sheet Metal Manual" to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

- A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.
- B. Exterior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish and color as selected from manufacturer's standard range.
- C. Interior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish and color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.02 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.
 - 1. Remove steel markings and erection tabs at all locations exposed to view.

3.03 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb. Fasten cladding to cold-formed metal framing at locations indicated in drawings.
- D. Locate end laps over supports. End laps minimum 2 inches (50 mm). Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners.
- G. Install sealant and gaskets, providing weather tight installation.
- H. Remove markings and erection tabs at all locations exposed to view.
- I. Install metal roof fascia; Minimum [0.024] inch ([.6096] mm) metal thickness as indicated in the drawings.

3.04 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Slope gutters per SMACNA's "Architectural Sheet Metal Manual."
- C. Connect downspouts to storm sewer system where indicated in the drawings.

3.05 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, overhead doors, windows and glass, and other items in accordance with manufacturer's instructions.

3.06 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
- B. Siding and Roofing: 1/8 inch (3 mm) from true position.

END OF SECTION

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SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1- GENERAL

1.1 SUMMARY

- A. This Section includes the following: (As Applicable)
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression demolition.
 - 7. Concrete bases.
 - 8. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- R. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- S. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- T. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- U. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- V. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- W. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- X. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part I "Quality Assurance" Article.
- Y. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- Z. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- AA. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- BB. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- CC. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- DD. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- EE. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- FF. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- GG. Attach to substrates as required to support applied loads.

3.6 GROUTING

- HH. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

- II. Clean surfaces that will come into contact with grout.
- JJ. Provide forms as required for placement of grout.
- KK. Avoid air entrapment during placement of grout.
- LL. Place grout, completely filling equipment bases.
- MM. Place grout on concrete bases and provide smooth bearing surface for equipment.
- NN. Place grout around anchors.
- OO. Cure placed grout.

END OF SECTION 210500

SECTION 211000

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
- B. See Division 10 Sections "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Classrooms: Light Hazard.
 - b. Storage / Electrical Rooms: Ordinary Hazard Group II
 - c. Wire Storage: Ordinary Hazard Group II
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq.ft. over 1500 sq. ft..
 - b. Ordinary-Hazard, Group II Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft..
 - 4. Maximum Protection Area per Sprinkler:
 - a. Light Hazard Areas: 225 sq. ft..
 - b. Ordinary Hazard Areas: 130 sq. ft..
 - c. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Ordinary-Hazard Occupancies: 250 gpm for 60 minutes.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- C. Field test reports and certificates.
- D. Field quality-control test reports.

- E. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-End, Ductile-Iron Pipe: AWWA C151, with factory- or field-formed, radius-cut-grooved ends according to AWWA C606.
 - 1. Grooved-Joint Piping Systems:
 - a. Available Manufacturers:
 - 1) Victaulic Co. of America.
 - b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD.
 - c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts.
 - d. Grooved-End Transition Flange: UL 213, gasketed fitting with key for ductile-iron-pipe dimensions. Include flange-type, ductile-iron housing with rubber gasket listed for use with housing and steel bolts and nuts.

2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.

3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with-grooved ends.
1. Grooved-Joint Piping Systems:
 - a. Available Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Ductilic, Inc.
 - 4) JDH Pacific, Inc.
 - 5) National Fittings, Inc.
 - 6) Shurjoint Piping Products, Inc.
 - 7) Southwestern Pipe, Inc.
 - 8) Star Pipe Products; Star Fittings Div.
 - 9) Victaulic Co. of America.
 - 10) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
1. NPS 2 and Smaller: Threaded.
 2. NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Available Manufacturers:
1. Anamet Inc.
 2. Flex-Hose Co., Inc.
 3. Flexicraft Industries.
 4. Flex-Pression, Ltd.
 5. Flex-Weld, Inc.
 6. Hyspan Precision Products, Inc.
 7. Mercer Rubber Co.
 8. Metraflex, Inc.
 9. Proco Products, Inc.
 10. Unaflex Inc.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.5 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

- B. Outlet Specialty Fittings:
 - 1. Available Manufacturers:
 - a. Anvil International, Inc.
 - b. Tyco Fire Products
 - c. Ductilic, Inc.
 - d. JDH Pacific, Inc.
 - e. National Fittings, Inc.
 - f. Shurjoint Piping Products, Inc.
 - g. Southwestern Pipe, Inc.
 - h. Star Pipe Products; Star Fittings Div.
 - i. Victaulic Co. of America.
 - j. Ward Manufacturing.
 - 2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
 - 3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Available Manufacturers:
 - a. Tyco Fire Products
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.

- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Available Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End and Croker Corp.
 - c. Potter-Roemer; Fire-Protection Div.

- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
 - 1. Available Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Tyco Fire Products
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.

- F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 - 1. Available Manufacturers:
 - a. CECA, LLC.
 - b. Merit.

2.6 LISTED FIRE-PROTECTION VALVES (As Applicable)

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

- B. Gate Valves with Wall Indicator Posts:
 - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
 - 2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.
 - 3. Available Manufacturers:
 - a. Grinnell Fire Protection.

- b. McWane, Inc.; Kennedy Valve Div.
 - c. NIBCO.
 - d. Stockham.
- C. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Available Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with grooved ends.
 - a. Available Manufacturers:
 - 1) Tyco Fire Products
 - 2) Global Safety Products, Inc.
 - 3) McWane, Inc.; Kennedy Valve Div.
 - 4) Mueller Company.
 - 5) NIBCO.
 - 6) Pratt, Henry Company.
 - 7) Victaulic Co. of America.
- D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
 - 1. Available Manufacturers:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Co.; Waterous Co.
 - c. Tyco Fire Products
 - d. Clow Valve Co.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Firematic Sprinkler Devices, Inc.
 - h. Globe Fire Sprinkler Corporation.
 - i. Grinnell Fire Protection.
 - j. Hammond Valve.
 - k. Matco-Norca, Inc.
 - l. McWane, Inc.; Kennedy Valve Div.
 - m. Mueller Company.
 - n. NIBCO.
 - o. Potter-Roemer; Fire Protection Div.
 - p. Reliable Automatic Sprinkler Co., Inc.
 - q. Star Sprinkler Inc.
 - r. Stockham.
 - s. United Brass Works, Inc.
 - t. Venus Fire Protection, Ltd.
 - u. Victaulic Co. of America.
 - v. Watts Industries, Inc.; Water Products Div.

2.7 UNLISTED GENERAL-DUTY VALVES

- A. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- B. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- C. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.8 SPECIALTY VALVES (As Applicable)

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Available Manufacturers:
 - a. AFAC Inc.
 - b. Tyco Fire Products
 - c. Firematic Sprinkler Devices, Inc.
 - d. Globe Fire Sprinkler Corporation.
 - e. Grinnell Fire Protection.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Star Sprinkler Inc.
 - h. Venus Fire Protection, Ltd.
 - i. Victaulic Co. of America.
 - j. Viking Corp.
 - 2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 - a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
 - 1. Available Manufacturers:
 - a. AFAC Inc.
 - b. Grinnell Fire Protection.

2.9 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Available Manufacturers:
 - 1. Tyco Fire Suppression & Building Products
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Victaulic Co. of America.
 - 5. Viking Corp.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1626, for residential applications.
 - 3. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
 - 1. Pendent sprinklers.
 - 2. Quick-response sprinklers.
 - 3. Recessed sprinklers, including escutcheon.
 - 4. Sidewall sprinklers.
 - 5. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, and bronze

- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, semi-recessed.
 - 2. Sidewall Mounting: Chrome-plated steel, semi-recessed.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

PART 3 - EXECUTION (As Applicable)

3.1 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.2 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. NPS 2 and Smaller: Threaded-end, black, standard-weight (schedule 40) steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- B. NPS 2 and Smaller: Grooved-end, black, standard-weight (schedule 40) or thin wall (schedule 10) steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- C. NPS 2 1/2 and Larger: Grooved-end, black, standard-weight (schedule 40) or thin wall (schedule 10) steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- D. NPS 2 1/2 and Larger: Grooved-end, galvanized, standard-weight (schedule 40) or thin wall (schedule 10) steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - b. Throttling Duty: Use globe valves.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.

- D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

3.5 WATER-SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.

3.6 PIPING INSTALLATION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- J. Fill wet-pipe sprinkler system piping with water.

3.7 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

3.8 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Pendent sprinklers.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
 - b. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.9 SPRINKLER INSTALLATION (As Applicable)

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- F. Electrical Connections: Power wiring is specified in Division 26.
- G. Connect alarm devices to fire alarm.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.11 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.12 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Coordinate with fire alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 211000

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms where allowed by authority having jurisdiction.
- F. PVC Pipe: ASTM D 1785, Schedule 40 where allowed by authority having jurisdiction.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

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SECTION 22 0513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.

- 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 22 0516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal-bellows expansion joints.
 - 2. Pipe bends and loops.
 - 3. Alignment guides and anchors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product certificates.
- E. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adsko Manufacturing, LLC.
 - b. Anamet, Inc.
 - c. Badger Industries.

- d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex-Pression, Ltd.
 - h. Flex-Weld, Inc.
 - i. Hyspan Precision Products, Inc.
 - j. Metraflex, Inc.
 - k. Piping Technology & Products, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics, Inc.; Pathway Division.
 - n. Tozen America Corp.
 - o. Unaflex Inc.
 - p. WahlcoMetroflex.
- 2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
 - 3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
 - 4. Metal-Bellows Expansion Joints for Steel Piping: Multiple-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
 - 5. Minimum Pressure Rating: 175 psig, unless otherwise indicated.
 - 6. Configuration: Double-bellows type with base, unless otherwise indicated.
 - 7. End Connections: Flanged.

2.2 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adsko Manufacturing, LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Piping Technology & Products, Inc.
 - i. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.

- E. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION

SECTION 22 0519

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermometers.
 - 2. Gages.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Trerice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or Plastic.
- F. Connector: Rigid, straight type.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Miljoco Corp.
 - 2. Palmer - Wahl Instruments Inc.

3. Trerice, H. O. Co.
 4. Weiss Instruments, Inc.
 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- C. Case: Dry type, stainless steel with 3-inch diameter.
- D. Element: Bimetal coil.
- E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark-color metal.
- G. Window: Glass or plastic.
- H. Ring: Stainless steel.
- I. Connector: Rigid, back type.
- J. Stem: Metal, for thermowell installation and of length to suit installation.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Miljoco Corp.
 2. Palmer - Wahl Instruments Inc.
 3. Trerice, H. O. Co.
 4. Weiss Instruments, Inc.
 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Liquid filled type, metal or plastic, 6-inch diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 6. Pointer: Red or other dark-color metal.

7. Window: Glass or plastic.
 8. Ring: Metal or plastic.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
 2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install bimetallic-actuated dial thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install dry-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install dry-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage.
- E. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- F. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION

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SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Iron, single-flange butterfly valves.
 - 4. Bronze swing check valves.
 - 5. Iron swing check valves.
 - 6. Iron swing check valves with closure control.
 - 7. Bronze gate valves.
 - 8. Iron gate valves.
 - 9. Bronze globe valves.
 - 10. Iron globe valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.

- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.7 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.8 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.

- c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- B. Class 125, OS&Y, Iron Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Ball, or butterfly valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125, nonmetallic disc.
 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 4. Bronze Swing Check Valves: Class 125, nonmetallic disc.
 5. Bronze Gate Valves: Class 125.
 6. Bronze Globe Valves: Class 125, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
 5. Iron Gate Valves: Class 125, OS&Y.
 6. Iron Globe Valves: Class 125.

END OF SECTION

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SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
- D. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
- E. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Carpenter & Paterson, Inc.
 3. Empire Industries, Inc.
 4. Globe Pipe Hanger Products, Inc.
 5. Grinnell Corp.
 6. PHD Manufacturing, Inc.
 7. PHS Industries, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
 - 7. Buckaroos Inc
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.

- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 22 0548

VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Elastomeric hangers.
 - 5. Spring hangers.
 - 6. Spring hangers with vertical-limit stops.
 - 7. Pipe riser resilient supports.
 - 8. Resilient pipe guides.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.

3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- C. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.
- D. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- G. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- H. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Equipment Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
- B. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- E. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

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SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Provide equipment's drawing designation or unique equipment number as indicated on plans and/or schedules.

- D. Equipment Label Schedule: For each item of equipment to be labeled, indicate on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section .
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Blue.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.

END OF SECTION

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SECTION 22 0700

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Polyolefin.
 - e. Polystyrene.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

C. References:

1. North American Commercial and Industrial Insulation Standards (Latest Edition). Published by Midwest Insulation Contractors Association (MICA)
2. NAIMA CI228 Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation 33°F to 60°F (0.5°C to 15.6°C) Latest Edition. Published by North American Insulation Manufacturers Association (NAIMA).
3. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.
4. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
6. ASTM C335 Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
7. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
8. ASTM C547 Standard Specifications for Mineral Fiber Pipe Insulation.
9. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
10. ASTM C795 Standard Specifications for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

11. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
12. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings (only when noted by engineer on drawings):
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, formaldehydes, lead, mercury, polybrominated diphenyl ether fire retardants or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; 1000 Series Spin-Glas.
 - b. Owens Corning; High Temperature Industrial Board Insulations.
 - c. Rock Wool Manufacturing Company; Delta Board.
 - d. Roxul Inc.; Roxul RW.
 - e. Thermafiber; Thermafiber Industrial Felt.
- H. Mineral-Fiber, Preformed Pipe Insulation: Mineral-Fiber, Preformed Pipe Insulation, complying with ASTM C 547, Type I (850 degrees F) or Type IV (1000 degrees F); ASTM C 585, ASTM C 411, ASTM C 795, and UL/ULC Classified. Fiberglass bonded with a thermosetting resin. Provide insulation with factory applied white ASJ SSL or white ASJ+ SSL+ vapor retarder jacket with self-sealing lap closure, complying with ASTM C 1136. Thermal conductivity ASTM C 335 (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 1,000 degrees F. Flame spread/Smoke-developed rating (ASTM E84) of 25/50. Must be UL Validated Formaldehyde-free.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; Earthwool 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
- I. Mineral-Fiber, Pipe and Tank insulation, complying with ASTM C 1393; Type I, II and Category 1. Semi-rigid board material in roll form with fiberglass adhered perpendicular to the vapor retarding facing. Fiberglass bonded with a bio-based thermosetting resin. Minimum thickness shall be 1.0" or more as required by code. Provide insulation with factory-applied **[glass mat facing.] [FSK] [White ASJ+]** vapor retarder facing complying with ASTM C 1136. Compressive Strength per ASTM C 165, not less than 125 PSF at 10% deformation. Thermal conductivity (k-value) at 100 degrees F mean temperature is 0.26 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature range of 850 degrees F. Flame spread/Smoke-developed rating (ASTM E84) of 25/50. Must be UL Validated Formaldehyde-free.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.

- b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- K. Polystyrene: (For outdoor use only) Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; AeroSeal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

- e. Mon-Eco Industries, Inc.; 22-25.
- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
8. Materials shall be compatible with insulation materials, jackets, and substrates.
9. Fire- and water-resistant, flexible, elastomeric sealant.
10. Service Temperature Range: Minus 40 to plus 250 deg F.
11. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ+-SSL+: ASJ+ vapor retarder jacket with self-sealing lap closure, complying with ASTM C 1136 Type I, II, III, IV, and VII secured with self-sealing longitudinal laps and matching ASJ+ butt wraps.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.

- C. Aluminum Jacket: Comply with ASTM C 1729, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Sheet and roll stock ready for shop or field sizing.
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches.
 3. Film Thickness: 4 mils.
 4. Adhesive Thickness: 1.5 mils.
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM C1729, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in

position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.

- b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches.
 - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
- 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Installations of insulations should be in accordance with manufacturer installation instructions and practices detailed by the North American Commercial and Industrial Insulation Standards manual (latest edition). Go to micainsulation.org for additional information regarding Insulation Standards.
- C. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular

- surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe

- insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of cellular-glass insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to the pipe with factory applied white ASJ or ASJ+ vapor retarder jacket with SSL or SSL+ closure system. Use the SSL or SSL+ closure system in lieu of wire or banding for securement.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure longitudinal lap with provided SSL or SSL+ closure system.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments by building out pipe insulation O.D. with pre-molded pipe insulation collars of appropriate sizes or use pipe and tank insulation to build out to the flange O.D. or the I.D. of the insulation that is to be installed over the flange. Some fill of the flange spaces with blanket is appropriate before the insulation of the flange is installed over the flange.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.9 POLYOLEFIN INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 POLYSTYRENE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed section of polystyrene insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit

allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.12 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 EQUIPMENT INSULATION SCHEDULE (AS APPLICABLE)

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-Exchanger (Water-to-Water for Domestic Water Heating Service) Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.

- D. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
 - 1. Flexible Elastomeric: R-6 Minimum.
 - 2. Mineral-Fiber Pipe and Tank: R-6 Minimum.
 - 3. Polyolefin: R-6 Minimum.
- E. Domestic Hot-Water Storage Tank Insulation: Mineral-Fiber Pipe and Tank: R-12.5 Minimum.
- F. Piping System Filter-Housing Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.

3.15 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.16 INDOOR PIPING INSULATION SCHEDULE

- 1. Domestic Hot and Recirculated Hot Water Minimum Insulation Thickness:

FLUID OPERATING TEMP (°F)	INSULATION CONDITIVITY		Nominal Pipe Size		
	Btu x in./ (h x ft ² x °F)	Mean Rating Temperature °F	< 1"	1" to < 1-1/2"	1-1/2" to <4"
201-250	0.27-0.30	150	2.5"	2.5"	2.5"
141-200	0.25-0.29	125	1.5"	1.5"	2.0
105-140	0.21-0.28	100	1.0"	1.0"	1.5"
40-60	0.21-0.27	75	0.5"	0.5"	1.0"

- a. Insulation shall be one of the following:
 - 2. Flexible Elastomeric
 - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I
 - 4. Polyolefin
 - 5. Flexible Elastomeric
 - 6. Mineral-Fiber, Preformed Pipe Insulation, Type I
 - 7. Polyolefin:
- B. Domestic Cold Water: Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1/2 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 3. Polyolefin: 1/2 inch thick.
 - 4. Flexible Elastomeric: 1/2 inch thick.
 - 5. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

6. Polyolefin: 1/2 inch thick.
- C. Stormwater and Overflow: Insulation shall be one of the following:
 1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 3. Polyolefin: 1 inch thick.
 - D. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:
 1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 3. Polyolefin: 1 inch thick.
 - E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
 1. Flexible Elastomeric: 1/2 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 3. Polyolefin: 1/2 inch thick.

3.17 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping: Insulation shall be one of the following:
 1. Cellular Glass: 2 inches thick.
 2. Flexible Elastomeric: 2 inches thick.
 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 4. Polyolefin: 2 inches thick.
 5. Polystyrene: 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 1. None.
 2. Aluminum, Smooth: 0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 1. None.
 2. Aluminum, Smooth: 0.024 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 1. None.
 2. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
- F. Piping, Concealed:
 1. PVC: 20 mils thick.
 2. Aluminum, Smooth: 0.016 inch thick.
- G. Piping, Exposed:
 1. PVC: 20 mils thick.

2. Aluminum, Smooth: 0.020 inch thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 1. PVC: 30 mils thick.
 2. Aluminum, Smooth: 0.020 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 1. Painted Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 1. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
- F. Piping, Concealed:
 1. None.
 2. PVC: 30 mils thick.
 3. Aluminum, Smooth: 0.020 inch thick.
- G. Piping, Exposed:
 1. Painted Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.

3.20 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

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SECTION 22 1113
FACILITY WATER DISTRIBUTION PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene-monomer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- G. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 PRODUCTS

2.01 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
 3. Pipe thickness: 4"-8" pipe, class 51
10" and larger, class 50
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
 3. Pipe thickness: 4"-8" pipe, class 51
10" and larger, class 50

2.02 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.
 1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
- B. PVC, Schedule 80 Pipe: ASTM D 1785.
 1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- C. PVC, AWWA Pipe: AWWA C900, Class 305, DR 14 with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.03 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, BCuP Series.
- B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.04 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements of City of Catoosa.
 2. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.05 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 1. Manufacturers: Subject to compliance with requirements of City of Catoosa.
 2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.06 CHECK VALVES

- A. AWWA Check Valves:
 1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 175 psig.

2.07 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
 1. Manufacturers: Subject to compliance with requirements of City of Catoosa.

- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.08 WATER METERS

- A. Water meters will be subject to compliance with requirements of City of Tulsa.

2.09 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Subject to compliance with requirements of City of Tulsa.

2.10 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
 - 1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
 - a. Standard: ASSE 1060.
 - b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced-aluminum or-fiberglass construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.
 - 2) Electric heating cable or heater with self-limiting temperature control.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

3.03 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 - 2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 - 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
 - b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
 - c. Check Valves: AWWA C508, swing type.
 - 4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
 - 5. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.

3.04 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of City of Tulsa water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
- E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- F. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

- G. Install piping by tunneling by boring, under streets and other obstructions that cannot be disturbed.
- H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping.
- J. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.
- K. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.05 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.06 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Locking mechanical joints.
 - 2. Set-screw mechanical retainer glands.
 - 3. Bolted flanged joints.
 - 4. Heat-fused joints.
 - 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 6. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 7. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 8. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 - 9. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.07 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.08 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according requirements of City of Tulsa.

3.09 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.10 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

3.11 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

3.12 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. AWWA Fire Hydrants: Comply with AWWA M17.

3.13 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.
- C. Connect water-distribution piping to interior domestic water piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.14 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Pressure and leakage testing shall be in accordance with AWWA C-601. Remake leaking joint reactions with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.15 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.16 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) NVent LLC.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: CPVC or PVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

2.8 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.9 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.10 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.12 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

- 6. NPS 6: 10 feet with 5/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with set screw.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, stamped steel with set screw.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.

- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.15 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6, shall be one of the following:
 - 1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.
- H. Aboveground domestic water piping, NPS 5 and NPS 6, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.

3.17 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) NVent LLC.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: CPVC or PVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

2.8 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.9 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.10 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.12 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

- 6. NPS 6: 10 feet with 5/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with set screw.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, stamped steel with set screw.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.

- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.15 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6, shall be one of the following:
 - 1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.
- H. Aboveground domestic water piping, NPS 5 and NPS 6, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and brazed soldered joints.

3.17 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Trap-seal primer valves.
- B. See Division 22 Section "Domestic Water Piping" for water meters.
- C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.
- D. See Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Rain Bird Corporation.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1012.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze.
 - 5. Finish: Chrome plated.
- B. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Configuration: Designed for horizontal, straight through flow.
 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- C. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Configuration: Designed for horizontal, straight through flow.
 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- D. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1003.
 3. Pressure Rating: Initial working pressure of 150 psig.
 4. Design Outlet Pressure Setting: 80 psig.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
 6. Valves for Booster Heater Water Supply: Include integral bypass.
 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 2 or smaller.
 - 5. Body: Copper alloy.
 - 6. Port: Standard or full port.
 - 7. Ball: Chrome-plated brass.
 - 8. Seats and Seals: Replaceable.
 - 9. End Connections: Solder joint or threaded.
 - 10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Tempered-Water Setting: 100 deg F.
 - 9. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

9. Tempered-Water Setting: As indicated on plan.
10. Valve Finish: Rough bronze.
11. Piping Finish: Copper.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with 3/64" round perforations, unless otherwise indicated.
 5. Drain: Pipe plug.

2.7 HOSE BIBBS

- A. Hose Bibbs:
 1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body Material: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 6. Pressure Rating: 125 psig.
 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 9. Finish for Exterior Service: Rough bronze.
 10. Finish for Interior Service: Chrome or nickel plated.
 11. Operation for Equipment Rooms: Wheel handle or operating key.
 12. Operation for Exterior Service: Operating key.
 13. Operation for Interior Service: Operating key.
 14. Include operating key with each operating-key hose bibb.
 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

- A. Wall Hydrants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Woodford Manufacturing Company.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 3. Pressure Rating: 125 psig.
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 6. Inlet: NPS 3/4 or NPS 1.
 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 8. Box: Deep, flush mounting with cover.
 9. Box and Cover Finish: Polished nickel bronze.

10. Operating Keys(s): One with each wall hydrant.

2.9 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. PPP Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Metal bellows or Copper tube with piston.
 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install water hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Water pressure-reducing valves.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Supply-type, trap-seal primer valves.
- K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221123 - DOMESTIC WATER CIRCULATION PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic hot-water circulation:
 - 1. Close-coupled, in-line, sealless centrifugal pumps.
- B. Related Sections include the following:
 - 1. None.

1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.

- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Bell & Gossett Domestic Pump; ITT Industries.
 - 2. Grundfos Pumps Corp.
 - 3. Taco, Inc.
- B. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 - 2. Casing: Bronze, with threaded companion-flange connections.
 - 3. Impeller: Corrosion-resistant material.
 - 4. Motor: Single speed, unless otherwise indicated. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
- C. Capacities and Characteristics:
 - 1. Capacity: Schedule
 - 2. Total Dynamic Head: Schedule
 - 3. Maximum Operating Pressure: 125 psig
 - 4. Maximum Continuous Operating Temperature: 220 deg F
 - 5. Motor Horsepower: Schedule
 - 6. Electrical Characteristics:
 - a. Volts: 115

- b. Phases: Single
- c. Hertz: 60.
- d. Full-Load Amperes: .95
- e. Minimum Circuit Ampacity: 1.19
- f. Maximum Overcurrent Protection: 15

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Square D.
 - c. White-Rodgers Div.; Emerson Electric Co.
 - 2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
 - 3. Range: **65 to 200 deg F**
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: **24 V, ac**
 - 7. Settings: Start pump at **105 deg F**

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- C. Install in-line, sealless centrifugal pumps with motor and pump shafts horizontal.
- D. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight.

3.2 CONTROL INSTALLATION

- A. Install immersion-type thermostats in hot-water return piping.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.

- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping.
 - 2. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps.
- D. Connect thermostats to pumps that they control.

3.4 STARTUP SERVICE

- A. Contractor shall be responsible for start-up.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

END OF SECTION 221123

SECTION 22 11 23 (15440) - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Domestic Water Inline Pumps

B. Related Sections:

1. Section 22 05 23 - General Duty Valves for Plumbing Piping
2. Section 22 05 19 - Meters and Gages for Plumbing Piping
3. Section 22 11 16 - "Domestic Water Piping
4. Section 22 11 23.13 (15444) - Domestic Water Packaged Booster Pumps: for booster systems.
5. Section 22 34 00 (15486) – Fuel-Fired Domestic Water Heaters.
6. Division 26 Sections for power-supply wiring, field-installed disconnects, electrical devices, and motor controllers.

1.02 REFERENCES

A. [ASTM International \(ASTM\)](#) Publications: (Former American Society for Testing and Materials)

1. B36 "Standard Specification for Brass Plate, Sheet, Strip, And Rolled Bar"
2. B584 "Standard Specification for Copper Alloy Sand Castings for General Applications"

B. [National Fire Protection Association \(NFPA\)](#) Publications:

1. 70 "National Electric Code"

C. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"
3. 778 "Standard for Motor-Operated Water Pumps"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

B. [Submit "Letter of Conformance" in accordance with Section 01 33 00 \(01330\) indicating specified items selected for use in project with the following supporting data.](#)

1. Product Data:

- a. Include certified performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties; and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.
2. Maintenance Data: For each pump specified to include in maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of pumps through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in [NFPA 70](#), Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Domestic Water Inline Pumps:
 - a. [Grundfos](#)
 - b. [Armstrong Pumps, Inc.](#)
 - c. [ITT Industries](#)
 - d. [Taco, Inc.](#)

2.02 GENERAL

- A. Description: Factory-assembled and -tested, single-stage, centrifugal pump units; complying with [UL 778](#); suitable for potable-water service; with all-bronze or stainless-steel construction and components in contact with water made of corrosion-resistant materials.
- B. Motors: Comply with requirements in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment" with built-in thermal-overload protection appropriate for motor size and duty.
- C. End Connections for NPS 2 (DN50) and Smaller: Threaded. Pumps available only with flanged ends may be furnished with threaded companion flanges.
- D. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.
- E. Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.
- F. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles.

2.03 DOMESTIC WATER IN-LINE PUMPS

- A. Description: Horizontal in-line circulator, rated for 125-psig minimum working pressure and minimum continuous water temperature of 225 deg F.
 - 1. Construction: Radially split, all-bronze casing.
 - 2. Impeller: [ASTM B36](#), rolled brass; or [ASTM B584](#), cast bronze; overhung, single suction, and keyed to shaft.
 - 3. Seal: Mechanical.
 - 4. Shaft and Sleeve: Steel shaft, with oil-lubricated copper sleeve.
 - 5. Pump Bearings: Oil-lubricated, bronze-journal or thrust type.

6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
7. Motor: Single speed, with oil-lubricated bearings, unless otherwise indicated; and resiliently mounted to pump casing.
 - a. Motor Size: For motors larger than 1/2 hp, select motor size that will not overload through full range of pump performance curve.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water distribution piping to verify actual locations of connections before pump installation.

3.02 INSTALLATION

- A. Install pumps according to manufacturer's written instructions and with access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- B. Support pumps and piping so weight of each is not supported by the other.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 1. Connect water distribution piping to pumps. Install suction and discharge pipe equal to or greater than size of pump nozzles. Refer to Section 22 11 16 - "Domestic Water Piping."
 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Section 22 05 23 - "General Duty Valves for Plumbing Piping" for general-duty valves.
 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Section 22 05 19 - "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.
- B. Electrical wiring and connections are specified in Division 26 Sections.
- C. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in [UL 486A](#) and [UL 486B](#).

3.04 COMMISSIONING

- A. Check suction piping connections for tightness.
- B. Final Checks before Starting: Perform the following preventive maintenance operations:
 1. Lubricate oil-lubricated-type bearings.
 2. Verify that pump is free to rotate by hand and that pump for handling hot liquids is free to rotate with pump hot and cold. Do not operate pump if it is bound or drags, until cause of trouble is determined and corrected.
 3. Verify that pump controls are correct for required application.
- C. Starting procedure for pumps is as follows:
 1. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

2. Open circulating line valve if pump should not be operated against dead shutoff.
3. Open discharge valve slowly.
4. Check general mechanical operation of pump and motor.
5. Close circulating line valve once there is sufficient flow through pump to prevent overheating.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps as specified below:
 1. Conduct training as specified in Division 01 Sections.
 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.

END OF SECTION

SECTION 22 1313
FACILITY SANITARY SEWERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes gravity-flow, nonpressure, sanitary sewerage outside the building, with the following components:
 - 1. Pipe and fittings.
 - 2. Nonpressure and pressure couplings.
 - 3. Cleanouts.
 - 4. Manholes.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene-monomer rubber.
- B. LLDPE: Linear low-density, polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe materials.
 - 2. Special pipe fittings.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.02 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: AWWA C151, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

2.03 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

- B. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
 - 1. PVC, SDR 26 Socket Fittings: ASTM D 3034.

2.04 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 1. Top-Loading Classification: Heavy and Extra-heavy duty.
 - 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.05 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 8-inch (200-mm) minimum thickness for floor slab, extending at least 4 inches beyond the manhole wall, and 4-inch (100-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Riser Sections: 4-inch (100-mm) minimum thickness, and of length to provide depth indicated.
 - 5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 6. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 - 7. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 8. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
 - 9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 11. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.
- B. Cast-in-Place-Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
 - 1. Ballast: Increase thickness of concrete as required to prevent flotation.
 - 2. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 3. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.

4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

2.06 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.02 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Shielded flexiblecouplings for same or minor difference OD pipes.
 - b. Shielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 2. Use pressure-type pipe couplings for force-main joints.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

3.03 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install cleanouts for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with 36-inch minimum cover.
 - 4. Install piping below frost line.
 - 5. Install ductile-iron special fittings according to AWWA C600.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.04 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
 - 2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
 - 3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
 - 4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 - 5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

3.05 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.06 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Construct cast-in-place manholes as indicated.
- D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
- E. Form continuous concrete channels and benches between inlets and outlet.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.
- G. Install manhole cover inserts in frame and immediately below cover.

3.07 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.08 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.09 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use warning tape or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Test deflection according to the requirements of ASTM 2321. Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, ASTM F2261, and the following:
 - a. Allowable leakage is maximum of 10 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.

- e. Test and inspect joints for leaks.
- f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
- 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- 7. Manholes: Perform hydraulic testing according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

- A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. See Division 22 Section "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- D. Solid-Wall PVC Pipe: (Where allowed by authority having jurisdiction) ASTM D 2665, solid-wall drain, waste, and vent.
 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. (Where allowed by authority having jurisdiction)
- D. Aboveground, soil, waste, and vent piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. (Where allowed by authority having jurisdiction)
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. (Where allowed by authority having jurisdiction)
- F. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. (Where allowed by authority having jurisdiction)

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Use gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.
- K. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 2. NPS 3: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
- L. Install supports for vertical PVC piping every 48 inches.
- M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Roof flashing assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.
 - 7. Grease interceptors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with access check valve.
 - 6. End Connections: Hub and spigot or hubless.
 - 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
 - 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Closure: Brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Polished bronze.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Medium Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.

- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
- 5. Closure: Countersunk or raised-head, brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
- 3. Body Material: Gray iron.
- 4. Outlet: Bottom.
- 5. Sediment Bucket: As noted on plans.
- 6. Top or Strainer Material: As noted on plans.
- 7. Top of Body and Strainer Finish: As noted on plans.
- 8. Top Shape: As noted on plans.
- 9. Dimensions of Top or Strainer: As noted on plans
- 10. Top Loading Classification: Medium Duty.
- 11. Funnel: As noted on plans.
- 12. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection where required.
- 13. Trap Material: Cast iron.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

- 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
- 2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

- 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
- 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.6 GREASE INTERCEPTORS

- A. Grease Interceptors:
1. Interceptors shall meet the requirements of the Applicable Plumbing Code and Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping as required by Authority having Jurisdiction. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Assemble open drain fittings and install with top of hub 1 inch above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.

- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with Grade Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Install flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- B. Set flashing on floors and roofs in solid coating of bituminous cement.
- C. Secure flashing into sleeve and specialty clamping ring or device.
- D. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 22 31 00 (15469) - DOMESTIC WATER SOFTENERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Commercial Water Softeners
 - 2. Chemicals
 - 3. Water Testing Sets
- B. Related Sections:
 - 1. Section 22 07 00 (15083) - Pipe Insulation: for softener-piping insulation.

1.02 REFERENCES

- A. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
 - 1. [ASME](#)
- B. [ASTM International \(ASTM\)](#) Publications: (Former American Society for Testing and Materials)
 - 1. D859 "Test Method for Silica in Water"
 - 2. D1067 "Test Methods for Acidity or Alkalinity of Water"
 - 3. D1068 "Test Methods for Iron in Water"
 - 4. D1126 "Test Method for Hardness in Water"
 - 5. D1129 "Terminology Relating to Water"
 - 6. D3370 "Practices for Sampling Water from Closed Conduits"
- C. [National Fire Protection Association \(NFPA\)](#) Publications:
 - 1. 70 "National Electric Code"
- D. [NFS International \(NFS\)](#) Publications:
 - 1. NSF/ANSI 44 "Residential Cation Exchange Water Softeners"
 - 2. NSF/ANSI 61 "Drinking Water System Components--Health Effects"
- E. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
 - 2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
- B. [Submit "Letter of Conformance" in accordance with Section 01 33 00 \(01330\) indicating specified items selected for use in project with the following supporting data.](#)
 - 1. Product Data:
 - a. Include rated capacities; shipping, installed, and operating weights; ion-exchange resins; salt purity and form; furnished specialties; and accessories.
 - 2. Shop Drawings: Detail equipment layouts and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

- a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- 3. Certificates of Shop Inspection and Data Reports: For softener tanks, as required by [ASME](#) Boiler and Pressure Vessel Code.
- 4. Manufacturer's Field Service Reports: As specified in this Section.
- 5. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- 6. Maintenance Agreement: As specified in this Section.
- 7. Maintenance Data: For water softeners to include in maintenance manuals specified in Division 01.
- 8. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in [NFPA](#) 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period. Include coverage for the following:
 - 1. Attrition loss of resin not to exceed 3 percent per year.
 - 2. Resin not to be washed out of system during service run or backwashing period.
 - 3. Effluent turbidity not to be greater and color not to be darker than incoming water.
 - 4. Underdrain system, gravel, and resin not to become fouled, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.
 - 5. Response time shall be less than 24 from time of contact, seven (7) days per week.
- C. Warranty Period: Not less than three years from date of Substantial Completion.

1.06 MAINTENANCE SERVICE

- A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Commercial Water Softeners:
 - a. "One-Flow System"; [Watts](#)

- b. [Culligan International Co.](#)
- c. [Aquion Partners, L. P.; RainSoft Water Treatment Systems Div.](#)
- d. [Columbia Water Conditioning Systems, Inc.](#)

2.02 COMMERCIAL WATER SOFTENERS

- A. Description: Factory-assembled, pressure-type, commercial water softener.
- B. Configuration:
 - 1. [Twin unit with two softener tanks and one brine tank.](#)
- C. NSF Compliance:
 - 1. [NSF 44](#), "Cation Exchange Water Softeners."
 - 2. [NSF 44](#), "Cation Exchange Water Softeners," and [NSF 61](#), "Drinking Water System Components--Health Effects."
- D. Softener Tank: FRP, pressure-vessel quality. Include hydrostatic test at minimum of one and one-half times pressure rating and the following:
 - 1. Construction: [\[Non-ASME code.\] \[Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."\]](#)
 - 2. Pressure Rating: [\[100 psig minimum\] \[125 psig\].](#)
 - 3. Wetted Components: Suitable for water temperatures from [\[40 to at least 100 deg \] \[40 to at least 120 deg F\].](#)
 - 4. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - 5. Support Legs or Skirt: Constructed of structural steel, attached to tank bottom.
 - 6. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
 - 7. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, non-clogging plastic strainers; arranged for even flow distribution through resin bed.
 - 8. Liner: PE, ABS, or other material suitable for potable water.
- E. Softener Tank: Steel, electric-welded, pressure-vessel quality. Include hydrostatic test at minimum of one and one-half times pressure rating and the following:
 - 1. Construction: [\[Non-ASME code.\] \[Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels."\]](#)
 - 2. Pressure Rating: [\[100 psig minimum\] \[125 psig minimum\] \[150 psig\].](#)
 - 3. Wetted Components: Suitable for water temperatures from [\[40 to at least 100 deg\] \[40 to at least 120 deg F\].](#)
 - 4. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - 5. Handholes: 4 inches round or 4 by 6 inches elliptical, in top head and lower sidewall of tanks 30 inches and smaller in diameter.
 - 6. Manhole: 11 by 15 inches in top head of tanks larger than 30 inches in diameter.
 - 7. Support Legs or Skirt: Constructed of structural steel, welded to tank bottom.
 - 8. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication.
 - 9. Finish: Exterior of tank spray painted with rust-resistant prime coat, 2- to 3-mil dry film thickness. Interior sandblasted and lined with epoxy-polyamide coating, 8- to 10-mil dry film thickness.

10. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
 11. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, non-clogging PE strainers; arranged for even flow distribution through resin bed.
 12. Liner: PE, ABS, or other material suitable for potable water.
- F. Controls: Fully automatic; factory mounted on units and factory-wired cycle controls. Include the following:
1. Adjustable duration of various regeneration steps.
 2. Push-button start and complete manual operation.
 3. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
 4. Sequence of Operation: Program multi-port pilot-control valve to automatically pressure actuate main operating valve through steps of regeneration and return to service. Include the following:
 - a. Pointer on pilot-control valve to indicate cycle of operation.
 - b. Means of manual operation of pilot-control valve if power fails.
 5. Main Operating Valves: Industrial, automatic, multi-port, diaphragm type with the following features:
 - a. Slow opening and closing, non-slam operation.
 - b. Diaphragm guiding on full perimeter from fully open to fully closed.
 - c. Isolated dissimilar metals within valve.
 - d. Self-adjusting, internal, automatic brine injector that will draw brine and rinse at constant rate independent of pressure.
 - e. Valve for single unit with internal automatic bypass of raw water during regeneration.
 - f. Sampling cocks for soft water.
 - g. Special tools are not required for service.
 6. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.
 - a. Meter Control: Equip each softener tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons. Design so signal will continue until reset.
 - b. Demand-Initiated Control: Equip single softener-tank units with automatic-reset-head water meter that will electrically activate cycle controller to initiate regeneration at preset total in gallons. Design so head will automatically reset to preset total in gallons (liters) for next service run.
 - c. Demand-Initiated Control: Equip each softener tank of twin units with automatic-reset-head water meters that will electrically activate cycle controllers to initiate regeneration at preset total in gallons. Design so heads will automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.
 - d. Demand-Initiated Control: Equip twin softener-tank units with automatic-reset-head water meter in common outlet header that will electrically activate cycle controller to automatically regenerate one softener tank at preset total in gallons (liters) and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.

- e. Demand-Initiated Control: Equip each softener tank of multiple tank units with automatic-reset-head water meters that will electrically activate cycle controllers to automatically regenerate at preset total in gallon. Design so heads will automatically reset to preset total in gallons for next service run. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
- f. Demand-Initiated Control: Equip multiple softener-tank units with automatic-reset-head water meter in common outlet header that will electrically activate cycle controller to automatically regenerate one softener tank at preset total in gallons and divert flow to other tanks. Set to repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
- G. Brine Tank: Combination brine and brine measuring. Include section with salt platform and screen for dry-salt storage and section for brine, or single section for wet-salt storage without platform.
- H. Brine Tank: Combination brine and brine measuring. Include section with salt platform and screen for dry-salt storage and section for brine.
- I. Brine Tank: Combination brine and brine measuring. Include single wet-salt storage section.
 - 1. Construction: Fabricated from 3/16-inch-thick fiberglass or 3/8-inch-thick molded PE. Include plastic cover.
 - 2. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill. Include brine tubing and fittings.
 - 3. Size: Sufficient for at least four regenerations at full salting.
- J. Include the following factory-installed accessories:
 - 1. Piping, valves, drains, and pressure gages.
 - 2. Sampling cocks.
 - 3. Main-operating-valve position indicators.
 - 4. Water meters.

2.03 CHEMICALS

- A. Ion-Exchange Resin: High-capacity, sulfonated polystyrene that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Include capacity to 30,000 grains of calcium carbonate hardness/cu. ft. of resin when regenerated with 15 lb of salt.
- B. Salt for Brine-Tank Applications: High-purity, sodium chloride that is free of dirt and foreign material. Rock and granulated forms are unacceptable.
 - 1. Form: [Food-grade salt pellets] [Salt pellets] [Solar salt, crystallized in shallow ponds and milled into irregular particles] [Plain, brine block salt].

2.04 WATER TESTING SETS

- A. Water-Hardness Testing Set: Manufacturer's standard testing apparatus and chemicals with testing procedure instructions and metal container suitable for wall mounting.

PART 3 EXECUTION

3.01 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for equipment. Refer to Section 03 30 00 (03300) - "Cast-in-Place Concrete" and Section 21/22/23 95 00 (15050) "Basic Mechanical Materials and Methods."

3.02 WATER SOFTENER INSTALLATION

- A. Install water softener equipment on concrete bases, level and plumb, according to manufacturer's written instructions, layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing servicing are accessible.
- B. Anchor tanks and floor-mounting accessories to substrate.
- C. Install seismic restraints for tanks and floor-mounting accessories and anchor to substrate (where required).
- D. Install pressure gages on raw-water inlet and soft-water outlet piping of each water softener tank. Refer to Section 22 05 19 "Meters and Gages" for pressure gages.
- E. Install water testing sets near each water softener and mount on wall where indicated.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections to dissimilar-metal water piping with dielectric fittings. Refer to Section 21/22/23 95 00 (15050) "Basic Mechanical Materials and Methods" for dielectric fittings.
- D. Install drains as indirect wastes to spill into open drains or over floor drains.
- E. Install brine lines and fittings furnished by manufacturer but not specified to be factory mounted.
- F. Install electrical connections for power, controls, and devices. Electrical power wiring, devices, and connections are specified in Division 26 Sections.
- G. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in [UL 486A](#) and [UL 486B](#).

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field assembly of components and installation of water softeners, including piping and electrical connections. Report results in writing.
 - 1. Leak Tests: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
 - 1. [ASTM D859](#), "Test Method for Silica in Water."
 - 2. [ASTM D1067](#), "Test Methods for Acidity or Alkalinity of Water."
 - 3. [ASTM D1068](#), "Test Methods for Iron in Water."
 - 4. [ASTM D1126](#), "Test Method for Hardness in Water."

5. [ASTM](#) D1129, "Terminology Relating to Water."
6. [ASTM](#) D3370, "Practices for Sampling Water from Closed Conduits."

3.05 COMMISSIONING

- A. Engage a factory-authorized service representative to perform startup service.
- B. Perform the following final checks before startup:
 1. Water Piping Systems: Verify that tests have been completed.
 2. Load Softener Tank: Install gravel to cover lower distribution system and add water; smooth gravel surface and add softening resin.
 3. Load Brine Tank: Add water and fill tank with pellet-form salt.
- C. Energize circuits.
- D. Adjust operating controls.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
 1. Conduct training as specified in Section 01 79 00 (01820) - "Training".
 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.

END OF SECTION

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SECTION 22 3400

FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
 - 1. Commercial, power-burner, storage, (Natural Gas or Propane) water heaters.
 - 2. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: From date of Substantial Completion:
 - a. Commercial, Propane Water Heaters: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the water heater schedule shown in the construction documents.

2.2 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, Power-Burner, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - 1. Manufacturers:
 - a. Bradford White Corporation.
 - b. PVI Industries, LLC.
 - c. RHEEM.
 - d. Smith, A. O. Water Products Company.
 - e. STATE
 - 2. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - 4. Burner: Comply with UL 795 for power-burner water heaters and for natural-gas fuel.
 - a. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - 5. Temperature Control: Adjustable thermostat.
 - 6. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - 7. Special Requirements: NSF 5 construction.
 - 8. Draft Hood: Draft diverter; complying with ANSI Z21.12.
 - 9. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
- B. Capacity and Characteristics:
 - 1. Capacity: See water heater schedule.
 - 2. Recovery: See water heater schedule.
 - 3. Temperature Setting: See water heater schedule.

4. Fuel Gas Demand: See water heater schedule.
5. Fuel Gas Input: See water heater schedule.
6. Gas Pressure Required at Burner: See water heater schedule.
7. Electrical Characteristics: See water heater schedule.
8. Minimum Vent Diameter: See water heater schedule.

2.3 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Provide dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- E. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas water heaters according to NFPA 54.
 1. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
 2. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters

that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

- F. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- H. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:(As Applicable)
 - 1. Faucets.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Water closets.
 - 7. Urinals.
 - 8. Lavatories.
 - 9. Kitchen sinks.
- B. Related Sections include the following:
 - 1. Division 22 Section "Security Plumbing Fixtures."
 - 2. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Sinks: ANSI Z124.6.
 - 4. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 5. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 6. Stainless-Steel Sinks: ASME A112.19.3.
 - 7. Vitreous-China Fixtures: ASME A112.19.2M.
 - 8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Faucets: ASME A112.18.1.
 - 4. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 5. Hose-Coupling Threads: ASME B1.20.7.
 - 6. Manual-Control Antiscald Faucets: ASTM F 444.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 - 9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 10. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Delta Faucet Company.
 - d. Eljer.
 - e. Kohler Co.
 - f. Moen, Inc.
 - g. T & S Brass and Bronze Works, Inc.
 2. Description: As noted on plans. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.5 gpm.

2.2 SINK FAUCETS

- A. Sink Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Delta Faucet Company.
 - d. Eljer.
 - e. Kohler Co.
 - f. Moen, Inc.
 - g. T & S Brass and Bronze Works, Inc.

2. Description: As noted on plans. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.

2.3 FLUSHOMETERS

- A. Flushometers,:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Coyne & Delany Co.
 - b. Delta Faucet Company.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group; Commercial Brass Operation.
 2. Description: Flushometer for urinal and/or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

2.4 TOILET SEATS

- A. Toilet Seats:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Church Seats.
 - c. Kohler Co.
 - d. Olsonite Corp.
 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SS, self-sustaining.
 - e. Class: Standard commercial.
 - f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.6 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Water-Closet Supports, :
 - 1. Description: Combination carrier designed for mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- D. Urinal Supports, :
 - 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Lavatory Supports, :
 - 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- F. Sink Supports, :
 - 1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.7 WATER CLOSETS

- A. Water Closets, :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - e. TOTO USA, Inc.
 - 2. Description: Vitreous-china fixture designed for flushometer valve operation.

2.8 URINALS

- A. Urinals, :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.

- c. Eljer.
- d. Kohler Co.
- e. TOTO USA, Inc.
- 2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

2.9 LAVATORIES

- A. Lavatories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - e. TOTO USA, Inc.
 - 2. Description: Vitreous-china fixture.
 - a. Drain Piping: Chrome-plated, cast-brass P-trap; 0.032-inch- thick tubular brass waste to wall; and wall escutcheon.
 - b. Drain Piping: P-trap; tubular waste to wall; and wall escutcheon.
 - c. Protective Shielding Guard(s):
 - d. Fixture Support: Lavatory.

2.10 OWNER FURNISHED KITCHEN SINKS

- A. Owner Furnished Kitchen Sinks:
 - 1. Provide and install items specified on plans for the support and installation of owner provided sinks. Provide installation of owner provided sinks.
 - 2. Description: Stainless-steel kitchen sinks.
 - a. Sink Faucet: As specified on plans.
 - b. Supplies: Copper with stops.
 - c. Drain Piping: Copper.
 - d. Disposer: Installation of owner furnished item.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.

- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- S. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4700

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Type PB, pressure with bubbler, Style W, wall-mounting water coolers.
 - 2. Fixture supports.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Water Coolers,:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Larco, Inc.
 - e. Oasis Corporation.

- f. Sunroc Corp.
- 2. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult-mounting height.
 - a. Cabinet: Bilevel with two attached cabinets, vinyl-covered steel with stainless-steel top.
 - b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - c. Control: Push bar.
 - d. Supply: NPS 3/8 with ball, gate, or globe valve.
 - e. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
 - f. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: 5 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
 - 2) Electrical Characteristics: 120-V ac; single phase; 60 Hz.
 - g. Support: Type II, water cooler carrier. Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 7. Insert manufacturer's name.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

END OF SECTION

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SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solve Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.

- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
- D. See Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
- E. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
- F. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Design hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.
- F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.
- G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code-Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Globe Pipe Hanger Products, Inc.
 - 3. Grinnell Corp.
 - 4. PHD Manufacturing, Inc.
 - 5. PHS Industries, Inc.
- C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:

- a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
- D. See Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
- E. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
- F. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Design hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.
- F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.
- G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code-Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Globe Pipe Hanger Products, Inc.
 - 3. Grinnell Corp.
 - 4. PHD Manufacturing, Inc.
 - 5. PHS Industries, Inc.
- C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:

- a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 0548

VIBRATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- D. Pads>: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- K. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to

allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 3. Hilti, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. TOLCO Incorporated; a brand of NIBCO INC.
 - 7. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of **40 feet** and longitudinal supports a maximum of **80 feet** o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction] providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Yellow.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

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SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Kitchen hood airflow balancing.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit 6 copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB or TABB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing."

1.4 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents." See "Design Data" Article in the Evaluations.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 4. Sensors are located to sense only the intended conditions.
 - 5. Sequence of operation for control modes is according to the Contract Documents.
 - 6. Controller set points are set at indicated values.
 - 7. Interlocked systems are operating.
 - 8. Changeover from heating to cooling mode occurs according to indicated values.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.

- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
- 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
- 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
- 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.7 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 - 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood exhaust-duct connection.
 - 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 - 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
 - 1. Check duct slopes as required.
 - 2. Verify that duct access is installed as required.
 - 3. Verify that point of termination is as required.
 - 4. Verify that duct air velocity is within the range required.
 - 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.

3.8 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.

- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.9 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.10 FINAL REPORT (SYSTEM/COMPONENT AS APPLICABLE)

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.

- f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

C. Referenced Standards:

1. North American Commercial and Industrial Insulation Standards. 9th or Latest Edition. Published by Midwest Insulation Contractors Association (MICA).
2. AH-124 Fibrous Glass Duct Liner Standard. Latest Edition. Known as the NAIMA FGDLS. Published by North American Insulation Manufacturers Association (NAIMA).
3. AH-122 Cleaning Fibrous Glass Insulated Air Duct Systems. Latest Edition. Published by North American Insulation Manufacturers Association (NAIMA).
4. HVAC Duct Construction Standard, Metal & Flexible. Latest Edition. Known as the SMACNA DCS. Published by Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
5. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials
6. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
7. ASTM C916 Standard Specification for Adhesives for Duct Thermal Insulation
- 8.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label

insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Fiberglass insulations shall have a formaldehyde-free binder.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, formaldehyde, poly-brominated diphenyl ether fire retardants, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber, Preformed Pipe Insulation: Mineral-Fiber, Preformed Pipe Insulation, complying with ASTM C 547, Type I (850 degrees F) or Type IV (1000 degrees F); ASTM C 585, ASTM C 411, ASTM C 795, and UL/ULC Classified. Fiberglass bonded with a thermosetting resin.

Provide insulation with factory applied white ASJ SSL or white ASJ+ SSL+ vapor retarder jacket with self-sealing lap closure, complying with ASTM C 1136. Thermal conductivity ASTM C 335 (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 1,000 degrees F. Flame spread/Smoke-developed rating (ASTM E84) of 25/50. Subject to compliance with requirements, provide basis of design product. Products by others, meeting all properties of the basis product, will be acceptable.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglass Pipe Insulation.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- J. Mineral-Fiber, Flexible Blanket (Duct Wrap) insulation: Comply with ASTM C 553, Type I, II, and III; ASTM C 1136 Type II; and ASTM C 1290, Type III. UL/ULC Classified per UL 723 for FSK; NFPA 90A and 90B. Fiberglass bonded with a thermosetting resin. Minimum density 1.0 PCF and thickness 2-3/16". Provide insulation with factory applied FSK or white PSK vapor retarding facing complying with ASTM C 1136. Thermal conductivity (k-value) at 75 degrees F mean temperature is 0.27 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 250 degrees F with FSK or white ASJ+ facing, 350 degrees F for un-faced material. Flame spread/Smoke-developed rating (ASTM E84) of 25/50. Subject to compliance with requirements, provide basis of design product. Products by others, meeting all properties of the basis product, will be acceptable.
 - a. Basis-of-Design Product: Knauf Insulation; Atmosphere® Duct Wrap with ECOSE®.
 - b. 2. Manson Insulation; Alley Wrap™ B Duct Wrap with ECOSE®.
- K. Mineral-Fiber, Rigid Board insulation, complying with ASTM C 612, Type IA or Type IB. Fiberglass bonded with a thermosetting resin. Provide insulation with factory-applied FSK facing or with factory-applied white ASJ+ facing complying with ASTM C 1136. UL/ULC Classified per UL 723 for unfaced; ASJ+, and FSK. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x deg. F., or less. Maximum service temperature of 450 degrees F. Density of nominal **[3.0] [6.0]** pounds per cubic foot. Flame spread/Smoke-developed rating (ASTM E84) of 25/50. Subject to compliance with requirements, provide basis of design product. Products by others, meeting all properties of the basis product, will be acceptable.
 - a. Basis-of-Design Product: Knauf Insulation; Earthwool® Insulation Board with ECOSE®.
 - b. Manson Insulation; AK Board™ Insulation with ECOSE®.
- L. Mineral-Fiber, Flexible Duct Liner Insulation, complying with ASTM C 1071 Type I, NFPA 90A and 90B, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Rotary-fiberglass bonded with thermosetting resin, having factory-applied edge coating and a bonded mat-faced airstream surface treated with antimicrobial agent. Products by others meeting the properties of the basis product will be acceptable. Duct liner must meet or exceed the following performance properties:
 1. Surface Burning Characteristics: ASTM E84, UL 723 – Flame spread less than 25 and Smoke developed less than 50.

2. Thermal Conductivity (k-Factor) at 75°F mean temperature: ASTM C177/C518/C1114 – Less than .24 Btu x in. /h x sq. ft. x deg. F
3. Noise Reduction Coefficient (NRC): ASTM C423, Type “A” Mounting
 - a. 1.5 PCF Density: 1” = .70, 1-1/2” = .80, 2” = .95
 - b. 2.0 PCF Density: 1/2” = .50, 1” = .70, 1-1/2” = .85
4. Maximum Rated Air Velocity: ASTM C1071 – 6,000 ft. /min. (30.5 m/sec.).
5. Maximum Service Temperature: ASTM C411 – 250 degrees F.
6. Water Vapor Sorption: ASTM C1104 – Not exceeding 3 percent by weight.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
8. Mold & Mildew Growth/Fungi Resistance: ASTM C1338, ASTM G21/G22 – Pass.
9. Corrosiveness/Corrosion: ASTM C665 / C1617 - Does Not Accelerate / Pass.
10. Required Markings: EI rating, UL label, duct liner thickness, and other markings required by UL 181 on each full roll of duct liner.
11. Duct liner adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Adhesive shall meet the requirements of ASTM C916.
 - a. **Subject to compliance with requirements; provide the basis of design product. Products by others, meeting all the properties of the basis product, will be acceptable.**
 - i. Knauf Insulation; Atmosphere® Duct Liner with ECOSE®.
 - ii. Manson Insulation; Akousti-Liner™ Duct Liner with ECOSE®.
 - iii. Johns Manville; Spiracoustic Plus or Linacoustic RC-HP

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.

- c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
 - 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 4. Permanently flexible, elastomeric sealant.
 - 5. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 6. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ+-SSL+: ASJ+ vapor retarder jacket with self-sealing lap closure, complying with ASTM C 1136 Type I, II, III, IV, and VII secured with self-sealing longitudinal laps and matching ASJ+ butt wraps.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 - 5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- 6. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - c. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - c. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - c. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Aluminum Bands: ASTM C1729, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.

- b. PABCO Metals Corporation; Bands.
- c. RPR Products, Inc.; Bands.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.

- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - D. Wire: 0.080-inch nickel-copper alloy.
 - 1. Manufacturers: Subject to compliance with requirements:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.
- 2.8 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installations of insulations should be in accordance with manufacturer installation instructions and practices detailed by the North American Commercial and Industrial Insulation Standards manual (latest edition). Go to micainsulation.org for additional information regarding Insulation Standards.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.

2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping "Firestopping and fire-resistive joint sealers".
- F. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.

3.4 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches on center
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to the pipe with factory-applied white ASJ or ASJ+ vapor retarder jacket with SSL or SSL+ closure system. Use the SSL or SSL+ closure system in lieu of wire or banding for securement.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure longitudinal lap with provided SSL or SSL+ closure system.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments by building out the pipe insulation OD with pre-molded pipe insulation collars of the appropriate sizes or use pipe and tank insulation to build out to the flange OD or the ID of the insulation that is to be installed over the flange. Some fill of the flange spaces with blanket is appropriate before the insulation for the flange is installed over the flange.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
 1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.9 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in non conditioned space.
 - 4. Indoor, exposed return located in non conditioned space.
 - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 7. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

- B. Items Not Insulated:
1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

All supply & return shall be insulated with installed R-6 for concealed ductwork and R-8 for outdoor ductwork in climate zones 0-4 and shall be R-12 in climate zones 5-8.

- A. Concealed, Supply-Air Duct and Plenum Minimum Insulation: Fiberglass Duct Wrap, 2 3/16" inches thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct and Plenum Minimum Insulation: Fiberglass Duct Wrap, 2 3/16" inches thick and 0.75-lb/cu. ft. nominal density.
- C. Concealed, Outdoor-Air Duct and Plenum Minimum Insulation: Fiberglass Duct Wrap, 2 3/16" inches thick and 0.75-lb/cu. ft. nominal density.
- D. Concealed, Exhaust-Air Duct and Plenum Minimum Insulation: Fiberglass Duct Wrap, 1 inch thick and 0.75-lb/cu. ft. nominal density. For the first 10'-0" to prevent condensation.
- E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.
- F. Exposed, Return-Air Duct and Plenum Minimum Insulation: Closed Cell Liner, 1 inch thick and 0.75-lb/cu. ft. nominal density to prevent condensation.
- G. Exposed, Supply-Air Spiral round duct insulation: Closed Cell Liner, 1 inch thick and 0.75-lb/cu. ft. nominal density to prevent condensation.
- H. Exterior, Supply-Air Duct insulation: Closed Cell liner, minimum 2" thick and 2.0-lb/cu. ft. with R-8 in climate zones 0-4 and shall be R-12 in climate zones 5-8.
- I. Exterior, Return-Air Duct insulation: Closed Cell liner, minimum 2" thick and 2.0-lb/cu. ft. with R-8 in climate zones 0-4 and shall be R-12 in climate zones 5-8.

3.13 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping unless subject to freezing.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Closed cell, 1" inch thick for piping less than 1".

- B. Refrigerant Suction and Hot-Gas Piping: Closed cell, 1" inch thick for piping greater than 1".
- C. VRF refrigerant piping insulation per manufacturer requirement or applicable energy code if more stringent.

END OF SECTION 230700

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Project Specification: CN - Tahlequah Headstart

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.0 SECTION INCLUDES

1.1 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION

1.2 APPROVED CONTROL SYSTEM MANUFACTURES

1.3 QUALITY ASSURANCE

1.4 CODES AND STANDARDS

1.5 SYSTEM PERFORMANCE

1.6 SUBMITTAL REQUIREMENTS

1.7 WARRANTY REQUIREMENTS

1.8 SYSTEM MAINTENANCE AND REMOTE ANALYSIS

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

1.10 DEFINITIONS

1.1 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION

A. Provide a new Building Automation System (BAS) to integrate and control all mechanical equipment associated with this project.

1. The Building Automation System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.

2. The BAS shall meet open standard protocol communication standards (As defined in System Communications Section) to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BAS manufacturers in future projects.

3. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.

4. The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by the security permissions of the operator role. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

1.2 APPROVED CONTROL SYSTEM MANUFACTURES

A. Approved BAS Manufacturers

1. Trane Tracer®
2. Johnson Controls Metasys
3. ES2
4. Alerton

1.3 QUALITY ASSURANCE

A. BAS Manufacturer Qualifications

1. The BAS manufacturer shall have an established business office within 50.00 miles of the project site and must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.
2. The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.
3. The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, actuators, etc.) need not be manufactured by the BAS manufacturer listed in this specification.
4. Independent representatives of BAS manufacturers are not acceptable. BAS vendor must be corporate owned entity of BAS manufacturer.

1.4 CODES AND STANDARDS

A. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
2. National Electrical Code -- NFPA 70.
3. Federal Communications Commission -- Part J.

4. ASHRAE/ANSI 135-2012 (BACnet) - (System Level Devices) - Building Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.
5. ASHRAE/ANSI 135-2012 (BACnet) - (Unit Level Devices) - Unit Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

1.5 SYSTEM PERFORMANCE

A. Performance Standards. The BAS system shall conform to the following:

1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 10 seconds of the operator's request.
2. Graphic Refresh. The system shall update all dynamic points with current data within 10 seconds.
3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 5 seconds. Analog objects shall start to adjust within 5 seconds.
4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 10 seconds.
5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 10 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

1.6 SUBMITTAL REQUIREMENTS

A. BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications.

1. Provide three (3) printed copies of submittal package for review and approval.

B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the BAS manufacturer of furnishing quantities required based upon contract documents.

C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.

D. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.

E. Submit the following within 90 days of contract award:

1. A complete bill of materials of equipment to be used indicating quantities, manufacturers and model numbers.
2. A schedule of all control valves including the valve size, pressure drop, model number (including pattern and connections), flow, CV, body pressure rating, and location.
3. A schedule of all control dampers including damper size, pressure drop, manufacturer, and model number.
4. Provide all manufacturers' technical cut sheets for major system components. When technical cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Include:
 - a. Building Controllers
 - b. Custom Application Controllers
 - c. Application Specific Controllers
 - d. Operator Workstations
 - e. Portable Operator Terminals
 - f. Auxiliary Control Devices
5. Provide proposed Building Automation System architectural diagram depicting various controller types, workstations, device locations, addresses, and communication cable requirements
6. Provide detailed termination drawings showing all required field and factory terminations, as well as terminal tie-ins to DDC controls provided by mechanical equipment manufacturers. Terminal numbers shall be clearly labeled.
7. Provide a sequence of operation for each controlled mechanical system and terminal end devices.
8. Provide a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet system level device (i.e. Building Controller & Operator Workstations) type. This defines the points list for proper coordination of interoperability with other building systems if applicable for this project.

F. Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg and .pdf drawing files shall be provided.
2. Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.
3. Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:
 - a. Procedures for operating the BAS including logging on/off, alarm management, generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.
 - b. Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.
 - c. Documentation, installation, and maintenance information for all third party hardware/software products provided including personal computers, printers, hubs, sensors, valves, etc.
 - d. Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
 - e. Licenses, Guarantee, and Warranty documents for all equipment and systems.

G. Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

1.7 WARRANTY REQUIREMENTS

A. Warrant all work as follows:

1. BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).
2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.

3. To ensure that the owner will have the most current operating system provided by the manufacturer, the BAS manufacturer shall include licensing and labor costs to facilitate software/firmware updates throughout the warranty period at no charge to the owner. These updates shall include upgrades for functional enhancements associated with the following: operator workstation software, project specific software, graphics, database, firmware updates, and all security related service packs. Written authorization by the Owner must be granted prior to the installation of these updates.

4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

1.8 SYSTEM MAINTENANCE AND REMOTE ANALYSIS

A. The BAS Manufacture shall provide Building Automation System remote support and system analysis for a period of 1 year (beginning the date of substantial completion).

B. The BAS manufacturer shall setup a secure remote connection for data collection, analytics and remote technical support for the HVAC systems included in this contract.

1. Provide technician support during the warranty period to diagnose issues remotely through the secure remote connection.

2. The building owner is responsible for providing adequate internet access.

C. Connectivity / Remote Access / Network Security

1. Provide and maintain secure remote access to the facilities Building Automation System (BAS) or other building systems. Users accessing service through this connection shall not have access to the building owners network. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be "exposed" or "forwarded".

2. Secure remote access to the BAS shall be available anywhere, anytime, using a compatible client device (PC/tablet/phone)

3. The Owner will provide up to Three (3) IP drops and IP addresses on the owners network to gain access to the internet. The BAS manufacture shall coordinate with the Owners IT team, verify the proposed system shall meet all network security requirements and any other network configuration information necessary to each control contractor for the purpose of configuring each Area Controller on the network. It shall be the responsibility of the BAS manufacture to coordinate with the owner for network connectivity.

D. The BAS Manufacture shall provide a professional analysis for the facility HVAC systems.

1. The analysis shall consist of an evaluation of HVAC systems including charts and graphs which indicate both current building performance and opportunities for building and HVAC system performance improvement.

E. The following shall be provided after substantial completion of the project:

1. Orientation meeting with the building owner's representative to identify the HVAC systems that will be evaluated.
2. System setup for data collection and analytics. BAS Manufacture to setup a secure remote data collection and analytics for identified systems.
3. Assessment analysis shall be performed by trained personnel with relevant professional credentials in HVAC systems, energy management and building optimization methodologies.
4. Consultation meeting with owner to review performance reports and improvement opportunities.

F. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of owner.

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project specific software and documentation shall become the owner's property upon project completion. This includes the following:

1. Operator Graphic files
2. As-built hardware design drawings
3. Operating & Maintenance Manuals
4. BAS System software database

1.10 DEFINITIONS

- A. DDC: Direct digital control
- B. I/O: Input/output.
- C. MS/TP: Manager Subordinate / Token Passing.
- D. POT: Portable Operator's Terminal.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.
- G. BAS/ATC: Building Automation System/Automatic Temperature Controls.

PART 2 PRODUCTS

2.0 SECTION INCLUDES

- 2.1 MATERIALS:
- 2.2 SYSTEM COMMUNICATION
- 2.3 OPERATOR INTERFACE
- 2.4 BUILDING CONTROLLER SOFTWARE

2.5 BUILDING / SYSTEM CONTROLLERS

2.6 ADVANCED APPLICATION CONTROLLERS:

2.7 APPLICATION-SPECIFIC CONTROLLERS

2.8 COOLING PLANT - PUMPING CONTROLLER

2.9 APPLICATION CONTROLLER for Packaged Rooftop Units

2.10 INPUT/OUTPUT INTERFACE:

2.11 POWER SUPPLIES:

2.12 AUXILLARY CONTROL DEVICES:

2.13 WIRING AND RACEWAYS:

2.1 MATERIALS:

A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing by the owner or the owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.2 SYSTEM COMMUNICATION

A. System Communications

1. Each workstation, building controller, and equipment controller communication interface shall utilize the BACnet™ protocol with an Ethernet (IEEE 802.3, 802.11), RS485 (EIA-485), or Zigbee® (802.15.4) physical interface and an appropriate data link technology as defined in ANSI®/ASHRAE® Standard 135-2012. (e.g. BACnet IP, BACnet IPv6, BACnet MS/TP, BACnet Zigbee).
2. All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.
3. All documented status and control points, schedule, alarm, and data-log services or objects shall be available as standard object types as defined in ANSI®/ASHRAE® Standard 135-2012.
4. Each System Controller shall communicate with a network of Custom Application and Application Specific Controllers utilizing one or more of the interfaces documented within Field Bus Communications below.
5. For minimally managed IP networks, BACnet communication shall support BACnet Secure Connect (BACnet/SC), a secure and encrypted datalink layer specifically designed for those networks.

B. Field Bus Communications

1. BACnet™

a. All equipment and plant controllers shall be BTL listed as a BACnet Application Specific Controller (B-ASC) or a BACnet Advanced Application Controller (B-AAC) as defined in ANSI®/ASHRAE® Standard 135-2012.

b. All communication shall conform to ANSI®/ASHRAE® Standard 135-2012.

c. System Controller shall function as a BACnet router to each unit controller providing a globally unique BACnet Device ID for all BACnet controllers within the system.

d. BACnet Zigbee®

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet Zigbee as defined in ANSI®/ASHRAE® Standard 135-2012.

2) Each equipment controller wireless communication interface shall self-heal to maintain operation in the event of network communication failure.

3) Each zone sensor wireless communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications. Sensing options shall include temperature, relative humidity, CO2, and occupancy.

e. BACnet MS/TP

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet MS/TP as defined in ANSI®/ASHRAE® Standard 135-2012.

C. Variable Refrigerant Flow (VRF) Communications

1. The VRF system shall communicate with the BAS using one of the following communications methods.

a. The VRF system and the BAS shall utilize ANSI®/ASHRAE® Standard 135 (BACnet) protocol revision 12 or greater.

b. Recognizing that VRF manufacturers utilize proprietary protocols to pass information between VRF equipment components. A gateway device is an accepted method to convert proprietary data to BACnet data. BACnet data shall conform to BACnet protocol revision 12 or greater.

c. When a device is capable of data exchange with the BACnet protocol across non-IP network segments, the BACnet protocol shall be used to exchange data. If a device does not support the BACnet protocol an alternative protocol may be used. Data exchanged using the alternative protocol shall be converted to the BACnet protocol to allow integration to the BAS.

2. To promote BAS interoperability, each instance of the following VRF system components shall be visible to the BAS network as a virtual BACnet device.

a. Indoor equipment

b. Outdoor equipment

- c. Refrigerant manifold devices
 - d. Outdoor air ventilation systems
3. Virtual BACnet device functionality shall conform to BACnet protocol revision 12 or greater and meet the minimum functionality defined by BACnet device profile B-ASC.
 4. The VRF indoor equipment shall support wireless zone sensors. Sensing options shall include temperature, relative humidity, CO2, and occupancy. Each zone sensor wireless communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications.

2.3 OPERATOR INTERFACE

A. Provide Building Operator Web Interface

1. Manufacturer shall provide a user interface with time-of-day schedules, data collection, dashboards, reports and building summary, system applications, and self-expiring timed overrides. Manufacturer shall provide a published user and applications guide(s) that detail the system application operation, configuration, setup and troubleshooting.
2. The building operator web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).
3. User Roles
 - a. The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.
 - b. User login/logoff attempts shall be recorded.
 - c. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
4. On-Line Help and Training
 - a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
 - b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.
5. Equipment and Application Pages
 - a. The building operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
 - 1) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:

a) Each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These graphics shall show all points dynamically as specified in the points list.

b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.

2) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.

3) Historical Data (As defined in Trend Logs section of CONTROLLER SOFTWARE) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

b. VAV Air System. An operator shall be able to view and control (where applicable) the following parameters via the building operator web interface:

- 1) System Mode
- 2) System Occupancy
- 3) Ventilation (Outdoor air flow) setpoint
- 4) Ventilation (Outdoor air flow) status
- 5) Air Handler Static pressure setpoint
- 6) Air Handler Static pressure status
- 7) Air Handler occupancy status
- 8) Air Handler Supply air cooling and heating set points
- 9) Air Handler minimum, maximum and nominal static pressure setpoints
- 10) VAV box minimum and maximum flow
- 11) VAV box drive open and close overrides
- 12) VAV box occupancy status
- 13) VAV box Airflow to space
- 14) Average space temperature
- 15) Minimum space temperature
- 16) Maximum space temperature

c. Chilled Water System. An operator shall be able to view and control (where applicable) the following parameters via the building operator web interface:

- 1) System mode of the chiller plant
- 2) Chiller enable/disable status

- 3) System supply water setpoint
- 4) System supply and return water temperature
- 5) System Chilled water pump status
- 6) System Chilled water flow
- 7) Bypass pipe flow rate (if applicable)
- 8) Bypass pipe flow rate (if applicable)
- 9) Bypass pipe flow rate (if applicable)
- 10) Bypass pipe flow rate (if applicable)
- 11) Override capabilities to force an added chiller, subtract a chiller, or change of sequence.
- 12) Control to remove a chiller from a sequence temporarily for service purposes.

6. System Graphics. Building operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

- a. Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
- b. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
- c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

7. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

8. Manual Control and Override

- a. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
- b. Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
- c. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.

- d. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
9. Scheduling. - The scheduling application shall provide graphical representation of the day, week, month and exception events.

10. Alarm/Event Notification

- a. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any building operator web interface.
 - 1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
 - 2) The operator shall be able to acknowledge and add comments to alarms
 - 3) Alarm/event messages shall use full language, easily recognized descriptors.
- b. Alarm Suppression. Alarms shall be able to be suppressed based on load/source relationships to present the likely root cause to the building operator as described in ASHRAE Guideline 36. Load/Source relationships shall be configurable by the user through a web interface.

11. Reports and Logs.

- a. The building operator web interface shall provide a reporting package that allows the operator to select reports.
- b. The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
- c. The following standard reports shall be available without requiring a user to manually configure the report:
 - 1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
 - 2) All Points in Override Report: Provide an on demand report showing all overrides in effect.
 - 3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
 - 4) Points report: Provide a report that lists the current value of all points
 - 5) ASHRAE Standard 147 Report: Provide a daily report that shows the operating condition of each chiller as required by ASHRAE Standard 147. At minimum this report shall include:
 - a) Chilled Water (or other fluid) inlet and outlet temperature
 - b) Chilled Water (or other fluid) flow
 - c) Chilled Water (or other fluid) inlet and outlet pressures

- d) Evaporator refrigerant pressure and temperature
 - e) Condenser refrigerant pressure and liquid temperature
 - f) Condenser water inlet and outlet temperatures
 - g) Condenser water flow
 - h) Oil pressure and temperature
 - i) Oil level (if applicable)
 - j) Compressor refrigerant discharge temperature
 - k) Compressor refrigerant suction temperature
 - l) Manual entry field for addition of refrigerant
 - m) Manual entry field for addition of oil
 - n) Manual entry field for vibration levels
 - o) Motor amperes per phase
 - p) Motor volts per phase
 - q) Purge exhaust time or discharge count
 - r) Ambient temperatures (dry bulb and wet bulb)
 - s) Date and time Data Logged
 - t) [Note: ASHRAE Standard 147 Report compliance requires that optional equipment and monitoring features be provided on the associated chiller(s).]
- d. The controls vendor shall provide a hardening report that summarizes the port configuration details to ensure sites have not been exposed to the Internet in alignment with Cyber Security best practices.

B. Provide Mobile App Interface

1. Provide mobile (smart phone or tablet) interfaces to the building automation system, compatible with iOS and Android™ operating systems.
2. Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status and setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
3. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching and zooming" required).
4. This phone/tablet interface shall function remotely from the facility while following IT security best practices (e.g. no ports exposed to the internet).
5. The operator interface shall support system access on a mobile device via a mobile app to:

- a. Alarm log
- b. System Status
- c. Equipment status
- d. Space Status
- e. Standard Equipment graphics
- f. Override set points
- g. Override occupancy
- h. Acknowledge Alarms
- i. Add Comment(s) to Alarms

2.4 BUILDING CONTROLLER SOFTWARE

A. Manufacturer shall provide standard applications to deliver HVAC system control. Standard applications include Time of Day Scheduling with Optimal Start/Stop, VAV Air Systems Control, Chiller Plant Control, Historical Trend Logs and Trim and Respond. Manufacturer shall provide system optimization strategies for functions such as fan pressure optimization and ventilation optimization.

B. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the building operator interface.

1. VAV Air Systems Applications

- a. The BAS shall provide air system applications that coordinate air handlers (AHU)/rooftop units (RTU) and Variable Air Volume Terminal equipment.
- b. The air system applications shall perform the following functions:
 - 1) Startup and shutdown the air handler safely. Ensure the VAV boxes are open sufficiently when the air handler is running, to prevent damage to the ductwork and VAV boxes due to high air pressure.
 - 2) Fan Pressure Optimization (ASHRAE 90.1, Guideline 36) - Minimize energy usage by controlling system static pressure to the lowest level while maintaining zone airflow requirements. Trim and respond reset logic shall reset setpoint within the range of min and max values based on zone requests.
 - 3) During commissioning, and with the engineer/owner, the controls contractor shall confirm the performance of Fan Pressure Optimization by conducting a field functional test that demonstrates critical zone reset.
 - 4) Ventilation Optimization (ASHRAE 62) – properly ventilate all spaces while minimizing operating energy costs, using measured outdoor air flow. Dynamically calculate the system outdoor air requirement based on “real time”

conditions in the spaces (i.e., number of occupants, CO2 levels, etc.) minimizing the amount of unconditioned outdoor air that must be brought into the building.

5) Demand Controlled Ventilation – the active ventilation setpoint shall modulate between the occupied ventilation and occupied standby ventilation setpoint; Resetting the setpoint based on CO2 levels in the space.

6) Discharge Air Temperature Reset (ASHRAE 90.1, Guideline 36) - Minimize energy usage by controlling discharge air temperature in response to building loads and outdoor air temperature. Trim and respond reset logic shall reset setpoint within the range of min and max values based on zone requests.

c. The Air Systems application shall provide a user interface that includes status of current system operation with real time data of key operating parameters. Key operating parameters for Guideline 36 include:

- 1) Duct Static Pressure
- 2) Duct Static Optimization Setpoint
- 3) Outdoor Airflow
- 4) Ventilation Optimization Setpoint
- 5) Duct Static Optimization Maximum VAV Damper/Source VAV Box
- 6) Ventilation Optimization Maximum VAV Vent Ratio/Source VAV box
- 7) Discharge Air Temperature
- 8) Discharge Air Temperature Optimization Setpoint
- 9) Duct Static Optimization System Requests
- 10) Discharge Air Temperature Optimization System Requests

d. The air system application status screens shall explain what optimization calculations are occurring, critical parameters, and source equipment members. The optimization status, inputs, and results shall be displayed for VAV Ventilation Optimization (calculating proper outside air intake), VAV Discharge Air Temperature Optimization (calculating proper discharge air temperature) and VAV Duct Static Pressure Optimization (calculating proper fan static pressure).

e. The air systems applications shall provide a user interface that enables configuration changes made by swipe and type fields, selection list, and check box entry for feature definition:

- 1) VAV Auxiliary Night Heat
- 2) VAV Source Temperature Distribution
- 3) Changeover System control
- 4) Start/Stop Delay operation

5) Enable/Disable Optimization Strategies (Duct Static Optimization, Discharge Air Temperature Optimization and Ventilation Optimization)

f. The operation of VAV Terminal equipment members of the VAV Air System shall be selected by check box to optionally participate in the following functions when for Guideline 36 applications:

- 1) System calculations (min, max, average)
- 2) Duct Pressure Optimization
- 3) Ventilation Optimization
- 4) Drive to Maximum Override
- 5) Common Source Temperature
- 6) Common Space
- 7) Discharge Air Temperature Optimization
- 8) Hot Water Temperature Optimization
- 9) Chilled Water Temperature Optimization

g. The air system application vendor shall provide a published applications guide that details the air system application operation, configuration, setup, and troubleshooting. The applications guide documentation shall be maintained under version control, and updated by the manufacture to reflect most recent feature updates as made available. Contents of the guide shall include:

- 1) Description of System Operation
- 2) Required Components
- 3) Sequences of Operation
- 4) Installation
- 5) Controller Setup
- 6) Required Programming
- 7) Commissioning
- 8) Optimization Strategies
- 9) Special Applications
- 10) Troubleshooting

h. The air system application shall present in plain user language the current operation with source zone information and reset events.

2. Chiller Plant Application

- a. The BAS shall provide a chiller plant application program that coordinates chiller equipment operation for minimal energy usage.
- b. The Chiller Plant application shall perform the following functions:
 - 1) The chiller plant control application shall have the ability to control up to 25 chillers as detailed in the sequence of operations.
 - 2) This application shall be able to control both constant and variable flow systems including variable primary flow as well as parallel, series and decoupled piping configurations.
 - 3) The chiller plant control application shall be able to control multiple chiller plants per site.
 - 4) Diagnostics/Protection The chiller plant application program shall be able to integrate individual chiller diagnostics into control action decisions.
 - 5) Event Processing - All chiller plant control and status events shall be recorded, at the operator's selection, in the building management system event log to facilitate troubleshooting.
 - 6) Alarm Indications - The chiller plant control status screens shall display chiller plant and individual chiller alarm messages.
 - 7) Chiller staging - The chiller plant control application shall include multiple add/subtract options for the chillers, including staging based on chiller plant leaving water temperature and staging based on chiller efficiency.
 - 8) Rotation of Chillers based on either runtime or schedule.
- c. The chiller plant control application vendor shall provide a published applications guide that details the chiller plant application operation, configuration, setup, and troubleshooting. The applications guide documentation shall be maintained under version control, and updated by the manufacture to reflect most recent feature updates as made available. Contents of the guide shall include:
 - 1) Description of chiller types
 - 2) Description of Plant types
 - 3) Necessary hardware, equipment, sensors, outputs, and controls
 - 4) Commissioning and programming
 - 5) Sequences of operation
 - 6) Soft Start
 - 7) Rapid Power Fail Recovery
 - 8) Ambient Lockout
 - 9) Add Logic

- 10) Subtract Logic
- 11) Setpoint calculations
- 12) Unload at start
- 13) Low-load cycle avoidance
- 14) Feed-forward indication
- 15) Rotation strategies
- 16) Sequencing options
- 17) Troubleshooting
- 18) Special Applications

d. The chiller plant application shall present in plain user language the current and expected operation for upcoming Add, Subtract, and Rotation events using real time status and setpoint information.

3. Trend Logs

a. The system shall harvest trend logs for defined key measurements for each controlled HVAC device and HVAC application. Trend logs shall be captured for a minimum of 5 key operating points for each piece of HVAC equipment and HVAC application and stored for no less than 1 year at 15-minute intervals. Data Logs shall be capable of being configured on an interval or change of value basis.

- 1) Fan Coil
 - a) Discharge Air Temperature
 - b) Space Temperature Active
 - c) Space Temperature Setpoint Active
 - d) Air Flow Setpoint Active
 - e) Discharge Air Flow
- 2) Water Source Heat Pump
 - a) Discharge Air Temperature
 - b) Space Temperature Active
 - c) Space Temperature Setpoint Active
 - d) Air Flow Setpoint Active
 - e) Discharge Air Flow
- 3) Air Handling Unit/Rooftop (VAV)
 - a) Discharge Air Temperature

- b) Discharge Air Temperature Setpoint Active
 - c) Space Temperature Active
 - d) Cooling Capacity Status
 - e) Discharge Air Flow
- 4) Air Handling Unit/Rooftop (CV)
 - a) Discharge Air Temperature
 - b) Space Temperature Active
 - c) Space Temperature Setpoint Active
 - d) Cooling Capacity Status
 - e) Heating Capacity Primary Status
 - f) Outdoor Air Damper Position
- 5) VAV Box
 - a) Discharge Air Temperature
 - b) Space Temperature Active
 - c) Space Temperature Setpoint Active
 - d) Air Flow Setpoint Active
 - e) Discharge Air Flow

4. Trim and Respond

- a. The BAS shall provide a setpoint reset application program based on 'trim and respond' functionality as outlined in ASHRAE Guideline 36.

2.5 BUILDING / SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in CONTROLLER SOFTWARE section.

1. The controller shall provide a USB communications port for connection to a PC.
2. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
3. All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
4. Data shall be shared between networked System Controllers.

5. Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.

B. Controls manufacturer shall provide secure remote access to the Building Automation System (BAS). Secure remote access shall not require IP ports to be "exposed" (i.e. port-forwarded or external public IP addresses) to the Internet. Controls manufacturer shall update secure remote access software as necessary to follow cyber security best practices and respond to cyber security events.

2.6 ADVANCED APPLICATION CONTROLLERS:

A. Advance Application Controllers shall be used to control all equipment or applications of medium and high complexity, including but not limited to Air Handlers, Boiler Plants and Chiller Plants.

B. The Advanced Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Advanced Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.
3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
4. In case of communications failure, stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. For Stand-Alone Operation of Advanced Application Controllers:

1. Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
 - a. The Controller shall have a built in schedule (assessable with or without a display)
 - b. Support will be for at least 3 schedules with up to 10 events for each day of the week.
 - c. Each of the 3 schedules can be Analog, Binary or Multi-State
 - d. The controller shall support a minimum of 25 exceptions each with up to 10 events.

E. For ease of troubleshooting, the Controller shall support data trend logging.

1. With a minimum of 20,000 trending points total on a controller

2. Trends shall be capable of being collected at a minimum sample rate of once every second

3. Shall be capable of trending all BACnet points used by controller

4. Trends shall be capable of being scheduled or triggered.

F. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.

G. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Operating conditions:

- a. Temperature: -40°F to 158°F (-40°C to 70°C)

- b. Relative Humidity: 5% to 100% RH (non-condensing)

2. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.

3. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].

H. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

1. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.

2. Shall support flexibility in sensor type, the Controller shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.

3. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.

4. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.

5. The controller shall support pulse accumulator for connecting devices like energy meters.

6. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.

7. For future needs, any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.

8. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.

9. The Controller shall provide a dedicated static pressure input.

I. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:

1. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.

2. Expansion I/O can be mounted up to 650 ft. (200m) from control.

3. For optimized system operation, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).

J. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.

1. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.

2. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.

3. Software service tool connection through the following methods: direct cable connection to the Controller, connection through another controller on BACnet link

4. For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.

5. The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.

6. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.

7. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.

8. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).

9. To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller.

10. Controller data shall be maintained through a power failure.

K. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

L. Controller must meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit
4. BACnet Testing Laboratory (BTL) listed as BACnet Advanced Application Controller (B-AAC)

2.7 APPLICATION-SPECIFIC CONTROLLERS

A. General Description

1. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

2. Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV box, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.

B. The Application Specific Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Application Specific Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.
3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS
4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Stand-Alone Operation: Each piece of equipment specified in section “A” shall be controlled by a single controller and provide stand-alone control in the event that a BAS is not present.

E. Software

1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
2. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.

F. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

G. Input/Output:

1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
3. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
4. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
5. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
6. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
7. For future expansion and flexibility, the controller shall have either on board or through expansion, a minimum of 8 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion

points that require the BACnet network for communication with the controller are not allowed.

H. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
2. All binary output shall have LED's indicating the output state.
3. All wiring connectors shall removable without the use of a tool.
4. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
5. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
6. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
7. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
 - a. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
8. For ease of troubleshooting, the controller shall support BACnet data trend logging.
 - a. With a minimum of 20,000 trending points total on controller
 - b. Shall be capable of trending all BACnet points used by controller
 - c. Trends shall be capable of being collected at a minimum sample rate of once every second
 - d. Trends shall be capable of being scheduled or triggered

I. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

J. Controller shall have meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit
4. BACnet Testing Laboratory (BTL) Listed as BACnet Application Specific Controller (B-ASC)

2.8 COOLING PLANT - PUMPING CONTROLLER

A. A BACnet™ Advanced Application Controller shall be used to control the pumping controls associated with the cooling plant system.

B. The Advanced Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Advanced Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.
3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
4. In case of communications failure, stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. For Stand-Alone Operation of Advanced Application Controllers:

1. Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
 - a. The controller shall have a built in schedule (assessable with or without a display)
 - b. Support will be for at least 3 schedules with up to 10 events for each day of the week.
 - c. Each of the 3 schedules can be Analog, Binary or Multi-State
 - d. The controller shall support a minimum of 25 exceptions each with up to 10 events.

E. For ease of troubleshooting, the controller shall support data trend logging.

1. 25,000 samples minimum
2. Trends shall be capable of being collected at a minimum sample rate of once every second
3. Trends shall be capable of being scheduled or triggered.

F. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.

G. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Operating conditions:

- a. Temperature: -40°F to 158°F (-40°C to 70°C)
- b. Humidity: Between 5% to 100% RH (non-condensing)

2. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.

3. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].

H. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

- 1. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
- 2. Shall support flexibility in sensor type, the controller shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
- 3. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
- 4. Shall support flexibility in sensor type, the controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
- 5. The controller shall support pulse accumulator for connecting devices like energy meters.
- 6. In order to support a wide range of devices, the controller's binary output shall be able to drive at least 10VA each.
- 7. Any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.
- 8. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
- 9. The Controller shall provide a dedicated static pressure input.

I. Input/Output Expandability – The controller shall provide the following functionality in order to meet current and future application needs:

1. For the application flexibility, the controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
2. Expansion I/O can be mounted up to 650 ft. (200m) from control.
3. Expansion I/O can be added in as small as 4 point increments.
4. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).

J. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.

1. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
2. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.
3. Software service tool connection through the following methods: direct cable connection to the Controller, connection through another controller.
4. For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.
5. The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.
6. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
7. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
8. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
9. To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller.
10. Controller data shall be maintained through a power failure.

K. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

L. Controller must meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit
4. BACnet Testing Laboratory (BTL) listed as BACnet Advanced Application Controller (B-AAC)

2.9 APPLICATION CONTROLLER for Packaged Rooftop Units

A. The Rooftop Unit (RTU) Application Controller shall be a microprocessor-based DDC controller which, through hardware or firmware design, controls specified equipment. The controller is not user programmable, but is customized for operation within the confines of the equipment it is designed to serve.

B. The Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.
3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Software

1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or customized with use of service tool native to the controller.

E. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.

4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

F. Controller Input/Output: The controller shall have on board capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment.

1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following output types; 0-10VDC, 0-5VDC, 4-20mA, Binary.

2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, Pulse counts, and 200 to 20Kohm.

G. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.

2. All binary output shall have LED's indicating the output state.

3. All wiring connectors shall be removable without the use of a tool.

4. Software service tool connection through the following methods: direct cable connection to the controller, connection through another controller on BACnet link.

H. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

I. Controller shall meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment

2. UL94-5V, Flammability

3. FCC Part 15, Subpart B, Class B Limit

4. BACnet Testing Laboratory (BTL) listed

2.10 INPUT/OUTPUT INTERFACE:

A. Hardwired inputs and outputs may tie into the system through building, custom application, or ASCs.

B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and

noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

E. Analog inputs shall allow the monitoring of low voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have status lights. Outputs shall be selectable for either normally open or normally closed operation.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.11 POWER SUPPLIES:

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish overcurrent protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in overvoltage and overcurrent protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.

a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.

b. Line voltage units shall be UL recognized and CSA approved.

2.12 AUXILLARY CONTROL DEVICES:

A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
3. Damper shaft bearings shall be as recommended by manufacturer for application.
4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. Electric damper/valve actuators

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b. Steam Valves: 150% of operating (inlet) pressure.

E. Water Valves

1. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
2. Sizing Criteria:
 - a. Two-position service: Line size.
 - b. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 34.5 kPa (5 psi), whichever is greater.
 - c. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 34.5 kPa (5 psi) maximum.
 - d. Valves DN 15 (1/2 in.) through DN 50 (2 in.) shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
 - e. Valves DN 65 (2 1/2 in.) and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
3. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
 - a. Water zone valves—normally open preferred
 - b. Heating coils in air handlers - normally open
 - c. Chilled-water control valves - normally closed
 - d. Other applications—as scheduled or as required by sequences of operation
4. Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

F. Steam Valves

1. Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.

2. Sizing Criteria:

- a. Two-position service: pressure drop 10% to 20% of inlet psig
- b. Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig
- c. Modulating service: 101 to 350 kPa (16 to 50 psig); pressure drop 50% of inlet psig
- d. Modulating service: over 350 kPa (50 psig); pressure drop as scheduled on plans

G. Binary Temperature Devices

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

2. Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.

H. Wired Temperature Sensors

- 1. Temperature sensors shall be RTD or thermistor.
- 2. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross section.
- 3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
- 4. Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on plans.
- 5. Provide matched temperature sensors for differential temperature measurement.

I. Wired Humidity Sensors

- 1. Duct and room sensors shall have a sensing range of 20% to 80%.
- 2. Duct sensors shall be provided with a sampling chamber.

J. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

K. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

2.13 WIRING AND RACEWAYS:

- A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.
- B. All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.
- C. Fiber Optic Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 µm.

PART 3 EXECUTION

3.0 SECTION INCLUDES

- 3.1 EXAMINATION:
- 3.2 PROTECTION:
- 3.3 COORDINATION:
- 3.4 GENERAL WORKMANSHIP:
- 3.5 FIELD QUALITY CONTROL:
- 3.6 COMMUNICATION WIRING:
- 3.7 FIBER OPTIC CABLE:
- 3.8 INSTALLATION OF SENSORS:

3.9 FLOW SWITCH INSTALLATION:

3.10 WARNING LABELS:

3.11 IDENTIFICATION OF HARDWARE AND WIRING:

3.12 CONTROLLERS:

3.13 PROGRAMMING:

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

3.15 CLEANING:

3.16 TRAINING:

3.1 EXAMINATION:

A. The Contract Documents shall be thoroughly examined for coordination of control devices, their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.

B. The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 PROTECTION:

A. The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage thus caused.

B. The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION:

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the "Submittals," section of this specification for requirements.

C. Test and Balance

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
2. The contractor shall provide training in the use of these tools. This training will be planned for a duration of 4 hours.
3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process shall be returned to the contractor at the completion of the testing and balancing.

D. Life Safety

1. Duct smoke detectors required for air handler shutdown shall be supplied under Section 26100 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in the Sequences of Operation for this project.
2. Smoke dampers and actuators required for duct smoke isolation are provided under Section 26100. The contractor shall interlock these dampers to the air handlers as described in the Sequences of Operation for this project as applicable.
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section 26100. Control of these dampers shall be by 26100

E. Coordination with Controls Specified in Other Sections or Divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in the "Communication" section of this specification.
2. Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

3.4 GENERAL WORKMANSHIP:

- A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.

E. All control device installation and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.5 FIELD QUALITY CONTROL:

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.

B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.6 COMMUNICATION WIRING:

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

E. When a cable enters or exits a building, a lightning arrestor must be installed between the line and ground.

F. All runs of communication wiring shall be unspliced length when the length is commercially available.

G. All communication wiring shall be labeled to indicate origin and destination.

3.7 FIBER OPTIC CABLE:

A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.8 INSTALLATION OF SENSORS:

A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.

B. Sensors that require field mounting shall meet the BAS manufacturer's recommendations and be coordinated with the mechanical equipment they will be associated.

C. Mount sensors rigidly and adequately for the environment the sensor will operate.

D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes.

E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.

F. Install duct static pressure tap with tube end facing directly down-stream of air flow.

G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.

H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.

J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.

K. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.

3.9 FLOW SWITCH INSTALLATION:

A. Coordinate installation of flow switch with Mechanical Contractor who will be responsible for installing a thread o let in steel piping applications. Copper pipe applications will require the use CxCxF Tee, and no pipe extensions or substitutions will be allowed.

B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream, or two feet, whichever is greater, from pipe fittings and other inline potential obstructions.

C. Install in accordance with manufacturers' instructions, which will require proper flow direction, horizontal alignment with flow switch mounting on the top of pipe.

3.10 WARNING LABELS:

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the BAS system.

B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

3.11 IDENTIFICATION OF HARDWARE AND WIRING:

A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.12 CONTROLLERS:

A. Provide a separate DDC Controller for individual HVAC mechanical equipment. BAS manufacturer shall furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.

1. Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.13 PROGRAMMING:

A. Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. BAS Operator's Interface

1. When Operator Workstation is specified, provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These standard graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.

2. The BAS manufacturer shall provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

3. As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

A. Start-up testing. All testing in this section shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all of the instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturer's recommendations.

4. Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starter, etc.) operate properly and normal positions are correct.

5. Verify all analog output devices (I/Ps, actuators, etc) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimal start/stop routines.

7. Alarms and Interlocks

a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.15 CLEANING:

A. The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING:

A. Provide minimum of (4) hours of operator training throughout the contract period. The training will be provided for personnel designated by the Owner.

B. These objectives will be divided into logical groupings; participants may attend one or more of these, depending on level of knowledge required:

1. Day-to-day BAS Operators

2. BAS Troubleshooting & Maintenance

_____END OF SECTION_____

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SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 4. Striker Plates: Steel, designed to protect tubing from penetrations.
 5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
 2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F. complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig .
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated brass.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- C. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Bronze Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Lee Brass Company.
- b. McDonald, A. Y. Mfg. Co.
- 2. Body: Bronze, complying with ASTM B 584.
- 3. Plug: Bronze.
- 4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 5. Operator: Square head or lug type with tamperproof feature where indicated.
- 6. Pressure Class: 125 psig.
- 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Valve Boxes:

- 1. Cast-iron, two-section box.
- 2. Top section with cover with "GAS" lettering.
- 3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
- 4. Adjustable cast-iron extensions of length required for depth of bury.
- 5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 PRESSURE REGULATORS

A. General Requirements:

- 1. Single stage and suitable for natural gas.
- 2. Steel jacket and corrosion-resistant components.
- 3. Elevation compensator.
- 4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
- 2. Body and Diaphragm Case: Die-cast aluminum.
- 3. Springs: Zinc-plated steel; interchangeable.
- 4. Diaphragm Plate: Zinc-plated steel.
- 5. Seat Disc: Nitrile rubber.
- 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
- 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
- 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.6 DIELECTRIC UNIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Capitol Manufacturing Company.
- 2. Central Plastics Company.
- 3. Hart Industries International, Inc.
- 4. McDonald, A. Y. Mfg. Co.
- 5. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
- 6. Wilkins; Zurn Plumbing Products Group.

B. Minimum Operating-Pressure Rating: 150 psig.

- C. Combination fitting of copper alloy and ferrous materials.
- D. Insulating materials suitable for natural gas.
- E. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in

annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 2. Cut threads full and clean using sharp dies.
 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 1. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 2. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
 1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.

- 2. Steel pipe with malleable-iron fittings and threaded joints.
 - B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
 - C. Underground, below building, piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
 - D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 - E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- 3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- 3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Bronze plug valve.
 - B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Bronze plug valve.
 - C. Valves in branch piping for single appliance shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Bronze plug valve.

END OF SECTION 231123

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SECTION 23 2300
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
 2. Suction Lines for Heat-Pump Applications: 535 psig.
 3. Hot-Gas and Liquid Lines: 535 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: **ASTM B 88, ACR**
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.
 - 4. Closing Spring: Stainless steel.
 - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Maximum Opening Pressure: 0.50 psig.

8. Working Pressure Rating: 500 psig.
 9. Maximum Operating Temperature: 275 deg F.
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and Voltage per manufacturer-V ac coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F.
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 700 psig
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 deg F.
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.

6. Maximum Operating Temperature: 275 deg F.
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig.
 8. Rated Flow: Per manufacturer.
 9. Working Pressure Rating: 500 psig.
 10. Maximum Operating Temperature: 240 deg F.
- L. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig.
 8. Rated Flow: Per manufacturer.
 9. Working Pressure Rating: 500 psig.
 10. Maximum Operating Temperature: 240 deg F.
- M. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig.
 4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
 2. DuPont Company; Fluorochemicals Div.

3. Honeywell, Inc.; Genetron Refrigerants.
 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410a: Penta fluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 for Conventional Air-Conditioning Applications: Copper, Type L ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 1. NPS 1-1/2 and Smaller Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
 2. NPS 2 to NPS 3 : Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed joints.
 3. NPS 4: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- G. Safety-Relief-Valve Discharge Piping:
 1. NPS 1-1/2: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
 2. NPS 2 to NPS 3: Copper, Type L drawn-temper tubing and wrought-copper fittings with brazed joints.
 3. NPS 4: Copper, Type L ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.

- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

- J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 : Maximum span, 60 inches; minimum rod size, 1/4 inch .
 - 2. NPS 5/8: Maximum span, 60 inches ; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches ; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches ; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet ; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet ; minimum rod size, 1/2 inch.
- D. Support multi floor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

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SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
 - 6. Seismic-restraint devices.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 - 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
 - 1. Static-Pressure Classes:
 - a. Supply Ducts: 1-inch wg.
 - b. Return Ducts (Negative Pressure): 1-inch wg.
 - c. Exhaust Ducts (Negative Pressure): 1-inch wg.
 - 2. Leakage Class:
 - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
 - b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
 - c. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Equipment installation based on equipment being used on Project.
 - 2. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 3 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as follows:
 - 1. Commercial Kitchen Hood Exhaust Ducts: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Carbon-steel sheet.
 - c. Welded seams and joints.
 - 2. Moist Environment Ducts: Aluminum.
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless-Steel Ducts: Galvanized steel.
 - 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- D. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.

- b. Rectangular Main to Round Branch: Spin in.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: (As applicable)
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Flange connectors.
 - 7. Turning vanes.
 - 8. Duct-mounted access doors.
 - 9. Flexible connectors.
 - 10. Flexible ducts.
 - 11. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Duro Dyne Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch- thick stainless steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Stainless steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Front of rear screens.
 - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexmaster U.S.A., Inc.
 - b. McGill AirFlow LLC.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, stainless-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Stainless-steel, 0.064 inch thick.
 6. Blade Axles: Stainless steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of Mestek, Inc.
 2. McGill AirFlow LLC.
 3. METALAIRE, Inc.
 4. Prefco; Perfect Air Control, Inc.
 5. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 3 hours.
- E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.

- 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.7 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Flexmaster U.S.A., Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Single wall with metal thickness applicable for duct pressure class.
 - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - 4. Factory set at 10-inch wg.
 - 5. Doors close when pressures are within set-point range.
 - 6. Hinge: Continuous piano.
 - 7. Latches: Cam.
 - 8. Seal: Neoprene or foam rubber.
 - 9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.8 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.10 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.

2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. Install duct test holes where required for testing and balancing purposes.
- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 3416
CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backward-inclined centrifugal fans.
 - 2. Forward-curved centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

PART 2 - PRODUCTS

2.1 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Acme Engineering & Mfg. Corp.
 - 3. Penn Ventilation.
 - 4. Twin City Fan.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Spun inlet cone with flange.
 - 3. Outlet flange.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded; cast-iron and fastened to shaft with set screws.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 50,000 hours.
- G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: [1.5] [1.4] [1.3] [1.2].
 - 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 6. Motor Mount: Adjustable for belt tensioning.
- H. Accessories:
 - 1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 - 2. Scroll Drain Connection: **NPS 1** steel pipe coupling welded to low point of fan scroll.
 - 3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 - 5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 - 6. Inlet Screens: Grid screen of same material as housing.
 - 7. Spark-Resistant Construction: AMCA 99.
 - 8. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 - 9. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

- I. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure Type: Totally enclosed, fan cooled.

2.2 FORWARD-CURVED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Acme Engineering & Mfg. Corp.
 - 3. Twin City Fan Company.
 - 4. Penn Ventilation.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Spun inlet cone with flange.
 - 3. Outlet flange.
- D. Forward-Curved Wheels: Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
- G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.5.
 - 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 6. Motor Mount: Adjustable for belt tensioning.
- H. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 2. Scroll Drain Connection: **NPS 1** steel pipe coupling welded to low point of fan scroll.
 3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 6. Inlet Screens: Grid screen of same material as housing.
 7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
- I. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using restrained spring isolators having a static deflection of **1 inch (25 mm)**. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of **1 inch**. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.

- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

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SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES AND REGISTERS

- A. Adjustable Bar Grille :
 - 1. Manufacturers: (Refer to schedule)
 - 2. Material: Refer drawings.
 - 3. Finish: refer drawings.
 - 4. Accessories: Front-blade gang operator.
- B. Fixed Face Grille:
 - 1. Manufacturers: (Refer to schedule)

2.3 CEILING DIFFUSER OUTLETS

- A. Rectangular and Square Ceiling Diffusers:
 - 1. Manufacturers: (Refer to schedule)
- B. Louver Face Diffuser:
 - 1. Manufacturers: (Refer to schedule)

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 74 14

DEDICATED OUTDOOR AIR UNITS (PACKAGED)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged outdoor air unit.
- B. Heat exchanger.
- C. Refrigeration components.
- D. Unit operating controls.
- E. Roof curb.
- F. Electrical power connections.
- G. Operation and maintenance service.

1.02 RELATED SECTIONS

- A. Section 230513- Motors
- B. Section 230548 - Vibration Isolation.
- C. Section 230700-Ductwork Insulation.

1.03 REFERENCES

- A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems. (all)

- B. ETL Listed and Labeled
- C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration. (all)
- D. Standard for Safety Heating and Cooling Equipment-Third Edition, UL 1995/CSA C22.2 236-05, dated February 18, 2005, with revisions through July 30, 2009 (all for cooling and for electric heat)
- E. Standard for Gas Unit Heaters And Gas-Fired Duct Furnaces ANSI Z83.8-2006, CSA 2.6-2006, Third Edition – 2006 (indirect gas-fired/e)
- F. Standard for Non-Recirculating Direct Gas-Fired Industrial Air Heaters, ANSI Z83.4/CSA 3.7 - 2003 with addenda ANSI Z83.4/CSA 3.7 - 2004a and addenda ANSI Z83.4/CSA 3.7 - 2006b (direct gas-fired/e)
- G. ANSI/ASHRAE/IESNA 90.1-2010 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
- H. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
- J. ANSI/NFPA 70-1995 - National Electric Code.
- K. International Fuel Gas Code (g/e)

1.04 SUBMITTALS

- A. Submit unit performance data including: capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components, and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

- E. Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.05 DELIVERY, STORAGE and HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.06 WARRANTY

- A. Provide parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.
- B. Provide five year extended warranty for compressors.
- C. Provide twenty-five year heat exchanger limited warranty.

1.07 REGULATORY REQUIREMENTS

- A. Unit shall conform to the appropriate standards listed in Section 1.03.

1. In the event the unit is not approved by a Nationally Recognized Testing Laboratory (NRTL) for compliance with the appropriate standards, the manufacturer shall, at manufacturer's expense, provide for a field certification and labeling of unit by an NRTL to the appropriate standards. Manufacturer shall, at manufacturer's cost, complete any and all modifications required by NRTL prior to certification and field labeling. Manufacturer shall include coverage of all modifications in unit warranty.

1.09 EXTRA MATERIALS

- A. Provide one set of filters.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install packaged outdoor air units as shown and scheduled on the contract documents. The units shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. **APPROVED MANUFACTURERS**
 1. Trane: As shown on the construction documents.
 2. Greenheck:
 3. Addison:
 4. Substitutions: submission for substitution is required a minimum of 10 working days prior to bid date as indicated under the general and/or supplemental conditions of these specifications. Bidding contractor shall be responsible for electrical and mechanical and structural modifications required when substituting a product other than the specified product. It shall be the responsibility of the bidding contractor to make the specifier aware of said modifications.

2.02 GENERAL UNIT DESCRIPTION

- A. Units furnished and installed shall be packaged outdoor air units as scheduled on contract documents and the specifications. Units shall consist of insulated weather-tight casing with compressors, air-cooled condenser coil, condenser fans, evaporator coil, air filters, supply motors and unit controls.
- B. Before shipment, each units shall be leak tested, dehydrated, charged with refrigerant (R-410A) and compressor oil, and factory run tested for proper control operation.
- C. For units 30 tons or less, coil shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion-resistant coating.
- D. Direct-drive, vertical discharge condenser fans must be provided with built-in thermal overload protection.

- E. Units shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- F. Units shall be dedicated downflow airflow as manufactured.
- G. Wiring internal to the unit shall be colored and numbered for identification.

2.03 UNIT CASING

- A. Cabinet: Zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B45. Structural members shall be a minimum of 16 gauge with access doors and removable panels of minimum 20 gauge.
- B. Panels: 2" double-wall foamed panel construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.
- C. Insulation: 2" polyisocyanurate Foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.

- D. Cabinet construction shall provide access panels for all parts requiring service.
- E. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
- F. Panels: Water- and air-tight hinged panels with handles shall provide access to filters, heating section; ERV and power exhaust fan section, supply air fan section, evaporator coil section, and unit control section. Door hardware shall be oriented to allow the door swing to be reversed.
1. Latches with hold down hooks will be factory installed on hinged access doors.
- G. Type 304 Stainless steel drain pan sloped in two directions to ensure positive drainage. Pan shall have a minimum depth of 2". Seams exposed to standing water shall be welded liquid tight. Base of pan shall be insulated with 1" thick foam insulation.
- H. Provide openings either on side of unit or thru the base for power, control and gas connections.
- I. Optional corrosion inhibiting coatings available for the unit exterior, interior and coils. Interior liner 304 stainless with seams sealed with caulk.
- J. Coil Coating: Coil will have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas with no material bridging between fins. The coating process will ensure complete coil encapsulation and a uniform dry film thickness from 0.6 – 1.2 mills on all surface areas including fin edges and meet 5b rating cross hatched adhesion per ASTM B3359- 93. Corrosion durability will be confirmed through testing with no less than 5,000 hours salt spray resistance per ASTM B117-90 using scribed aluminum test school coupons. The coil coating will meet the following test standards:
- MIL-C-46168 Chemical Agent Resistance – DS2, HCL Gas
 - CIDA-A-52474-A (GSA)
 - MIL-STD810F, Method 509.4 (Sand and Dust)
 - MIL-P-53084 (ME)-TACOM Approval

- MIL-DTL-12468 Decontamination Agent (STB)
 - DPG (Dugway Proving Grounds) Soil & Water Exposure Tests
 - GM9540P-97 Accelerated Corrosion Test (120 cycles)
 - ASTM B117-G85 Modified Salt Spray (Fog) Testing-2,000 hours
(tested by ARL for Lockheed Martin)
- K. The unit(s) must comply per above - spray coatings not acceptable
- L. The base of the unit shall have provisions for forklift and crane lifting

2.04 POWER WIRING

- A. Field wiring access to be provided thru unit base into isolated enclosure with removable cover.
- B. Power wiring to be single point connection.
- C. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.
- D. Factory mount and wire unit main power disconnect device overcurrent and SCCA rated for total unit power connection.
- E. Factory installed safety barrier shall isolate all high voltage components, mounted inside electrical compartment, to protect service personnel from incidental contact.
- F. Factory to mount and wire optional 120 volt convenience outlet. Field wiring of convenience outlet not acceptable.

2.05 LOW VOLTAGE CONTROLS

- A. Factory mount and wire line to 120 volt convenience outlet transformer. Field wiring of convenience outlet not acceptable.
- B. Factory mount and wire 24 volt control system complete with required transformers and fusing.
- C. Main Control Module (MCM) shall prevent simultaneous operation of any modes and shall enable operation in Dehumidification, Cooling, Heating or Economizer mode based on programmed settings for:
 - 1. Space conditions
 - 2. Outdoor air conditions
- D. MCM shall accept separate setpoints for Occupied and Unoccupied states.

- E. MCM shall control based on dew point design settings for Dehumidification and Economizer modes, and sensible temperature settings for heating and cooling modes.
- F. Factory installed and wired sensors shall monitor Outdoor Air (OA) temperature, humidity and evaporator leaving air temperature.
- G. Supply air sensor shall be furnished with unit. Installing contractor shall install remote mounted supply air sensor in supply air duct and LAN connections to unit.
- H. Rh sensors shall be furnished and field wired to unit.
- I. Optional modulating hot-gas reheat shall be enabled in dehumidification mode with modulation controlled by MCM to maintain supply air temperature & space temperature.
- J. System controls shall include anti-cycle timing and minimum compressor run/offtimes.
- K. Systems controls shall be digital, programmable type with access via factory installed and wired touchscreen, or through portable computer connection. All setpoints, unit functions, and status shall be accessible via the touchscreen or portable computer.
- L. MCM shall include preprogrammed test modes, engaged thru operator display, that permit operation in dehumidification, cooling, heating, or economizer test modes and facilitate complete start-up of all unit mechanical and control components.
- M. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.
- N. Field wiring of zone controls to be NEC Class II.

2.06 FANS AND MOTORS

- A. Indoor fan shall be direct drive plenum fan, factory installed and wired to on-board Variable Frequency Drive and shall be equipped with slide out service access.
- B. All fan motors shall meet the U.S. Energy Policy Act of 2005/10 (EPACT).
- C. All fan motors shall either be permanently lubricated and/ or have internal thermal overload protection.
- D. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- E. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.07 MODULATING INDIRECT GAS-FIRED BURNER HEATING SECTION

- A. Completely assembled and factory installed heating system shall be integral to unit and approved for use downstream from refrigerant cooling coils in units mounted outdoors. Threaded gas connection shall terminate at manual shut-off valve provided with unit.
- B. The unit shall have fully modulating, high turndown, and indirect gas- fired heat. The heating section will include high turn-down burners firing into individual stainless steel tubular heat exchangers. The heat exchangers shall be constructed of type 409 or optional type 304 stainless steel and be a tubular design capable of draining internal condensate. External flue to be constructed of type 304 stainless steel. Units with multiple heaters shall include one fully modulating high turndown heater with additional on-off heater sections. Total heater turndown shall be minimum listed below or higher.
- C. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision.
- D. Timed freeze stat shall monitor heat output and shall discontinue all heating attempts and or unit operation in the event the heating section fails to ignite or fails to maintain programmed supply air temperature/time.

- E. Inducer fan shall be direct drive high pressure centrifugal type and shall include built-in thermal overload protection.
- F. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow, loss of indoor airflow or flame rollout.

2.08 EVAPORATOR CONDENSOR AND REHEAT COILS

- A. Evaporator coils shall be constructed of copper tubes mechanically bonded to a configured aluminum plate fin. For units 30 tons or less, hot gas reheat coil shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion-resistant coating.
- B. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil, reheat coil and condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig.
- C. The condenser coil shall have a fin designed for ease of cleaning.
- D. Evaporator coil shall have six interlaced rows for superior sensible and latent cooling.
- E. Reheat coil shall be fully integrated into the supply air and fan system and capable of delivering design supply air temperature.
- F. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated a minimum of six inches.

2.09 CONDENSER SECTION

- A. Outdoor Fans: vertical discharge, direct drive fans with polymer blades. Fans shall be statically balanced.

2.10 REFRIGERANT CAPACITY CONTROL

- A. Units with scroll compressors shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to modulate compressor capacity during Dehumidification or Cooling modes to maintain evaporator Dehumidification or Cooling setpoint and prevent evaporator frosting or freezing.
- B. The RCC setpoint is factory set, and field adjustable, to maintain desired suction pressure and compressor discharge pressure.
- C. Capacity control for units equipped with digital scroll compressors, or variable speed compressors, shall be accomplished through compressor controls.

2.11 REFRIGERATION SYSTEM

- A. Compressors: All units shall have direct-drive, hermetic, scroll type compressors or digital scroll with centrifugal type oil pumps.
- B. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- C. Internal overloads shall be provided with the scroll compressors. D. Each compressor shall have a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
- D. Provide each unit with hermetically sealed refrigerant circuits factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports.

2.12 OUTDOOR AIR SECTION (ERV)

- A. The rotating wheel heat exchanger shall be composed of a rotating cylinder in an insulated cassette frame complete with seals, drive motor and drive belt.
- B. The total energy wheel shall be coated with silica gel desiccant permanently bonded by a patented and proprietary process without the use of binders or adhesives, which may degrade desiccant performance
- C. The substrate shall be a lightweight polymer and will not degrade nor require additional coatings for applications in marine or coastal environments. Coated segments should be washable with detergent or alkaline coil cleaner and water. Desiccant will not dissolve nor deliquesce in the presence of water or high humidity.
- D. As the wheel rotates between the ventilation and exhaust air stream it picks should pick up sensible and latent heat energy and release it under the colder air stream. The driving force behind the exchange is the difference in temperature between the opposing air streams which is also called the thermal gradient.

2.13 BUILDING MANAGEMENT SYSTEM

- A. Interface control module to Energy Management System to be furnished and mounted by rooftop unit manufacturer. Through this interface module, all Energy Management. The interface module with necessary controls and sensors shall all be factory mounted (not field mounted). The only field connection to Energy Management System shall be a single communication link.
- B. Control Functions: Occupied/unoccupied mode, demand limiting, conditioning mode set points discharge air set point adjustment, and alarm shutdown.
- C. Diagnostic Functions: Include supply fan status,
- D. Provide capabilities for Boolean Processing and trend logs as well as "templated" reports and logs.

2.14 ROOF CURB

- A. Contractor shall provide factory supplied roof curb, 18 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
- B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall verify that roof is ready to receive work and opening dimensions are per scheduled model and manufacturer.
- B. Contractor shall verify that proper power supply adequate to supply the unit.

3.02 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Factory authorized start up commissioning only.
- B. Must have twenty authorized technicians within a 50 mile radius of job site.
- C. The manufacturer shall furnish an alternative price for:
 - 1. Extended compressor warranty for 5 years
 - 2. Extended heat exchanger warranty for 5 years
 - 3. Extended parts and labor by manufacturer to be provided to the owner for a period of 1 year
- D. The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

PART 4 SEQUENCE OF OPERATIONS

4.01 DEDICATED OUTDOOR AIR UNITS (OAU)

- A. Microprocessor controller - Each OAU shall be controlled by a stand- alone microprocessor based controller with resident control logic. The controller will interface with the BAS and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.
 - 1. Occupied Mode - All unit functions will be enabled for normal heating and cooling operation. Unit defaults to default temperature setpoints in the unit microprocessor when communication with

- BAS is lost.
2. Occupied Space Temperature Control - When in occupied mode as described above, the dedicated unit control shall operate stages of heating and cooling to maintain space temperature setpoint. Setpoints may be set by one of the following methods:
 - a. Remotely through BAS by the system operator;
 - b. Locally through the unit ROD; located in the space through the BAS system;
 - c. Locally through remote mounted unit ROD
 - B. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.
 - C. Unit status report - For each OAU unit, the BAS shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.
 - D. Supply Air Tempering - When the unit is in the heat mode, but not actively heating, outdoor air heat set point will continue heat operation at minimum fire to prevent space cycling.

END OF SECTION

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SECTION 23 8126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

- A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within one year from date of Substantial Completion.
- B. Parts: 5 years compressor & 1 year all parts
- C. Labor: 1 year

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Air Conditioning; Div. of Carrier Corp.
 - 2. Lennox Industries Inc.
 - 3. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 4. Sanyo Fisher (U.S.A.) Corp.
 - 5. Trane Co. (The); Unitary Products Group.
 - 6. York International Corp.

2.2 EVAPORATOR-FAN UNIT

- A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 1. Insulation: Faced, glass-fiber duct liner.
 - 2. Drain Pans: Galvanized steel, with connection for drain; insulated.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Electric Coil: Helical, nickel-chrome, electric-resistance heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
- D. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- E. Fan Motor: Multispeed.
- F. Filters: 2 inch thick, in fiberboard frames.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

- A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

- B. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Refrigerant Charge [R-410A].
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub cooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 0 deg F.
- H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- C. Additional Monitoring:
 - 1. Monitor constant and variable motor loads.
 - 2. Monitor variable frequency drive operation.
 - 3. Monitor economizer cycle.
 - 4. Monitor cooling load.
 - 5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install ground-mounted, compressor-condenser components on 4-inch thick, reinforced concrete base. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

3.2 CONNECTIONS

- A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, if required, to inspect, field-assembled components and equipment installation, including connections. Report results in writing.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 8239

UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Equipment schedules to include rated capacities, furnished specialties, and accessories.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Indeeco.
 - 2. Markel Products; a division of TPI Corporation.
 - 3. Marley Electric Heating; a division of Marley Engineered Products.
 - 4. QMark Electric Heating; a division of Marley Engineered Products.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
 - 1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
 - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.
- F. Fan: Aluminum propeller directly connected to motor.
 - 1. Motor: Permanently lubricated. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Comply with safety requirements in UL 1995.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches** above finished floor level.

- G. Size pipe sleeves to provide **1/4-inch** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

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SECTION 26 051

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Adjust list below to suit Project.
 - 2. Building wires and cables rated 600 V and less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- 1. Copper Conductors: Comply with NEMA WC 70.
- 2. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

2.2 CONNECTORS AND SPLICES

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain one of first two paragraphs and list of manufacturers below. See Section 016000 "Product Requirements."

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. AFC Cable Systems, Inc.
- 2. Hubbell Power Systems, Inc.

3. [O-Z/Gedney; EGS Electrical Group LLC.](#)
4. [3M; Electrical Products Division.](#)
5. [Tyco Electronics Corp.](#)

Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

PART 3 –EXECUTION

3.1 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. This Article provides examples of application requirements for conductors and cables. Edit to select wiring methods for various environments in Project. Add other methods if required.

Revise conductor insulation and cable type designations to suit Project conditions, authorities having jurisdiction, and practice. Refer to NFPA 70 and to UL's "Electrical Construction Equipment Directory" for additional application information about conductor sizes, insulation temperature ratings in cables, and product-use classifications and restrictions. See Editing Instruction No. 2 in the Evaluations for use of Type MI cable as service entrance conductor inside a building.

Service Entrance: Type XHHW, single conductors in raceway.

Exposed Feeders: Type THHN-THWN, single conductors in raceway.

Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway. Coordinate first paragraph below with Section 260543 "Underground Ducts and Raceways for Electrical Systems."

Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway.

Exposed Branch Circuits, Including in Crawlspace: Type THWN, single conductors in raceway.

Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THWN, single conductors in raceway. Coordinate first paragraph below with Section 260543 "Underground Ducts and Raceways for Electrical Systems."

Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway.

Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

Class 1 Control Circuits: Type THHN-THWN, in raceway.

Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

2.5 INSTALLATION OF CONDUCTORS AND CABLES

Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

Identify and color-code conductors and cables according to Section 260553

"Identification for Electrical Systems."

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Delete subparagraph below unless aluminum conductors are specified.

Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

Wiring at Outlets: Install conductor at each outlet, with at least **6 inches (150 mm)** of slack.

7. SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- 7.1.1 Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

8. FIRESTOPPING

- 8.1.1 Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

9. FIELD QUALITY CONTROL

- 9.1.1 Perform tests and inspections and prepare test reports.
Tests and Inspections:
Performing NETA tests on all conductors and cables can be expensive. Consider limiting testing to a certain group of conductors, such as service entrance and feeder conductors, or to those conductors feeding critical equipment and services. To require all conductors and cables to be tested, delete option in first subparagraph below and delete associated subparagraph.

After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, for compliance with requirements.

Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Consider the cost and benefit of infrared scanning of cable and conductor splices before retaining subparagraph and associated subparagraphs below.

Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

- b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

9.1.2 Test Reports: Prepare a written report to record the following:
Test procedures used.
Test results that comply with requirements.
Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

9.1.3 Remove and replace malfunctioning units and retest as specified above.

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1.1 SUMMARY

Section Includes: Grounding systems and equipment.

2. ACTION SUBMITTALS

2.1.1 Product Data: For each type of product indicated.

3. INFORMATIONAL SUBMITTALS

3.1.1 Field quality-control reports.

4. QUALITY ASSURANCE

4.1.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with UL 467 for grounding and bonding materials and equipment.

5. PRODUCTS

5.1.1 CONDUCTORS

Retain first paragraph below to require one of the two preferred conductor materials permitted by NFPA 70; delete to allow Contractor to retain any material that complies with Code. See "Grounding Products" Article in the Evaluations for discussion on alternative materials.

Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

6. CONNECTORS

- 6.1.1 Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- 6.1.2 Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
- 6.1.3 Pipe Connectors: Clamp type, sized for pipe.
- 6.1.4 Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

7. GROUNDING ELECTRODES

- 7.1.1 Ground Rods: Copper-clad; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

8. EXECUTION

8.1.1 APPLICATIONS

Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated. Coordinate first paragraph below with Drawings and with Section 260543 "Underground Ducts and Raceways for Electrical Systems."

Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

9. EQUIPMENT GROUNDING

- 9.1.1 Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

Feeders and branch circuits.

Lighting circuits.

Receptacle circuits.

Single-phase motor and appliance branch circuits.

Three-phase motor and appliance branch circuits.

Flexible raceway runs.

Armored and metal-clad cable runs.

Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

- 9.1.2 Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- 9.1.3 Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- 9.1.4 Coordinate first paragraph below with Drawings and with Sections for signal and communication equipment. Revise to suit Project.
- 9.1.5 Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.

Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

- 9.1.6 Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

10. INSTALLATION

- 10.1.1 Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- 10.1.2 Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least one rod then install additional ground rods as required spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

- 10.1.3 Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- 10.1.4 Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- 10.1.5 Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- 10.1.6 Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install **[tinned]** bonding jumper to bond across flexible duct connections to achieve continuity.

11. LABELING

- 11.1.1 Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- 11.1.2 Install labels at the telecommunications bonding conductor and grounding equalizer.
- 11.1.3 Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

12. FIELD QUALITY CONTROL

- 12.1.1 Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground- resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.

- 12.1.2 Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms Power Distribution Units or Panelboards Serving Electronic Equipment: 2 ohms

- 12.1.3 Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1.1 SUMMARY

Section includes:

Hangers and supports for electrical equipment and systems.
Construction requirements for concrete bases.

2. PERFORMANCE REQUIREMENTS

- 2.1.1 Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 2.1.2 Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- 2.1.3 Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 2.1.4 Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

3. ACTION SUBMITTALS

- 3.1.1 Product Data: For steel slotted support systems.
- 3.1.2 Retain first paragraph and subparagraphs below if supporting systems are required to withstand specific design loads and Architect either has delegated design responsibility to Contractor or wants to review structural data as another way to verify supporting system's compliance with performance requirements. Professional engineer qualifications are specified in Section 014000 "Quality Requirements."
- 3.1.3 Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.

4. INFORMATIONAL SUBMITTALS

- 4.1.1 Welding certificates.

5. QUALITY ASSURANCE

- 5.1.1 Delete first paragraph below if no welding. Retain "Welding certificates" Paragraph in "Informational Submittals" Article if retaining below. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.
- 5.1.2 Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 5.1.3 Comply with NFPA 70.

6. PRODUCTS

- 6.1.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
- 6.1.2 Retain this Article to specify default product requirements for basic supporting devices. Items to be supported include raceways, cables, wireways, cable trays, busways, boxes, cabinets, equipment, and other electrical products. Where support materials or workmanship is unique to a particular product, specify unique features that are the exception to these default requirements in the Section that specifies the product. Coordinate specifications for supporting devices with structural engineer and with Drawings.
- 6.1.3 Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
- 6.1.4 See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain one of two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Allied Tube & Conduit.

Cooper B-Line, Inc.; a division of Cooper Industries.

ERICO International Corporation.

GS Metals Corp.

Thomas & Betts Corporation.

Unistrut; Tyco International, Ltd.

Wesanco, Inc.

Retain one or more coating systems in first three subparagraphs below. If retaining more than one, specify in Part 3 where each coating system is required.

Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

Channel Dimensions: Selected for applicable load criteria.

- 6.1.5 Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- 6.1.6 Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- 6.1.7 Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- 6.1.8 Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- 6.1.9 Coordinate paragraph and subparagraphs below with installation requirements in Part 3.
- 6.1.10 Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
 2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Hilti Inc.
 - ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - MKT Fastening, LLC.
 - Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
- 6.1.11 Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- 6.1.12 See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain one of first two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Cooper B-Line, Inc.; a division of Cooper Industries.

Empire Tool and Manufacturing Co., Inc.

Hilti Inc.

ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

MKT Fastening, LLC.

Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

Toggle Bolts: All-steel springhead type.

Hanger Rods: Threaded steel.

7. FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- 7.1.1 Equipment supports in this Article require calculation of load and strength for each component and detailing of each assembly. Coordinate specifications for each equipment support with structural engineer and with Drawings.
- 7.1.2 Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- 7.1.3 Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

8. EXECUTION

- 8.1.1 APPLICATION
- 8.1.2 Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- 8.1.3 In first paragraph below, support spacings in NECA 1, Table 1, are more detailed and specific and generally stricter than those permitted by NFPA 70 for EMT, IMC, and RMC. Revise to suit Project, and consider retaining reference to NECA table for critical projects.
- 8.1.4 Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- 8.1.5 Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
- 8.1.6 Secure raceways and cables to these supports with two-bolt conduit clamps.
- 8.1.7 Retain paragraph below for projects where seismic design requirements do not apply. Consider retaining for light-commercial projects only.
- 8.1.8 Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

9. SUPPORT INSTALLATION

- 9.1.1 Consult structural engineer for requirements in this Article.
- 9.1.2 Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- 9.1.3 Retain first paragraph below to permit raceways running perpendicular to bar joists and trusses to be supported by letting them rest within the joist or truss openings. NECA 1 does not mention this method. If seismic design requirements apply, consult structural engineer or authorities having jurisdiction before permitting this support method and specify seismic requirements in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- 9.1.4 Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, as permitted in NFPA 70.
- 9.1.5 Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- 9.1.6 Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

To Wood: Fasten with lag screws or through bolts.

To New Concrete: Bolt to concrete inserts.

To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

To Existing Concrete: Expansion anchor fasteners. Retain first subparagraph below if powder-actuated devices are allowed. Consider deleting if Project contains both lightweight and standard-weight concrete or more than one thickness of concrete slab.

Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4

inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69

To Light Steel: Sheet metal screws.

Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- 9.1.7 Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

10. INSTALLATION OF FABRICATED METAL SUPPORTS

- 10.1.1 Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- 10.1.2 Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- 10.1.3 Field Welding: Comply with AWS D1.1/D1.1M.

11. CONCRETE BASES

- 11.1.1 Coordinate this Article with Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete."
- 11.1.2 Coordinate paragraphs and subparagraphs below with Sections specifying supported equipment.
- 11.1.3 Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- 11.1.4 Use **3000-psi (20.7-MPa)** 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- 11.1.5 Anchor equipment to concrete base.

Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor bolts to elevations required for proper attachment to supported equipment.

Install anchor bolts according to anchor-bolt manufacturer's written instructions.

12. PAINTING

- 12.1.1 Retain paragraph and subparagraph below if a painting Section is not in Project Manual.
- 12.1.2 Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- 12.1.3 Retain first paragraph below if a painting Section is in Project Manual.
- 12.1.4 Touchup: Comply with requirements architectural specifications for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- 12.1.5 Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

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SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R as required by location unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
 - 1. Material: Aluminum with clear anodized finish.
 - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Semi-adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773 galvanized, cast iron with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)
- M. Gangable boxes are allowed.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Fiberglass.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Standard: Comply with SCTE 77.
 2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC."
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete..
1. Standard: Comply with SCTE 77.
 2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC."
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed, Not Subject to Physical Damage: EMT or RNC.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC or IMC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel] in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to RNC, Type EPC-40-PVC, GRC or IMC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F (70 deg C)** temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F (86 deg C)** temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F (70 deg C)** temperature change.
 - d. Attics: **135 deg F (75 deg C)** temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **[center]** **[top]** **[bottom]** of box unless otherwise indicated.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

W. Locate boxes so that cover or plate will not span different building finishes.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

- AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field
 2. Legend: Indicate voltage

- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, [0.010 inch (0.25 mm)] thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field
 - 2. Legend: Indicate voltage
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with black letters on white face
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be [1 inch (25 mm)]

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
- G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot (10-m) maximum intervals.

- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
 2. Power.
 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit] conductors.
 - a. Color shall be factory applied
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

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SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Field quality-control reports.
- C. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
 - b. Outdoor Locations: NEMA 250, Type 3R
 - c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X stainless steel
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.

3. Ground Lugs and Bus Configured Terminators: Compression type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
 - G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
 - I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, power and feeder distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- E. Mains: **Circuit breaker**
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: **Bolt-on** circuit breakers.
- G. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- H. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

- B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: Circuit breaker
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: 120-V branch circuit or 24-V control circuit
- G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFE) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches (2286 mm above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

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SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. [Leviton Mfg. Company Inc. \(Leviton\).](#)
4. [Pass & Seymour/Legrand \(Pass & Seymour\).](#)

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. [Products](#): Subject to compliance with requirements, provide the following:
 - a. [Cooper; 5351 \(single\), CR5362 \(duplex\).](#)
 - b. [Hubbell; HBL5351 \(single\), HBL5352 \(duplex\).](#)
 - c. [Leviton; 5891 \(single\), 5352 \(duplex\).](#)
 - d. [Pass & Seymour; 5361 \(single\), 5362 \(duplex\).](#)

2.4 GFCI RECEPTACLES

- A. General Description:
1. Straight blade, **feed**-through type.
 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. [Products](#): Subject to compliance with requirements, provide the following
 - a. [Cooper; VGF20.](#)
 - b. [Hubbell; GFR5352L.](#)
 - c. [Pass & Seymour; 2095.](#)
 - d. [Leviton; 7590.](#)

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. **Products:** Subject to compliance with requirements, provide the following:

- 1) Single Pole:
- 2) Cooper; AH1221.
- 3) Hubbell; HBL1221.
- 4) Leviton; 1221-2.
- 5) Pass & Seymour; CSB20AC1.
- 6)
- 7) Two Pole:
- 8) Cooper; AH1222.
- 9) Hubbell; HBL1222.
- 10) Leviton; 1222-2.
- 11) Pass & Seymour; CSB20AC2.
- 12) Three Way:
- 13) Cooper; AH1223.
- 14) Hubbell; HBL1223.
- 15) Leviton; 1223-2.
- 16) Pass & Seymour; CSB20AC3.
- 17) Four Way:
- 18) Cooper; AH1224.
- 19) Hubbell; HBL1224.
- 20) Leviton; 1224-2.
- 21) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:

1. **Products:** Subject to compliance with requirements, provide the following

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Leviton; 1221-LH1.
- d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. **Description:** Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. **Products:** Subject to compliance with requirements, provide the following

- a. Cooper; AH1221L.
- b. Hubbell; HBL1221L.
- c. Leviton; 1221-2L.

- d. [Pass & Seymour; PS20AC1-L.](#)
- 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 DECORATOR-STYLE DEVICES

- A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
 - 1. [Products](#): Subject to compliance with requirements, provide the following
 - a. [Cooper; 6252.](#)
 - b. [Hubbell; DR15.](#)
 - c. [Leviton; 16252.](#)
 - d. [Pass & Seymour; 26252.](#)
- B. GFCI, **Feed-Through** Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
 - 1. [Products](#): Subject to compliance with requirements, provide the following
 - a. [Cooper; VGF15.](#)
 - b. [Hubbell; GF15LA.](#)
 - c. [Leviton; 8599.](#)
 - d. [Pass & Seymour; 1594.](#)
- C. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - 1. [Products](#): Subject to compliance with requirements, provide the following
 - a. [Cooper; 7621 \(single pole\), 7623 \(three way\).](#)
 - b. [Hubbell; DS115 \(single pole\), DS315 \(three way\).](#)
 - c. [Leviton; 56291-2 \(single pole\), 5623-2 \(three way\).](#)
 - d. [Pass & Seymour; 2621 \(single pole\), 2623 \(three way\).](#)
- D. Lighted Toggle Switches, Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.
 - 1. [Products](#): Subject to compliance with requirements, provide the following
 - a. [Cooper; 7631 \(single pole\), 7633 \(three way\).](#)
 - b. [Hubbell; DS120IL \(single pole\), DS320 \(three way\).](#)
 - c. [Leviton; 5631-2 \(single pole\), 5633-2 \(three way\).](#)
 - d. [Pass & Seymour; 2625 \(single pole\), 2626 \(three way\).](#)
 - 2. Description: With neon-lighted handle, illuminated when switch is "off."

2.7 RESIDENTIAL DEVICES

- A. Fan Speed Controls:
 - 1. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
 - 2. Comply with UL 1917.

3. Continuously adjustable knob type unit 5 A
- B. Telephone Outlet:
1. **Products:** Subject to compliance with requirements, provide the following
 - a. [Cooper; 3560-6.](#)
 - b. [Leviton; 40649.](#)
 2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6. Comply with UL 1863.
- C. Combination TV and Telephone Outlet:
1. **Products:** Subject to compliance with requirements, provide the following
 - a. [Cooper; 3562.](#)
 - b. [Leviton; 40159.](#)
 2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6 Comply with UL 1863.

2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 1. 600 W; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for All Spaces 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant die-cast metal with lockable cover.

2.10 FINISHES

- A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Type HD, Heavy Duty, Double position. Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed
- G. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens Energy & Automation, Inc.
 5. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Lugs: Suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 1. Cooper Bussmann, Inc.
 2. Ferraz Shawmut, Inc.
 3. Littelfuse, Inc.

- C. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- D. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Control Circuit: 120-V ac; with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- F. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight ON pilot light.
 - 3. Isolated neutral lug.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Retain option in first paragraph below if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.
- B. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - 2. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - 3. [Siemens Energy & Automation, Inc.](#)
 - 4. [Square D; a brand of Schneider Electric.](#)
- C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I²t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1
2. Outdoor Locations: NEMA 250, Type 3R
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X stainless steel
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Gas engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Load banks.
 - 6. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquid petroleum.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

- C. Manufacturer Seismic Qualification Certification: Submit certification that] engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For [installer] [manufacturer] [and] [testing agency].
- E. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.
 - 6. Report of exhaust emissions showing compliance with applicable regulations.
 - 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within **100 miles (160 km)** of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
 - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - F. Comply with ASME B15.1.
 - G. Comply with NFPA 37.
 - H. Comply with NFPA 70.
 - I. Comply with NFPA 99.
 - J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
 - K. Comply with UL 2200.
 - L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
 - M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- 1.6 PROJECT CONDITIONS
- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 1. Ambient Temperature: [5 to 40 deg C] [Minus 15 to plus 40 deg C].
 2. Relative Humidity: 0 to 95 percent.
 3. Altitude: Sea level to 1000 feet (300 m).
 - C. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:
- 1.7 COORDINATION
- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
 - B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Division 07 Section "Roof Accessories."

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide [12] <Insert number> months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Caterpillar; Engine Div.
 2. Generac Power Systems, Inc.
 3. Kohler Co.; Generator Division.
 4. Onan/Cummins Power Generation; Industrial Business Group.
 5. MTU Power Systems.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated.
 2. Output Connections: Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Natural gas.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 - 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.
 - 1. Configuration: Horizontal air discharge.
 - 2. Radiator Core Tubes: Aluminum.
 - 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 5. Fan: Driven by totally enclosed electric motor with sealed bearings.

6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- J. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- K. Muffler/Silencer: Residential type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 18 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 95 dBA or less.
- L. Muffler/Silencer: Industrial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 12 dB at 500 Hz.
 2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 87 dBA or less.
- M. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- N. Starting System: 12-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel.
- E. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:
 - 1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
 - 2. Switchboard Construction: Freestanding unit complying with Division 26 Section "Switchboards."
 - 3. Switchgear Construction: Freestanding unit complying with Division 26 Section "Low-Voltage Switchgear."
 - 4. Current and Potential Transformers: Instrument accuracy class.
- F. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level [1] [2] system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).

9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Generator overload.
- G. Indicating and Protective Devices and Controls:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Generator overload.
- H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- I. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- J. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- K. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
 2. Lube-oil, low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature prealarm.
 6. Lube-oil, low-pressure prealarm.
 7. Fuel tank, low-fuel level.
 8. Low coolant level.

- L. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- M. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- D. Generator Disconnect Switch: Molded-case type, 100 percent rated.
 - 1. Rating: Matched to generator output rating.
 - 2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
- E. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

- F. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.7 LOAD BANK

- A. Description: Permanent, outdoor, weatherproof, remote-controlled, forced-air-cooled, resistive and reactive unit capable of providing a balanced 3-phase, delta-connected load to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. Unit may be composed of separate resistive and reactive load banks controlled by a common control panel. Unit shall be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.
- B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.
- C. Reactive Load Elements: Epoxy-encapsulated reactor coils.
- D. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.

- E. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
- F. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- G. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with ~~1/2-inch-~~ (13-mm-) square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge.
- H. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.
- I. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
- J. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Prefabricated or preengineered walk-in enclosure with the following features:
 - 1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Space Heater: Thermostatically controlled and sized to prevent condensation.
 - 4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 - 5. Hinged Doors: With padlocking provisions.
 - 6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 8. Muffler Location: Within enclosure.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

- D. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 MOTORS

- A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - 1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
 - 2. Durometer Rating: 50.
 - 3. Number of Layers: Three.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to ~~1/4-inch-~~ (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.

3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of **1 inch (25 mm)** on **4-inch- (100-mm-)** high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set and heat exchanger. Piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect cooling-system water piping to engine-generator set with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 1. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 23 Section "Facility Natural-Gas Piping."
- F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.

- d. Verify that measurements are within manufacturer's specifications.
 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 32 13

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SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes automatic transfer switches rated 600 V and less.
- B. See Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.
- C. See Division 21 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 70.

- D. Comply with NFPA 99.
- E. Comply with NFPA 110.
- F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. AC Data Systems, Inc.
 - b. Caterpillar; Engine Div.
 - c. Emerson; ASCO Power Technologies, LP.
 - d. Generac Power Systems, Inc.
 - e. GE Zenith Controls.
 - f. Kohler Power Systems; Generator Division.
 - g. Onan/Cummins Power Generation; Industrial Business Group.
 - h. Russelectric, Inc.
 - i. Spectrum Detroit Diesel.
 - 2. Transfer Switches Using Molded-Case Switches or Circuit Breakers:
 - a. AC Data Systems, Inc.
 - b. Eaton Electrical Inc.; Cutler-Hammer.
 - c. GE Zenith Controls.
 - d. Hubbell Industrial Controls, Inc.
 - e. Lake Shore Electric Corporation.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- J. Battery Charger: For generator starting batteries.
 - 1. Float type rated 2 A.
 - 2. Ammeter to display charging current.
 - 3. Fused ac inputs and dc outputs.
- K. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.
- F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated.

- G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.
- H. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

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SECTION 26 5100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260943 "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
3. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings:** Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. **Product Certificates:** For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- I. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Section 233713 "Diffusers, Registers, and Grilles."
 - 1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 - 2. Heat-Removal Units: Air path leads through lamp cavity.
 - 3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
 - 4. Dampers: Operable from outside fixture for control of return-air volume.
 - 5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than [10] [20] percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.98 or higher.

B. luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

E. Ballasts for Low-Temperature Environments: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

F. Ballasts for Residential Applications: Fixtures designated as "Residential" may use low-power-factor electronic ballasts having a Class B sound rating and total harmonic distortion of approximately 30 percent.

G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 30 percent of rated lamp lumens.
2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.95 or higher.
 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 700 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Nightlight Connection: Operate one fluorescent lamp continuously.
 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.

5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
 2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
 3. Lamp end-of-life detection and shutdown circuit.
 4. Sound Rating: Class A.
 5. Total Harmonic Distortion Rating: Less than 10 percent.
 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 7. Lamp Current Crest Factor: 1.5 or less.
 8. Power Factor: 0.90 or higher.
 9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 10. Protection: Class P thermal cutout.
- C. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

2.7 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
 2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 - 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
 - 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.9 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 - 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.10 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 and color temperature 4000 K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [**12 gage (2.68 mm)**]
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [**12 gage (2.68 mm)**]
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.12 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

- A. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces.
- B. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Exterior luminaires with lamps and ballasts.
 2. Luminaire-mounted photoelectric relays.
 3. Poles and accessories.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.
- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.
1. Basic wind speed for calculating wind load for poles exceeding 49.2 feet (15 m) in height is 90 mph (40 m/s)
 - a. Wind Importance Factor: 1.30.
 - b. Minimum Design Life: 50 years
 - c. Velocity Conversion Factors: 1.0
 2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 90 mph (40 m/s)
 - a. Wind Importance Factor: 1.3
 - b. Minimum Design Life: 50 years .
 - c. Velocity Conversion Factors: 1.0

1.3 ACTION SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, **provide product indicated on Drawings**

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
 - 1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
 - 2. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of **[manufacturer's standard]** **[custom]** color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: **Dark bronze**
- O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.
 - b. Lamp tube configuration (twin, quad, triple), base type, and nominal wattage for compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (preheat, rapid start, instant start) compact fluorescent luminaires.

- e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 FLUORESCENT BALLASTS AND LAMPS

- A. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
 - 2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.
- B. Ballast Characteristics:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Sound Rating: Class A.
 - 3. Total Harmonic Distortion Rating: Less than 10 percent.
 - 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 - 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 - 6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures [0 deg F (minus 18 deg C)] [minus 20 deg F (minus 29 deg C)] and higher.

2.5 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:
 - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 - 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
 - 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 - 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall

have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

2.6 HID LAMPS

- A. Low-Pressure Sodium Lamps: ANSI C78.43.
- B. Metal-Halide Lamps: ANSI C78.43, minimum CRI 65, and CCT color temperature 4000 K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K
- D. Ceramic, pulse-start, metal-halide lamps in paragraph below are available in ratings from about 40 to 250 W. Besides advantages inherent in pulse-start technology, these lamps have an improved CRI, between 80 and 94, with higher initial and maintained lumen output.
- E. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 and CCT color temperature 4000 K.

2.7 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws

2.8 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top [**4 inches (100 mm)**] above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

2.9 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top **[4 inches (100 mm)]** above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

2.10 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

2.11 GROUNDING

- A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

END OF SECTION 265600

**SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Grounding and Bonding
 - 2. Identification
 - 3. Pathways
 - 4. Firestopping
- B. Related Requirements:
 - 1. Section 260526 "Grounding and Bonding for Electrical Systems".
 - 2. Section 271000 "Structured Cabling".
 - 3. Section 274116 "Integrated Audio-Video Equipment".
 - 4. Section 281300 "Access Control Systems".
 - 5. Section 282300 "Video Surveillance Systems".
 - 6. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.
 - 7. NFPA-70, National Electrical Code. (Check with the AHJ for the edition in force.)
 - 8. BICSI, Telecommunications Distribution Methods Manual, current edition.
 - 9. BICSI, Information Transport Systems Installation Methods Manual, current edition.
 - 10. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.
 - 11. CNGIT GOV Network Construction Standards and Requirements Manual.
 - 12. If a conflict exists and cannot be remediated by the above referenced codes, standards, and the Cherokee Nation Government Information Technology Construction Standards and Requirements Manual, CNGIT will have overall authority for the resolution.

1.03 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. FTP: Shielded twisted pair.
- F. F/FTP: Overall foil screened cable with foil screened twisted pair.
- G. F/UTP: Overall foil screened cable with unscreened twisted pair.
- H. IDC: Insulation displacement connector.
- I. LAN: Local area network.
- J. Modular jack: Also commonly called an "outlet," it is the fixed, female connector.
- K. MPTL: Modular Plug Terminated Link. Also commonly called a "plug" or "connector," it is the removable, male telecommunications connector. Formerly known as "direct connect".
- L. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the building's service equipment (power) ground (formerly known as the telecommunications main grounding busbar).
- M. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.

- N. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.
- O. RCDD: Registered Communications Distribution Designer.
- P. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- Q. SBB: Secondary bonding busbar. Formerly known as the telecommunications grounding busbar (TGB).
- R. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- S. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- T. S/FTP: Overall braid screened cable with foil screened twisted pair.
- U. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- V. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the bonding conductor for telecommunications (BCT).
- W. TEBC: Telecommunications equipment bonding conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.
- X. UTP: Unscreened/unshielded twisted pair.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. TBC, PBB, SBBs, and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of TBC connection.
 - b. Result of the bonding-resistance test at each SBB and its nearest grounding electrode.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ICT Technician, who shall be always present when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as an RCDD to perform the on-site inspections.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-D.

2.02 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Chatsworth Products, Inc.
 - 2. Panduit Corp.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Chatsworth Products, Inc.
 - 2. Panduit Corp.
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installed shall be in an accessible position to be inspected and labeled.

- G. Welded Connections shall be positioned In an accessible position to be inspected and labeled.

2.04 GROUNDING BUSBARS

- A. Manufacturers: Panduit
 - 1. Primary bonding busbar.
 - 2. Secondary bonding busbar.
 - 3. Refer to 271000 Appendix A for current part number.
- B. PBB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as PBB and shall comply with TIA-607-D.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. SBB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-D.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-D. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 - 3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.05 GROUND RODS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Harger Lightning & Grounding.
 - 2. TE Connectivity Ltd.
- B. Ground Rods: Copper-clad steel; 5/8" diameter by 96-inch length.

2.06 IDENTIFICATION

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Panduit Corporation
- B. Self-laminating adhesive labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.07 METAL CONDUIT AND FITTINGS

- A. To be provided by others.

2.08 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
 - 1. Refer to 271000 Appendix A for current part numbers.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- D. Firestop: Provide intumescent firestop blocks where cable trays are continuous through fire rated walls.

2.09 J-HOOKS

- A. Description: Prefabricated cable supports for telecommunications cable.
- B. Manufacturers: Panduit
 - 1. Or approved equivalent.
 - 2. Refer to 271000 Appendix A for current part numbers.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-E.

2.10 SLEEVES

- A. Subject to compliance with requirements, provide products by the following:
 - 1. STI EZ Path fire assemblies.
 - 2. Utilize gang plates where multiple cable management devices are required to penetrate fire rated assemblies.
 - 3. Refer to 271000 Appendix A for current part numbers.
- B. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- D. Sleeves & Pathways Penetrating Fire Rated Assemblies: Provide a cable management device where cables penetrate fire rated walls or floors. The fire-rated cable management device shall contain integrated intumescent firestop materials sufficient to maintain the hourly rating of the assembly being penetrated. The fire-rated cable management device shall contain an inner smoke seal capable of achieving an L-Rating less than or equal to 5 CFM/Square Foot for penetrations in smoke barriers.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized-steel sheet.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
- G. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

- H. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-D.

3.03 APPLICATION

- A. J-Hooks
 - 1. All cabling not in cable trays must be supported by J-Hooks with hook and loop fasteners spaced at intervals no greater than 5 feet.
- B. Conductors: Install solid conductor for No. 8AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the PBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- C. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.
- E. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- F. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install conductors without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing and bond both ends of the conduit to an SBB.

3.04 GROUNDING ELECTRODE SYSTEM

- A. The TBC between the PBB and the ac service equipment ground shall be sized per TIA-607-D, paragraph 6.3 Conductors.

3.05 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 72 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.06 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the PBB with insulated bonding conductor.
- E. Interconnections: Interconnect all SBBs with the PBB with the telecommunications backbone conductor. If more than one PBB is installed, interconnect PBBs using the backbone bonding conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted or vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the SBB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is in the same room or space, bond each SBB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the SBB in communications rooms and spaces. Comply with TIA-568.1-D and TIA-568.2-D when grounding shielded balanced twisted-pair cables.
- J. Rack and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the SBB.
- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the SBB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the SBB at the perimeter of the room.

3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-C.
 - 1. Administration Class: 1, 2, 3 or 4 as defined in TIA-606-C.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-C for the appropriate level of administration.
- C. Comply with requirements in Section 271000 "Structured Cabling" for cable and asset management software.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
 - 1. Handwritten labels shall not be permitted.
 - 2. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 3. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 4. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 5. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a device.
 - b. Label each unit and field within distribution racks and frames.
 - 6. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- G. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-C requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.
- H. Grounding and bonding labels shall be preprinted or computer-printed type.
 - 1. Label PBB(s) with "fs-PBB," where "fs" is the telecommunications space identifier for the space containing the PBB.
 - 2. Label SBB(s) with "fs-SBB," where "fs" is the telecommunications space identifier for the space containing the SBB.
 - 3. Label the TBC and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a PBB and an SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the PBB and each SBB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the TBC exceeds .5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system shall be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.09 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
- B. Minimum Pathway Size: 3/4-inch trade size for aluminum cables, and 1 inch for optical-fiber and copper cables.
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.

3.10 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
 2. ANSI/BICSI N1-19.
 3. TIA-606-C.
 4. TIA-607-D.
 5. TIA-569-E.
 6. NECA 101.
 7. NECA 102.
 8. NECA 105.
 9. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078400 "Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Complete pathway installation before starting conductor installation.
- E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- F. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid, and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.

3. Install with a maximum of two 90-degree bends or equivalent for each 100 feet length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- G. J-Hooks:
1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 2. Shall be supported by dedicated support wires or threaded rod (minimum 3/8"). Do not use ceiling grid support wire or support rods.
 3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power, and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than 5 feet apart on center.
 5. Provide a hook at each change in direction.
 6. J or U shape.

3.11 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with the manufacturer's requirements to meet the UL listed assembly as tested.
- B. Cable trays shall be bonded together in accordance with the manufacturer's requirements to maintain UL listed assembly, with splice washer kits or splice plates listed for grounding purposes.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.12 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in this Section.

3.13 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Firestopping," and 271000 "Structured Cabling".

END OF SECTION

**SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Metallic surface pathways.
 - 4. Boxes, enclosures, and cabinets.
 - 5. Polymer-concrete handholes and boxes for exterior underground cabling.
 - 6. Fiberglass handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. PVC: Polyvinyl chloride conduit.
- E. RTRC: Reinforced thermosetting resin conduit.

1.04 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Conduit and fittings.
 - 2. Boxes, enclosures, and cabinets.
 - 3. Underground handholes and boxes.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. Underground ducts, piping, and structures in location of underground enclosures and handholes.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-E.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated GRC or IMC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.

- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Set screw or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-E.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651A.
- F. RTRC: Comply with UL 2515A and NEMA TC 14.
- G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-E.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.04 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman; nVent
 - 2. MonoSystems, Inc.
 - 3. Old Castle Infrastructure.
 - 4. Quazite; Hubbell Incorporated, Power Systems.
 - 5. Wiremold; Legrand North America, LLC.

- C. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-E.
 - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 - 3. Box extensions used to accommodate new building finishes shall be of the same material as recessed box.
 - 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 - 5. Gangable boxes are allowed.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.
 - 1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4, with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures:
 - a. Material: Steel.
 - b. Finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Plastic.
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet, where required, for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Oldcastle Infrastructure Inc.; CRH Americas.
 - 2. Quazite; Hubbell Incorporated, Power Systems.
 - 3. Martin Enterprises

- C. General Requirements for Polymer Concrete Handholes:
 - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-E and SCTE 77.
- D. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 2. Cover Legend: Molded lettering, "COMMUNICATIONS".
- F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- G. Handholes 24 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or fiberglass.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Oldcastle Infrastructure Inc.; CRH Americas.
 - 2. Quazite; Hubbell Incorporated, Power Systems.
 - 3. Martin Enterprises.
- C. General Requirements for Fiberglass Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-E and SCTE 77.
- D. Color of Frame and Cover: Gray or Green.
- E. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "COMMUNICATIONS".
- I. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- J. Handholes 24 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.07 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: RNC, Type EPC-40-PVC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- D. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. ANSI/BICSI N1-2019.
 - 3. TIA-569-E.
 - 4. NECA 101
 - 5. NECA 102.
 - 6. NECA 105.
 - 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- E. Install conduit in the most direct path possible. Strive to keep conduit parallel and perpendicular as depicted.
- F. The conduit system shall be continuous. (i.e. conduit, pull boxes, etc.) between the point of origin and the destination. Daisy chaining of conduit is not allowed under any variance or circumstance.
- G. Conduit runs shall be no longer than 100' between pull boxes.
- H. Pull boxes shall not be used as corners. Conduit and cable shall enter one side and exit opposite side.
- I. Pull boxes shall be sized to accept the planned number of conduits plus 2 additional conduits of the same size.
- J. Conduit system shall contain no bends greater than 90 degrees and no more than 180 degrees total bends in the aggregate.
- K. If a bend greater than 90 degrees is required the Contractor shall install an appropriately sized pull box within 3 feet of the bend.
- L. Flexible conduit shall not be used.

- M. All conduit bends shall be smooth and continuous. The conduit bend radius shall be at least 10 times the internal diameter of the conduit.
- N. "LB"s shall not be used.
- O. All conduits shall be reamed, swabbed, and dried prior to any cable installation.
- P. Cap or plug all conduits after drying to prevent water and debris entering conduit.
- Q. Install plastic or nylon pull cord/s within all installed conduit, leaving 10' of slack at each hand-hole or pull box.
- R. Metallic conduit shall be bonded to a ground on one or both ends in accordance with local and national codes.
- S. Complete pathway installation before starting conductor installation.
- T. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- U. Conduit shall stub above slab/grade minimum 4".
- V. Support conduit and pull boxes within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- W. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- X. Support conduit within 12 inches of enclosures to which attached.
- Y. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- Z. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- AA. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- BB. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- CC. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- DD. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- EE. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- FF. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- GG. All field cut conduit ends shall be properly reamed in accordance with industry best practices.
- HH. Install pull rope/tape in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

Secure pull rope/tape, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

- II. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
- JJ. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- KK. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified.
 - 2. Trench bottom shall be calculated so that topmost conduit edge is no less than 18" below finished grade.
 - 3. Install backfill as specified.
 - 4. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
 - 5. Duct banks with greater than 1 level shall have conduit spacers to maintain proper spacing and support per manufacturers requirements.
 - 6. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
 - 8. Warning tape with trace wire: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align tape along centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

- D. Install handholes with bottom below frost line, 24" depth of frost line below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut the wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 27 0528

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Surface pathways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
2. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- F. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Continuous HDPE: Comply with UL 651B.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

2.4 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
 - 1. Material: Aluminum with clear anodized finish.
 - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-B.
 - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal
 - 2. Type: Semi-adjustable.
 - 3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, round
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [cast aluminum] [galvanized, cast iron] with gasketed cover.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)
- J. Gangable boxes are prohibited.
- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic or fiberglass
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
 - 1. NEMA 250, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with TIA-569-B.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Standard: Comply with SCTE 77.
 - 2. Configuration: Designed for flush burial with **open** bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "COMMUNICATIONS."
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete
 - 1. Standard: Comply with SCTE 77.
 - 2. Color of Frame and Cover: Gray

3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "COMMUNICATIONS."

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC,].
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT
 2. Exposed, Not Subject to Severe Physical Damage: EMT
 3. Exposed and Subject to Severe Physical Damage: GRC.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT
 5. Damp or Wet Locations: GRC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway
 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use setscrew fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds [120 deg F (49 deg C)]

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum

pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- H. Stub-ups to Above Recessed Ceilings:
 - 1. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- K. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Spare Pathways: Install pull wires in empty pathways. Cap underground pathways designated as spare above grade alongside pathways in use.
- N. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
- O. Pathways for Optical-Fiber and Communications Cable: Install pathways as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements.
- P. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound.
- Q. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: [125 deg F (70 deg C)] temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: [155 deg F (86 deg C)] temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: [125 deg F (70 deg C)] > temperature change.
 - d. Attics: [135 deg F (75 deg C)] temperature change.
 - e. >.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Mount boxes at heights indicated on Drawings in accordance with ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- C. Install handholes with bottom below frost line, below grade.
- D. Field cut openings for conduits according to enclosure manufacturer's written instructions.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.

END OF SECTION 270528

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SECTION 27 1000 STRUCTURED CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.
- C. NFPA-70, National Electrical Code. (Check with the AHJ for the edition being used.)
- D. BICSI, Telecommunications Distribution Methods Manual, current edition.
- E. BICSI, Information Transport Systems Installation Methods Manual, current edition.
- F. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.
- G. Cherokee Nation Government Information Technology Network Construction Standards and Requirements Manual, current edition.

1.02 SUMMARY

- A. Section Includes:
 - 1. Backboards
 - 2. Backbone cabling
 - 3. Horizontal cabling
 - 4. Entrance protection
 - 5. Boxes, enclosures, and cabinets
 - 6. Power strips
 - 7. Uninterruptible power supply (UPS)
 - 8. 19-inch freestanding/wall mounted equipment cabinets/racks
 - 9. Ladder cable tray/wire mesh basket trays
- B. Related Requirements:
 - 1. Section 270500 "Common Work Results for Communications".
 - 2. Section 274116 "Integrated Audio-Video Equipment".
 - 3. Section 281300 "Access Control Systems".
 - 4. Section 282300 "Video Surveillance Systems".
 - 5. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.
 - 6. NFPA-70, National Electrical Code. (Check with the AHJ for the edition being used.)
 - 7. BICSI, Telecommunications Distribution Methods Manual, current edition.
 - 8. BICSI, Information Transport Systems Installation Methods Manual, current edition.
 - 9. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.
 - 10. CNIT GOVIT Network Construction Standards and Requirements Manual.
 - 11. If a conflict exists and cannot be remediated by the above referenced codes, standards, and the Cherokee Nation Information Technology Network Construction Standards and Requirements Manual, CNI GOVIT will have overall authority for the resolution.

1.03 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. CNGIT - Cherokee Nation Information Technology Government Network Group.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. F/FTP: Overall foil screened cable with foil screened twisted pair.

- G. F/UTP: Overall foil screened cable with unscreened twisted pair.
- H. IDC: Insulation displacement connector.
- I. Modular jack: Also commonly called an "outlet," it is the fixed, female connector.
- J. LAN: Local area network.
- K. MPTL: Modular Plug Terminated Link. Also commonly called a "plug" or "connector," it is the removable, male telecommunications connector. Formerly known as "direct connect."
- L. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- M. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the building's service equipment (power) ground (formerly known as the telecommunications main grounding busbar).
- N. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.
- O. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.
- P. RCDD: Registered Communications Distribution Designer.
- Q. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- R. SBB: Secondary bonding busbar. Formerly known as the telecommunications grounding busbar (TGB).
- S. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- T. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- U. S/FTP: Overall braid screened cable with foil screened twisted pair.
- V. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the Bonding Conductor for Telecommunications (BCT).
- W. TEBC: Telecommunications Equipment Bonding Conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.
- X. UTP: Unscreened/unshielded twisted pair.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. General Performance: Backbone and horizontal cabling system shall comply with transmission standards in TIA-568.1-E, when tested according to test procedures of this standard, and the requirements of TIA-568.4-D.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- D. Telecommunications Pathways and Spaces: Comply with TIA-569-E.
- E. Grounding: Comply with TIA-607-D.
- F. Backbone cabling subsystem description.

1. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
 2. Copper backbone cabling cross-connects may be in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of the copper backbone cabling.
 3. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
 4. Coaxial cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
 5. Backbone cabling cross-connects may be in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of the backbone cabling.
- G. Horizontal cabling subsystem description.
1. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 2. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 3. TIA-568.1-E requires that a minimum of two equipment outlets be installed for each work area.
 4. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 5. Bridged taps and splices shall not be installed in the horizontal cabling.
 6. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.
 7. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.05 ACTION SUBMITTALS

- A. Submit all applicable, current manufacturer certificate(s) showing Contractor is certified by the cabling manufacturer and can provide the necessary warranty required by the contract documents.
- B. Provide manufacturer cut sheets for each piece of equipment specified. Include the manufacturer name, model number and description of each listed component. If the data sheet includes multiple part numbers or models, the Contractor will indicate which model is being submitted by marking the appropriate model number with a cloud or box.
- C. Submit for approval, details of all materials, equipment, and systems to be furnished. Work shall not proceed without the Owner and/or the construction manager's approval of the submitted items. Digital copies in PDF format of the following shall be submitted:

1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly. Partial submittals will not be considered, reviewed, or stored, and such submittals will not be returned except at the request and expense of the Contractor.
- D. Any materials and equipment listed that are not in accordance with specification requirements may be rejected.
- E. The approval of material and equipment systems is a general approval subject to the Drawings, specifications, and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of errors. The Contractor shall carefully check and correct all documentation prior to submission for approval.
- F. Product data for the following:
 1. Backbone cabling.
 2. Horizontal cabling.
 3. Power strips.
 4. Uninterruptible power supply.
 5. 19-inch freestanding equipment racks/cabinets.
 6. Ladder cable tray/wire mesh basket tray.

1.06 INFORMATIONAL SUBMITTALS

- A. Structured Cabling System (SCS) sub-contractor is defined as an employer of workers trained and approved by the manufacturer.
- B. The sub-contractor will utilize the authorized manufacturer components and distribution channels in provisioning this project. Submit authorized manufacturer factory training certificates.
- C. Communications systems specified shall be installed under the direction of a qualified sub-contractor. Qualification requirements shall include submittal by the Contractor to the Owner of the following:
 1. List of previous projects (3) of this scope, size, and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
 2. Shall provide current certificates that they are manufacturer-authorized for work to be performed and able to offer an extended manufacturer's warranty for work performed in the state where the Work is being performed.
 3. Sub-contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD) and provide a certificate showing their current registration.
 4. Qualification Data: Current certificates from the manufacturer for installer, installation supervisor, and field inspector.
- D. As-Built Data: Plans showing as-built locations of structured cabling infrastructure and pathways, including the following:
 1. Main cable routing from each telecommunications room.
 2. Network outlet locations, to include wireless access points, Access Control and Video Surveillance devices, and surveillance cameras.
 3. Rack elevations of equipment racks/cabinets.
 4. Plan views of each telecommunications room.
 5. Location of each firestop system penetration.
- E. Source quality-control reports.
- F. Product Certificates: For each type of product.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For voice/data and cabling to include in operation, and maintenance manuals. Requirements of this section shall be provided in addition to items specified by other specification sections.
- B. Closeout submittals will be submitted under this section with the following provisions.
 - 1. Maintenance Data: Include manufacturer's operating instructions, original copies of all software, recommended maintenance required and maintenance intervals.
 - 2. A complete part list.
 - 3. Record Drawings shall show the following:
 - a. Update the original submittals of the floor plans. Relocate any device that may have been moved or altered during the life span of the project. Devices shall include all cable pathways, outlets and other devices included in the telecommunications system.
 - b. Each device shall be labeled as per the direction of the Owner representative.
 - c. Update the line diagram Drawings provided during the submittal phase that indicated device locations back to the MDF/IDF. This will include any changes to the port locations, quantities, or locations, etc.
 - d. Title blocks used on all Drawings will be that of the Contractor and shall include the following:
 - 1) Company name
 - 2) Company address and phone number for service
 - 3) Date on the Drawings will match the date of acceptance for warranty purposes.
 - 4) Do not use the A/E title block, copyright date, signature, or seals for any reason.
 - 4. Drawing documentation will be in the following format:
 - a. One (1) copy transmitted to the General Contractor through their approved transmittal process.
 - 1) Drawings will be in both CAD (DWG) and PDF format, and the sub-contractor will include all files on each drive.
 - 2) Provide all PDF Drawings in black and white.
 - 3) One "E" size laminated drawing mounted to the wall in each Distributor Room, A, B, C or D.
 - 5. Drawings shall be provided to the A/E for review and acceptance prior to the Owner's final acceptance of the project.
 - a. The Drawings will be reviewed with the A/E and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.
- C. Completed record drawing will be required for use during the final acceptance process of the construction project. Failure to produce the record drawing during this process will result in a delay in the final acceptance to the project.
- D. Passing test results for every copper cable/conductor and every fiber strand which was furnished as part of the product. Tested items marked with an (*) shall not be acceptable.
- E. Testing equipment utilized for all cable testing shall be calibrated within the past 12 months by the manufacturer and have the latest version of software installed.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Adapters/cassettes/connecting blocks/: One of each type.
 - 2. Faceplates: One of each type.
 - 3. Jacks: Ten of each type.
 - 4. Multiuser Telecommunications Outlet Assemblies: One of each type.
 - 5. Patch-Panel Units: One of each type.
 - 6. Plugs: Ten of each type.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of cabling administration drawings, and field-testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a Certified Technician or Level 2 Installer, who shall always be present when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
 - 4. Firestopping: Installer shall be certified by the fire stop system manufacturer.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each strand on the reel before installation and compare it to factory test results.
 - 2. Test each pair of twisted pair cable for open and short circuits.
 - 3. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
- B. Return and do not install damaged materials from the site.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry.
- B. Field Measurements and Conditions: In addition to the provisions of the Conditions of the Contract, verify dimensions and obtain field measurements prior to producing shop Drawings and ordering products. Verify field conditions and conditions of adjoining Work before proceeding with Work specified in this Section.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.13 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Contractor shall provide a 25-year manufacturer's warranty on all copper and fiber links and/or channels.
 - 2. Manufacturer's warranty shall meet the following criteria:
 - a. A 25-year guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
 - b. This warranty will cover all registered channels.
 - 1) This warranty may be invoked only if entire channel links are comprised of continuous manufacturer components and cable, including patch cords.
 - c. The telecommunications Contractor will correct any problems and malfunctions that are warranty-related issues without charge for the entire warranty period.
 - d. If the manufacturer warranty is needed by the Owner within the warranted period and the original installer is no longer in business, manufacturer shall find a substitute manufacturer certified contractor and assume costs to fulfill the obligations of the warranty.
 - e. Upon acceptance of the warranty paperwork and test results from the Contractor, the manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to the Owner.
 - f. The warranty period shall commence following the final acceptance of the project by the Owner and written confirmation of warranty from the manufacturer.
- B. Testing and Inspection of Communications Equipment
 - 1. Provide tests specified below, in accordance with:

2. TIA-568.2-D and TIA-568.2-D-2 for copper cabling when applicable under individual items of material, equipment, and Work specified in this Specification.
3. TIA-568.3-D and TIA-568.3-D-1 for fiber optic cabling when applicable under individual items of material, equipment, and Work specified in this Specification.
 - a. Furnish all test equipment and instruments required for the tests.
 - b. Responsible, qualified employees of the Contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
- C. Perform end-to-end tests of all permanent links.

PART 2 PRODUCTS

2.01 BACKBOARDS

- A. Backboards: Plywood, A/C rated, fire-retardant treated, 3/4 by 48 by 96 inches.
- B. Provide and install a minimum of one (1) sheet, or as depicted on T Series Drawings, whichever is greater.
- C. Backboard Paint: Fire retardant, pre-painted to match wall paint color.
- D. Paint plywood on all six sides. Fire rating stamps shall be taped off during painting and removed so that stamp remains visible for inspection.
- E. Plywood to be mounted with bottom edge no lower than (NLT) 6" AFF when mounted Vertically and NLT 36" if mounted Horizontally.

2.02 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 1. Communications Plenum Rated: Type CMP complying with UL 1685.
 2. Communications Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
 3. Communications, Non-plenum: Type CMR complying with UL 1666.
 4. Communications Non-plenum: Type CMP or Type CMR in listed plenum or riser communications raceway.
 5. Communications Non-plenum: Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

2.03 COPPER BACKBONE CABLING

- A. Manufacturers: Subject to compliance with requirements, provide materials by the following:
 1. Panduit: Category 6A, 4-pair, UTP or CAT5E 25PR UTP, as noted on T Series Drawings.
 2. Refer to Appendix A for current part number.

2.04 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Panduit
 2. Refer to Appendix A for current part numbers.
- C. General Requirements for Cable Connecting Hardware:
 1. Twisted pair cable hardware shall meet the performance requirements of Category 6A.

- a. Wiring pinout scheme shall be T568B.
- 2. Comply with TIA-568.2-D, IDC type, with modules designed for punch-down caps or tools.
- 3. Cables shall be terminated with connecting hardware of the same category or higher.
- 4. Source Limitations: Obtain twisted pair cable hardware from sole source from single manufacturer or from same manufacturer as twisted pair cable, from sole source.
- D. Connecting Blocks: 110-style IDC for Category 6A. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- G. Plugs and Plug Assemblies:
 - 1. Male; eight position eight conductor; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568.2-D.
 - 3. Marked to indicate transmission performance.
- H. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standard: Comply with TIA-568.2-D.
 - 4. Marked to indicate transmission performance.
- I. Patch Cords: Factory-made, four-pair cables; terminated with an eight-position modular plug at each end.
 - 1. 7' patch cords for floor mounted racks.
 - 2. 2' patch cords for wall mounted cabinets.
 - 3. Provide patch cords with bend-relief-compliant boots to ensure Category 6A performance.
 - 4. Provide patch cords with latch guards to protect against snagging.
 - 5. Provide patch cords with color-coded boots for circuit identification.
- J. Faceplates:
 - 1. Two, Four, or Six port, vertical single gang faceplates with windows and clear plastic covers designed to mount to single gang wall boxes.
 - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 4. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work-area cords.
 - a. Flush-mount jacks, positioning the cord at a 90-degree angle.
- K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.05 FIBER OPTIC BACKBONE CABLING

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Panduit or approved equivalent.

2.06 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

- A. Description: Single mode, fiber optic distribution cable, 9/125-micrometer, 12 or 96 fibers, tight buffered, armored optical fiber cable. See Appendix A for current part number.
 1. Refer to Appendix A for current part numbers.
- B. Standards:
 1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568.3-D for performance specifications.
 3. Comply with ICEA S-104-696 for mechanical properties.
- C. Armored cable shall be aluminum armored type.
- D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- E. Jacket:
 1. Jacket Color: Yellow.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 1. Riser Rated, armored (Conductive): Type OFCR or Type OFCP; complying with UL 1666.

2.07 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Panduit
 1. Refer to Appendix A for current part numbers.

2.08 COPPER HORIZONTAL CABLING

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 1. TIA-568.1-E requires that a minimum of two equipment outlets be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.09 CATEGORY 6A TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of:
 1. Category 6A cable at frequencies up to 500MHz.
- B. Manufacturers: Panduit.
 1. Refer to Appendix A for current part numbers.

- C. Standard: Comply with TIA-568.2-D for Category 6A cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pair (UTP).
- F. Cable Rating: Plenum.
- G. Jacket:
 - 1. Network/work area outlets: Blue thermoplastic.
 - 2. Above ceiling devices (cameras, waps, etc): Blue thermoplastic.
 - 3. TV: Blue thermoplastic.

2.10 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect and terminate twisted pair copper communications cable.
 - 1. Refer to Appendix A for current part numbers.
- B. Manufacturers: Panduit
- C. Connecting Blocks:
 - 1. 110-style IDC for Category 6A.
- D. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inchequipment racks.
 - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- G. Patch Cords: Factory-made, four-pair cables in 84-inch lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots to ensure performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall be color-coded for circuit identification:
 - a. Network – Blue
 - b. Security – Yellow
 - c. AV – Violet
 - d. Special – Black
- H. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568.2-D.
 - 3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - a. Network – Blue
 - b. Security – Yellow
 - c. AV – Blue

- d. Special – Blue
- 2. Designed to snap-in to a patch panel or faceplate.
- 3. Standard: Comply with TIA-568.2-D.
- 4. Marked to indicate transmission performance.
- J. Faceplate:
 - 1. Two, Four, or Six port, vertical single gang faceplates designed to mount to single gang wall boxes.
 - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 4. For use with snap-in jacks accommodating any combination of twisted pair and optical fiber work area cords.
 - a. Flush mounting jacks, positioning the cord at a 90-degree angle.
- K. Legend:
 - 1. Machine printed, in the field, using adhesive-tape label.
 - 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.11 POWER DISTRIBUTION UNITS AND TRANSFER SWITCHES

- A. Comply with requirements in Section 270500 "Common Work Results for Communications".
- B. Power Strips: Comply with UL 1363.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rack mounting, with detachable or integral flanges.
 - 3. Height: 1 RU.
 - 4. Housing: Metal.
 - 5. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
 - 6. 10' Power cord with L5-20P.
 - 7. LED indicator lights for power and protection status.
 - 8. LED indicator lights for reverse polarity and open outlet ground.
 - 9. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 10. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 - 11. Close-coupled, direct plug-in line cord.
 - 12. Rocker-type on-off switch illuminated when in on position.
 - 13. Surge Protection: UL 1449, Type 3.
 - a. Maximum Surge Current, Line to Neutral: 27 kA.
 - b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
 - c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and 500 V for neutral to ground.

2.12 UNINTERRUPTIBLE POWER SUPPLY

- A. Comply with requirements in Section 270500 "Common Work Results for Communications".
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. APC.
- C. UPS: Verify rack load with Owner for properly sized supply.
 - 1. Rack mounted.
 - 2. Height: 2RU or 3RU.
 - 3. Housing: Metal.
 - 4. NEMA input connection: will depend on the battery size.
 - 5. Rear-facing receptacles.

6. 120V nominal output voltage.
7. 50/60Hz output frequency.
8. Output connections:
 - a. Six (6) NEMA 5-15R, battery backup.
 - b. Two (2) NEMA 5-20R, battery backup.

2.13 19-INCH EQUIPMENT RACKS

- A. Description: Two and four-post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Panduit
 2. See Appendix A for current part numbers.
- C. General Requirements:
 1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Material: Aluminum.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
 4. Color: Black.
- D. Floor-Mounted Racks:
 1. Overall Height: 84 inches.
 2. Overall Depth: 23 inches.
 3. Upright Depth: 3 inches
 4. Two-Post Load Rating: 400 lb.
 5. Four-Post Load Rating: 1000 lb.
 6. Number of Rack Units per Rack: 45.
 - a. Numbering: Every rack unit, on interior of rack.
 7. Threads: 12-24.
 8. Vertical and horizontal cable management channels, top and bottom cable troughs, and grounding studs.
 9. Base shall have a minimum of four mounting holes for permanent attachment to floor.
 10. Top shall have provisions for attaching to cable tray or ceiling.
 11. Self-leveling.
- E. Cable Management:
 1. Vertical cable manager.
 2. Horizontal cable manager.
 3. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
 4. Refer to Appendix A for current part numbers.

2.14 LADDER CABLE TRAY

- A. Manufacturer: Chatsworth Products, Inc.
 1. Universal cable runway: Refer to Appendix A for current part numbers.
 2. Provide accessories per manufacturer's instructions.

PART 3 EXECUTION

3.01 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

- B. Comply with requirements in Section 270500 "Common Work Results for Communications Systems" for materials and installation requirements for underground, buried or aerial pathways.

3.02 INSTALLATION PRACTICES

- A. Comply with NECA 1, NECA 301, and ANSI/BICSI NI-19.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Coordinate layout and installation of communications equipment in racks and in room. Coordinate service entrance configuration with service provider. Coordinate electrical requirements for UPS with the Electrical Consultant.
 - 1. Comply with TIA-568.1-E, TIA-568.2-D and TIA-568.3-D.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
 - 4. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 - 5. Record agreements reached in meetings and distribute them to other participants.
 - 6. Adjustments to locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment requires approval from the Architect.
 - 7. Adjustments to configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room requires approval from the Architect.
 - 8. Install 110-style IDC termination hardware unless otherwise indicated.
 - 9. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
 - 10. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 11. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 12. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 13. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section Use lacing bars and distribution spools.
 - 14. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 15. Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.
 - 16. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- E. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

- F. Installation of Cable Routed Exposed under Raised Floors:
 - 1. Install plenum-rated cable only.
 - 2. Install cabling after the flooring system has been installed in raised floor areas.
 - 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
 - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-E for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
- I. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.
- J. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- K. Backboards:
 - 1. Install from 6 inches to 8 feet, 6 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
 - 2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
 - 3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA- 569-E.

3.03 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in equipment rooms for compliance with color-coding for pin assignments and inspect copper cabling connections for compliance with TIA-568.1-E.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and patch cords, and labeling of all components.
 - 3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - 4. Provide testing with Fluke Networks instruments that have the latest edition of software installed and that have been calibrated by the manufacturer within the last 12 months.
 - 5. Copper Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568.2-D. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in

- "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturers for channel or link test configuration.
- b. Fluke tests results shall be sent to the manufacturer for warranty purposes.
6. Optical Fiber Cable Tests:
- a. Test instruments shall meet or exceed applicable requirements in TIA-568.1-E. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturers for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 db. Attenuation test results shall be less than those calculated according to equation in TIA-568.1-E.
- B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
 - C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
 - D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.04 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**
- A. Comply with requirements in Section 270500 "Common Work Results for Communications."
- 3.05 FIRESTOPPING**
- A. Comply with requirements in Section 078400 "Penetration Firestopping."
 - B. Comply with TIA-569-E, Annex A, "Firestopping."
 - C. "Firestopping Practices" chapter.
- 3.06 IDENTIFICATION**
- A. Comply with requirements in Section 270500 "Common Work Results for Communications Systems".

END OF SECTION

Appendix A – Materials List

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
	PUP6AHD04BU-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, Blue color
	PUP6AHD04WH-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, White color
	PUP6AHD04OR-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, Orange color
	PUR6AV04BU-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Blue color
	PUR6AV04WH-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, White color
	PUR6AV04OR-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Orange color
	CJ6X88TGBU	Panduit	Cat 6A RJ45 jack, blue color
	CJ6X88TGOR	Panduit	Cat 6A RJ45 jack, orange color
	CJ6X88TGIW	Panduit	Cat 6A RJ45 jack, off white color
	CJ6X88TGYL	Panduit	Cat 6A RJ45 jack, yellow color
	CJ6X88TGBU-24	Panduit	Cat 6A RJ45 jack, blue color, 24 pack
	CJ6X88TGOR-24	Panduit	Cat 6A RJ45 jack, orange color, 24 pack
	CJ6X88TGIW-24	Panduit	Cat 6A RJ45 jack, off white color, 24 pack
	CJ6X88TGYL-24	Panduit	Cat 6A RJ45 jack, yellow color, 24 pack
	FP6X88MTG	Panduit	Cat 6A RJ45 plug, TG field terminable
	UTP6AX7BU	Panduit	Cat 6A UTP patch cord, 7 ft, Blue color
	UTP28X10BU	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Blue color
	UTP6AX7WH	Panduit	Cat 6A UTP patch cord, 7 ft, Off White color
	UTP28X10WH	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Off White
	UTP6AX7YL	Panduit	Cat 6A UTP patch cord, 7 ft, Yellow color
	UTP6AX20YL	Panduit	Cat 6A UTP patch cord, 20 ft, Yellow color
	UTP28X10YL	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Yellow
	UTP28X10OR	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Orange
	PFO6X04BL-CEG	Panduit	Shielded F/UTP Cable, Cat 6A, OSP, Black color
	8136100	General	Shielded F/UTP Cable, Cat 6A, OSP, Black color
	CFPL2IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 2 Mini-Com modules, off white color

Product Category	Part Number	Manufacturer	Part Description
	CFPL3IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 3 Mini-Com modules, off white color
	CFPL4IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 4 Mini-Com modules, off white color
	CFP1IW	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 1 Mini-Com modules, off white color
	CMBIW-X	Panduit	Mini-Com blank module
	CBIW	Panduit	Single gang faceplate frame accepts two 1/2 size module inserts or three 1/3 size module inserts.
	CHS2IW-X	Panduit	Two module space, 1/2 size, sloped insert accepts two Mini-Com modules
	CHB2IW-X	Panduit	1/2 Blank Insert
	KWPY	Panduit	Stainless steel phone plate
	Vendor specific	Panduit	Mini-Com Snap -On Modular furniture faceplates
	CBXQ2IW-A	Panduit	Surface Mount Box with label, accepts up to 2 Mini-Com modules, Off White color
	CBXQ4IW-A	Panduit	Surface Mount Box with label, accepts up to 4 Mini-Com modules, Off White Color
	CBXQ6IW-A	Panduit	Surface Mount Box with label, accepts up to 6 Mini-Com modules, Off White Color
	CPPL24WBL Y	Panduit	Mini-Com Patch Panel, Flat, 1 RU, 24 ports
	CPPL48WBL Y	Panduit	Mini-Com Patch Panel, Flat, 2 RU, 48 ports
	CPPLA24WBL Y	Panduit	Mini-Com Patch Panel, Angled, 1 RU, 24 ports
	CPPLA48WBL Y	Panduit	Mini-Com Patch Panel, Angled, 2 RU, 48 ports
	SRB19DSBL	Panduit	19" Deep Strain Relief Bar
For switch mapping	CPP48FMVNSWBL Y	Panduit	48-Port, 2 RU Patch Panel with Vertical Numbering
For switch mapping	UTP28SP8INBU	Panduit	Category 6A Performance, 28AWG, UTP Patch Cord, CM/LSZH, Blue, 8in
Fiber Cabling Products			
	FODPZ**Y	Panduit	Fiber Distribution Cable, OM4, Plenum, **=fibers
	FOPPZ24Y	Panduit	Fiber Interlocking Armor Cable, OM4, P, **=fibers
	FSDP9**Y	Panduit	Fiber Distribution Cable, OS2, Plenum, **=fibers
	FSPP9**Y	Panduit	Fiber Interlocking Armor Cable, OS2, P, **=fibers

Product Category	Part Number	Manufacturer	Part Description
	FLCSMCXAQY	Panduit	LC OptiCam® OM3/OM4 50/125µm MM simplex connector, aqua
	FLCSSCBUY	Panduit	LC OptiCam® SM, 9um, simplex connector, blue
	FAP6WAQDLC FAP12WAQDLC	Panduit	Opticom® OM3/4 LC Fiber adapter panels, 6 & 12 ports
	FAP6WBUDLCZ FAP12WBUDLCZ	Panduit	Opticom® OS2 LC Fiber adapter panels, 6 & 12 ports
	FZ2ERQ1Q1SNM***	Panduit	OM4, LC push pull to LC push pull patch cord, 16mm jacket, riser (OFNR) rated, Standard IL; ***=length in meters
	FCE1U, FCE2U, FCE4U	Panduit	Opticom® Rack Mount Fiber Enclosure, 1,2, or 4 RU; Holds up to 4/8/12 FAPs
	FLEX1U06, FLEX2U06, FLEX4U06	Panduit	HD Flex Fiber Enclosure, 1 RU, 2 RU & 4 RU
	FHSXO-12-10P, FHSZO-12-10P, FHS9N-12-10P	Panduit	HD Flex Fiber Splice Cassette with 12-pigtails, OM3, OM4 & SM
Racks, Cabinets and Cable Management			
	R2PS	Panduit	2-Post Steel Rack
	R4P	Panduit	4-Post Steel Rack
	4220W	Dell	4-Post Rack Enclosure
	PR2VD06 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 6" wide, 7 ft, Black with door(s)
	PR2VD08 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 8" wide, 7 ft, Black with door(s)
	PR2VD10 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 10" wide, 7 ft, Black with door(s)
	PR2VD12 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 12" wide, 7 ft, Black with door(s)
	PR2VEP	Panduit	PatchRunner 2 End Panel
	NM1 (Dual-sided)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 1RU, Black
	NM2 (Dual-sided)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 2RU, Black

Product Category	Part Number	Manufacturer	Part Description
	XG64222BS0004	Panduit	FlexFusion Cabinet, 600mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
	XG74222BS0004	Panduit	FlexFusion Cabinet, 700mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
	XG84222BS0004	Panduit	FlexFusion Cabinet, 800mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
Bonding and Grounding			
	RBRB19U	Panduit	Grounding busbar for threaded rails
	RGRB19CN	Panduit	Grounding busbar for cage nut mounting rails
	GB2B0312TPI-1	Panduit	Secondary Bonding Busbar, 1/4" by 2" by 12" (SBB)
	RGCBNJ660P22	Panduit	Rack bonding conductor (CBN jumper)
	GB4N0007TPI-1	Panduit	Primary Bonding Busbar, 1/4" by 4" by 12" (PBB)
	GPQC**-1/0	Panduit	Access Floor Grounding Clamps; ** = size
	RGESD2-1	Panduit	Electrostatic Discharge port kit for #12-24 tapped holes
	RGESD2B-1	Panduit	Electrostatic Discharge port kit for cage nut mounting rails
	REGESDWS	Panduit	Electrostatic Discharge protection wrist strap
	RGTBSG-C	Panduit	Green thread-forming bonding screw, #12-24 x 1/2", 100 pack
	CNBK	Panduit	Green bonding cage nut, #12-24 bonding cage nuts, 50 pack
	ACG24K	Panduit	Armored Fiber Bonding Kit
Fire Barriers			
	EZDP44	Specified Technologies (STI)	Fire Barrier CBL Pathway Single EZ Path W/WPLT Series 44

Product Category	Part Number	Manufacturer	Part Description
J-Hooks			
	JP75 Series	Panduit	J-Pro Cable Support System, .75"
	JP131 Series	Panduit	J-Pro Cable Support System, 1.3"
	JP2 Series	Panduit	J-Pro Cable Support System, 2"
	JP4 Series	Panduit	J-Pro Cable Support System, 4"
Above Floor Raceway			
	AFR4BCBL6	Panduit	Above Floor Raceway – 6 Foot Base and Cover, Black color
	AFR4CCBL	Panduit	Above Floor Raceway, Coupler Fitting, Black color
	AFR4TRT70BL	Panduit	Above Floor Raceway, Transition to T70 Fitting. Black color
	AFR4RABL	Panduit	Above Floor Raceway, Right Angle Fitting, Black color
	AFR4ECBL	Panduit	Above Floor Raceway, End Cap Fitting, Black color
	AFR4JB2SBL	Panduit	Above Floor Raceway, Junction Box, Black color
Other Cabling Accessories			
	HLS-15R0	Panduit	Tak-Ty® hook & loop strip roll, 15' length, .75 width, nylon loop, polyethylene hook, black.
	HLS-75R0	Panduit	Tak-Ty® hook & loop strip roll, 75' length, .75 width, nylon loop, polyethylene hook, black.
	TTR-35RX0	Panduit	Tak-Tape® Hook and Loop 35' Rolls, 10 Roll-pack, black.
	PSL-DCJB-C	Panduit	RJ45 Jack Block out Device, 100 block-outs (red) and 5 removal tools (black), polycarbonate.
	PSL-DCPL-C	Panduit	RJ45 Plug Lock-In Device, 100 devices (red) and 5 installation/removal tool (black), polycarbonate.
	PSL-USBA	Panduit	USB type A block-out device, 5 devices (red) and 1 removal tool (black), polycarbonate.
Ladder Rack Pathway			

Product Category	Part Number	Manufacturer	Part Description
	10250-724	Chatsworth	Universal cable runway, Black – 24-Inch-Wide Reference
	11301-702	Chatsworth	Butt Splice Kit, 2" Stringer, Black Reference
	10724-724	Chatsworth	Cable runway radius bend – 24inch Wide Reference
	11309-701	Chatsworth	Foot kit, cable runway Reference
	11421-724	Chatsworth	Wall angle support kit, cable runway – 24inch Wide Reference
	31470-712	Chatsworth	Cable runway standoff support kit Reference
	10506-702	Chatsworth	Cable runway elevation kit Reference
	11302-701	Chatsworth	Junction-splice kit Reference
	10723-724	Chatsworth	Cable runway radius bend Reference
	11959-724	Chatsworth	Corner Bracket 24-inch Radius, Reference
	11746-724	Chatsworth	Triangular Supports Bracket, steel Reference
	11310-003	Chatsworth	Threaded Ceiling Kit, Cable Runway
	11421-712	Chatsworth	Wall Angle Support Kit, Cable Runway
	10250-712	Chatsworth	Universal Cable Runway – 12 inch wide
	10723-712	Chatsworth	Cable Runway Radius Bend 90-Degree Outside Bend – 12 inch Wide
	10724-712	Chatsworth	Cable Runway Radius Bend 90-Degree Inside Bend – 12 inch Wide
	11301-702	Chatsworth	Butt-Splice Kit
	11298-701	Chatsworth	Heavy Duty Junction-Splice Kit
	10642-001	Chatsworth	Protective End Caps for Runway
	10622-010	Chatsworth	Standard Busbar 4"Wx1/4"Hx10"L
	40164-001	Chatsworth	#6AWG Ground Strap
	10250-718	Chatsworth	Universal Cable Runway
	10723-718	Chatsworth	Cable Runway Radius Bend 90 degree Outside Bend
	10724-718	Chatsworth	Cable Runway Radius Bend 90 degree Inside Bend
	11421-718	Chatsworth	Wall Angle Support Kit, Cable Runway
	11304-000	Chatsworth	Chatsworth J-bolt Kit

Product Category	Part Number	Manufacturer	Part Description
	11301-001	Chatsworth	Butt-Splice Kit
	10506-706	Chatsworth	Cable Runway Elevation Kit 6"
	11201-701	Chatsworth	Cable Runway Radius Drop Stringer
	12100-718	Chatsworth	Cable Runway Radius Drop Cross Member
Basket Tray Pathway	Equivalents will be accepted.		
	CF 54/300	Cablofil	2" deep, 12" wide, 10' stick
	CF 54/450	Cablofil	2" deep, 18" wide, 10' stick
	CF 54/600	Cablofil	2" deep, 24" wide, 10' stick
	CF 105/300	Cablofil	4" deep, 12" wide, 10' stick
	CF 105/450	Cablofil	4" deep, 18" wide, 10' stick
	CF 105/600	Cablofil	4" deep, 24" wide, 10' stick
	FAS P	Cablofil	Trapeze
	AS	Cablofil	Trapeze Clips
	CS	Cablofil	L Bracket
	CRP	Cablofil	Universal Wall Bracket
	ED 275	Cablofil	Universal Splice Bar
	SWK	Cablofil	¼ Hardware Bolts
	EZT 90 KIT	Cablofil	Hardware for 90's

<END OF APPENDIX A>

SECTION 27 4116 INTEGRATED AUDIO VISUAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.
- C. Contractor responsible for coordinating all conduit, cable pathways and final power requirements.

1.02 SUMMARY

- A. Section Includes
 - 1. Integrated Audio-Video Equipment Hardware
 - 2. Configuration Software
 - 3. Control Interfaces
 - 4. Power Supplies
 - 5. Projection Screens
 - 6. Television Displays
- B. Related Requirements
 - 1. Section 26 0100 Electrical Special Provisions
 - 2. Section 26 0533 Raceways and Boxes
 - 3. Section 26 2726 Wiring Devices
 - 4. Section 27 0500 Common Work Results for Communications
 - 5. Section 27 1000 Structured Cabling

1.03 DEFINITIONS

- A. AVIXA: Trade association representing the professional audiovisual and information communications industries worldwide.
- B. CTS: Certified Technology Specialist
- C. EMI: Electromagnetic interference.
- D. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the buildings service equipment (power) ground (formerly known as the telecommunications main grounding busbar).
- E. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.
- F. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.
- G. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- H. SBB: Secondary bonding busbar. Formerly known as the telecommunications grounding busbar (SBB).
- I. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- J. S/FTP: Overall braid screened cable with foil screened twisted pair.
- K. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- L. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.

- M. TEBC: Telecommunications equipment bonding conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

1.04 SUBMITTALS

- A. Successful Contractor will submit a single electronic PDF copy of the submittal package within 20 days of written notification to proceed or other written documentation from the Architect or General Contractor. Documents will be organized into the following sections:
- B. General
 - 1. Provide submittals in accordance with Owner's approved construction schedule. Submittals shall consist of a cover page, table of contents (TOC), product data, prequalification certificate, shop drawings and warranty documents.
 - 2. Partial submittals shall not be acceptable without prior approval by Owner.
 - 3. The contract shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.
 - 4. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for each and every part of the system.
 - 5. No portion of the work shall commence, or equipment ordered until the Owner has approved the submittals.
 - 6. All work to be performed in accordance with approved submittals.
 - 7. Submit a detailed completion schedule with the submittals.
 - 8. Provide submittals in accordance with Division 1 requirements and Owners approved construction schedule.
 - 9. Submittals shall not be combined with additional scope awarded.
- C. Pre-Installation Submittals: Contractor shall supply the following for review within 20 business days of contract award.
 - 1. Configuration file for audio digital signal processors (DSP), drafted in DSP manufacturer's provided software.
 - 2. Processor power required of DSP shall not exceed 95% total processing capacity.
 - a. If processing power required exceeds available processing power, Contractor shall immediately notify Owner during pre-installation phase.
 - 3. Copy of manufacturer configuration software, or link to manufacturer website download page for accessing configuration software.
 - a. Version: Submitted software shall be identical version used to create DSP configuration.
 - 4. Layouts of physical and virtual user controls in graphical format. This shall include:
 - a. Engraved buttons and overlays
 - b. Machine-printed adhesive labels
 - c. Graphical user interfaces for touch panels or web interfaces.
- D. Submittal Requirements
 - 1. Cover Page and Section 1 — Information, Pricing and Material
 - a. Cover sheet containing the Company Name and/or logo, Title of submittal package, client name, and Contractor work address with a point of contact (POC) and phone number.
 - 2. Table of Contents (TOC)
 - a. Listing, in order, of all submittal documents.
 - 3. Section 2 — Product Data
 - a. Manufacturer's catalog information showing dimensions, colors, and configurations.

- b. Submittals will include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for each item listed in the specifications and the bill of materials.
 - c. In cases of multiple product numbers on a single cut sheet, the Contractor will identify the proper part number with an arrow, check mark or highlight.
- 4. Section 3 – Pre-Qualification Certificate
 - a. Contractor will submit the following documents with project proposal:
 - 1) A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
 - 2) Training certificates for design, engineering and installation of the proposed products.
- 5. Section 4 – Warranty Documentation
 - a. Warranty will be for one year from final acceptance of the final product.
 - b. Complete documentation regarding the manufacturer's warranty will be submitted as part of the proposal. This will include, but is not limited to, a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
- 6. Section 5 – Record Drawings
 - a. Contractor shall provide record drawings for the submittal package that will be used throughout the inspection process and into substantial completion / final acceptance. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings. Use of any part of the Architect title block is not acceptable at any time.
 - b. The drawings shall include the following information:
 - 1) All shown drop locations shall be labeled in accordance with the specifications.
 - 2) Provide the audio-visual equipment rack elevation details demonstrating the locations of the equipment, power raceways and thermal management.
 - 3) All overhead rigging and installation details.
 - 4) Required wood blocking details with dimensions.
- 7. Any and all changes to the scope of work during the project shall be included in the drawings upon completion of system(s) installation and will be used as part of the substantial completion process. Reference the section on close out documentation for additional information on the substantial completion process.
- E. The Contractor shall provide all materials, equipment, labor and all other incidental materials and appliances necessary, as described herein and in the drawings, to provide complete turn-key and functional systems, regardless of any materials and/or equipment not listed or described in this specification and/or supplementary drawings.
- F. Contractor shall provide system optimization services and shall complete an internal system commissioning. A commissioning plan shall be submitted in writing to the Owner and or Owner's representative for approval. Notify the Owner and or Owner's representative two weeks prior to the start of commissioning to allow for Owner representation to be present during all testing and commissioning. Final testing and commissioning shall be completed by Owner's representative.
- G. General elements of the work shall consist of but not limited to following major items:
 - 1. Submittal preparation and processing.
 - 2. Any deviation from the manufacturer's installation instructions shall be requested prior to the work being done.
 - 3. Any unapproved deviations will be corrected at the installer's sole expense
 - 4. Procure all permits and licenses required to complete this installation.
 - 5. Attend job construction and progress meetings.
 - 6. Provide audio-visual cabling according to the correct application and environment(s).
 - 7. Verify conditions and dimensions at the job site prior to installation.
 - 8. Perform initial testing, programming and adjustments with written reports.

9. Preparation of Operational and Maintenance manuals and Project Record (as-built) documents.
10. Providing training for Owner.
11. Providing warranty service.
12. Remove all job specific created debris to approved collection points.

1.05 REFERENCES

- A. Specifications, Standards and Codes: All work shall be in accordance with the current editions of the following:
 1. AVIXA Rack Building for Audiovisual System 2019
 2. AVIXA Cable Labeling for Audiovisual Systems
 3. ANSI T1.404 (DS3) and CATV Applications.
 4. ANSI S4.48-1992
 5. ANSI X3T9.5 TPPMD.
 6. American Society of Testing and Materials (ASTM).
 7. TIA (Telecommunications Industries Association &
 8. EIA (Electronic Industries Alliance)
 9. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual.
 10. Federal Communications Systems (FCC).
 11. Institute of Electrical and Electronics Engineers (IEEE).
 12. National Electrical Code (NEC) (Latest revision and pertinent addendums).
 13. National Electrical Manufacturer's Association (NEMA).
 14. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums).
 15. "Basic Principles for suspended Loudspeaker Systems", Technical Notes Volume 1, Number 19, JBL Professional or latest edition.
 16. "Handbook for Riggers" 1977 Revised Edition, Newberry, W.G., Calgary, Alberta Canada.
 17. Underwriters Laboratory (UL)
 18. Americans with Disabilities Act (ADA)
 19. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document with the exception of the ADA, NFPA and NEC publications.

1.06 IT COORDINATION

- A. Where connection between components or control features are accomplished over the Owner's LAN, Contractor shall coordinate with the Owners IT department for IP addresses, firewall access, and other issues pertaining to successful integration.

1.07 GENERAL REQUIREMENTS

- A. This section covers the general requirements for the installation of the Integrated Audio-Video system by the Contractor.
 1. In the installation of this work, the Contractor shall comply in every way with the requirements of Owner's standards, local and state laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. If, in the opinion of the Contractor, there is anything in the plans or specifications that will not strictly comply with the above laws, ordinances, and rules, the matter shall be referred to the attention of customer's representatives for a decision before proceeding with that part of the work. No change in the plans or in the Specifications shall be made without full consent in writing by the Owner's representative's engineer.
 2. The Contractor shall obtain the customer's permission before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors, partition ceilings.
 3. The Contractor shall be responsible for and repair all damage to building due to carelessness of workers, and exercise reasonable care to avoid any damage to customer property.

- The Contractor will report to the customer representatives any damage to the building which may exist or may occur during the occupancy of the quarters.
4. Contractor shall provide components, wire, connectors, materials, parts, equipment and labor necessary for the complete installation of the system, in full accordance with the recommendations of the equipment manufacturers and the requirements, specifications and all applicable codes.
 5. The Contractor shall be responsible for installation of proper grounding and bonding.
 6. The Contractor shall take necessary steps to ensure that required firefighting apparatus is accessible always. Flammable materials shall be kept in suitable places outside the building.
 7. The Contractor shall install the materials in accordance with the manufacturer's specifications.
 8. Equipment shall be held firmly in place with manufacturer's recommendation and/or EIA standard types of mounting hardware. All equipment shall be installed to provide reasonable safety to the operator.
 9. The Contractor shall promptly correct all defects for which the Contractor is responsible.
 10. The Contractor shall insure that all records and reports, City relations, engineering, metering, inspections, testing, quality or service standards and safety measures comply with standards applicable for the State where the work is being performed.
 11. The Contractor shall coordinate all work with the customer's assignee or as will be designated at a future date.
 12. The Contractor shall remove all excess material and debris and return to original state of cleanliness. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap wire, etc., and dispose of such items daily.
 13. Upon completion of installation and prior to acceptance, all equipment shall be thoroughly cleaned and made free from extraneous bits of solder, wire, etc. by the Contractor. Contractor shall cleanup work area and remove ALL waste and trash. Debris resulting from the installation shall be removed from all areas and disposed of by the Contractor.
 14. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
 15. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
 16. An appropriate installation schedule shall be developed by the Contractor and will be subject to approval by the customer's representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.
 17. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a walk-through of the project location with customer's engineers to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.
 18. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
 19. The Contractor shall not roll or store cable reels without an appropriate underlay.
 20. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
 21. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to all damages sustained to the cables by the installation Contractor during the implementation.
 22. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.
 - a. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.

23. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.
24. All wiring, materials, and equipment must be suitable for the environment they are to be permanently installed in.
25. All equipment proposed by the Contractor must be new and unused. Equipment refers to all hardware, software, equipment, cabling, materials and incidentals etc.
26. Manufacturer's original box or shipping container from one (1) of every serialized

1.08 SUBMITTALS

- A. Successful Contractor will submit a single electronic PDF copy of the submittal package within 20 days of written notification to proceed or other written documentation from the Architect or General Contractor. Documents will be organized into the following sections:
- B. General
 1. Partial submittals shall not be acceptable without prior approval by Architect.
 2. The contract shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.
 3. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for every part of the system.
 4. No portion of the work shall commence, or equipment ordered until the Architect has approved the submittals.
 5. All work to be performed in accordance with approved submittals.
 6. Provide submittals in accordance with Division 00 and 01 requirements and Owner's approved construction schedule.
 7. Submittals shall not be combined with additional scope awarded or other sections.
 8. No portion of the submittal package may be excluded without written permission by the Architect.
- C. Submittal Requirements
 1. Section 1 — Cover Sheet and Table of Contents
 - a. Cover sheet containing the Company Name and/or logo, Title of submittal package, client name, and Contractor work address with a point of contact (POC) and phone number and name of submittal preparer.
 - b. Table of Contents (TOC)
 - c. Listing, in order, of all following submittal Sections.
 2. Section 2 — Product Data
 - a. Manufacturer's catalog information showing dimensions, colors, and configurations.
 - b. Submittals will include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets containing make and model numbers for each item listed in the specifications and the bill of materials only. No lengthy installation or operation manuals will be accepted.
 - c. The product data shall be divided by system(s) and in the order presented in this specification document.
 - d. In cases of multiple product numbers on a single cut sheet, the Contractor will identify the proper part number with an arrow, check mark or highlight.
 3. Section 3 — Pre-Qualification Certificate
 - a. Contractor will submit the following documents with project proposal:
 - 1) A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
 - 2) Training certificates for design, engineering and installation of the proposed products.
 - 3) Minimum AVIXA CTS certification for On Site Project Supervisor and Project Manager.
 4. Section 4 — Warranty Documentation

- a. Installation warranty will be for one year from substantial completion of the project. Substantial Completion is the point of the completion of training.
 - b. Complete documentation regarding the manufacturer's warranty will be submitted as part of the proposal. This will include, but is not limited to, a sample of the warranty that would be provided to the customer at substantial completion.
5. Section 5 – Record Drawings
 - a. Contractor shall provide record drawings for the submittal package that will be used throughout the inspection process and into substantial completion / final acceptance. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings. Use of any part of the Architect title block is not acceptable at any time.
 - b. The drawings shall include the following information:
 - 1) All shown audio-video drop locations shall be labeled and shown in accordance with the construction floor plans and reflective ceiling plans.
 - 2) Provide the audio-visual equipment rack elevation details demonstrating the locations of the equipment, power raceways and thermal management.
 - 3) All overhead rigging and installation details.
 - 4) Required support backing details with dimensions.
 - 5) Final conduit and cable pathways for coordination with E.C.
6. Section 6 – Technical Submittals
 - a. Configuration file for audio digital signal processors (DSP), drafted in DSP manufacturer's provided software.
 - b. Processor power required of DSP shall not exceed 95% total processing capacity.
 - 1) If processing power required exceeds available processing power, Contractor shall immediately notify Architect during pre-installation phase.
 - c. Copy of manufacturer configuration software, or link to manufacturer website download page for accessing configuration software.
 - 1) Version: Submitted software shall be identical version used to create DSP configuration.
 - d. Layouts of physical and virtual user controls in graphical format. This shall include:
 - 1) Engraved buttons and overlays
 - 2) Machine-printed adhesive labels
 - 3) Graphical user interfaces for touch panels or web interfaces.
7. Section 7 – Project Schedule
 - a. Contractor shall provide a work schedule detailing the points in which tasks are to begin and end, major milestones are to be completed as well as predecessors that are required in order for task to begin or be completed.
8. Any and all changes to the scope of work during the project shall be included in the drawings upon completion of system(s) installation and will be used as part of the substantial completion process. Reference the section on close out documentation for additional information on the substantial completion process.

1.09 QUALITY ASSURANCE

- A. The Contractor is bound by the intent of these specifications to provide a complete and functional Integrated Audio-Video System as described herein which meets or exceeds all standard currently established for such systems, regardless of any errors or omissions.
 1. ICS control functionality, verification of presets, volume controls, mute controls, etc.
 2. Stable operation, completely free of feedbacks and distortion throughout entire range of available ICS controls.
 3. Correct routing of all signals to intended destination.
 4. Unity gain structure.
 5. Output transducer (speaker protection processing functionality).
 6. AEC functionality
 7. Provide measurement test results per ANSI/InfoComm 1m-2009 ACU.

8. Outdoor sound system measurements shall be provided at a minimum of one measurement per 50 seats. Measurements shall be performed using pink noise test signal at a volume congruent with nominal system operation. Measurements shall indicate
 - a. Site plan map of seating areas and test locations.
 - b. Frequency response from 40Hz-16kHz in 1/3 octave resolution.
 - c. SPL (A weighted) of the test signal as measured from each location.
 - d. Weather condition at time of test; including temperature, humidity and average wind speeds.
9. Loudspeaker performance shall exhibit frequency response of +/-3dB from 40Hz to 8kHz throughout 70% of the listening area, and +/-6dB throughout remaining listening area.
- B. Provide all necessary labor, materials, tools, transportation, services, ancillary items and coordination to furnish the Owner a complete turnkey system as described herein.
- C. The Owner's representative will make regular progress inspections. The Contractor shall make their job supervisor available to assist during these visits.
- D. The Contractor shall thoroughly familiarize themselves with the complete construction documents, to have visited all sites affecting the proposed work, studied bid package information and all necessary details of the complete set of drawings and specifications and to have included in the proposal an amount to cover all work.
- E. The Contractor shall keep a complete set of drawings, specification, reviewed submittals and progress markups on the job site always. These documents shall be made available during Owner's representative site progress visits. Changes made during installation shall be noted on the project markup set.
- F. Submission of bids shall be deemed evidence of Contractor's knowledge, review and examination of the construction documents.
- G. Provide a competent supervisor and supporting technical personnel with a minimum of AVIXA CTS certification and is acceptable to the General Contractor, Owner and Consultant during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.
- H. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document except for the NFPA publications, which shall have precedence.

1.10 PROJECT EXPERIENCE AND PERFORMANCE REQUIREMENTS

- A. The Contractor must be an experienced A/V Contractor, that is primarily engaged in the business of A/V system integration.
- B. The contractor must show proof that A/V System integration is the primary function of the company.
- C. The Contractor shall show proof, as part of the bid, that it has been in the A/V system installation business for a period of not less than 3 years and has successfully, completed projects of similar size and scope.
- D. The Contractor will provide proof that it supports a well-trained maintenance force in the area local to the project.
- E. The Contractor must maintain a fully staffed installation and service facility equipped with appropriate test equipment for repair of systems such as those specified herein.
- F. Provide a competent supervisor and supporting technical personnel with a minimum of AVIXA CTS certification and is acceptable to the General Contractor, Owner and Architect during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.
- G. The Contractor shall be, or have direct relations through their subcontractors, an approved manufacturer's representative for all products they furnish and install.
- H. References:

1. The Contractor shall submit the names, addresses and telephone numbers of the operating personnel who can be contacted regarding previous installed systems.
2. Submitting incomplete or inaccurate reference information can be a reason to disqualify bidding Contractor.

1.11 COOPERATION AND COORDINATION

- A. Cooperate and coordinate as required with other Contractors who are responsible for work not included in this section.
- B. Provide all information as required or requested by the Owner, Architect, Consultant or General Contractor for the project to be completed to the satisfaction of the Owner.
- C. Notify general Contractor in a timely manner of system design or installation conflicts, which affect the intended use, or performance of the system.
- D. Attend job construction and progress meetings that the Owner, GC, or Architect deems necessary.

1.12 QUALIFICATIONS

- A. Manufacturer
 1. Manufacturer will have a minimum of ten (10) years' experience in the manufacture of sound system products.
 2. Maintain a 24-hour toll free telephone assistance line or online presence for customer and installer support.
- B. Contractor
 1. The Contractor shall be a business engaged primarily in Audio-Video integration.
 2. The Contractor selected to provide the installation of this system will be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.
 3. The Contractor will utilize the authorized manufacturer components in provisioning this Project.
 4. Contractor will have a minimum of three (3) years of recent experience with the proposed manufacturers' products.
 5. Contractor will have a minimum of five (5) years' experience with the design, installation and project management of local sound systems.
 6. Contractor will comply with all federal, state and local statutes regarding qualifications of firms.
 7. The Contractor will be experienced in all aspects of this work and will be required to demonstrate direct experience on recent systems of similar type and size.
 8. The Contractor will have personnel who are adequately trained in the usage of such tools and equipment.
 9. Contractor must provide On Site Supervision and Project Management by person(s) with a minimum of AVIXA CTS certification.
 10. The Contractor must have previously established offices located within 75 miles of the project location as the starting point.
 11. The customer reserves the right to reject bid of any bidder who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.13 BID

- A. Contractor will be required to provide the following documents with the bid response.
 1. Training certificates for design, engineering and installation of the proposed product types.
 2. The contractor must show proof that A/V System integration is the primary function of the company.
 3. Contractor will provide a list of all current installations that will be ongoing during this project, and the manpower requirements for each of those installations.

4. The preferred Contractor will have a minimum of (3) three references. Contractors providing a reference with an invalid phone number will be considered as an incomplete response and may be disqualified.
5. Contractor will provide a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
6. Contractor will submit a resume of qualification with the Contractor's bid proposal indicating the following:
 - a. A technical resume of experience for the Contractor's Project Manager and on-site installation supervisor (Project Foreman) who will be assigned to this project. The project manager should have a minimum of 5 years' experience on projects of similar size and design. The Project Foreman will have a minimum of 3 years related project experience working crews of 4 or more personnel with a minimum of AVIXA CTS certification.
 - b. A list of technical product training attended by the Contractor's personnel that will install the system.
 - c. Any sub-Contractor, who will assist this section Contractor in performance of this work, will have the same training and certification as the Contractor. The use of Sub-contractors is not prohibited for this project.

1.14 DELIVERY STORAGE AND HANDLING

- A. Comply with requirements of Section 01 66 00 – Product Storage and Handling Requirements.
- B. Deliver, Storage and Protection
 1. Contractor shall verify all site conditions are suitable for delivery of product.
 2. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
 3. Contractor shall provide all equipment and materials necessary for the delivery of materials safely and securely on site.

1.15 PROJECT CONDITIONS

- A. Project Environmental Requirements.
- B. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

PART 2 PRODUCTS

2.01 PRODUCT SPECIFICATIONS

- A. Hardware: Contractor shall supply equipment, accessories, cables, and connectors necessary for system to operate according to stated functional requirements, whether said products are listed.
- B. Software: Contractor shall utilize Manufacturer's official current version of configuration software.
- C. Control Interfaces: Shall be labeled or configured with graphical user interface as appropriate.
- D. Power Supplies: As required, Contractor shall provide necessary power supplies for amplifiers requiring DC voltage to power Ethernet card when forced in standby mode.
- E. Uninterruptible Power Supplies (UPS): Contractor shall provide a minimum of one UPS per audio-visual equipment rack for all pre-power amplifier equipment, whether specified or shown. Signal processing equipment and a minimal amount of audio amplifiers shall be connected to the UPS to allow for the Owner to announce emergency instructions of the audio-video system if desired.

2.02 GENERAL

- A. Unless otherwise provided in the specifications, reference to any equipment, material, article, or patented process, by trade name, make or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. If the respondent wished

to make a substitution to the specifications, the respondent shall furnish to the Engineer the name of the manufacturer, the model number, and other identifying data and information necessary to aid the Engineer in evaluating the substitution, and such substitution shall be subject to the Engineer's approval. Substitutions shall be approved only if determined by the Engineer to be equivalent to that specified. A proposal containing a substitution is subject to disqualification if the customer's representative does not approve the substitution. Quantities of products should be verified with drawings and any discrepancies reported to the Owner's representative in writing for resolution.

- B. Unapproved product substitutions which have been provided and/or installed will be replaced with the specified products at Contractor's sole expense.
- C. Furnish all accessories items necessary to integrate each piece of equipment into the system including rack mounts and other mounting devices, special connectors and interfaces.
- D. Coordinate with architect the finish of all exposed items to blend with adjacent architectural elements of the building.
- E. Major components of the system such as DSP, power amplifiers, mixer-preamplifiers, and tuners, shall have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources.

2.03 CONFERENCE ROOMS 107 & 133

- A. The conference room audio visual systems shall be an independent and distinct system.
- B. Display (TV-65"):
 - 1. Acceptable Manufacturer: LG
 - 2. Acceptable Model: 65" UH5F-H
- C. Display Mount:
 - 1. Acceptable Manufacturer: Chief
 - 2. Acceptable Model: LTM1U
- D. CPU
 - 1. Acceptable Manufacturer: Intel
 - 2. Acceptable Model: NUC 12 Pro Kit
- E. Conferencing Bar (VTC)
 - 1. Acceptable Manufacturer: Crestron
 - 2. Acceptable Model: UC-SB-P50
- F. HDMI Extension Kit (AV):
 - 1. Acceptable manufacturer: Comprehensive
 - 2. Acceptable Model: CHE-HDBTWP100K
 - a. Install transmitter in floor box (provided by others).
 - b. Provide 6' HDMI patch cable to display.
 - c. Provide 15' HDMI user cable.
- G. AV Brush Plate (TV):
 - 1. Acceptable manufacturer: Vanco
 - 2. Acceptable Model: 120817X
 - a. Install behind display for AV cable pathway.
- H. Floor Box (FB)
 - 1. Acceptable Manufacturer: FSR
 - 2. Acceptable Model: FL-400-PLP-BLK-C

2.04 WIRE AND CABLE

- A. Minimum Specifications
 - 1. All wire and cable shall be UL approved, meet all national, state and local codes, and manufacturers recommendations for connected components for its intended application.

2. Plenum Insulation shall be rated for a minimum of 300 volts and satisfy the Underwriters Laboratories (UL) listed fire rated cable insulation requirements in plenum areas.
 3. Cable runs shall be continuous runs. Mid-span cable splicing is not acceptable.
 4. Any pulling compound or lubricant used in cable installation shall not deteriorate the conductor or the insulation.
 5. All cabling shall have machine generated labels self-laminating or wrap around. Handwritten labels shall not be accepted.
 6. Under carpet wiring and flat wiring shall not be used.
 7. Manufacturers recommended cabling supersedes wire specified below.
 8. Contractor responsible for verifying all plenum rated spaces prior to installation. Provide Plenum rated cable as required.
 9. Contractor to verify and provide cabling that is applicable to its installed environment.
 10. All Pre-Amplifier audio cable shall be balanced unless otherwise noted.
 11. NO CABLE TIES
- B. HDBaseT AND AVoIP CABLES
1. CAT 6A or better
 2. Ensure that the cables pairs remain twisted together for canceling out Electromagnetic Interference (EMI) from the external sources are not exposed even partially, as it results in EMI issues.
 3. Use cables that are resistive to bend loss if excessive bending of cables cannot be prevented due to installation constraints.
 4. Avoid mounting the cabling components in places that block accessibility to other equipment (such as a power strip or fans) in and out of the racks.
 5. Avoid
 - a. Applying extra twists.
 - b. Pulling or stretching beyond the specified pulling load rate.
 - c. Bending it beyond the specified bend radius, and not beyond 90°.
 - d. Creating tension in the suspension runs.
 - e. Stapling or applying pressure with the cable ties.
 6. Avoid exposing cables to areas of condensation and direct sunlight.
 7. Remove the abandoned cables, as they restrict the airflow, and contribute to the possible increase in the operational temperatures, which can affect the durability of the system.
 8. The NEC (NFPA 70), Article 800.133 (2005 NEC) indicates the separation requirements. This section of the NEC specifies the following: Communication wires and cables shall be separated at least 50 mm (2 inches) from conductors of any electric, power, Class 1, non-power limited fire alarm, or medium-power network-powered broadband communication circuits. However, there are multiple exceptions to this generic rule, so refer to the NEC (NFPA 70) standard for more information.
- C. ACCEPTABLE MANUFACTURERS
1. Panduit
- D. JACKS, CONNECTORS AND WALLPLATES
1. All custom A/V panels shall be minimum 1/8" brushed aluminum with engraved paint filled legends unless otherwise noted.
 2. All AV connectors shall be Neutrik or Switchcraft brand (non-crimp) or approved alternative.
 3. All HDBaseT and AV/IP connectors shall be Panduit or approved alternative.
- E. OTHER REQUIREMENTS
1. All materials and equipment proposed by the Contractor shall be new and unused. Equipment refers to all hardware, cabling, materials and incidentals, etc.
 2. All equipment shall be installed per the manufacturer's instructions.
 3. All boxes should be stored until substantial completion.
 4. System shall be complete and free from all hums, buzzes and defects.

5. Any alternates must be approved by the system designer prior to bid.

PART 3 EXECUTION

3.01 INSTALLATION

- A. This Section includes installation requirements of the Integrated Audio-Video. If you have any questions regarding the intent or application of any feature, submit these questions to the principal contact for this project, as indicated in Division 00. This section covers the general requirements for the installation of the equipment by the Contractor.
 1. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
 2. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
 3. An appropriate construction schedule shall be developed by the Contractor and will be subject to approval by the customer's representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.
 4. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a "walk-through" of the project location with the customer's representatives to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.
 5. The Contractor shall be responsible for completing a standardized report form addressing the weekly progress of the installation schedule.
 6. The Contractor shall maintain conductor polarity identification at the main equipment room, backbone, and horizontal connections in accordance with industry practices.
 7. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.
 8. The Contractor shall be responsible for labeling all cable, distribution frames, and outlet locations, according to industry standards.
 9. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
 10. The Contractor shall not roll or store cable reels without an appropriate underlay.
 11. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
 12. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the installation Contractor during the implementation.
 13. The Contractor shall plug conduits where cabling has been installed by the installation Contractor in the equipment rooms, backbone and other cable entrance locations with re-entenable duct seal of flame-retardant putty.
 14. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.
 15. Wiring, materials, and equipment will be delivered and stored in a clean dry space. They will be properly packaged in factory fabricated type containers and protected from damaging fumes, construction debris and traffic until job completion.
 16. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.
 17. All installation techniques and fixtures shall result in ease of maintenance and ready access to all components for testing measurements. All external screws, nuts, and locking washers shall be stainless steel. No self-tapping screws shall be used unless specifically approved by the customer's representatives. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass. All materials used in installation

shall be resistant to fungus growth and moisture deterioration. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.

18. The Contractor will submit for approval, a detailed description of the procedures and equipment included for the complete operational installation.

B. Control Systems

1. Contractor shall meet with owner and whomever the Owner deems appropriate to discuss control features and navigation. Once agreement is received on the control navigation, the Contractor shall submit detailed documentation and GUI configuration and programming for approval. This process will continue until contractor obtains documented approval from the Owner for control design. Contractor shall provide reasonable hours for changes once the system is operational to ensure the Owner's satisfaction. The control software shall be delivered to the Owner upon substantial completion of the project.

C. Wiring Plan Requirements

1. Distribution of the cabling will be accomplished through cable trays, conduit raceways, ducts, core-holes, extended columns, false half columns and plenums. Cabling shall be run at right angles from cable trays. Horizontal cable segments will be placed in cable trays and with cable exits/entrances supported by distribution rings or J Hooks. Cable may not rest on ceiling tile, be supported on existing ducting, tied, or supported by fire alarm, security or electrical infrastructure nor interlaced with existing cable.
2. The Contractor shall be responsible for providing an approved ground at all equipment locations. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and frameworks. All grounds shall consist of minimum 12 AWG copper wire or larger as required by code and shall be supplied from an approved building ground and bonded to the main electrical ground.
3. Observe proper circuit and loudspeaker wiring polarity. Properly and clearly label connections and wires as to function and polarity. No cables will be wired with polarity reversal between connectors, at either end. Take care when wiring microphone cables to ensure that constant polarity is maintained.

D. Cable Management

1. Maintain segregation of cables. AC power cables or speaker cables should not be run parallel within close proximity to signal wires (within 2"), unless the wires are twisted.
2. Bend radius for twisted-pair cables is standardized at 12" (3" diameter).
3. Bundle cables within the guidelines of 2005 National Electrical Code (NEC) in Article 310.15(B)(2).

E. Rack Dressing

1. All Racks require Lacer Bars or Strips to provide clean cable management withing the rack.
2. All racks require the cable segregation of AC cables, Speaker Cables, low impedance balanced cabling and twisted pair cables.
3. All AV Racks should be assembled and tested at the Contractor's facility and transported to the job site when possible.
4. No Cable Ties; Velcro only.

F. Identification, Labeling and Documentation

1. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with permanently attached, self-laminating markings that will not impair the equipment or present a hazard to maintenance personnel.
2. Place wire identification numbers on each end of all conductors. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed. Hand-written labels are not acceptable.
3. Mark all spare conductors and coiled neatly located at the bottom of the equipment rack.

3.02 TESTING REQUIREMENTS

- A. The Contractor shall perform sample tests in the presence of the customer's representatives. Performing the testing procedures specified herein assures that the equipment and interconnection meets the performance characteristics specified. If testing indicates that the performance characteristics are not met, the test shall be declared a failure. The communication equipment and interconnection cabling shall be modified and/or repaired accordingly. The failed test and any other test that may be affected by the modification and/or repair shall be rerun. After all components have been installed, the integrity of the equipment and interconnection cabling shall be verified.
- B. If system test fails because of any component(s) in the system, the failed component(s) shall be corrected or substituted with other components and the tests shall be repeated. If a component has been modified because of the system test failure, a report shall be prepared and delivered to customer's representatives prior to retesting. The Contractor shall prepare and submit all test procedures and data forms for the post installation and system test to the customer's representatives.
- C. The test report shall contain the description of all tests performed, the results obtained, and any required adjustments or modifications necessary because of testing and installation. This report shall reflect the as-built communication equipment and interconnection cabling. An authorized representative of the Contractor shall sign the test report. At least three copies of the test report shall be sent to the customer's representatives.
- D. The test procedures shall have the Owner's representative's approval before the tests.
- E. Contractor shall demonstrate to the Owner's representatives that the equipment operates as specified and that the tests meet performance requirements.
- F. The Contractor shall ensure that the equipment is in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive hum, RF interference, or instability of any form.
- G. The Contractor shall test each operational component and adjust for equal sound levels at a given volume setting and replace defective items.
- H. Contractor shall ensure that all loudspeaker and distributed audio systems described herein are balanced and optimized for maximum quality sound and coverage of listening areas.

3.03 TRAINING

- A. System training shall be provided for the operator/user and technical staff.
 - 1. Operator/user training shall be held at Owner's convenience and to the Owner's satisfaction.
 - 2. Technical operation and maintenance training shall be held at Owner's convenience and to the Owner's satisfaction.
 - 3. The Contractor shall provide documentation demonstrating the Owner and/or Owner's Representatives understand the operation and maintenance of the system.
- B. Complete operation and maintenance manuals and preliminary as-built drawings shall be delivered to the Owner one week prior to training sessions.
- C. Operator/user training shall minimally consist of:
 - 1. Provide printed reference material for each trainee that documents and explains in layman's terms:
 - a. System block diagram
 - b. Normal day-to-day operation
 - c. Operator selectable features
 - 2. Provide a hands-on training with Q & A session
- D. Technical Operations and Maintenance training shall consist of:
 - 1. The technical explanation shall be sufficiently thorough that staff personnel shall be able to make any programming changes required, analyze malfunctions and make equipment substitutions or bypasses necessary to maintain system operation except for the malfunctioning equipment or circuits.

2. Provide printed reference material for each trainee that documents and explains in technical terms:
 - a. System block diagram with technical features
 - b. Technical operation, adjustments and programming
 - c. System features and programming
 - d. Review of as-built drawings.
 3. Provide a hands-on training with Q & A session.
- E. Contractor will provide a complete and comprehensive list of the maintenance schedule for all installed and/or provided equipment. The list shall be provided in both printed and Adobe Acrobat formats.

3.04 ACCEPTANCE OF SYSTEMS

- A. Specifications set forth for construction of the system have been devised to insure system compatibility and performance. Compliance to these specifications will be determined during periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the plant commences.
- B. Prior to Contractor performed final testing, deliver preliminary as-build documents to Owner for use in conducting testing observation.
- C. Project Record Documentation
 1. Upon completion of final engineering and incorporation of the Architect review comments, Contractor will provide to the Architect for its records the following close out documentation:
 - a. Record or As Build Drawings which shall include but not limited to:
 - 1) Functional block diagrams for each Integrated Audio-Video System
 - 2) All Integrated Audio-Video or Audio-Visual junction box locations
 - 3) Audio Visual equipment rack locations
 - 4) Rack elevations
 - (a) Rack elevations shall show all components as installed under this contract.
 - (b) Contractor will label each component describing the component. (Examples: Cafeteria Amplifier or Gymnasium DSP etc).
 - 5) Floor plan drawings with device locations and associated assigned item number.
 - 6) Mounting detail for equipment and hardware.
 - 7) Schedule of all devices with associated panel termination, zoning, power circuits, etc.
 - 8) Corrected product submittal information
 - b. A complete inventory list of installed products shall include:
 - 1) Manufacture Name
 - 2) Model Number
 - 3) Serial Number
 - 4) Room number and/or description of installed location
 - c. Operation and Maintenance Manuals shall include
 - 1) Include detailed procedures for system operation that begin with startup procedures and continue through system shut down referenced in section 3.3 Training.
 - 2) List of manufacture recommended maintenance and intervals with manufacture support contact information.
- D. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings.
 1. Use of any part of the Architect title block is not acceptable at any time.
- E. Drawing documentation will be in the following format:
 1. Two (2) electronic copies, one per flash drive shall be provided.
 - a. Drawings will be in both CAD (DWG) and PDF format and the Contractor will include all files on each drive.

- b. File transfer is acceptable.
 - 2. Drawings shall be provided to the architect two weeks prior to the final testing and commissioning of the system. Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.
 - 3. The drawings will be reviewed on site with the architect and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.
- F. Testing Results
- 1. In addition to the project record drawings, the Contractor shall provide the testing information for all audio-visual cabling.
 - a. Test results shall be provided to the architect two weeks prior to expected final acceptance of the system(s). Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.
 - b. The drawings will be reviewed on site with the architect and the Owner prior to the final acceptance process. Test results rejected for any reason will delay the final acceptance process until resolved.
- G. Once accepted by the architect and Owner all documentation / program code becomes the property of the Owner
- H. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, declare substantial completion of the project.

3.05 WARRANTY

- A. The Contractor shall warrant and guarantee all work against defects in material, equipment or workmanship for one (1) year from the date of substantial completion of the entire project.
- B. Upon receipt of written notice, Contractor shall remedy defects within thirty (30) days or the Owner shall correct the defects and the Contractor, or its surety shall be liable for expenses.

END OF SECTION

**SECTION 27 5116
PUBLIC ADDRESS SYSTEMS**

PART 1 GENERAL

1.01 SCOPE

- A. Provide a complete and functioning Public Address System according to construction documents, applicable local and state codes and laws.
- B. Furnish and install all equipment, accessories, cabling, devices, and materials in accordance with the project specifications and drawings to ensure a fully operational intercom, master clock, secondary clock, and class change time tone communication system of the highest quality.
- C. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Intercom System Contractor to provide all features and functions as outlined in these specifications.
- D. Equipment manufactured by Valcom Inc. shall be considered as meeting all specifications as the base bid. The Owner or Owner's Representative must approve all alternate systems. Alternate bidders supplying another system shall make aware their intentions and provide all information, including catalog cuts, shop and working drawings, data sheets, and a demonstration of the proposed system features. This information must be presented to the relative parties as to allow sufficient time to review all materials.
- E. The Intercom Communication System Contractor (The Contractor) shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit.
- F. Coordinate all final power requirements and cable pathways.
- G. Perform system testing and optimization services.
- H. Complete final acceptance demonstration for the Architect, Owner and/or Owner's Representative.
- I. Provide warranty as described within.
- J. Provide training for the Owner as outlined within.
- K. Provide and install specified Public Address System network switch.

1.02 SUMMARY

- A. The Contractor shall provide all materials, equipment, labor and all other incidental materials and appliances necessary, as described herein and in the drawings, to provide complete turn-key and functional systems, regardless of any materials and/or equipment not listed or described in this specification and/or supplementary drawings.
- B. Contractor shall provide system optimization services and shall complete an internal system commissioning. A commissioning plan shall be submitted in writing to the Owner and or Owner's representative for approval. Notify the Owner and or Owner's representative two weeks prior to the start of commissioning to allow for Owner representation to be present during all testing and commissioning. Final testing and commissioning shall be completed by Owner's representative.
- C. General elements of the work shall consist of but not limited to following major items:
 - 1. All equipment shall be installed per the manufacturer's installation instructions.
 - 2. Any deviation from the manufacturer's installation instructions shall be requested prior to the work being done.
 - 3. Any unapproved deviations will be corrected at the installer's sole expense
 - 4. Procure all permits and licenses required to complete this installation.
 - 5. Attend job construction and progress meetings.
 - 6. Provide all materials and essential ancillary equipment required to make a properly operating systems as defined in the related drawings and specifications.

7. Provide cabling according to the correct application and environment(s).
8. Verify conditions and dimensions at the job site prior to installation.
9. Submittal preparation and processing.
10. Perform installation according to project documents.
11. Perform initial testing, programming and adjustments with written reports.
12. Provide labor and materials to complete final commissioning services.
13. Demonstrate system for final adjustments and approval by the Architect and/or Owner.
14. Preparation of Operational and Maintenance manuals and Project Record (as-built) documents.
15. Providing training for Owner.
16. Providing warranty service.
17. Remove all job specific created debris to approved collection points.

1.03 RELATED SECTIONS

- A. The general provisions of the Contract and the requirements of work specified in these sections:
- B. Division 00 – Procuring and Contracting Requirements
- C. Division 26 – Raceways, Exposed System Wiring and Related Documents.
- D. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions
ANSI/NFPA-70, National Electric Code. (check with the AHJ for the edition being used.)
- E. BICSI, Telecommunications Distribution Methods Manual, current edition.
- F. BICSI, Information Transport Systems Installation Methods Manual, current edition.
- G. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.
- H. CN GOVIT-Infrastructure Standards for Telecom Spaces

1.04 RELATED REQUIREMENTS

- A. Section 01 81 13 – Sustainable Design Requirements: Action and Informational Submittals
 1. This project is pursuing LEED Healthcare v4: Silver Certification
 2. Refer to this section for additional, required LEED submittals not included in this specification section.

1.05 REFERENCES

- A. Specifications, Standards and Codes: All work shall be in accordance with the current editions of the following:
 1. AVIXA Rack Building for Audiovisual Systems 2019.
 2. ANSI T1.404 (DS3) and CATV Applications.
 3. ANSI S4.48-1992
 4. ANSI X3T9.5 TPPMD.
 5. American Society of Testing and Materials (ASTM).
 6. TIA/EIA (Telecommunications Industries Association & Electronic Industries Association) building telecommunication wiring standards
 7. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual.
 8. Federal Communications Systems (FCC).
 9. Institute of Electrical and Electronics Engineers (IEEE).
 10. National Electrical Code (NEC) (Latest revision and pertinent addendums).
 11. National Electrical Manufacturer's Association (NEMA).
 12. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums).
 13. "Basic Principles for suspended Loudspeaker Systems", Technical Notes Volume 1, Number 19, JBL Professional or latest edition.
 14. "Handbook for Riggers" 1977 Revised Edition, Newberry, W.G., Calgary, Alberta Canada.

15. Underwriters Laboratory (UL)
16. Americans with Disabilities Act (ADA)
17. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document with the exception of the ADA, NFPA and NEC publications.

1.06 IT COORDINATION

- A. Where connection between components or control features are accomplished over the Owner's LAN, Contractor shall coordinate with the Owners IT department for IP addresses, firewall access, and other issues pertaining to successful integration.

1.07 GENERAL REQUIREMENTS

- A. This section covers the general requirements for the installation of the Public Address System by the Contractor.
 1. In the installation of this work, the Contractor shall comply in every way with the requirements of Owner's standards, local and state laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. If, in the opinion of the Contractor, there is anything in the plans or specifications that will not strictly comply with the above laws, ordinances, and rules, the matter shall be referred to the attention of customer's representatives for a decision before proceeding with that part of the work. No change in the plans or in the Specifications shall be made without full consent in writing by the Owner's representative's engineer.
 2. The Contractor shall obtain the customer's permission before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors, partition ceilings.
 3. The Contractor shall be responsible for and repair all damage to building due to carelessness of workers, and exercise reasonable care to avoid any damage to customer property. The Contractor will report to the customer representatives any damage to the building which may exist or may occur during the occupancy of the quarters.
 4. Contractor shall provide components, wire, connectors, materials, parts, equipment and labor necessary for the complete installation of the system, in full accordance with the recommendations of the equipment manufacturers and the requirements, specifications and all applicable codes.
 5. The Contractor shall be responsible for installation of proper grounding and bonding.
 6. The Contractor shall take necessary steps to ensure that required firefighting apparatus is accessible always. Flammable materials shall be kept in suitable places outside the building.
 7. The Contractor shall install the materials in accordance with the manufacturer's specifications.
 8. Equipment shall be held firmly in place with manufacturer's recommendation and/or EIA standard types of mounting hardware. All equipment shall be installed to provide reasonable safety to the operator.
 9. The Contractor shall promptly correct all defects for which the Contractor is responsible.
 10. The Contractor shall insure that all records and reports, City relations, engineering, metering, inspections, testing, quality or service standards and safety measures comply with standards applicable for the State where the work is being performed.
 11. The Contractor shall coordinate all work with the customer's assignee or as will be designated at a future date.
 12. The Contractor shall remove all excess material and debris and return to original state of cleanliness. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap wire, etc., and dispose of such items daily.
 13. Upon completion of installation and prior to acceptance, all equipment shall be thoroughly cleaned and made free from extraneous bits of solder, wire, etc. by the Contractor. Contractor shall cleanup work area and remove ALL waste and trash. Debris resulting from the installation shall be removed from all areas and disposed of by the Contractor.

14. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
15. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
16. An appropriate installation schedule shall be developed by the Contractor and will be subject to approval by the customer's representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.
17. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a walk-through of the project location with customer's engineers to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.
18. The Contractor shall be responsible for completing a standardized report form addressing the weekly progress of the installation schedule.
19. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
20. The Contractor shall not roll or store cable reels without an appropriate underlay.
21. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
22. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the installation Contractor during the implementation.
23. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.
24. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.
25. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.
26. All wiring, materials, and equipment must be suitable for the environment they are to be permanently installed in.
27. All equipment proposed by the Contractor must be new and unused. Equipment refers to all hardware, software, equipment, cabling, materials and incidentals etc.

1.08 SUBMITTALS

- A. Successful Contractor will submit a single electronic PDF copy of the submittal package within 20 days of written notification to proceed or other written documentation from the Architect or General Contractor. Documents will be organized into the following sections:
- B. General
 1. Partial submittals shall not be acceptable without prior approval by Architect.
 2. The contract shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.
 3. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for every part of the system.
 4. No portion of the work shall commence, or equipment ordered until the Architect has approved the submittals.
 5. All work to be performed in accordance with approved submittals.
 6. Provide submittals in accordance with Division 00 and 01 requirements and Owner's approved construction schedule.
 7. Submittals shall not be combined with additional scope awarded or other sections. Separate submittals shall be required.

8. No portion of the submittal package may be excluded without written permission by the Architect.
- C. Submittal Requirements
1. Section 1 — Cover Sheet and Table of Contents
 - a. Cover sheet containing the Company Name and/or logo, Title of submittal package, client name, and Contractor work address with a point of contact (POC) and phone number and name of submittal preparer.
 - b. Table of Contents (TOC)
 - c. Listing, in order, of all following submittal Sections.
 2. Section 2 — Product Data
 - a. Manufacturer's catalog information showing dimensions, colors, and configurations.
 - b. Submittals will include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets containing make and model numbers for each item listed in the specifications and the bill of materials only. No lengthy installation or operation manuals will be accepted.
 - c. The product data shall be divided by system(s) and in the order presented in this specification document.
 - d. In cases of multiple product numbers on a single cut sheet, the Contractor will identify the proper part number with an arrow, check mark or highlight.
 3. Section 3 — Pre-Qualification Certificate
 - a. Contractor will submit the following documents with project proposal:
 - 1) A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
 - 2) Training certificates for design, engineering and installation of the proposed products.
 4. Section 4 — Warranty Documentation
 - a. Installation warranty will be for one year from substantial completion of the project. Substantial Completion is the point of the completion of training.
 - b. Complete documentation regarding the manufacturer's warranty will be submitted as part of the proposal. This will include, but is not limited to, a sample of the warranty that would be provided to the customer at substantial completion.
 5. Section 5 – Record Drawings
 - a. Contractor shall provide record drawings for the submittal package that will be used throughout the inspection process and into substantial completion / final acceptance. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings. Use of any part of the Architect title block is not acceptable at any time.
 - b. The drawings shall include the following information:
 - 1) All shown Public Address System drop locations shall be labeled and shown in accordance with the construction floor plans and reflective ceiling plans.
 - 2) Public Address System block diagrams, or functionals, for all systems. Reproduction of Public Address System Consultant diagrams, or functionals, shall not be permitted.
 - 3) Provide the Public Address System equipment rack elevation details demonstrating the locations of the equipment, power raceways and thermal management.
 - 4) All overhead rigging and installation details.
 - 5) Required support backing details with dimensions.
 - 6) Final conduit and cable pathways for coordination with E.C.
 6. Section 6 – Technical Submittals
 - a. Copy of manufacturer configuration software, or link to manufacturer website download page for accessing configuration software.
 - 1) Version: Submitted software shall be identical version used to create DSP configuration.

- b. Layouts of physical and virtual user controls in graphical format. This shall include:
 - 1) Engraved buttons and overlays
 - 2) Machine-printed adhesive labels
 - 3) Graphical user interfaces for touch panels or web interfaces.
- 7. Section 7 – Project Schedule
 - a. Contractor shall provide a work schedule detailing the points in which tasks are to begin and end, major milestones are to be completed as well as predecessors that are required in order for task to begin or be completed.
- 8. Any and all changes to the scope of work during the project shall be included in the drawings upon completion of system(s) installation and will be used as part of the substantial completion process. Reference the section on close out documentation for additional information on the substantial completion process.

1.09 QUALITY ASSURANCE

- A. The Contractor is bound by the intent of these specifications to provide a complete and functional Public Address System as described herein which meets or exceeds all standard currently established for such systems, regardless of any errors or omissions.
 - 1. ICS control functionality, verification of presets, volume controls, mute controls, etc.
 - 2. Stable operation, completely free of feedbacks and distortion throughout entire range of available ICS controls.
 - 3. Correct routing of all signals to intended destination.
 - 4. Unity gain structure.
 - 5. Output transducer (speaker protection processing functionality).
 - 6. Provide measurement test results per ANSI/InfoComm 1m-2009 ACU.
- B. Provide all necessary labor, materials, tools, transportation, services, ancillary items and coordination to furnish the Owner a complete turnkey system as described herein.
- C. The Owner's representative will make regular progress inspections. The Contractor shall make their job supervisor available to assist during these visits.
- D. The Contractor shall thoroughly familiarize themselves with the complete construction documents, to have visited all sites affecting the proposed work, studied bid package information and all necessary details of the complete set of drawings and specifications and to have included in the proposal an amount to cover all work.
- E. The Contractor shall keep a complete set of drawings, specification, reviewed submittals and progress markups on the job site always. These documents shall be made available during Owner's representative site progress visits. Changes made during installation shall be noted on the project markup set.
- F. Submission of bids shall be deemed evidence of Contractor's knowledge, review and examination of the construction documents.
- G. Provide a competent supervisor and supporting technical personnel with a minimum of AVIXA CTS certification and is acceptable to the General Contractor, Owner and Consultant during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.
- H. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document except for the NFPA publications, which shall have precedence.

1.10 PROJECT EXPERIENCE AND PERFORMANCE REQUIREMENTS

- A. The Contractor must be an experienced Public Address Systems Contractor that is primarily engaged in the business of Public Address System integration.
- B. The Contractor shall show proof, as part of the bid, that it has been in the Public Address System installation business for a period of not less than 3 years and has successfully, completed projects of similar size and scope.

- C. The Contractor will provide proof that it supports a well-trained maintenance force in the area local to the project.
- D. The Contractor must maintain a fully staffed installation and service facility equipped with appropriate test equipment for repair of systems such as those specified herein.
- E. Provide a competent supervisor and supporting technical personnel with a minimum of AVIXA CTS certification and is acceptable to the General Contractor, Owner and Architect during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.
- F. The Contractor shall be, or have direct relations through their subcontractors, an approved manufacturer's representative for all products they furnish and install.
- G. References:
 - 1. The Contractor shall submit the names, addresses and telephone numbers of the operating personnel who can be contacted regarding previous installed systems.
 - 2. Submitting incomplete or inaccurate reference information can be a reason to disqualify bidding Contractor.

1.11 COOPERATION AND COORDINATION

- A. Cooperate and coordinate as required with other Contractors who are responsible for work not included in this section.
- B. Provide all information as required or requested by the Owner, Architect, Consultant or General Contractor for the project to be completed to the satisfaction of the Owner.
- C. Notify general Contractor in a timely manner of system design or installation conflicts, which affect the intended use, or performance of the system.
- D. Attend job construction and progress meetings that the Owner, GC, or Architect deems necessary.

1.12 QUALIFICATIONS

- A. Manufacturer
 - 1. Manufacturer will have a minimum of ten (10) years' experience in the manufacture of sound system products.
 - 2. Maintain a 24-hour toll free telephone assistance line or online presence for customer and installer support.
- B. Contractor
 - 1. The Contractor selected to provide the installation of this system will be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.
 - 2. The Contractor will utilize the authorized manufacturer components in provisioning this Project.
 - 3. Contractor will have a minimum of three (3) years of recent experience with the proposed manufacturers' products.
 - 4. Contractor will have a minimum of five (5) years' experience with the design, installation, and project management of Public Address Systems.
 - 5. Contractor will comply with all federal, state and local statutes regarding qualifications of firms.
 - 6. The Contractor will be experienced in all aspects of this work and will be required to demonstrate direct experience on recent systems of similar type and size.
 - 7. The Contractor will have personnel who are adequately trained in the usage of such tools and equipment.
 - 8. Contractor must provide On Site Supervision and Project Management by person(s) with a minimum of AVIXA CTS certification.
 - 9. The Contractor must have previously established offices located within 75 miles of the project location as the starting point.

10. The customer reserves the right to reject bid of any bidder who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.13 BID

- A. Contractor will be required to provide the following documents with the bid response.
 1. Training certificates for design, engineering and installation of the proposed product types.
 2. The contractor must show proof that A/V System integration is the primary function of the company.
 3. Contractor will provide a list of all current installations that will be ongoing during this project, and the manpower requirements for each of those installations.
 4. The preferred Contractor will have a minimum of (3) three references. Contractors providing a reference with an invalid phone number will be considered as an incomplete response and may be disqualified.
 5. Contractor will provide a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
 6. Contractor will submit a resume of qualification with the Contractor's bid proposal indicating the following:
 - a. A technical resume of experience for the Contractor's Project Manager and on-site installation supervisor (Project Foreman) who will be assigned to this project. The project manager should have a minimum of 5 years' experience on projects of similar size and design. The Project Foreman will have a minimum of 3 years related project experience working crews of 4 or more personnel with a minimum of AVIXA CTS certification.
 - b. A list of technical product training attended by the Contractor's personnel that will install the system.
 - c. Any sub-Contractor, who will assist this section Contractor in performance of this work, will have the same training and certification as the Contractor. The use of Sub-contractors is not prohibited for this project.

1.14 DELIVERY STORAGE AND HANDLING

- A. Comply with requirements of Section 01 66 00 – Product Storage and Handling Requirements.
- B. Deliver, Storage and Protection
 1. Contractor shall verify all site conditions are suitable for delivery of product.
 2. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
 3. Contractor shall provide all equipment and materials necessary for the delivery of materials safely and securely on site.

1.15 PROJECT CONDITIONS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

PART 2 PRODUCT AND EQUIPMENT

2.01 MANUFACTURERS

- A. Valcom: System for Paging/Clocking and Speakers.
- B. Alternate manufacturers must be submitted for approval by the Owner / Owner's Representative.

2.02 AMPLIFICATION AND CONTROL EQUIPMENT

- A. Valcom Paging Control Unit:
 1. IP6000.
 - a. The server shall communicate with VIP-102B setup tool for setup and dial code and group information. Users shall have the ability to enter names for displaying dial codes, page groups, inputs, events, and schedules.

2. Registers to phone system via SIP license with two available FXO fall back circuits.
 3. Provides audio feedback elimination.
 4. Provide off-site programming via Browser base programming.
 5. Capable of using Valcom IP speakers
 6. System speakers shall be capable of using standard UTP telephone/data wiring for installation, thus allowing for only one type of wiring infrastructure.
 7. Valcom Server shall be housed in the MDF.
 8. Paging zones shall be one for each classroom (12), one for all common areas, and one for all call zone.
 9. The dial code for the paging server will be 900.
 10. Any other paging servers added will be 901, 902, and so on.
 11. Once the paging server(s) pull an IP address, they shall be reserved in DHCP.
- B. Valcom IP Gateway:
1. VIP-801A – IP PoE SIP Audio gateway.
- C. Valcom Paging Speakers/Horns:
1. 2'x2' Lay-in Talkback Speakers- VE4022A
 - a. For use in classrooms and gross motor rooms.
 - b. Include VE-2975 call button.
 2. 2'x2' Lay-in Speakers- VE4002A
 - a. For use in corridors and common areas.
 3. Indoor/Outdoor Horn- VE130AL-GY
 4. Verify speaker types and quantities on plans.
- D. Valcom Volume Control:
1. Volume control will be handled by the software deployed by the client.
- E. Valcom Console:
1. Interactive Console- VE8092
- F. Valcom Power Supply:
1. Power for each speaker will be from a POE port from the client's network switch.
- G. Protection:
1. The General Contractor/Construction Manager shall provide all necessary protection on the AC power feed and on all station lines entering and leaving the building.
 2. The General Contractor/Construction Manager shall note the type of protection devices and all relative information in the system drawings.
 3. The Contractor shall provide a battery back-up for the control unit and all power supplies.

2.03 BATTERY BACKUP POWER UNIT

- A. Unit shall be rack mounted, consisting of time-delay relay, sealed lead-calcium battery, battery charger, on-off switch, "normal" and "emergency" indicating lights, and adequate capacity to supply maximum equipment power requirements for one hour of continuous full operation.
- B. Unit shall supply public address equipment with 12- to 15-V dc power automatically during an outage of normal 120-V ac power.
- C. Battery shall be on float charge when not supplying system and able to transfer automatically to supply system after three to five seconds of continuous outage of normal power, as sensed by time-delay relay.
- D. Unit shall automatically retransfer system to normal supply when normal power has been reestablished for three to five seconds continuously.
- E. Provide and install Cyber Power PR2200LCDRT2U.

2.04 WIRE AND CABLE

- A. Minimum Specifications

1. All wire and cable shall be UL approved, meet all national, state and local codes, and manufacturers recommendations for connected components for its intended application.
 2. Plenum Insulation shall be rated for a minimum of 300 volts and satisfy the Underwriters Laboratories (UL) listed fire rated cable insulation requirements in plenum areas.
 3. Cable runs shall be continuous runs. Mid-span cable splicing is not acceptable.
 4. Any pulling compound or lubricant used in cable installation shall not deteriorate the conductor or the insulation.
 5. All cabling shall have machine generated labels self-laminating or wrap around. Handwritten labels shall not be accepted.
 6. Under carpet wiring and flat wiring shall not be used.
 7. Manufacturers recommended cabling supersedes wire specified below.
 8. Contractor responsible for verifying all plenum rated spaces prior to installation. Provide Plenum rated cable as required.
 9. Contractor to verify and provide cabling that is applicable to its installed environment.
 10. All Pre-Amplifier audio cable shall be balanced unless otherwise noted.
 11. NO CABLE TIES
- B. HDBaseT AND AV/IP CABLES
1. All HDBaseT and AV/IP cabling meet Section 27 10 00 Structured Cabling or approved alternative and shall be CAT6 or better.
 2. Ensure that the cables pairs remain twisted together for canceling out Electromagnetic Interference (EMI) from the external sources are not exposed even partially, as it results in EMI issues.
 3. Use cables that are resistive to bend loss if excessive bending of cables cannot be prevented due to installation constraints.
 4. Avoid mounting the cabling components in places that block accessibility to other equipment (such as a power strip or fans) in and out of the racks.
 5. Avoid
 - a. Applying extra twists.
 - b. Pulling or stretching beyond the specified pulling load rate.
 - c. Bending it beyond the specified bend radius, and not beyond 90°.
 - d. Creating tension in the suspension runs.
 - e. Stapling or applying pressure with the cable ties.
 6. Avoid exposing cables to areas of condensation and direct sunlight.
 7. Remove the abandoned cables, as they restrict the airflow, and contribute to the possible increase in the operational temperatures, which can affect the durability of the system.
 8. The NEC (NFPA 70), Article 800.133 (2005 NEC) indicates the separation requirements. This section of the NEC specifies the following: Communication wires and cables shall be separated at least 50 mm (2 inches) from conductors of any electric, power, Class 1, non-power limited fire alarm, or medium-power network-powered broadband communication circuits. However, there are multiple exceptions to this generic rule, so refer to the NEC (NPFA 70) standard for more information.
- C. Acceptable Manufacturers
1. Belden
 2. West Penn
 3. Crestron
 4. Extron
 5. Liberty
 6. Windy City Wire
- D. Jacks, Connectors and Wall plates
1. All custom A/V panels shall be minimum 1/8" brushed aluminum with engraved paint filled legends unless otherwise noted.
 2. All AV connectors shall be Neutrik or Switchcraft brand (non-crimp) or approved alternative.

3. All HDBaseT and AV/IP connectors shall meet Section 27 10 00 Structured Cabling or approved alternative.
- E. Other Requirements
 1. All materials and equipment proposed by the Contractor shall be new and unused. Equipment refers to all hardware, cabling, materials and incidentals, etc.
 2. All equipment shall be installed per the manufacturer's instructions.
 3. All boxes should be stored until substantial completion.
 4. System shall be complete and free from all hums, buzzes and defects.
 5. Any alternates must be approved by the system designer prior to bid.

PART 3 EXECUTION

3.01 INSTALLATION

- A. This Section includes installation requirements of the Public Address System. If you have any questions regarding the intent or application of any feature, submit these questions to the principal contact for this project, as indicated in Division 00. This section covers the general requirements for the installation of the equipment by the Contractor.
 1. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
 2. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
 3. An appropriate construction schedule shall be developed by the Contractor and will be subject to approval by the customer's representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.
 4. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a "walk-through" of the project location with the customer's representatives to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.
 5. The Contractor shall be responsible for completing a standardized report form addressing the weekly progress of the installation schedule.
 6. The Contractor shall maintain conductor polarity identification at the main equipment room, backbone, and horizontal connections in accordance with industry practices.
 7. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.
 8. The Contractor shall be responsible for labeling all cable, distribution frames, and outlet locations, according to industry standards.
 9. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
 10. The Contractor shall not roll or store cable reels without an appropriate underlay.
 11. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
 12. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the installation Contractor during the implementation.
 13. The Contractor shall plug conduits where cabling has been installed by the installation Contractor in the equipment rooms, backbone and other cable entrance locations with re-entenable duct seal of flame-retardant putty.
 14. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.

15. Wiring, materials, and equipment will be delivered and stored in a clean dry space. They will be properly packaged in factory fabricated type containers and protected from damaging fumes, construction debris and traffic until job completion.
 16. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.
 17. All installation techniques and fixtures shall result in ease of maintenance and ready access to all components for testing measurements. All external screws, nuts, and locking washers shall be stainless steel. No self-tapping screws shall be used unless specifically approved by the customer's representatives. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass. All materials used in installation shall be resistant to fungus growth and moisture deterioration. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.
 18. The Contractor will submit for approval, a detailed description of the procedures and equipment included for the complete operational installation.
- B. Control Systems
1. Contractor shall meet with owner and whomever the Owner deems appropriate to discuss control features and navigation. Once agreement is received on the control navigation, the Contractor shall submit detailed documentation and GUI configuration and programming for approval. This process will continue until contractor obtains documented approval of control design. Contractor shall provide reasonable hours for changes once the system is operational to ensure the Owner's satisfaction. The control software shall be delivered to the Owner upon substantial completion of the project.
- C. Wiring Plan Requirements
1. Distribution of the cabling will be accomplished through cable trays, conduit raceways, ducts, core-holes, extended columns, false half columns and plenums. Cabling shall be run at right angles from cable trays. Horizontal cable segments will be placed in cable trays and with cable exits/entrances supported by distribution rings or J Hooks. Cable may not rest on ceiling tile, be supported on existing ducting, tied or supported by fire alarm, security or electrical infrastructure nor interlaced with existing cable.
 2. The Contractor shall be responsible for providing an approved ground at all equipment locations. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and frame-works. All grounds shall consist of minimum 12 AWG copper wire or larger as required by code and shall be supplied from an approved building ground and bonded to the main electrical ground.
 3. Observe proper circuit and loudspeaker wiring polarity. Properly and clearly label connections and wires as to function and polarity. No cables will be wired with polarity reversal between connectors, at either end. Take care when wiring microphone cables to ensure that constant polarity is maintained.
- D. Cable Management
1. Maintain segregation of cables. AC power cables or speaker cables should not be run parallel within close proximity to signal wires (within 2"), unless the wires are twisted.
 2. Bend radius for twisted-pair cables is standardized at 12" (3" diameter).
 3. Bundle cables within the guidelines of 2005 National Electrical Code (NEC) in Article 310.15(B)(2).
- E. Rack Dressing
1. All Racks require Lacer Bars or Strips to provide clean cable management withing the rack.
 2. All racks require the cable segregation of AC cables, Speaker Cables, low impedance balanced cabling and twisted pair cables.
 3. All AV Racks should be assembled and tested at the Contractor's facility and transported to the job site when possible.
 4. No Cable Ties; Velcro only.

- F. Identification, Labeling and Documentation
 - 1. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with permanently attached, self-laminating markings that will not impair the equipment or present a hazard to maintenance personnel.
 - 2. Place wire identification numbers on each end of all conductors. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed. Hand-written labels are not acceptable.
 - 3. Mark all spare conductors and coiled neatly located at the bottom of the equipment rack.

3.02 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: A factory representative shall be onsite to assist in system programming and commissioning.
- B. Perform the following field tests and inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing school intercom and program equipment and after electrical circuitry has been energized, test for compliance with requirements.
- C. Operational Test: Test originating station-to-station, all-call, and page messages at each intercom station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
- D. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
- E. Verify the server and devices are running the latest software revisions.

3.04 START UP SERVICE

- A. Engage a factory-authorized service representative to perform startup service and initial system programming.
- B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

3.05 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels and for any initial troubleshooting.

3.06 TESTING REQUIREMENTS

- A. The Contractor shall perform sample tests in the presence of the customer's representatives. Performing the testing procedures specified herein assures that the equipment and interconnection meets the performance characteristics specified. If testing indicates that the performance characteristics are not met, the test shall be declared a failure. The communication equipment and interconnection cabling shall be modified and/or repaired accordingly. The failed test and any other test that may be affected by the modification and/or repair shall be rerun. After all components have been installed, the integrity of the equipment and interconnection cabling shall be verified.
- B. If system test fails because of any component(s) in the system, the failed component(s) shall be corrected or substituted with other components and the tests shall be repeated. If a component has been modified because of the system test failure, a report shall be prepared and delivered to customer's representatives prior to retesting. The Contractor shall prepare and submit all test procedures and data forms for the post installation and system test to the customer's representatives.

- C. The test report shall contain the description of all tests performed, the results obtained, and any required adjustments or modifications necessary because of testing and installation. This report shall reflect the as-built communication equipment and interconnection cabling. An authorized representative of the Contractor shall sign the test report. At least three copies of the test report shall be sent to the customer's representatives.
- D. The test procedures shall have the Owner's representative's approval before the tests.
- E. Contractor shall demonstrate to the Owner's representatives that the equipment operates as specified and that the tests meet performance requirements.
- F. The Contractor shall ensure that the equipment is in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive hum, RF interference, or instability of any form.
- G. The Contractor shall test each operational component and adjust for equal sound levels at a given volume setting and replace defective items.
- H. Contractor shall ensure that all loudspeaker and distributed audio systems described herein are balanced and optimized for maximum quality sound and coverage of listening areas.

3.07 TRAINING

- A. System training shall be provided for the operator/user and technical staff.
 - 1. Operator/user training shall be held at Owner's convenience and to the Owner's satisfaction.
 - 2. Technical operation and maintenance training shall be held at Owner's convenience and to the Owner's satisfaction.
 - 3. The Contractor shall provide documentation demonstrating the Owner and/or Owner's Representatives understand the operation and maintenance of the system.
- B. Complete operation and maintenance manuals and preliminary as-built drawings shall be delivered to the Owner one week prior to training sessions.
- C. Operator/user training shall minimally consist of:
 - 1. Provide printed reference material for each trainee that documents and explains in lay-man's terms:
 - a. System block diagram
 - b. Normal day-to-day operation
 - c. Operator selectable features
 - 2. Provide a hands-on training with Q & A session
- D. Technical Operations and Maintenance training shall consist of:
 - 1. The technical explanation shall be sufficiently thorough that staff personnel shall be able to make any programming changes required, analyze malfunctions and make equipment substitutions or bypasses necessary to maintain system operation except for the malfunctioning equipment or circuits.
 - 2. Provide printed reference material for each trainee that documents and explains in technical terms:
 - a. System block diagram with technical features
 - b. Technical operation, adjustments and programming
 - c. System features and programming
 - d. Review of as-built drawings.
 - 3. Provide a hands-on training with Q & A session.
- E. Contractor will provide a complete and comprehensive list of the maintenance schedule for all installed and/or provided equipment. The list shall be provided in both printed and Adobe Acrobat formats.

3.08 ACCEPTANCE OF SYSTEMS

- A. Specifications set forth for construction of the system have been devised to insure system compatibility and performance. Compliance to these specifications will be determined during

periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the system commences.

- B. Prior to Contractor performed final testing, deliver preliminary as-build documents to Owner for use in conducting testing observation.
- C. Project Record Documentation
 - 1. Upon completion of final engineering and incorporation of the Architect review comments, Contractor will provide to the Architect for its records the following close out documentation prior to scheduling of Consultant Final Observation:
 - a. Record or As Build Drawings which shall include but not limited to:
 - 1) Functional block diagrams for Public Address System.
 - 2) All Public Address System junction box locations.
 - 3) Public Address equipment rack locations
 - 4) Rack elevations
 - (a) Rack elevations shall show all components as installed under this contract.
 - (b) Contractor will label each component describing the component. (
 - 5) Floor plan drawings with device locations and associated assigned item number.
 - 6) Mounting detail for equipment and hardware.
 - 7) Schedule of all devices with associated panel termination, zoning, power circuits, etc.
 - 8) Corrected product submittal information
 - b. A complete inventory list of installed products shall include:
 - 1) Manufacturer Name
 - 2) Model Number
 - 3) Serial Number
 - 4) Room number and/or description of installed location
 - c. Operation and Maintenance Manuals shall include
 - 1) Include detailed procedures for system operation that begin with startup procedures and continue through system shut down referenced in section 3.3 Training.
 - 2) List of manufacture recommended maintenance and intervals with manufacture support contact information.
- D. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings.
 - 1. Use of any part of the Architect title block is not acceptable at any time.
- E. Drawing documentation will be in the following format:
 - 1. Two (2) electronic copies, one per flash drive shall be provided.
 - a. Drawings will be in both CAD (DWG) and PDF format and the Contractor will include all files on each drive.
 - b. File transfer is acceptable.
 - 2. Drawings shall be provided to the architect two weeks prior to the final observation and commissioning of the system. Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.
 - 3. The drawings will be reviewed on site with the architect and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.
- F. Testing Results
 - 1. In addition to the project record drawings, the Contractor shall provide the testing information.
 - a. Test results shall be provided to the architect two weeks prior to expected final acceptance of the system(s). Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.

- b. Test results rejected for any reason will delay the final acceptance process until resolved.
- G. Once accepted by the Architect and Owner all documentation / program code becomes the property of the Owner
- H. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, declare substantial completion of the project.

3.09 WARRANTY

- A. The Contractor shall warrant and guarantee all work against defects in material, equipment or workmanship for one (1) year from the date of substantial completion of the entire project.
- B. Upon receipt of written notice, Contractor shall remedy defects within thirty (30) days or the Owner shall correct the defects and the Contractor, or its surety shall be liable for expenses.

END OF SECTION

**SECTION 28 0511
CYBERSECURITY REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Contractor shall coordinate with the Owner's information technology department to understand and conform to Owner's standards and guidelines for protecting systems from cyber threats. Contractor's key personnel responsible for device configuration and programming shall be trained in and follow industry best practices and manufacturer recommended practices related to cybersecurity for all devices, servers, software applications and other intelligent components deployed or altered under this scope of work.
- B. Related Requirements:
 - 1. Section 274116 "Integrated A/V Equipment"
 - 2. Section 281300 "Access Control System".
 - 3. Section 282300 "Video Surveillance".

1.03 INFORMATIONAL SUBMITTALS

- A. Provide to Contractor with proposal:
 - 1. Manufacturer cyber hardening manuals or guides.
 - 2. Sub-contractor's plan for secure assignment of unique strong passwords to all installed products requiring passwords.
 - 3. List of cloud services and providers to be provisioned.

1.04 CLOSEOUT SUBMITTALS

- A. Asset Management: Provide a secured spreadsheet, or equivalent summary, of all security devices and software installed to include:
 - 1. Manufacturer, model and firmware or software version.
 - 2. Serial number and MAC address, if applicable.
 - 3. Network settings, including IP address, VLAN or subnet mask, default gateway.
 - 4. Equipment location.
 - 5. Device user names and passwords.
- B. Licenses:
 - 1. License files and license key numbers.
 - 2. Additional codes required for operation.
- C. Services and ports:
 - 1. Summary of enabled and disabled product services.
 - 2. Summary of all open ports.
- D. Security recommendations:
 - 1. Summary of additional recommended physical, network or program actions to enhance the cybersecurity of the installation.
- E. Post-installation vulnerability test report.

1.05 QUALIFICATIONS

- A. Contractor personnel assigned to device programming and software installation shall have been certified in these tasks by the Manufacturer or possess industry certifications acceptable to the Manufacturer and the Owner attesting to the necessary competence.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Before installation of the system, the Contractor shall coordinate with the Owner's information technology department for the following:
 - 1. System network settings, including IP addressing, VLANs, firewall ports, et.al.
 - 2. Anti-virus, anti-malware and other prevention and detection tools on servers and client machines
 - 3. Operating system versions and patch levels on servers and client machines
 - 4. Needs and methods for allowing remote access
 - 5. Password provisioning plan. No devices shall be deployed using their manufacturer default passwords.
 - 6. An asset management worksheet, to include:
 - a. Manufacturer, model, and firmware or software version
 - b. Device logical names
 - c. Serial number and MAC address, if applicable
 - d. Network settings, including IP address, VLAN or subnet mask, default gateway
 - e. Equipment location
 - f. Device user names and passwords
- B. The Contractor shall insure that all devices to be installed possess the current version of manufacturer firmware or software.
- C. All security system components, including servers and client machines, shall be stored in a secure environment prior to installation.
- D. Installers shall follow all recommended procedures and guidelines from the Manufacturers to securely provision network connected products.
- E. The Contractor and its authorized installers shall:
 - 1. Complete the Owner-approved asset management worksheet.
 - 2. Synchronize security devices with a common time base acceptable to the Owner.
 - 3. Disable all services and ports not required for ongoing system operation, including ICMP and discovery protocols (subject to Owner's standards).
 - 4. Provision device and system privileges in a manner approved by the Owner.
 - 5. Ensure only secure versions of all protocols are used, to include HTTPS, SFTP, SNMP v3.

3.02 PHYSICAL ACCESS

- A. The Contractor and its authorized installers shall make the Owner aware of any physical condition or circumstance at the project site which it deems to constitute a potential cyber risk.

3.03 FIELD QUALITY CONTROL

- A. Testing:
 - 1. In conjunction with the Owner's information technology department, the Contractor shall arrange for a post-installation vulnerability test to verify that additional cyber vulnerabilities have not been introduced into the Owner's network by this project.

END OF SECTION

**SECTION 28 1300
ACCESS CONTROL SYSTEMS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Access control panels
 - 2. Power Supplies
 - 3. Door position sensors
 - 4. Access control cable
 - 5. Card readers
- B. Related Requirements:
 - 1. Section 083113 - Door Hardware
 - 2. Section 270500 – Common Work Results for Communications
 - 3. Section 282300 – Video Surveillance

1.03 REFERENCES

- A. ANSI/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces
- B. ANSI/TIA 862 – Building Automation Systems (BAS)
- C. ANSI/TIA 606 – Administration Standard for Commercial Telecommunications Infrastructures
- D. International Standards Organization/International Electro Technical Commission (ISO/IEC) DIS 11801,
- E. ANSI/TIA 862 – Building Automation Systems Cabling Standard for Commercial Buildings.
- F. ANSI/TIA 568 – Telecommunications Cabling for Commercial Buildings.
- G. International Standards Organization (ISO) 7816
- H. Underwriters Laboratories (UL) Cable Certification and Follow up Program
- I. National Electrical Manufacturers Association (NEMA)
- J. American Society for Testing Materials (ASTM)
- K. National Electric Code (NEC), Latest Issue
- L. Institute of Electrical and Electronic Engineers (IEEE)
- M. UL Testing Bulletin
- N. Comply with the current version (at time of construction) of all applicable codes and standards. If retaining below, also retain "Schedule" Paragraph in "Submittals" Article.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.
 - 1. Provide electronic copies in pdf format.
 - 2. Provide manufacturer cut sheets for each piece of equipment specified. Include the manufacturer name, model number and description of each listed component.
 - a. If the data sheet includes multiple part numbers or models the bidding Contractor will indicate which model is being submitted by marking the appropriate model number with an "X" or an arrow.
 - 3. Provide a copy of current manufacturer's certifications and state licenses for the company and for all personnel who will provide services on this project.

4. No portion of the work shall commence or equipment ordered until the consultant and Owner have approved the submittals.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Shop drawings are required for the submittal package and will contain the following information:
 - a. Indicate the location of each device as it appears inside the building. Devices shall include all cable pathways, door contacts, motion sensors, access control panels, request to exit devices and other devices associated with the access control system.
 - b. All door locations shall be numbered to match the current door numbers at the client facilities today. Do not use the architectural door numbers. Coordinate with the Owner on door number locations.
 - c. Provide panel elevation details indicating the location and quantity of all panels that will be required in the project on a per campus basis.
 - d. Line diagram drawings indicating the connecting points on the panel for all devices. This will include the door controllers, DPS, RTE, motion sensors, alarm buttons, and door release buttons.
 - e. System labeling schedules, including electronic copy of labeling schedules. Each device shall be labeled as per the direction of the Owner.
 2. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
 - a. Door hardware
 - b. Card readers
 - c. Door controllers
 - d. Other access control devices
 3. Cable Administration Drawings: As specified in "Identification" Article.
 4. Battery and charger calculations for central station, workstations, and controllers.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified by other specification sections.
- B. Closeout Submittals will be submitted under this section with the following provisions.
 1. Maintenance Data: Include manufacturer's operating instructions, original copies of all software, recommended maintenance required and maintenance intervals.
 2. A complete parts list.
 3. A spreadsheet containing the following information about the access control system:
 - a. Panel Name (Coordinate with Owner representative)
 - b. IP Address assigned to each panel (Obtained from Owner representative)
 - c. MDF or IDF room that the panel originates in as per the design documents
 - d. Port number of the patch panel where the panel is connected
 - e. Port number of the switch where the panel is connected. (Obtained in coordination with Owner representative)
 4. Record drawings shall show the following:
 - a. Update the original submittals of the floor plans. Relocate any device that may have been moved or altered during the life span of the project. Devices shall include all cable pathways, door contacts, motion sensors, access control panels, request to exit devices and other devices associated with the access control system.
 - b. Each device shall be labeled as per the direction of the Owner representative.
 - c. All door locations shall be numbered to match the current door numbers on the facility. Do not use the architectural door numbers. Coordinate with the Owner on door number locations.
 - d. Provide panel elevation details indicating the location and quantity of all panels that were installed as part of this contract.

- e. Update the line diagram drawings provided during the submittal phase that indicated device locations back to the panel. This will include any changes to the door controllers, DPS, RTE, Motion sensors, alarm buttons, and door release buttons.
- f. Title blocks used on all drawings will be that of the Contractor and shall include the following:
 - 1) Company name
 - 2) Company address and phone number for service
 - 3) Date on the drawings will match the date of acceptance for warranty purposes.
- 5. Drawing documentation will be in the following format:
 - a. Two (2) electronic copies on USB flash drives
 - 1) Drawings will be in both CAD (DWG) and PDF format and the Contractor will include all files on each drive.
 - 2) Provide all drawings in black and white. Do not provide electronic drawings in color.
- 6. Drawings shall be provided to the consultant for review and on-site acceptance prior to the Owner's final acceptance of the project.
 - a. The drawings will be reviewed on site with the consultant and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.
- C. Completed record drawing will be required for use during the final acceptance process of the construction project. Failure to produce the record drawing during this process will result in a delay in the final acceptance to the project.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Cable installer; refer to Division 27 for all network cabling requirements.
- B. Acceptable Manufacturer
 - 1. The following manufacturer's systems will be acceptable for this project:
 - Genetec
 - 2280 Alfred-Nobel Blvd., Suite 400
 - Montreal, Quebec H4S 2A4
 - Canada
- C. Contractor
 - 1. The Contractor shall provide proof from Genetec that they are a certified Preferred integrator.
 - 2. The Contractor will utilize the authorized manufacturer components and distribution channels in provisioning this project. Contractors must be prepared to submit authorized manufacturer factory training certificates.
 - 3. The proposed Contractor shall have a minimum of three (3) years of recent experience with the proposed manufacturer's products.
 - 4. Preferred Contractor shall have a minimum of five (5) years' experience with the design, programming, installation and project management of access and control systems.
 - 5. The Contractor shall comply with all federal, state and local statutes as required by the Cherokee Nation of Oklahoma regarding qualifications of firms.
 - 6. The Contractor shall have adequately trained personnel in the usage of such tools and equipment and shall provide a quantity of certified technicians as part of their submittal response.
 - 7. The Contractor must have previously established offices located within two hundred (200) miles of the Owner Administration Building.
 - 8. The Contractor shall provide proof of licensing by the state Labor Commission of Oklahoma.

9. The Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance or service response. A Contractor that has any prior finding(s) of a license violation or has any litigation in process is unacceptable.
 10. The Owner reserves the right to reject bid of any bidder who has previously failed to perform properly, or complete on time, contracts of a similar nature.
- D. Subcontractors
1. No portion of this project shall be performed by subcontractors. unless approved by Owner and / or Owner representative.
 2. Unqualified bidders may not partner with a qualified bidder for any reason.

1.07 PROJECT CONDITIONS

- A. The Contractor shall review contractor documents and field conditions prior to the work.
- B. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
- C. Do not begin installation until instructed to perform by the Owner or Owner's representative.
- D. While on campus or on any land owned by the Owner, all Contractors will comply with Owner policies concerning alcohol, tobacco and firearms as well as any other Owner policy governing dress, behavior etc.
- E. Coordinate with the Owner's technology department in obtaining all the required IP addresses.
- F. The Owner makes no representations as to the accuracy or completeness of the site information furnished to the Contractor by the Owner and does not expressly or impliedly warrant same and is not responsible for any interpretations or conclusions reached by the Contractor with respect thereto. It is Contractor's sole responsibility to verify to its own satisfaction all site information.
- G. The Contractor is responsible for having visited the site and ascertained pertinent local conditions such as location, accessibility, and character of the site or building, the character and extent of existing work within and adjacent to the site, and any other work being performed thereon at the time of the submission of his proposal. Any failure to do so will not relieve him from responsibility for successfully performing the work without additional expense to the Owner.
- H. The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the contract documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported to the Owner at once.
- I. If in the performance of the contract, subsurface, latent, or concealed conditions at the site are found to be materially different from the information included in this specification and related drawings, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in work of the character shown and specified, the Owner shall be notified in writing of such conditions before they are disturbed. A/E, with the approval of the Owner, will promptly make such changes the specifications as deemed necessary to conform to the different conditions, and any increase or decrease in the work, or in the time within which the work is to be completed, resulting from such changes will be adjusted by change order subject to the prior approval of the Owner.
- J. Before submitting its proposal to the Owner, and continuously after execution of the contract, the Contractor shall carefully study and compare this specification and shall at once report to the Owner any error, inconsistency or omission the Contractor may discover, including any requirements which may be contrary to any law, ordinance, rule, regulation or order of any public authority bearing on the performance of the work. By submitting its proposal for the contract and the work, the Contractor agrees that the specification and related drawings appear accurate, consistent, and complete insofar as can reasonably be determined. If the Contractor has reported in writing an error, inconsistency or omission, has promptly stopped the affected work

until otherwise instructed, and has otherwise followed the instructions of the Owner, the Contractor shall not be liable to the Owner for any damage resulting from any such errors, inconsistencies or omissions in this specification and resulting Contract documents. The Contractor shall perform no portion of the work at any time without the contract documents and, where required, approved project drawings, product data or samples for such portion of the work.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of the delivery storage and handling specification sections in the project specification book.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials protected from exposure to harmful environmental conditions and at temperature conditions recommended by manufacturer.
- D. Handle products and systems in accordance with manufacturer's instructions.
- E. Contractor is required to remove all empty containers and other trash associated with the system. This includes all packaging, excess cable and other materials that hold no value to the Owner.

1.09 WARRANTY

- A. Comply with requirements of project closeout submittals and this specification.
- B. The Contractor warrants to the Owner that all materials and equipment furnished under this specification will be new unless otherwise specified, and that all work will be of good quality, free from faults and defects and in conformance with this specification. All work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- C. The Contractor warrants the materials, workmanship, and work to be in conformance with the Contract documents included in this Project, for one full year from date of Acceptance unless a longer warranty or special guarantee is specified. Contractor shall assign to Owner all warranties and guarantees from or rights against any manufacturer, supplier or distributor of equipment, fixtures and other material installed in or incorporated in the Work at the time of Acceptance by Owner.
- D. The warranty binds the Contractor to correct any work that does not conform to such Contract documents or any defects in workmanship or materials furnished under this contract which may be discovered within the one-year period. The Contractor shall, at its own expense, correct such defect after receiving notice from the Owner by repairing same to the condition called for in the Contract documents.
- E. Contractor shall warrantee the repaired/replace item for one year from date of repair/replace-ment. This warranty shall cover parts, labor, travel, and all other expenses.
- F. All replacement, installation, integration, maintenance, and testing provided in conjunction with the warranty provisions of such contract will be provided at no additional cost to the Owner.
- G. Warranty service shall be on a 24-hour/day, 365-day/year basis with a response time not to exceed six (6) hours. The respondent shall certify that its proposed service facility shall initiate, within 1 business day, on-site repair to any critical system product that fails while under warranty will be provided at no additional cost to the Owner.
- H. From date of project acceptance, Contractor shall provide biannual maintenance visit to ensure the system is functioning properly and that all devices are in good, working order and free from defects or damage. Maintenance visits shall be documented to include any issues and steps taken to remedy those issues. Including but not limited the following actions:

1. Access control systems devices and equipment including but not limited to panels, power supplies, card readers, door contacts, enclosures, etc.
 2. Software programming
 3. Calibration
 4. Cabling
- I. Upon receipt of written notice, Contractor shall remedy defects within two (2) calendar days or the Owner shall seek other means to correct the defects and the Contractor or its surety shall be liable for expenses.
1. If it becomes necessary for the Owner to contract out for warranty repairs, due to an inability or failure of the Contractor to perform such repairs, the Contractor shall reimburse the Owner for all invoices for parts, labor, materials, travel, per-diem, and all other related expenses such as shipping/handling costs to perform such repairs, within 30 days from presentation of an invoice from the Owner. This shall only occur after the Contractor has been given two (2) calendar days to remedy the problem. The cost limitation for such repairs will not exceed the actual costs as listed above which are directly related to the repair.

PART 2 PRODUCTS

2.01 CONTROL AND NETWORK CABLES AND PATHWAYS

- A. The Contractor will provide all pathways and control cabling for all RTE devices, door position switches, door release buttons, alarm buttons and card readers as required providing a complete and functioning system. All conduits and back boxes shall be provided by Division 26.
- B. Contractor will refer to the drawing for any locations of the devices and connect them into the required access control panels. All devices shown on the drawings will be considered a monitored device.
- C. All cabling for the approved manufacturer's hardware must meet the factory specifications, including the requirements for cable that is stranded, twisted, with an overall shield to eliminate electrical interference.
- D. Pair counts and wire gauge must meet the approved manufacturer's specifications based upon the distances and power level required.
- E. Plastic tie wraps are not permitted at any time on this project. All pathway areas shall be secured by the Contractor with Velcro tie wraps to secure cable bundles.
- F. All above-ceiling cabling installed for this system will be supported with j-hooks and/or cable tray where available secured to the building structural steel, walls, or by dedicated all thread rods or dedicated grid wire. Contractor will not share pathways with any other low voltage structured cable plant and will not use the grid wire that is supporting the ceiling at any time.
 1. Contractor will not secure j-hooks to the ceiling grid wire for any reason. Grid wire may be used to support independent j-hooks providing it is properly secured to the building structure. J-hooks will be spaced 48" - 60" apart.
- G. Cable pathways will not rest upon or be secured to ducts, pipes, or other utilities found in the overhead ceiling. Pathways not conforming to these requirements will be replaced or repaired by the Contractor immediately.
- H. Any cables showing signs of excessive bending or mishandling that result in damage to the cable jacket will be replaced at Contractor's expense.
- I. All cables and components, including but not limited to above-ceiling, in-wall, in-slab and underground shall be rated for the environment in which they are installed.
- J. The Contractor will use their own sleeves as needed to penetrate any walls and will fire stop the sleeves to meet all applicable codes. It will be the Contractor's responsibility to plan for any such penetrations. Wiring run through any penetration without a proper sleeve will be removed and replaced at the Contractor's expense. All sleeves shall require plastic bushings on each end of the sleeve. Contractors installing cabling in conduit sleeves without bushings shall replace the entire pathway.

- K. Conduit pathways shall be provided in all exterior door locations and on interior locations as needed. The Owner will not accept any exposed wiring for any reason below the ceiling. Coordinate all pathway rough in with other trades prior to the rough in and installation of the door frames. Bushings shall be provided and installed by the electrical Contractor in all cases where the electrical Contractor provides the conduit pathway or sleeves. Electrical Contractor should provide pathway trim-out at each door location.

2.02 ACCESS CONTROL PANELS

- A. Contractor will size out the appropriate Genetec manufactured wall mounted panel to accept the number of readers and inputs as shown on the drawings. The Genetec Synergis Cloud Link and Genetec Synergis Master Controller will connect to the Genetec controller located in the MDF.
- B. Contractor shall ensure all portal licenses meet the requirements of the current facility design and upgrade the software as required. Contractor shall add additional portal licenses to include 10 Client/Web connections, 5 mobile connections, 2 USB enrollment readers, Life Safety Power Supply Integration and 1-Year Software Maintenance Agreement (SMA) with pricing options for 3-year and 5-year SMA.
- C. Contractor will provide and install the access control panels in the identified rooms as needed.
 - 1. Acceptable Manufacturers
 - a. Mercury
 - 1) LP1502
 - 2) MR52-S3
 - 3) MR16OUT-S3
 - 4) MR16IN-S3
 - 5) Synergis Cloud Link
 - b. Contractor will coordinate with the Owner Technology Department on obtaining the proper I.P. address for the panels as needed.
- D. The Contractor will provide and install a dedicated power supply for all panel locations. Coordinate with Division 26 on the hard wiring of the power supply. The use of power cords or plug-in transformers for power supplies is not permitted.
- E. All access control panels will be installed on the provided plywood backboards in a centralized architecture back to the MDF/IDF based on reader and input counts and locations.
 - 1. Contractors who place the panel in locations not approved on the contract documents or by written authorization from the Architect will be required to move the panel to the approved location. Such a move will be performed at the Contractor's expense.
- F. A dedicated data drop shall be provided above ceiling from the panel location by Division 27. Contractor shall provide and install a conduit pathway from the top of the panel up to the ceiling space located directly above the panel for the patch cable pathway. Provide and install a white plastic bushing on the end of all conduits used for this connection.
 - 1. The patch cable shall be provided by Division 27 and the Contractor shall connect the patch cable from the faceplate above the ceiling to the panel.
- G. Owner Technology will plug in the patch cable from the patch panel to the switch. Coordinate with Owner Technology on this process.
- H. All access control panels shall have an 8 ½ by 11 laminated layout that has the following information placed inside or adjacent to the panel location. Contractor shall provide a mock-up of this document prior to deploying it inside the control panels.
 - 1. In the upper left corner of the layout provide the name of the installing company, phone number and State Security License number.
 - 2. In the upper right corner of the page provide the Name of the campus, the MDF or IDF room location.
 - 3. IP Address of the panel will be placed under the MDF / IDF room I.D., provide the subnet mask beneath the IP address.
 - 4. Place the gateway IP address information below the subnet mask

5. Place the service contract information (contact and phone number or just phone number will be acceptable)
6. Beneath the common information provide a line diagram showing each blade location and the name of the device attached to each input on each card.
7. All wiring shall be neatly dressed to each device input location and labeled within 1" of the termination at the input. Wiring includes all devices and the wiring bringing in the power for the power supply.
8. Wire all tamper switches on each control panel door back into the system.
9. Label the battery and power supply location with the name of the campus, the MDF or IDF room location (MDF, IDF A etc.) and the date in which the battery was installed. Labels shall consist of white backgrounds with black letters with a large font. Machine generated adhesive labels only. Nothing handwritten shall be acceptable.

2.03 TAMPER SWITCHES

- A. Wire all tamper switches on each control panel door back into the system.
 1. Acceptable Manufacturer:
 - a. Sentrol
 - b. GRI
 - c. Ademco
- B. Provide a tamper switch to sense the opening of all security equipment enclosures.
- C. Plunger type actuator sensor.
- D. Switch configuration normally closed when enclosure door is shut.

2.04 DOOR HARDWARE POWER SUPPLY

- A. Provide as required power supply(s) and battery backup, U.L. Listed and labeled for access control systems.
- B. Provide low battery reporting as an integration into the Genetec access control system programming. Standby battery operation time shall equal, or exceed, the standby operation time of the main panel; in any case, provide a minimum of 12 amp hours battery backup.
- C. Provide a U.L. Listed cabinet suitable for surface mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and a painted standard finish. The back box and door shall be constructed of 0.060" minimum steel with provisions for electrical conduit connections into the sides and top. The cabinet shall provide storage for backup batteries. The door shall provide a key lock to access system components, key alike with main panel. The cabinet shall be attack resistant and fitted with front and back tamper switches. All components shall be securely mounted and all cable routed and tie wrapped in a neat, professional manner.
- D. All cables will route via conduit pathways connecting the main power supply to the main alarm panel location. Placement of this sleeve is the responsibility of the Contractor.
- E. Division 26 shall provide power through a 120 VAC, 20-ampere breaker from spares scheduled in nearest panel.
- F. All electrical wiring shall be done on terminal strips – no wire nuts or caps are permitted at any time on any panel.
 1. Acceptable Manufacturer:
 - a. Altronix power supplies.
 - b. LifeSafety Power
 - c. Or approved equal
- G. Label the location of the circuit and electrical panel supporting the power supply inside the power supply cabinet and inside the access control cabinet.

2.05 DOOR POSITION SWITCHES

- A. Contractor shall provide and install new door contacts in the top of all new door frame locations or attached to the doors using surface mounted devices as shown on the plans.

- B. Flush Mount Door Position Switches
 - 1. Acceptable Manufacturer:
 - a. GE Sentrol 1078
 - b. Or approved equal

2.06 REQUEST TO EXIT DEVICES

- A. Door hardware shall utilize integrated request to exit devices by division 08.
- B. Security contractor shall be responsible for connecting the device into the access control system and ensuring proper operation.

2.07 CARD READERS

- A. See drawings for quantities and locations of card readers:
 - 1. Standard Readers:
 - a. HID SIGNO - WALL MOUNT.
 - b. HID SIGNO – MULLION MOUNT.
 - c. Wall and mullion mounted readers are not to be used interchangeably. See drawings for reader details.
- B. Route the required wiring to the nearest access control panel in a Contractor provided pathway.
- C. Some card readers may not be used in this project. Wall mount readers are preferred in all locations for card readers, mullion mounts are only to be used where a wall mount is not possible, and the Contractor shall obtain written approval prior to use of mullion mount card readers.

2.08 WIRE AND CABLE

- A. Minimum Specifications:
 - 1. All wire and cable shall be: UL approved, meet all national, state and local codes, and manufacturer's recommendations for connected components for its intended application.
 - 2. Cables installed shall be rated for the environment in which they are installed.
 - 3. Insulation shall be rated for a minimum of 300 volts.
 - 4. Conductors shall be 100% copper.
 - 5. Cable shall be shielded where required by equipment manufacturer.
- B. Minimum wire types and sizes:
 - 1. Low Voltage Power Cable - 14 to 18 AWG, twisted, stranded CL2P. AWG based on supplied current and distance.
 - 2. Alarm Point Monitoring Cable - 20 AWG, twisted, stranded CL2P
 - 3. Card Reader Cable - 20 AWG twisted, stranded, shielded CL2P
 - 4. Control Point Cable - 18 AWG twisted, stranded CL2P
- C. Composite/Banana cable required:
 - 1. Acceptable Manufacturer:
 - a. General
 - b. Or approved equal

2.09 VIDEO INTERCOM/DOOR STATION

- A. Contractor shall furnish and install a video intercom at locations shown on drawings.
- B. Intercom shall provide two way audio as well as video to the workstation indicated via Genetec integration.
- C. Intercom shall be capable of unlocking associated door via means of initiating valid access granted via access control software.
- D. Approved hardware:
 - 1. Mullion Mounted:
 - a. Axis 88116-E Network Video Intercom
 - 2. Standard wall mounted:
 - a. Axis A8207-VE MKII

- E. Contractor shall provide SD card for each door station.
- F. Approved hardware:
 - 1. Axis 64GB SD Card.

2.10 ACCESS CONTROL SOFTWARE

- A. Owner's standard is Genetec Synergis, Enterprise
- B. Site will attach to Owner's existing Genetec site ID.
- C. Site will utilize Owner's existing Genetec Synergis Site license.
- D. The Contractor will be responsible for furnishing all necessary reader licenses.

2.11 ACCESS CONTROL SERVER/SERVER HARDWARE

- A. This site will utilize the Owner's existing directory server.

2.12 SOFTWARE/LICENSING

- A. The Owner's standard is Genetec Synergis Enterprise.
- B. Owner's existing site ID will be utilized, the contractor shall be responsible for furnishing all necessary reader licenses required as well as any other licensing requirements beyond the site ID.
- C. Coordinate license purchasing with Owner upon bid award for site ID information.

2.13 DOOR RELEASE BUTTONS

- A. Contractor shall furnish and install door release buttons as indicated on the drawings.
- B. Door release buttons shall log valid access granted in the access control software.
- C. Approved hardware:
 - 1. United Security Products HUB-2SA
 - 2. Approved equivalent

2.14 DURESS BUTTONS

- A. Contractor shall furnish and install duress buttons mounted under workstation installed in a discrete accessible location.
- B. Duress buttons shall be different in look and feel from the door release buttons to prevent accidental use.
- C. Coordinate with Owner prior to finalizing installation for duress sequence programming.
- D. Approved hardware:
 - 1. HUB-2S-ES

2.15 MISCELLANEOUS EQUIPMENT

- A. The Contractor will provide any necessary consumable materials and support hardware necessary to facilitate the installation of the System.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Furnish and install, complete with all accessories and functioning access control system from Genetec for the Cherokee Nation of Oklahoma (Owner) Child Development Center.
- B. Unless otherwise stated in this specification, all equipment, material, and articles incorporated in the work covered by this specification are to be new and of the most suitable grade for the purpose intended.
- C. All work under this Contract shall be performed in a skillful and professional manner. The Contractor agrees to employ only orderly and competent employees, skillful in the performance of the type of work required under this contract; and agrees that whenever informed by the Owner in writing that any employee(s) on the work is (are), in its opinion, incompetent, unfaithful or disorderly, shall be discharged from the work and shall not again be employed on the work without the Owner's written consent.

- D. Materials or work described in words, which so applied, have a well-known technical or trade meaning shall be held to refer to such recognized standards. Neither custom nor usage of trade shall require the Owner to accept materials or workmanship not in strict and complete compliance with the contract documents.
- E. The Contractor shall provide all materials, equipment, labor and all other incidental materials and appliances necessary, as described herein and in the drawings, to provide a complete turn-key and functional system, regardless of any materials and/or equipment not listed or described in this specification and/or supplementary drawings.
- F. Refer to the technology drawings for all device locations.
- G. The Contractor shall provide all necessary devices on the access control system, per the installation instructions furnished with each product and as outlined in this specification.
- H. The system will be monitored by the Owners' personnel. The Contractor will set the system to provide email and SMS messaging to the required parties during the programming phase of this project.
- I. Provide operational programming support.
- J. The Contractor shall be responsible for providing integrated lock power. This will allow for the integration with Genetec to show low battery, loss of lock power, recycle lock power, etc. in the Genetec Security Desk interface.
- K. Division 8 shall obtain all lock permits required for the Local Authorities Having Jurisdiction.
- L. Wiring color codes will be strictly observed, and terminations will be uniform throughout the system.
- M. Identification markings and systems will be uniform.
- N. The Contractor shall perform the work in accordance with the Contract documents and submittals as well as all local and state codes.

3.02 SPECIAL REQUIREMENTS FOR CABLE ROUTING AND INSTALLATION

- A. Cabling
 - 1. All cabling used throughout this project will comply with the requirements as outlined in the National Electric Code (NEC) Articles 725, 760, 770, and 800 and the appropriate local codes.
 - 2. All copper cabling will bear the appropriate markings for the environment in which they are installed.
 - 3. Cabling shall be supported with continuous supports, J-hooks, spaced 48-60" apart. Secure J-hooks to building structure, all thread or a dedicated grid wire. Do not support pathways from existing trades such as plumbing, fire suppression or HVAC. Do not hang wiring from electrical conduits or allow the wiring to touch any other device, trade, structure of the building etc.
- B. Fire Stopping
 - 1. Fire stopping equipment and practices will comply with applicable national and local codes.
 - 2. Sealing of openings between floors, through rated fire and smoke walls, existing or created by the Contractor for cable pass through will be the responsibility of the Contractor.
 - 3. Sealing material and application of this material will be accomplished in such a manner, which is acceptable to the local fire and building authorities having jurisdiction over this work.
 - 4. Creation of such openings as are necessary for cable passage between locations as shown on the drawings will be the responsibility of the Contractor's work.
 - 5. Any openings created by or for the Contractor and left unused will also be sealed as part of this work.
- C. Contractor Responsibility

1. The Contractor will be responsible for damage to any surfaces or work disrupted because of this work. Repair of surfaces, including painting, will be included as necessary.
2. The Contractor will rectify damaged caused at the Contractor's sole expense.

3.03 PRIMARY SERVER DATABASE AND PROGRAMMING REQUIREMENTS

- A. The system must be able to report the programmed alarm events through various means of communication including email, SMS Text and through the client software.
- B. The system will be required to record images based on criteria established in the specifications for all interior and exterior camera locations.
- C. The system will utilize a structured cable plant provided by Division 27.
- D. The system cameras shall be incorporated into the Genetec access control system by the Contractor.
- E. Programing all new device, panel and controller locations into the new system.
 1. Program each panel and program into the network.
 - a. All necessary IP addresses and VLAN configurations will be provided by the Owner's technology department.
 2. Contractor Programing
 - a. All inputs, outputs, card readers, locks, card reader groups, portal group's access levels shall be set in coordination with the Owner.
 - b. Integration with Active Directory – coordinate with the Owner prior to start of work. This will include setting up automatic updates from Software (used by the Owners technology department).
 - c. Load all staff data into the data base as directed by the Owner.
 - d. Emergency alarm buttons shall be programmed per item 2.8.
 - e. Credential permissions. Coordinate with Owner.
 3. Owner Programming
 - a. Time schedule and time schedule groups will be set up by the Owner.
- F. It will be the responsibility of the Contractor to obtain the electronic copies of the floor plans from the Architect through the Owner's Representative for the creation of the campus map.
 1. Campus floor plans shall be created for each facility and shall show the following status changes at all monitored door locations.
 - a. All monitored door location statuses.
 - 1) Door closed event
 - 2) Door open event
 - 3) Door forced event
 - 4) Door held open alarm
 - 5) Certain doors may need additional event programming such as after-hours alerts. Coordinate with CNO surveillance for event coordination.

3.04 TRAINING ON ACCESS CONTROL SYSTEM

- A. Submit training plans and instructor qualifications in accordance with the requirements of this Section.
- B. Develop separate training modules for the following:
 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
 2. Operators: create and program credentials, manage the control station and workstations, and enroll personnel.
 3. Security personnel.
 4. Hardware maintenance personnel.
 5. Corporate management.

- C. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for Owner personnel. Training shall include general information on new system layout including MDF/IDF locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
- D. Provide the security personnel and IT systems administrators with training in the use, operation, and maintenance of the entire access control system. The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Contractor shall provide up to two (2) additional, full-system training sessions during the one year warranty period at the request of the facility staff. Coordinate the total of four (4) training sessions with the Owner. Completed facility sessions will be witnessed and documented by the Architect/Security Consultant or Owner's Representative, and approved by the Owners' representative. Instruction is not to begin until the system is operational as designed.
- E. The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
- F. Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
- G. Training Software: Enables operators to practice system operation including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- H. All testing and training shall be compliant with the manufacturer.

3.05 TESTING WARRANTY SERVICES

- A. A factory-trained representative of the manufacturer shall supervise the final connections and testing of the system, and it shall be subject to the final acceptance of the Architect/Engineer and Owner.
- B. Contractor shall make a thorough inspection of all device locations to ensure the following:
 - 1. Confirm all devices are properly located and connected as per the technology drawings, construction specification documents and manufacturer's best practices or installation instructions for a complete and functional system.
- C. The Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

3.06 LABELING

- A. System components and wiring shall be comprehensively labeled.
 - 1. All labels shall be machine generated.
 - 2. Handwritten labels are not acceptable.

3.07 TECHNICAL SUPPORT

- A. Contractor shall provide on-site, move day technical support on per/hour basis at such levels and at such times as the Owner deems necessary during the physical move to the site.
- B. The personnel providing technical support will:

1. Have thorough and in-depth knowledge of the System and Materials that were used as well as have direct project experience.
2. Be skilled in all use of equipment and materials used under the Contract.
3. Be competent to troubleshoot and fix problems associated with Contractor provided materials.

3.08 FINAL ACCEPTANCE

- A. The integrator will perform on-going reviews of all work for compliance with the contract documents with a representative from the Architect. All work will be performed in a high-quality manner and the overall appearance will be clean, neat and orderly.
- B. The following is a partial list of items that will be examined and will comply satisfactorily in all instances during the final acceptance process.
 1. Is the cable plant properly installed as per these specifications?
 2. Do all pathway methods and materials meet Owner established pathway standards as well as ANSI/TIA-569 and 862?
 3. Are all pathway penetrations properly fire stopped?
 4. Are all labeling inside the control panels machine generated?
 5. Has the floor plan been set up in the access control system and does it show all card reader locations as requested?
 6. Confirm the successful operation of the door release button in the receptionist desk area.
 7. Confirm the function of the door release and alarm button functions.
 8. Verify all REX devices are operational and functioning within the system.
 9. Verify function of all motion detection. Verify no false alarms through movement along the exterior windows.
 10. Verify all proximity readers are correctly operating and reporting.
 11. Has the system been programmed with all the features requested by the Owner?
 12. Demonstration and training shall be performed prior to system acceptance.
 13. Have all record drawings and deliverables been transmitted to Owner through and approved by the Architect?

END OF SECTION

SECTION 28 2300
VIDEO SURVEILLANCE SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
- B. Related Requirements:
 - 1. Section 270500 – Common Work Results for Communications
 - 2. Section 281300 – Access Control Systems

1.03 REFERENCES

- A. ANSI/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces
- B. ANSI/TIA 862 – Building Automation Systems (BAS)
- C. ANSI/TIA 606 – Administration Standard for Commercial Telecommunications Infrastructures
- D. International Standards Organization/International Electro Technical Commission (ISO/IEC) DIS 11801,
- E. ANSI/TIA 862 – Building Automation Systems Cabling Standard for Commercial Buildings.
- F. ANSI/TIA 568 - Telecommunications Cabling for Commercial Buildings.
- G. International Standards Organization (ISO) 7816
- H. Underwriters Laboratories (UL®) Cable Certification and Follow up Program
- I. National Electrical Manufacturers Association (NEMA)
- J. American Society for Testing Materials (ASTM)
- K. National Electric Code (NEC®), Latest Issue
- L. Institute of Electrical and Electronic Engineers (IEEE)
- M. UL Testing Bulletin
- N. Comply with the current version (at time of construction) of all applicable codes and standards.

1.04 ACTION SUBMITTALS

- A. Provide product data cut sheets for all listed products in section two of this specification with the following provisions:
 - 1. Provide electronic copies in pdf format.
 - 2. Shop drawings are required for the submittal package and will contain the following information:
 - a. Indicate the location of each device as it appears inside the building. Devices shall include all cable pathways, cameras and other devices associated with the video surveillance system.
 - b. Each device shall be labeled as per the direction of the Owner representative.
 - c. Line diagram drawings indicating the connecting points for all devices.
 - 3. Provide manufacturer cut sheets for each piece of equipment specified. Include the manufacturer name, model number and description of each listed component.
 - a. If the data sheet includes multiple part numbers or models the Contractor will indicate which model is being submitted by marking the appropriate model number with an “X” or an arrow.
 - 4. Provide a copy of current manufacturer’s certifications for the company and for all personnel who will provide services on this project.

- B. No portion of the work shall commence, or equipment ordered until the consultant and Owner have approved the submittals.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified by other specification sections.
- B. Closeout Submittals will be submitted under this section with the following provisions.
 - 1. Maintenance Data: Include manufacturer's operating instructions, original copies of all software, recommended maintenance required and maintenance intervals.
 - 2. A complete parts list.
 - 3. A spreadsheet containing the following information about the video surveillance system:
 - a. Camera numbers IP Address assigned to each device (Obtained from Owner representative)
 - b. MDF or IDF room that the cable originates from as per the design documents.
 - c. Port number of the patch panel where the device is connected (If applicable).
 - d. Port number of the switch or ONT where the device is connected. (Obtained in coordination with Owner representative)
 - 4. Record drawings shall show the following:
 - a. Update the original submittals of the floor plans. Relocate any device that may have been moved or altered during the life span of the project.
 - b. Each device shall be labeled as per the direction of the Owner representative.
 - c. Update the line diagram drawings provided during the submittal phase that indicated device locations back to the IDF. This will include any changes to the camera numbering or locations.
 - d. Title blocks used on all drawings will be that of the Contractor and shall include the following:
 - 1) Company name
 - 2) Company address and phone number for service
 - 3) Date on the drawings will match the date of acceptance for warranty purposes.
 - 5. Drawing documentation will be in the following format:
 - a. Two (2) electronic copies
 - 1) Drawings will be in PDF format and the Contractor will include all files on each drive.
 - 2) Provide all drawings in black and white. Do not provide electronic drawings in color.
 - 6. Drawings shall be provided to the consultant for review and on-site acceptance prior to the Owner's final acceptance of the project.
 - a. The drawings will be reviewed on site with the consultant and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.
 - b. Completed record drawing will be required for use during the final acceptance process of the construction project. Failure to produce the record drawing during this process will result in a delay in the final acceptance to the project.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Cable installer; refer to Division 27 for all network cabling requirements.
- B. The following manufacturer is the Owner-standard for the video management system:
 - 1. Genetec
- C. The following camera manufacturers shall be allowed on this project:
 - 1. Axis
- D. Contractor

1. The Contractor shall provide proof from the specified manufacturer that they are Genetec Preferred authorized integrator.
 2. The Contractor will utilize the authorized manufacturer components and distribution channels in provisioning this project. Contractors must be prepared to submit authorized manufacturer factory training certificates.
 3. The proposed Contractor shall have a minimum of three (3) years of recent experience with the proposed manufacturer's products.
 4. Preferred Contractor shall have a minimum of five (5) years' experience with the design, programming, installation and project management of video surveillance systems.
 5. The Contractor shall comply with all federal, state and local statutes as required by the Cherokee Nation of Oklahoma regarding qualifications of firms.
 6. The Contractor shall have adequately trained personnel in the usage of such tools and equipment and shall provide a quantity of certified technicians as part of their submittal response.
 7. The Contractor must have previously established offices located within two hundred (200) miles of the Owner Administration Building.
 8. The Contractor shall provide proof of licensing by the state Labor Commission of Oklahoma.
 9. The Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance or service response. A Contractor that has any prior finding(s) of a license violation or has any litigation in process is unacceptable.
 10. The Owner reserves the right to reject bid of any bidder who has previously failed to perform properly, or complete on time, contracts of a similar nature.
- E. Subcontractors
1. No portion of this project shall be performed by subcontractors. unless approved by Owner and / or Owner representative.
- F. Unqualified bidders may not partner with a qualified bidder for any reason.

1.07 PROJECT CONDITIONS

- A. The Contractor shall review contractor documents and field conditions prior to the work.
- B. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
- C. Do not begin installation until instructed to perform by the Owner or Owner's representative.
- D. While on campus or on any land owned by the Owner all Contractors will comply with Owner policies concerning alcohol, tobacco and firearms as well as any other Owner policy governing dress, behavior etc.
- E. Coordinate with the Owner Technology Department in obtaining all the required IP addresses
- F. The Owner makes no representations as to the accuracy or completeness of the site information furnished to the Contractor by the Owner and does not expressly or impliedly warrant same and is not responsible for any interpretations or conclusions reached by the Contractor with respect thereto. It is Contractor's sole responsibility to verify to its own satisfaction all site information.
- G. The Contractor is responsible for having visited the site and ascertained pertinent local conditions such as location, accessibility, and character of the site or building, the character and extent of existing work within and adjacent to the site, and any other work being performed thereon at the time of the submission of his proposal. Any failure to do so will not relieve him from responsibility for successfully performing the work without additional expense to the Owner.
- H. The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the contract documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported to the Owner at once.

- I. If in the performance of the contract, subsurface, latent, or concealed conditions at the site are found to be materially different from the information included in this specification and related drawings, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in work of the character shown and specified, the Owner shall be notified in writing of such conditions before they are disturbed. A/E, with the approval of the Owner, will promptly make such changes the specifications as deemed necessary to conform to the different conditions, and any increase or decrease in the work, or in the time within which the work is to be completed, resulting from such changes will be adjusted by change order subject to the prior approval of the Owner.
- J. Before submitting its proposal to the Owner, and continuously after execution of the contract, the Contractor shall carefully study and compare this specification and shall at once report to the Owner any error, inconsistency or omission the Contractor may discover, including any requirements which may be contrary to any law, ordinance, rule, regulation or order of any public authority bearing on the performance of the work. By submitting its proposal for the contract and the work, the Contractor agrees that the specification and related drawings appear accurate, consistent, and complete insofar as can reasonably be determined. If the Contractor has reported in writing an error, inconsistency or omission, has promptly stopped the affected work until otherwise instructed, and has otherwise followed the instructions of the Owner, the Contractor shall not be liable to the Owner for any damage resulting from any such errors, inconsistencies or omissions in this specification and resulting Contract documents. The Contractor shall perform no portion of the work at any time without the contract documents and, where required, approved project drawings, product data or samples for such portion of the work.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of the delivery storage and handling specification sections in the project specification book.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials protected from exposure to harmful environmental conditions and at temperature conditions recommended by manufacturer.
- D. Handle products and systems in accordance with manufacturer's instructions.
- E. Contractor is required to remove all empty containers and other trash associated with the system. This includes all packaging, excess cable and other materials that hold no value to the Owner.

1.09 WARRANTY

- A. Comply with requirements of project closeout submittals and this specification.
- B. The Contractor warrants to the Owner that all materials and equipment furnished under this specification will be new unless otherwise specified, and that all work will be of good quality, free from faults and defects and in conformance with this specification. All work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- C. The Contractor warrants the materials, workmanship, and work to be in conformance with the Contract documents included in this Project, for one full year from date of Acceptance unless a longer warranty or special guarantee is specified. Contractor shall assign to Owner all warranties and guarantees from or rights against any manufacturer, supplier or distributor of equipment, fixtures and other material installed in or incorporated in the Work at the time of Acceptance by Owner.
- D. The warranty binds the Contractor to correct any work that does not conform to such Contract documents or any defects in workmanship or materials furnished under this contract which may be discovered within the one-year period. The Contractor shall, at its own expense, correct

such defect after receiving notice from the Owner by repairing same to the condition called for in the Contract documents.

- E. Contractor shall warrantee the repaired/replace item for one year from date of repair/replacement. This warranty shall cover parts, labor, travel and all other expenses.
- F. All replacement, installation, integration, maintenance, and testing provided in conjunction with the warranty provisions of such contract will be provided at no additional cost to the Owner.
- G. Warranty service shall be on a 24-hour/day, 365-day/year basis with a response time not to exceed six (6) hours. The respondent shall certify that its proposed service facility shall initiate, within 1 business day, on-site repair to any critical system product that fails while under warranty will be provided at no additional cost to the Owner.
- H. From date of project acceptance, Contractor shall provide biannual maintenance visit to ensure the system is functioning properly and that all devices are in good, working order and free from defects or damage. Maintenance visits shall be documented to include any issues and steps taken to remedy those issues. Including but not limited the following actions:
 - 1. Video surveillance systems devices and equipment including but not limited to cameras, enclosures, mounts, etc.
 - 2. Software programming
 - 3. Calibration
 - 4. Cabling
- I. Upon receipt of written notice, Contractor shall remedy defects within two (2) calendar days or the Owner shall seek other means to correct the defects and the Contractor or its surety shall be liable for expenses.
 - 1. If it becomes necessary for the Owner to contract out for warranty repairs, due to an inability or failure of the Contractor to perform such repairs, the Contractor shall reimburse the Owner for all invoices for parts, labor, materials, travel, per-diem, and all other related expenses such as shipping/handling costs to perform such repairs, within 30 days from presentation of an invoice from the Owner. This shall only occur after the Contractor has been given two (2) calendar days to remedy the problem. The cost limitation for such repairs will not exceed the actual costs as listed above which are directly related to the repair.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers and model numbers shall not be substituted without specific notice in an addendum or other formal documentation process. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Owner, of equivalent or better quality than that of the product specified.
- B. Acceptable VMS manufacturer: Genetec
- C. Acceptable Camera manufacturer: AXIS
 - 1. AXIS – M3077-PLE:
 - 2. AXIS – M4317-PLVE
 - 3. AXIS – P4705-PLVE
 - 4. AXIS – P4707-PLVE
 - 5. AXIS – M4308-PLE
 - 6. AXIS – M3216-LVE
 - 7. AXIS – M3085-V
 - 8. AXIS – M3086-V
 - 9. AXIS – P1375
 - 10. AXIS – P1468-PLE

2.02 CONTROL AND NETWORK CABLES

- A. The data cable plant for all surveillance camera devices shall be installed by division 27. This will include the horizontal cable, the faceplates, inserts and copper patch cables required for each location.
 - 1. The Contractor will provide any additional cabling that may be needed to provide additional power (above the 802.3af requirements) for exterior camera heaters, blowers etc.
- B. Cabling for all approved manufacturer's hardware must meet factory specifications, including the requirements for cable that is stranded, twisted, with an overall shield to eliminate electrical interference.
- C. Pair counts and wire gauge must meet the approved manufacturer's specifications based upon wiring distances.
- D. Contractor will be responsible for dressing in the patch cables at each camera location. Do not allow the cables to rest on the ceiling tiles, conduits, pipes, insulation, HVAC ductwork or other trades pathways. Support the patch cable with a dedicated J-hook adjacent to the camera location.
- E. Do not use plastic tie wraps on the patch cables at any time. Patch cables found with plastic tie wraps on them shall be replaced completely at the Contractor's expense. Patch cable support will be provided with the structured cabling maintenance loop or the Contractor shall provide and install their own j-hook to support the patch cable.
- F. Additional cabling required for the cameras shall be provided and installed by the Contractor as needed. All cabling shall be rated for the environment in which it is installed and shall be supported in J-hooks spaced apart at 48-60". All j-hooks shall be properly secured to the building structure, dedicated all thread or dedicated grid wire. Do not use the ceiling grid support wire for any reason. Dedicated grid wire used only for the J-hook may be installed.
- G. All cables and components, including but not limited to above-ceiling, in-wall, in-slab and underground shall be rated for the environment in which they are installed.
- H. Sleeve penetrations in all exterior walls will be made by division 26. Coordinate all final heights camera locations with other trades on the job site prior to final installation. The Contractor will fire stop the sleeves to meet all applicable codes. It will be the Contractor's responsibility to plan for any such penetrations. Wiring run through any penetration without a proper sleeve will be removed and replaced at the Contractor's expense. All sleeves shall require white plastic bushings on each end of the sleeve. Contractors installing cabling in conduit sleeves without bushings shall replace the entire pathway. Split bushings shall not be accepted for any reason. Failure to coordinate the final location with division 26 and the Owner may result in the cameras being relocated at the Contractor's expense.

2.03 INTERIOR CAMERAS

- A. See item 2.1.C for all acceptable manufacturers for this project.
- B. Refer to the camera designator and part number column within the camera schedule located in the drawings for all new camera types to be used in specific locations. Cameras will be positioned in or near the locations shown on the drawings but all final viewing areas and heights will be established with the client prior to installation. Failure to coordinate the views with the representative prior to installation may result in cameras being relocated at the Contractor cost. Contractor shall meet with the Owner Technology Department for all final rough in locations.
- C. The Contractor will notify the architect if the proposed location is blocked by any obstructions and propose an alternate location for the camera as needed.
- D. Contractor is required to provide for all licenses that are required for a complete and functioning system.
- E. Cameras shall utilize h.265 compression.

2.04 EXTERIOR CAMERAS – FIXED

- A. Refer to the drawings for all camera locations. Cameras will be positioned in or near the locations shown on the drawings but all final viewing areas and heights will be established with the client prior to installation. Failure to coordinate the views with the Owner prior to installation may result in cameras being relocated at the Contractor expense. Contractor shall meet with the Owner Technology and Facilities Managers, the General Contractor and the electrical Contractor for all final rough in locations.
- B. The Contractor will notify the architect if the proposed location is blocked by any obstructions and propose an alternate location for the camera as needed.
- C. Contractor is required to provide for all license seats that are required for a complete and functioning system.
- D. Exterior dome cameras shall utilize wall mounts and shall not be mounted vertically on walls.

2.05 CAMERA MOUNTS

- A. Ceiling mounted interior cameras will not be supported directly on the ceiling tile and will have a T-bar or other type system that will keep the camera weight supported on the grid and not the tile.
 - 1. Acceptable mount manufacturer shall match the camera make and model.
 - 2. In addition to grid supported mounts, all new ceiling cameras will be supported with additional security wire that will prevent the camera from falling should the ceiling grid be removed. This wire can be attached to the camera directly only by following the manufacturer's recommendations.
 - 3. Do not install the support wire onto any other cable pathway, dedicated ceiling grid wire or sprinkler system.
 - 4. New ceiling mounted cameras at all other locations will be trimmed out with white colored mounts and trim kits. This is required for all lay in ceiling locations.
- B. Interior wall mounted camera locations (if applicable) will be mounted directly on the provided back box. Verify all locations on site.
 - 1. Interior wall mounted camera locations will be installed with white colored flush mounts and trim out kits.
 - 2. Coordinate all final locations and heights with the Owner and other trades prior to final rough in locations. Failure to coordinate with these parties may result in the camera location being changed at the Contractor's expense. The locations of the cameras will be, in the opinion of the installing Contractor, at the height to provide the optimum image needed by the client.
- C. See section three for more information regarding workmanship expectations.

2.06 MEDIA CONVERTERS FOR SITE CAMERAS.

- A. Security contractor shall furnish and install media converters necessary to make a functional network connection from the site cameras(s) back to the MDF/IDF.
- B. Media converters shall be hardened/ruggedized and rated for the environment in which they are installed.
- C. Coordinate fiber/connector type with Division 27.

2.07 VIDEO MANAGEMENT STORAGE SERVER

- A. The Owner's standard for video storage is Genetec Stream vault.
- B. The contractor will be responsible for furnishing an archive server only. The Owner's existing directory server will be utilized.
- C. The contractor shall base server calculations on the following Owner's video retention standards.
 - 1. 20FPS
 - 2. Full Resolution
 - 3. Record continuously from the hours of 8AM to 5PM. Motion detection only for the remaining hours of the day.

4. Minimum 30 days retention.
5. Minimum Raid level 5.
6. Shall include redundant power supplies.
7. Server(s) shall be rack mountable.

2.08 VIDEO MANAGEMENT SOFTWARE

- A. The Owner's standard for video management software is Genetec Omnicast Enterprise.
- B. This system will attach to the Owner's existing system ID and utilize the existing site license.
- C. The contractor will be responsible for furnishing all necessary camera licenses to make fully functional video management system.
- D. Coordinate license purchase with manufacturer for system ID.

2.09 NETWORK SWITCHES

- A. Security Contractor will be responsible for furnishing POE network switches for the surveillance system only.
- B. Security Contractor will utilize patch cables provided by division 27 cabling contractor.
- C. Approved Models:
 1. Axis T85 series network switches.
- D. Access Control equipment may also use surveillance network switches.

2.10 SD CARDS

- A. Contractor shall be responsible for furnishing and installing SD cards for all cameras with an available SD card slot.
- B. Approved hardware:
 1. AXIS Surveillance Card 64 GB 5801-951

2.11 MISCELLANEOUS EQUIPMENT

- A. The Contractor will provide any necessary Velcro, clamps, j-hooks, and support hardware, etc., necessary to facilitate the installation of any component in the system.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Furnish and install, complete with all accessories and functioning video surveillance system from Genetec for the Cherokee Nation of Oklahoma (Owner) Child Development Center.
- B. Unless otherwise specifically provided in this contract, all equipment, material, and articles incorporated in the work covered by this contract are to be new and of the most suitable grade for the purpose intended.
- C. All work under this contract shall be performed in a skillful and professional manner. The Contractor agrees to employ only orderly and competent employees, skillful in the performance of the type of work required under this contract; and agrees that whenever informed by the Owner in writing that any employee(s) on the work is (are), in its opinion, incompetent, unfaithful or disorderly, shall be discharged from the work and shall not again be employed on the work without the Owner's written consent.
- D. Materials or work described in words, which so applied, have a well-known technical or trade meaning shall be held to refer to such recognized standards. Neither custom nor usage of trade shall require the Owner to accept materials or workmanship not in strict and complete compliance with the contract documents.
- E. The Contractor shall perform the work in accordance with the Contract documents and submittals as well as all local and state codes.
- F. The Contractor shall arrange for the securing of all necessary permits and pay for same.
- G. Components of the system will be installed in a neat, professional manner as deemed by the Owner / architect / security consultant.

- H. Wiring color codes will be strictly observed, and terminations will be uniform throughout the system.
- I. Identification markings and systems will be uniform with machine generated labels. No hand-written labels are permitted.
- J. Do not place cameras in final locations where field of view objectives cannot be met. Confer with Owner representative on final placement of cameras prior to any final rough in. Failure to coordinate with the Owner representative prior to installing the cameras may result in relocation of the camera at the Contractor's expense. Position cameras to avoid direct light sources and extreme backlit situations. Orient camera for best image and adjust as required or directed by the Owner.
- K. Div. 27 shall provide and install the data cabling for this system. Any additional cables required for system functions will be provided and installed by the Contractor. Cabling shall be supported with j-hooks secured to the building structural steel or by dedicated grid wire. Contractor will not share pathways with any other low voltage structured cable plant.
- L. Contractor will not secure j-hooks to the ceiling grid wire for any reason. Grid wire may be used to support independent j-hooks providing it is properly secured to the building structure. J-hooks will be spaced 48-60" apart. Do not secure cable pathways to ducts, pipes, or other utilities found in the overhead ceiling. Pathways not conforming to these requirements will be replaced by the Contractor immediately.
- M. All ceiling mounted camera locations shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices and techniques for each type of camera mount used. Do not support camera devices from the drop ceiling grid wire.
- N. All exterior security cameras will be properly secured to the sides of the exterior wall at the locations shown on the technology drawings. Plastic anchors will not be accepted at any exterior or interior wall mount location.
- O. Conduit and sleeve penetrations through the outer wall for security cameras will be provided and installed by division 26. The Contractor shall be required to provide protective plastic bushings, colored, white, placed at the ends of the conduit sleeves prior to pulling in any cabling to the camera.
- P. Seal all exterior cameras, including those under roof, with RTV or silicon sealant at locations where mounting contacts wall surface.
- Q. Sealant will be rated for UV protection use clear sealant.
- R. The Contractor shall make a thorough inspection of all camera locations to ensure the following:
 - 1. Confirm all devices are properly located and connected as per the technology drawings and the construction specification documents for a complete and functional system.
 - 2. Installed in accordance to manufacturer's instructions.
- S. Acrylic domes and windows shall be treated after installation with approved plastic cleaner and polish. All domes will be cleaned prior to final acceptance.
- T. Only equipment devices have been shown on the contract drawings. For the purposes of clarity, specific wiring between equipment has not been shown.
- U. All equipment and components shall be installed in strict compliance with manufacturer's recommendations and the requirements of the components UL listing. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation. Refer to the manufacturer's riser / connection diagrams for all specific system installation / termination / wiring data.
- V. All equipment and components shall be new and the manufacturer's current model. All like devices shall be of the same manufacturer and model number.

- W. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Cameras shall not be supported solely by suspended ceiling tiles. Fasteners and supports shall be adequate to support the required load.

3.02 TRAINING ON VIDEO SURVEILLANCE SYSTEM

- A. Submit training plans and instructor qualifications in accordance with the requirements of this Section.
- B. Develop separate training modules for the following:
 - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
 - 2. Security personnel.
 - 3. Hardware maintenance personnel.
 - 4. Corporate management.
- C. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for Owner personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
- D. Provide the security personnel and IT systems administrators with training in the use, operation, and maintenance of the entire video surveillance system. The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Contractor shall provide up to two (2) additional, full-system training sessions during the one-year warranty period at the request of the facility staff. Coordinate the total of four (4) training sessions with the Owner. Completed facility sessions will be witnessed and documented by the Architect/Security Consultant or Owner's Representative, and approved by the Owners' representative. Instruction is not to begin until the system is operational as designed.
- E. The training documents will cover the operation and the maintenance manuals and the control console operator's manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
- F. Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
- G. The service manual shall be written in laymen's language and printed to become a permanent reference document for maintenance personnel, describing how to run internal self-diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
- H. Training Software: Enables operators to practice system operation including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- I. All testing and training shall be compliant with the manufacturer.

3.03 TESTING WARRANTY SERVICES

- A. A factory-trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner.
- B. The Contractor shall make a thorough inspection of all camera locations to ensure the following:

1. Confirm all devices are properly located and connected as per the technology drawings and the construction specification documents for a complete and functional system.
 2. Installed in accordance to manufacturer's instructions.
- C. The Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty, whichever is greater.

3.04 MISCELLANEOUS EQUIPMENT

- A. The Contractor will provide any necessary Velcro, clamps, j-hooks, and support hardware, etc., necessary to facilitate the installation of the System.

3.05 LABELING

- A. System components and wiring shall be comprehensively labeled.
1. All labels shall be machine generated.
 2. Handwritten labels are not acceptable.
 3. Do not place the IP addresses for the cameras on the outer domes or anywhere else they can be seen by the public.

3.06 TECHNICAL SUPPORT

- A. On site move day support
1. Contractor will provide an additional 24 hours for technical support at such levels and at such times as The Owner deems necessary during the physical move to the site.
- B. The personnel providing technical support will:
1. Have thorough and in-depth knowledge of the System and Materials that were used as well as have direct project experience.
 2. Be skilled in all use of equipment and materials used under the Contract.
 3. Be competent to troubleshoot and fix problems associated with Contractor provided materials.
- C. Contractor will allow the Owner two weeks of recording time and will then return to adjust as directed by an authorized Owner representative. Contractor will coordinate this visit through the construction manager.
- D. Contractor will then allow the Owner two additional weeks of recording times, verify that storage capability will meet the Owner required days of storage based on the information provided in section two of this specification and make final adjustments prior to final inspection by the Owner representative.

3.07 FINAL ACCEPTANCE

- A. All substantial completion and or final acceptance site inspections shall include the Contractor's record documentation. Failure to coordinate the final documents with the installed product will result in additional delays to final acceptance or substantial completion.
- B. The following items shall be reviewed during the final acceptance walk:
1. All camera locations match the records drawings.
 2. All cameras are properly labeled and identified both in the field and on the record drawings.
 3. All camera viewing angles are set to the client's approval.
 4. Camera motion settings and recording properties are properly set in the server.
 5. Cameras are properly identified on the electronics copy of the VMS floor plans (maps).

END OF SECTION

SECTION 283100 (13850)

FIRE DETECTION AND ALARM SYSTEM

ENGINEERING SPECIFICATION INTELLIGENT REPORTING FIRE DETECTION SYSTEM

PART 1 GENERAL

1.1. DESCRIPTION:

- A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated networked system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein with full communication to the existing Notifier network as installed by Endex Inc. of Tulsa.
- B. The FACP and peripheral devices shall be manufactured by Notifier brand fire alarm systems.

1.2. SCOPE:

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.
- B. Basic Performance:
 - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style A) as part of an addressable device connected by the SLC Circuit.
 - 3. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) as part of an addressable device connected by the SLC Circuit.
 - 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the system display shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.3. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. **Certifications:**

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. POST CONTRACT MAINTENANCE:

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.
- C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.
 2. Each circuit in the fire alarm system shall be tested semiannually.
 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6. POST CONTRACT EXPANSIONS:

- A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

- B. As part of the submittal, include a quotation for all parts and material, and all installation

and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

- C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.
- D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification appliances connected to the addressable monitor/control modules.
- E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

1.8. APPROVALS:

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE:

- A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits, Signaling Line Circuits, and Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

- E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The

control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall be a NOTIFIER Model NFS-320 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:

- a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
- b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:

The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of 318 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
4. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.
5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
8. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
9. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector sensitivity test, meeting requirements of NFPA 72.
 - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. The ability to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS presignal, meeting NFPA 72 requirements.
 - h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 requirements for activation of notification circuits within 10 seconds of initiating device activation.
 - i. Periodic detector test, conducted automatically by the software.
 - j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two

- software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day/night automatic adjustment of detector sensitivity.
 - o. Device blink control for sleeping areas.
10. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
 11. Network Communication
 - a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.

D. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The system shall support an 80 character display. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.
2. The display shall provide all the controls and indicators used by the system operator:
 - a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
4. The display shall also provide Light-Emitting Diodes.
 - a. The 80-character display shall provide 12 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.
5. The display shall provide a QWERTY type keypad
 - a. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
6. The system shall support the display of battery charging current and voltage on the 80-character LCD display.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support one SLC. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector

maintenance requirements.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
 - a. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

H. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

I. Power Supply:

1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 200 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:

Ground Fault LED
AC Power Fail LED
NAC on LED (4)

5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

J. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values
 - e. Device zone assignments
 - f. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.

10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
11. Waterflow Operation

An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
12. Supervisory Operation

An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. Signal Silence Operation

The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.
14. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

2.4. SYSTEM COMPONENTS:

A. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
7. The system shall allow a minimum of 32 terminal mode LCD annunciators and

shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.

8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

B. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

C. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on

command from the control panel.

9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Multi Criteria Acclimating Detector

1. The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

D. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

E. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

2.6. BATTERIES:

- A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
- C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all waterflow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

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SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
1. Protecting existing trees, vegetation to remain.
 2. Removing existing trees, vegetation.
 3. Clearing and grubbing.
 4. Stripping and stockpiling topsoil.
 5. Removing above- and below-grade site improvements.
 6. Disconnecting, capping or sealing, and removing site utilities.
 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
 2. Division 1 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
 3. Division 1 Section "Execution" for verifying utility locations and for recording field measurements.
 4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.03 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.04 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.06 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.07 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Refer to Stormwater Pollution Prevention Plan.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE PROTECTION

- A. Do not excavate within tree protection zones, unless otherwise indicated.
- B. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.04 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.

3.05 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 12 inches below exposed subgrade.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within tree protection zones.
 - 3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.07 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.08 DISPOSAL

- A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 1100
STORMWATER POLLUTION PREVENTION PLAN

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Stormwater Pollution Prevention Plan.
- B. Related Sections include the following:
 - 1. Division 02 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 2. Division 02 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with Oklahoma Department of Transportation Standard Specifications for Highway Construction and Oklahoma Department of Environmental Quality. Maintain one copy on site.

PART 2 PRODUCTS – Not applicable.

PART 3 EXECUTION

3.01 EXECUTION

- A. Contractor shall review and familiarize himself with all aspects of the Stormwater Pollution Prevention Plan and perform work accordingly.
- B. Contractor is responsible for filling out and submitting the NOI along with the SWPPP to ODEQ for review and approval.
- C. Contractor is responsible for filling out and submitting the NOT upon completion of permanent erosion control measures.

END OF SECTION

SECTION 31 2000 EARTH MOVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for areas outside the building perimeter.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Subbase and base course for paving.
 - 4. Subsurface drainage backfill for walls and trenches.
 - 5. Excavating and backfilling for utility trenches.
- B. Related Sections include the following:
 - 1. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
 - 2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
 - 3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
 - 4. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 5. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.

1.03 UNIT PRICES

- A. Unit prices for earthwork are included in Division 01 Section "Unit Prices."

1.04 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Initial Backfill: Fill free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit and as defined by utility trench detail on the plans.

- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, or ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base course, drainage fill, or topsoil materials.
- L. Utilities: Underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
 - 2. Geotextile.
 - 3. Controlled low-strength material, including design mixture.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 698 for each soil material proposed for fill and backfill.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.06 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- B. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient on site materials do not match the Geotech report for engineered fill.
- B. Base Course: Naturally graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; conforming to ODOT Type "A" aggregate base.
- C. Engineered Fill (Structural Fill):
 - 1. Imported Low Volume Change Cohesive Soils:
 - a. Plasticity Index (PI) of 7 to 18
 - b. Liquid Limit maximum of 40

- c. Containing at least 30 percent fines (material passing the No.200 sieve, based on dry weight)
 - d. Shall not contain rock fragments greater than 3.0 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - e. Prior to any filling operations, samples shall be tested by and approved by Geotech Engineer.
- D. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. Or as defined by the utility trench details.
 - E. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
 - F. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
 - G. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
 - H. Fly Ash: ASTM C618, Class C

2.02 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 - 4. Tear Strength: 56 lbf; ASTM D 4533.
 - 5. Puncture Strength: 56 lbf; ASTM D 4833.
 - 6. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - 4. Tear Strength: 90 lbf; ASTM D 4533.
 - 5. Puncture Strength: 90 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.03 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
 - 1. Portland Cement: ASTM C 150, Type I, II or III.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C 869.
 - 5. Water: ASTM C 94/C 94M.
 - 6. Air-Entraining Admixture: ASTM C 260.
- B. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495.

2.04 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

- A. Explosives: No explosives are allowed.

3.04 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsuitable soil materials and rock, replace with approved engineered fill materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs on grade.

- f. 6 inches beneath pipe in trenches.

3.05 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: If unsuitable material is encountered during foundation bearing grade testing and inspections (DCP Testing), over excavate to suitable bearing material and backfill with engineered fill or ODOT Type "A" Aggregate. The over excavation should also extend laterally a minimum of 2/3 of the total depth of over excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Construct a 24-inch layer of low volume change engineered fill below floor slab. The thickness of the low volume change fill zone does not include the thickness of any granular leveling material below the floor slab. This layer of fill shall extend at least 5 feet beyond the building perimeter.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- B. Construct an 10-inch layer of low volume change engineered fill below pavement. The thickness of the low volume change fill zone does not include the thickness of any granular leveling material below the pavement. This layer of fill shall extend at least 2 feet beyond the pavement footprint.

3.07 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.08 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. After stripping and completing any cuts, the subgrade shall be proofrolled. Proof-roll subgrade under the observation of the geotechnical engineer, with a loaded, tandem-axle dump truck weighing at least 25 tons, to locate any zones that are soft or unstable. The Proofrolling should involve overlapping passes in mutually perpendicular directions. Where rutting or pumping is observed during proof-rolling, the unstable soils shall be over-excavated and replaced with low volume change soils.
- C. After completing the proof-rolling and required over-excavations and before placing any fill, the exposed subgrade shall be scarified to a depth of at least twelve (12) inches and moisture conditioned to within a range of 1 percent below to 3 percent above the soils material's optimum moisture content. The scarified zone shall be compacted to at least 98 percent of the material's standard Proctor maximum dry density, per ASTM D-698.

- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.09 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated on-site suitable soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, sub-drainage, damp-proofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill of , free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.
- E. Backfill voids while installing and removing shoring and bracing.
- F. Place and compact final backfill to final subgrade elevation.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- H. Construct clay "trench plug" that extends at least 5 feet out from the face of the building exterior. The plug material shall consist of clay compacted at a water content at or above the soils optimum water content. The clay fill shall be placed to completely surround the utility line and be compacted to at least 95% standard proctor density.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use on-site soils.
 - 2. Under walks and pavements, use engineered fill.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.
- D. Prior to placing fill, the exposed subgrade shall be scarified to a depth of at least 12 inches, moisture conditioned to within a range of 1 percent below to 3 percent above the material's optimum moisture content and recompact to at least 98 percent of the material's standard proctor maximum dry density, determined in accordance with ASTM D-698, the standard proctor procedure.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of the material's optimum moisture content, determined in accordance with ASTM D-698, (standard Proctor procedure).

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 9 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Backfill and fill soil materials shall be moisture conditioned to within 2 percent of the optimum moisture content.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 :
 - 1. Under structures, building slabs, steps, and pavements, scarify, and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material to at least 98 percent.
 - 2. Under walkways, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material to at least 98 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches in unpaved areas, compact each layer of initial and final backfill soil material at 85 percent. In paved areas, compact utility trench backfill to at least 98 percent.

3.16 SUBGRADE STABILIZATION

- A. Building & Pavement Subgrade Stabilization:
 - 1. If the existing soils in pavement areas have a PI greater than 18 the soil shall be stabilized with Quick Lime or Hydrated Lime.
 - a. 6 percent Hydrated Lime, based on the material's compacted dry unit weight, shall be used to treat the subgrade soils to reach the necessary PI per section 2.01.C.1.
 - b. 5 percent Hydrated Lime, based on the material's compacted dry unit weight, shall be used to treat the subgrade soils to reach the necessary PI per section 2.01.C.1.
 - c. The modification/stabilization procedure shall be in general accordance with the 2019 ODOT Standard Specifications for Highway Construction Section 307 Subgrade Treatment.
 - d. Lime stabilized subgrade shall be compacted within 2 hours after the addition of water to the mix.
 - e. Actual amount shall be determined in the field to reduce the PI per section 2.01.C.1.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks and Pavements: minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 BASE COURSES

- A. Place base course on subgrade free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Where indicated, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Shape base course to required crown elevations and cross-slope grades.
 - 3. Place base course in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D-698.
- C. On prepared subgrade beneath building slab on grade place granular base as follows:
 - 1. 4 inches of compacted granular base with a Plasticity Index of not more than 6, a maximum particle size of 1.5 inches and not more than 15 percent passing a No. 200 sieve.

3.19 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Contact Engineer for subgrade proofrolling.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Perform Atterberg limits tests on fly ash and cement kiln dust treated fill/backfill materials placed in the building area for the low volume change fill layer at frequency of at least 1 test per 5,000 SF of area with at least 2 test per lift. Intent of Atterberg limits testing is to determine if the soil has been effectively treated.
- F. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.
- G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion prior to placement of subsequent base course, paving, or foundations above. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Foundation excavations shall be maintained in a drained/de-watered condition throughout foundation construction. Water shall not be allowed to pond in any excavation. Bearing soils left exposed overnight or to potential rainfall shall be protected with a 3" mud mat of lean concrete with a minimum compressive strength at the end of 28 days of 1,500 pounds per square inch. Depth of foundation excavations shall be increased as necessary to accommodate the mud mat thickness without reducing the specified footing thickness.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove waste material, including unsuitable soil, trash, and debris, and legally dispose of it off Owner's property. Retain paragraph above or paragraph and subparagraph below.
- B. Transport surplus engineered fill to designated storage areas on Owner's property.

END OF SECTION

SECTION 31 2001

STRUCTURAL EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for slabs-on-grade.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for concrete slabs-on-grade.
 - 4. Subsurface drainage backfill for walls and trenches.
 - 5. Excavating well hole to accommodate elevator-cylinder assembly.
- B. Related Sections:
 - 1. Section 00 3100 – Available Information
 - 2. Section 01 4000 – Quality Requirements
 - 3. Section 03 3000 – Cast-in-Place Concrete

1.3 DEFINITIONS

- A. Backfill: Soil material, free-draining granular fill material or controlled low-strength material used to fill an excavation.
- B. Borrow Soil: Approved soil imported from off-site for use as fill or backfill.
- C. Drainage Course: Aggregate layer placed below the vapor retarder and which supports the slab-on-grade and minimizes upward capillary flow of pore water.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- E. Fill: Approved soil materials used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or the top surface of a backfill.

1.4 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches
- C. Qualification Data: For qualified testing agency.
- D. Material Test Reports: For each on-site, off site and any borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.
- E. Blasting is not allowed.
- F. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Preexcavation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Unexpected or unforeseen subgrade conditions discovered during construction shall be immediately brought to the attention of the Owner, Architect, Structural Engineer and the Geotechnical Engineer that performed the soil borings and wrote the geotechnical report. Time is of the essence. Additional soils and foundation design recommendations, if required due to unexpected or unforeseen subgrade conditions, shall be provided by the Geotechnical Engineer that performed the soil boring and wrote and the geotechnical report, and/or the structural engineer of record. All services pertaining to any additional recommendations shall be approved by the Owner prior to the start of work by the consultant and will be paid by the Owner at each consultant's current standard hourly rates.
- B. Cover holes and trenches when work is not in progress.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- D. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
1. Do not proceed with work on adjoining property until directed by Architect.
- E. Utility Locator Service: Notify "The Oklahoma One Call System" (Call Okie) for area where Project is located before beginning earth moving operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient approved soil materials are not available from excavations.
- B. Structural Fill: An approved, low volume change soil consisting of cohesive materials having a liquid limit (LL) of less than 40, a plasticity index (PI) of greater than 7 and less than or equal to 18, containing rock sizes no larger than 3 inches, and containing at least 15% fines (material passing the No. 200 sieve, based on dry weight) to be used under the building area. Fill materials shall be free of organic material and debris. Portions of the onsite residual soils and existing fills may be suitable for structural fill provided they are tested and approved by the Owner's testing agency.
- C. Free-Draining Granular Fill: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve, to be used for drainage course below slabs, backfill behind walls and in drainage trenches. Material shall be compacted to 95 percent of the maximum dry relative density using a plate-type vibratory compactor.
- D. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state and approved by the Owner's testing agency.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
1. Portland Cement: ASTM C 150, Type I, II or III.
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869.
 5. Water: ASTM C 94.
 6. Air-Entraining Admixture: ASTM C 260.
 7. Minimum 28-day unconfined compressive strength: 50 psi

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations. Full responsibility for repairs and replacement rests with Contractor.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. A 24 inch thick layer of structural fill shall be constructed beneath the floor slab. The thickness of the structural fill layer does not include the thickness of the drainage course beneath the floor slabs. Overexcavate existing soils as required to achieve the specified thickness of structural fill.
- E. After stripping and completing all cuts, proof-roll the exposed subgrade with a fully-loaded, pneumatic-tired, 10-wheeled tandem-axle dump truck weighing not less than 25 tons. Overexcavate and replace soft, unstable or unsuitable materials with approved structural fill if they cannot be stabilized in place.
- F. After completing proof-rolling and before placing any fill, scarify the exposed subgrade to a minimum depth of 12 inches, moisture condition to a level within a range of 1 percent below to 3 percent above the material's optimum moisture content, and compact to at least 98 percent of its maximum standard Proctor dry density.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

- B. Where bedrock or similar materials are encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, take required steps to proceed with the general grading operation of the work, and remove or excavate such materials by means which will cause no additional cost to the Owner, nor endanger buildings or structures whether on or off site.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base, free of any loose material to receive other work.
 - a. Hand auger testing shall be conducted at the bottom of each column footing to verify the bearing material.

3.6 SUBGRADE INSPECTION

- A. Notify Architect and Owner's testing agency when excavations have reached required subgrade.
- B. If Architect and/or Owner's testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 25 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect and/or Owner's testing agency, and replace with compacted backfill or fill as directed.
 - 3. Proof-rolling shall be performed in the presence of a Geotechnical Engineer licensed in the state where the project is located and shall be evaluated by the Geotechnical Engineer.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect and/or Owner's testing agency, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect and/or Owner's testing agency.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Removing concrete formwork.
 3. Removing trash and debris.
 4. Removing temporary shoring and bracing, and sheeting.
 5. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Use free-draining granular fill for drainage course below slab-on-grade and behind retaining walls.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under steps and ramps, use structural fill.
 2. Under building slabs, use structural fill.
 3. Under footings and foundation, use structural fill.
 - a. Unstable soils present at footing excavations shall be removed and replaced with structural fill.
 - 1) Overexcavation for compacted backfill placement below footings shall extend laterally beyond all edges of the footings at least 8-inches per foot of overexcavation depth below footing base elevation.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within a range of 1 percent below to 3 percent above optimum moisture content.
 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698.
 - 1. Under structures, building slabs and steps, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent of the soil's maximum standard Proctor dry density.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Grading inside Building Lines:
 - 1. Grade areas under building to allow for a 9 inch combined thickness of slab and drainage course below slab.
 - 2. Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Refer to Contract Drawings.
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of free-draining granular fill on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of free-draining granular fill, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each free-draining granular fill layer to 85 percent of maximum dry relative density according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact free-draining granular fill over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each free-draining granular fill layer to 85 percent of maximum dry relative density according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course in compacted thickness shown on plans in a single layer.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry relative density according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified testing agency employing a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of structural fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material placement and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections. The qualified testing agency shall employ at least one Geotechnical Engineer or Geotechnical Engineering Consultant, licensed in the state where the project is located.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect and/or Owner's testing agency.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at every 2 feet of compacted fill and backfill thickness, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

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SECTION 31 2316 EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Document REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL EVALUATION CHEROKEE NATION CHILD DEVELOPMENT CENTER- Dated March 5, 2024: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- C. Section 31 2200 - Grading: Grading.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2200 - Unit Prices, for general requirements applicable to unit prices for excavation.
- B. Unit Price ____ : Excavating Soil Materials.
 - 1. Measurement Method: By the cubic foot (cubic meter).
 - 2. Includes: Excavating to required elevations, loading and placing materials in stockpile, and dewatering.
 - 3. Does Not Include Over-Excavation: Payment will not be made for over-excavated work nor for replacement materials.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

1.06 QUALITY ASSURANCE

- A. Temporary Support and Excavation Protection Plan:
 - 1. Indicate sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.
 - 2. Include drawings and calculations for bracing and shoring.
 - 3. Bracing and shoring design to meet requirements of OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
- B. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Shoring Installer Qualifications: Company specializing in performing the shoring and bracing work of this section with minimum 10 years of documented experience.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.

- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.03 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- E. Rock Removal
 - 1. Excavate and remove rock by mechanical methods only; use of explosives is prohibited.
 - 2. Mechanical Methods: Drill holes and utilize expansive tools to fracture rock.
 - 3. If rock is uncovered requiring the explosives method for rock disintegration, notify the Architect.
 - 4. Form level bearing at bottom of excavations.
 - 5. Remove shaled layers to provide sound and unshattered base for footings.
 - 6. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter

3.04 FILLING AND BACKFILLING

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.06 CLEANING

- A. Stockpile excavated material to be re-used in area designated on site as directed by Owner.

3.07 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 3116 TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chemical soil treatment.
- B. Site-applied termiticide for wood, steel, and concrete.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- D. Test Reports: Indicate regulatory agency approval reports when required.
- E. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- F. Manufacturer's Instructions: Indicate caution requirement.
- G. Record and document moisture content of soil before application, date and rate of application, areas of application, and diary of toxicity meter readings and corresponding soil coverage.
- H. Installer Qualifications: Company specializing in performing work of the type specified and with minimum ten years of documented experience.
- I. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of ten years documented experience.
 - 2. Approved by manufacturer of treatment materials.
 - 3. Licensed in the State in which the Project is located.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Mixes: Mix toxicant to manufacturer's instructions.
- D. Toxicant Chemical: EPA approved; synthetically color dyed to permit visual identification of treated soil.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
 - 3. Soil Within 10 feet (3 m) of Building Perimeter For a Depth of 5 feet (1.5 m).
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 INSTALLATION - SITE-APPLIED TERMITICIDE

- A. Comply with manufacturer's written instructions.

3.04 PROTECTION

- A. Do not permit soil grading over treated work.
- B. Protect sheet materials from damage after completed installation. Repair damage with manufacturer's recommended products and according to the manufacturer's written instructions.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving.
 - 2. Pavement-marking paint.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for aggregate sub base and base courses and for aggregate pavement shoulders.
 - 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.03 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. ODOT: Oklahoma Department of Transportation.

1.04 SYSTEM DESCRIPTION

- A. Retain this Article if specifying state or local DOT standard paving mixes; delete if specifying paving mixes other than those of state or local DOT.
- B. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of ODOT.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Qualification Data: For manufacturer.
- D. Material Test Reports: For each paving material.
- E. Material Certificates: For each paving material, signed by manufacturers.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by ODOT.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Regulatory Requirements: Comply with ODOT standard specifications for highway construction.
- D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - 2. Review condition of subgrade and preparatory work.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delete this Article if pavement-marking materials are not required.
- B. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- C. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 PRODUCTS

2.01 AGGREGATES

- C. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.
- D. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- E. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

- A. Asphalt Binder, Asphalt Cement and Tack Coat in accordance with ODOT standard specifications for highway construction.
- B. Water: Potable.

2.03 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073, Grade Nos. 2 or 3.
- C. Joint Sealant: ASTM D 3405, hot-applied, single-component, polymer-modified bituminous sealant.

- D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than 45 minutes.
1. Color: As indicated.

2.04 MIXES

- A. Surface Slurry: Type 1 slurry seal as defined by ISSA slurry seal guidelines – ISSA A105.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- B. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.02 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in lifts of 3" or less.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at minimum temperature of 250 deg F, or higher temperature as required by the grade of asphalt cement used.
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.03 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3.04 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F, or higher temperature as required by the grade of asphalt cement used.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.05 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.06 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 30 mils. To be applied in two 15 mil coats.
 - 1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.08 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow excavated materials to accumulate on-site.

END OF SECTION

SECTION 32 1313
CONCRETE PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways and roadways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walkways.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.04 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For manufacturer.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- F. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.06 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.02 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- H. Plain Steel Wire: ASTM A 82.
- I. Deformed-Steel Wire: ASTM A 496.
- J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed.
- K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- P. Zinc Repair Material: ASTM A 780.

2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use one of cementitious materials, of the same type, brand, and source throughout the Project:
1. Portland Cement
- B. Normal-Weight Aggregates: ASTM C 33, Class coarse aggregate, uniformly graded. Conform to ODOT specifications for highway construction. Provide aggregates from a single source.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures as allowed by ODOT specifications for highway construction.

2.04 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Reducer: Monomolecular film
1. Representative Products:
 - a. Confilm, Masterbuilders, Inc.
 - b. E-con evaporation control, L & M Construction Chemicals, Inc.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
1. Products: Conform to ODOT.
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
1. Products: Conform to ODOT.

2.05 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
1. Color: As indicated by manufacturer's designation Match Architect's sample As selected by Architect from manufacturer's full range.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
1. Types I and II, non-load bearing IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E.

- Y. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
1. Products: Conform to ODOT.

2.06 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than 45 minutes.
1. Color: As indicated.

2.07 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 4000 psi
 2. Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 3. Slump Limit: 4 inches plus or minus 1 inch.
 - a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 9 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.
 4. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size
- C. Calcium Chloride shall not be permitted in concrete mixtures.
- D. Chemical Admixtures: Conform to ODOT specifications for highway construction.
1. Use water-reducing admixture high-range, water-reducing admixture high-range, water-reducing and retarding admixture plasticizing and retarding admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Cementitious Materials: Conform to the ODOT specifications for highway construction Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
1. Fly Ash or Pozzolan: 15 percent.
 2. Ground Granulated Blast-Furnace Slag: 25 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 40 percent, with fly ash or pozzolan not exceeding 15 percent.
 4. Fly Ash or Pozzolan: not allowed in Right of Way pavements.

2.08 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete mixes larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 EXECUTION

3.01 EXAMINATION

- C. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- D. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 50 tons.
 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/4 inch require correction according to requirements in Division 31 Section "Earth Moving."
- E. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.02 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by Figure 2.1.5 of ACI 305. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, monomolecular film evaporation retarders, fog spray, covering with polyethylene sheeting, or wet cover.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 2. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 3. Provide tie bars at sides of pavement strips where indicated.
 - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade (within 12 hours of concrete pour), or otherwise damage surface and before developing random contraction cracks.
 - 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated and at construction joints. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- I. Screed pavement surfaces with a straightedge and strike off.
- J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- N. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
4. Take precautions to prevent development of plastic shrinkage cracks.

P. Wind:

1. Take precautions to prevent development of plastic shrinkage cracks.

3.07 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.09 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation: 1/4 inch .
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete pavement to cure for 21 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

**SECTION 32 1316
ARCHITECTURAL CONCRETE PAVING**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. ARCHITECTURAL CAST-IN-PLACE CONCRETE PAVING.

1.02 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 303 - Guide to Cast-in-Place Architectural Concrete Practice.
- C. ACI 305R - Hot Weather Concreting.
- D. ACI 306R - Cold Weather Concreting.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 347 - Guide to Formwork for Concrete.
- G. ASTM C33 - Standard Specifications for Concrete Aggregates.
- H. ASTM C150 - Standard Specifications for Portland Cement.
- I. ASTM C260 - Standard Specifications for Air-Entraining Admixtures for Concrete.
- J. ASTM C494 - Standard Specifications for Chemical Admixtures for Concrete.
- K. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- L. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
- M. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Paving jointing and pour sequence plan.
 - a. Proposed layout of expansion and control joints. Clearly delineate the different joint types. Refer to Drawings for joint layout patterns.
 - b. Layout of paving types/ colors as indicated in drawings and selected through sampling.
- D. Statement of Mix Design: submit one copy of statement prepared by batch plant servicing Project for each load delivered to Project. Statement shall include the following information:
 - 1. Name, address, and telephone number of batch plant preparing statement of mix design.
 - 2. Date of mix design.
 - 3. Project location.
 - 4. Contractor requesting load delivery.
 - 5. Mix design number.
 - 6. Integral color used.
 - 7. Gradations for sand and aggregate.
 - 8. Material weights, specific gravity, and absolute volumes.
 - 9. Basis of testing.
 - 10. Water/ cement ratio.
 - 11. PSI rating.
- E. Joints: Submit manufacturer's joint material and sealant. Provide manufacturer's standard colors for selection by Architect.

- F. Stamped Concrete: Submit product data, samples, and installation literature for material specified.
- G. Colored Concrete: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
- H. Concrete Sealer: Submit product data and application literature for material specified.
- I. Testing:
 - 1. Perform testing and analysis under provisions of Section 014000.
 - 2. Submit proposed mix design for each class of concrete for review prior to commencement of work.
 - 3. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
 - 4. Four concrete test cylinders will be taken for each class of concrete placed each day.
 - 5. One slump test will be taken for each set of test cylinders taken.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
- B. Installer Qualifications:
 - 1. The Installer shall provide a qualified foreman or supervisor who has a minimum of three years experience with imprinted and textured concrete, and who has successfully completed at least 25 Architectural Paving Systems concrete installations of high quality and similar in scope to that required.
 - 2. The concrete is cast in place, on the job site, by trained and experienced workmen who shall be employed by an approved manufacturer.
 - 3. Perform work in accordance with ACI 301, 302, 303.
 - 4. Obtain materials from same source throughout.
- C. Ready-Mixed Supplier Qualifications: Supplier of ready-mixed concrete products shall comply with ASTM C 94 requirements for production facilities and equipment. Supplier shall be certified according to NCRMA's "Certification of Ready Mixed Concrete Production Facilities Quality Control Manuals."
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- E. Mock-Up:
 - 1. Provide field sample prior to beginning work, 48 inches by 48 inches in size illustrating paving finish for each type of finish specified.
 - 2. Do not proceed with remaining work until workmanship, pattern, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
 - 4. Include control and expansion joints in mock up for review and approval.
 - 5. Retain samples of cements, sands, aggregates used in mockup for comparison with materials used in remaining work.
 - 6. Accepted mock-up slab is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
 - 7. Approved mock-up may remain as part of the Work. Un-approved mock-up shall be removed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 PROJECT CONDITIONS

- A. Do not place pavement when base surface or ambient temperature is less than 40 degrees F (4 degrees C) or if base surface is wet or frozen.

- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

- A. All materials manufactured warranted to be of uniform quality within manufacturing tolerances.

PART 2 - PRODUCTS

2.01 ARCHITECTURAL CONCRETE SYSTEM

- A. Manufacturers:
 - 1. The Bomanite Company, www.bomanite.com <<http://www.bomanite.com>>
 - 2. Approved equal.
 - 3. Requests for substitutions will be considered in accordance with provisions of Section 01 6000.
- B. Architectural Concrete Systems, reference Drawings for location:
 - 1. Bomanite Sandscape Texture
- C. Supporting Structure:
 - 1. Mix Design:
 - a. Mix and deliver concrete in accordance with ASTM C94, Alternate 2.
 - b. Use accelerating admixtures containing no calcium chloride in cold weather only when approved by testing laboratory. Use of admixtures will not relax cold weather placement requirements.
 - c. Use set retarding admixtures during hot weather only when approved by testing laboratory.
 - d. Add air entraining agent to concrete mix for concrete work exposed to exterior, in amounts of 4 to 7 percent of total concrete volume or as otherwise recommended by testing laboratory.
 - e. Add coloring admixture where scheduled in quantities recommended by coloring admixture manufacturer to achieve selected color.
 - f. Maintain water cement ratio to produce a minimum of 3 to maximum of 5 inch slump.
 - g. Use of calcium chloride is strictly prohibited.
 - 2. Subgrade:
 - a. Refer to drawings and specifications for scope of subgrade preparation.
 - 3. Reinforcement:
 - a. Fiber Reinforcement: ASTM C948, collated, fibrillated, 3/4 inch (19 mm) long virgin polypropylene fibers.
 - b. Reinforcing Steel: ASTM A615; Grade 60; deformed billet steel bars, uncoated finish.
- D. Primary Concrete Color:
 - 1. Color Hardener Concrete Color: To be determined through sampling.
- E. Secondary Concrete Color:
 - 1. Con Color: To be determined through sampling
- F. Pattern/ Texture:
 - 1. To be determined through sampling.
- G. Sealer:
 - 1. Commercial exterior grade, match existing to remain.

2.02 RELATED MATERIALS

- A. Cement: ASTM C150, type 1, Portland cement, gray color.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.
- D. Form Material: Conform to ACI 301. If using metal, material shall be free from deformities. If using wood, use construction grade lumber, sound and free of warp, minimum 2 inches (51 mm) nominal thickness, except where short radii of curves require thinner forms.

- E. Tie Wire: Annealed steel, minimum 16 gauge (1.519 mm) size.
- F. Dowels: ASTM A615; Grade 40, plain steel, uncoated finish.
- G. Miscellaneous Reinforcing Accessories: Spacers, chairs, ties, and other devices necessary for properly placing, spacing, supporting, and fastening reinforcement in place.
- H. Air-Entraining Admixture: ASTM C 206. Air Entrained Concrete shall be used wherever concrete is exposed to the freezing weather. Proportions of entrained air, as determined by ASTM C233, and C260, shall be as follows:
- I. Joint Fillers:
 - 1. Joint Filler: Polyethylene foam expansion joint material, 3/8 inch thick.
- J. Sealants: Two part polyurethane sealants, grade as required to suit application.
 - 1. Color: To be determined through sampling

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation of architectural concrete paving must be performed by certified installers only.

3.02 INSPECTION

- A. Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.
- B. Verify gradients and elevations of base are correct, and proper drainage has been provided so water does not stand in the area to receive paving.
- C. Beginning of installation means acceptance of existing conditions.

3.03 PREPARATION

- A. If vapor retarding membrane is not used, moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect and testing laboratory, minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Construct and remove forms in accordance with ACI 347.
- B. Place and secure forms to correct location, dimension, and profile. Adequately brace to withstand loads applied during concrete placement.
- C. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- D. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 INSERTS AND ACCESSORIES

- A. Make provisions for installation of inserts, accessories, anchors, and sleeves.

3.06 REINFORCEMENT

- A. Accurately place reinforcement in middle of slabs-on-grade.
- B. Discontinue every other bar of reinforcement at control and expansion joints.
- C. Support reinforcing on bar chairs. Securely saddle tie at intersections. Rigidly secure in place to minimize displacement during concrete pour.

3.07 JOINTS

- A. Intentional stoppage of concrete placing shall be at planned location of either an expansion joint or contraction joint.
- B. Provide sawed contraction joints in vehicular paving and curbs spaced as detailed on Drawings, but in no case greater than 20 feet (6 m) o.c. spacing.
 - 1. Saw joints after completion of finishing operations as soon as concrete has hardened to extent necessary to prevent revealing of joint or damage to adjacent concrete surfaces.

2. Saw joints same day that concrete is placed except that sawing of joints in concrete placed late in day may be delayed until morning of following day.
 3. In any event, saw joints within 18 hours after placing concrete.
 4. Use a power-driven concrete saw made especially for sawing concrete and maintain in good operating condition.
 5. Saw cut shall be to a depth equal to 1/4 of slab thickness.
 6. Align joints in vehicular paving with joints in adjacent pedestrian paving.
 7. Cut joints through curbs at right angles to back of curb.
- C. Place joint filler between paving components and building or other appurtenances.
 - D. Provide scored joints in sidewalks and plazas to a depth of 1/4 the slab thickness, and at intervals as indicated, but in no case spaced greater than width of walk.

3.08 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301, 302, and 304. Deposit concrete so that specified slab thickness will be obtained after vibrating and finishing operations. Minimize handling to prevent segregation. Consolidate concrete by suitable means to prevent formation of voids or honeycombs. Exercise care to prevent disturbance of forms and reinforcing and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain as designed.
 1. Hot Weather Placement: ACI 305.
 2. Cold Weather Placement: ACI 306.
 3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
 4. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- B. After consolidating and screeding, float concrete to gradients indicated. Use a straight edge to level and test surface in longitudinal direction to required grade. Finish edges to provide a smooth dense surface with 1/8 inch (3 mm) radius.
- C. Apply Color Hardener prior to finishing. Apply at rate recommended by manufacturer, evenly to the surface of the fresh concrete by the dry-shake method. Applied in two or more shakes, floated after each shake and troweled only after the final floating.
- D. Apply stencil and scored/ saw-cut pattern per approved mock-up.
- E. Apply finish sealer per approved mock-up or as specified to achieve design required.

3.09 SEALING

- A. Seal surface of paving using manufacturer-recommended sealer for best results.
- B. Final cleaning, calking, and sealing operations shall not commence until Architectural Concrete Paving surfaces have been completely and properly cured or 28 days, whichever is later.
- C. Follow Sealer directions when applying product (sealer must be applied in 3 to 6 coats).

3.10 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 014000.
- B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.11 PROTECTION

- A. Immediately after placement, protect concrete under provisions of Section 01500 from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION 321316

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SECTION 32 1373
CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.
- B. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
 - 2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
 - 3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- C. Qualification Data: For Installer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than four pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 2. When joint substrates are wet or covered with frost.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.03 COLD-APPLIED JOINT SEALANTS

- A. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
 1. Products:
 - a. Crafcro Inc.; Road Saver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.

2.04 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.05 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

**SECTION 32 1813
SYNTHETIC TURF SURFACING**

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

- A. Provide all labor, materials, equipment, and tools necessary for the complete installation of synthetic turf surface. Surface shall meet applicable safety standards as required by the ASTM and synthetic turf industry. The system shall consist of, but not limited to, the following:
 - 1. Provide all labor, materials, equipment, and tools necessary for the complete installation of synthetic turf surface. System must be certified and supported by test data that is less than 3 years executed. The system shall consist of, but not limited to, the following:
 - a. Synthetic turf carpet.
 - b. Synthetic turf infill.
 - c. Pad underlayment system.
 - d. Drainage stone.
 - e. Geotextile fabric.
 - f. Groomer/ Sweeper.
 - g. Edge restraint with tack strip.
- B. Coordinate work of this Section with grading, drainage, and base work necessary to shape and drain the area in preparation for installation of the synthetic turf in areas shown on Drawings.

1.02 REFERENCE STANDARDS

- A. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).
- D. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine; 2017.
- E. ASTM F1951 - Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
- F. ASTM D6662 - Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards; 2022.
- G. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment; 2022.
- H. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use; 2021.
- I. {RSTEMP#1402}

1.03 DEFINITIONS

- A. Use Zone: The area beneath and immediately adjacent to a play structure or equipment (play event) that is designated for unrestricted circulation around equipment, and on whose surface it is predicted that a user would land when falling from or exiting the equipment.
- B. Critical Fall Height: The maximum fall height at which the protective surfacing meets the requirements of ASTM F1292.
- C. Subbase: A layer under the resilient layer of the protective surfacing but over the subgrade; may be rigid, as in concrete or bituminous, or aggregate.
- D. Subgrade: The surface of the ground on which the protective surfacing system is installed.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.

- B. Product Data: Submit manufacturer's product data, including installation instructions, subsurface instructions, and certifications.
- C. Shop Drawings: Detailed scale drawings showing locations of site elements, bases, and anchorage points.
- D. Samples: Submit two 12"x12" samples of each synthetic grass color, and two samples demonstrating typical seam connection.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company regularly engaged in manufacturing products specified in this section, with not less than five years of documented experience.
 - 1. Surfacing installed in minimum 10 sites and been in successful service minimum 5 years.
 - 2. Manufacturer's Representative: Provide name, company name and address, and qualifications.
- B. Installer Qualifications: Company certified by manufacturer for training and experience installing the protective surfacing; provide installer's company name and address, and training and experience certificate.

1.06 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature range required by manufacturer.

1.07 PROJECT/ SITE CONDITIONS

- A. Environmental Requirements: Install surfacing system within condition parameters as required by the manufacturer.

1.08 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
- C. Warranty Period: non-prorated, 10 years, from date of Substantial Completion.

1.09 PRODUCT SUBSTITUTIONS

- A. Substitutions shall be submitted during bidding for review, and shall meet or exceed use and material product data of specified product. After contract award, requests for substitutions will be considered only in case of product unavailability or conditions beyond the control of the Contractor.

PART 2 PRODUCTS

2.01 SYNTHETIC TURF SURFACE

- A. Approved Manufacturers:
 - 1. Foreverlawn, Phone: 866.992.7876, www.foreverlawn.com
 - a. Product: Playground Grass Ultra
 - b. Product: Standard PlayMound - 10'
 - 2. Approved equal.
- B. Synthetic turf carpet shall meet or exceed the following requirements:
 - 1. Face Weight: 48 ounces/ square yard, minimum
 - 2. Total Weight: 103 ounces/ square yard, minimum
 - 3. Tufted Pile Height: 1-1/2 inch
 - 4. Color(s): to be determined through samples
 - 5. Tufting Gauge: 3/8 inch

6. Backing: Three-layer, BioCel polyurethane with geotextile nonwoven fabric on dual layer primary
 7. Yarn Type, Primary: Polyethylene slit film
 8. Yarn Type, Secondary: Heat set textured nylon monofilament
 9. Yarn Count, Primary: 5,040/ 1
 10. Yarn Count, Secondary: 4,200/ 8
 11. Tufting Construction: Dual yarn, same row
 12. Roll Width: 15 feet
 13. Infill: Envirofill, ratio as required by manufacturer for approved system
 14. Antimicrobial Protection
- C. Underlayment System:
1. SafetyFoam Pro, closed cell expanded polypropylene panel, depth as required to meet critical fall height requirements.
 2. Standard PlayMound.
- D. Splicing Material: micromechanical bonding per manufacturer's recommendation for specified system.
- E. Adhesive: type as required by manufacturer for approved synthetic turf system.

2.02 DRAINAGE STONE:

- A. Base drainage stone to be placed over geotextile filter fabric shall meet the following criteria:
1. U.S. Standard Sieve Mesh, Allowable Range % Passing
 - a. 2 inch (50 mm), 100% passing
 - b. 1.5 inch (38 mm), 90-100% passing
 - c. 1 inch (25 mm), 75-100% passing
 - d. 3/4 inch (19 mm), 65-100% passing
- B. Finish drainage stone to be placed over base drainage stone shall be washed clean stone with a gradation range that meets the bridging requirements with the Base Drainage Stone.
1. U.S. Standard Sieve Mesh, Allowable Range % Passing
 - a. 1/2 inch (12.5 mm), 100% passing
 - b. 3/8 inch (9.5 mm), 95-100% passing
 - c. US #4 (4.75 mm), 70-85% passing
 - d. US #8 (2.36 mm), 45-60% passing
 - e. US #16 (1.18 mm), 25-40% passing
 - f. US #40 (0.425 mm), 2-12% passing
 - g. US #200 (0.075 mm), 0-3% passing

2.03 GEOTEXTILE FABRIC:

- A. Provide geotextile filter fabric over the subgrade and in the areas designated on the Drawings.
- B. Geotextile filter fabric: Mirafi 500X or approved equal.

2.04 SYNTHETIC TURF GROOMER/ SWEEPER:

- A. Provide a surface groomer/ sweeper as part of the work as recommended by the manufacturer for routine maintenance of the synthetic turf system. Provide training for Owner's staff in use of equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Critical Fall Height: field verify requirements of play equipment.

3.02 BASE AND SYNTHETIC TURF CONSTRUCTION

- A. Comply with the requirements of the manufacturer and Contract Documents.
- B. General: The base shall be graded to provide smooth grade transitions, and shall provide proper drainage. Verify drainage system is performing effectively prior to proceeding with synthetic turf system installation.

- C. Do not proceed with installation until unsuitable conditions are corrected.
- D. Nailer Board: Installation of composite board per site requirements.
 - 1. Concrete/ Masonry edges: Nailer board attached directly to vertical concrete edge with Tapcon hardware situated a distance below concrete grade to accommodate finish elevation of synthetic turf.
 - 2. Non-concrete edges: Nailer board installed with round, steel stake, 3 per 10' board. Top of nailer boards to be situated a distance below grade to accommodate finish elevation of synthetic turf.
- E. Geotextile fabric: After verification of survey and before the placement of drainage stone, geotextile fabric shall be placed over the entire subgrade per the Drawings and manufacturer's recommendations. The fabric folded over the subsurface drainage trenches shall be unfolded and overlaid on the subgrade fabric. Wrinkles should be removed and the fabric should as smooth as possible.
- F. Drainage Stone: Reference Drawings and manufacturer's requirements.
 - 1. Placement and compaction of Base and Finish Drainage stone shall be in lifts as indicated by material testing. The stone should be rolled after the placement of each lift of stone.
 - 2. After lifts of drainage base stone have been installed, this surface should be proof rolled to lock in and stabilize the drainage stone.
 - 3. Drainage stone throughout the field shall be carefully smoothed and compacted. The entire base surface shall then be examined for irregularities and adjusted to a uniform grade per the grading plans.
 - 4. Tolerance for Finish Stone: Finish stone elevations must be within 1/4 of an inch plus or minus from the elevations shown on the plans.
 - 5. Contractor shall be required to correct areas out of tolerance and certify that corrections have been made prior to synthetic turf installation.
- G. Underlayment System: install and secure underlayment systems per manufacturer's requirements.
 - 1. Comply with manufacturer's thickness required to accommodate critical fall height of play equipment and requirements of ASTM F1292.
- H. Synthetic Turf: Place turf and cut to fit configuration as shown on Drawings. Turf and seams shall be attached and secured as required by the manufacturer for best results.
- I. Anchoring/ Edging: Edges of turf shall be secured to composite tack strip. Turf shall be secured per manufacturer's requirements for best results.
- J. Infill: Apply infill as required by the manufacturer for the ballast. Install and secure to minimize wash-out.

3.03 FIELD QUALITY CONTROL

- A. Obtain the services of the manufacturer's field representative to review the finished installation for compliance with specified requirements; submit report of field review.
- B. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
- C. Contractor shall engage certified inspector to review installation and provide certification of compliance with requirements.
- D. Remove and replace synthetic turf if inspection results indicate that it does not comply with requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with requirements.
- F. Repair or replace rejected work until compliance is achieved.

3.04 CLEANING AND PROTECTION

- A. Restore adjacent existing areas that have been damaged from the construction.

- B. Clean building and site of construction materials, dirt, stains, filings, and blemishes due to installation. Clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.
- C. Clean site area of excess construction materials, debris, and waste.
- D. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.
- E. Protect installed products until Date of Substantial Completion.
- F. Replace damaged products before Date of Substantial Completion.

END OF SECTION

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**SECTION 32 3113
CHAIN LINK FENCES AND GATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Wire fabric.
- C. Concrete.
- D. Manual gates with related hardware.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
- D. ASTM A428/A428M - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles; 2021.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- G. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
- H. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2017 (Reapproved 2022).
- I. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018.
- J. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2018).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, and hardware anchorage.
- D. Color samples: provide manufacturer's full range on suitable substrate.
- E. Sample copy of warranty.
- F. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.

1.05 QUALITY ASSURANCE

- A. The Contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified. The on-site supervisor shall not have less than five years of documented experience with the specified system.

1.06 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, materials shall be checked to ensure that no damages occurred during shipping or handling. Damaged materials shall be replaced at no cost to the Owner. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

1.07 WARRANTY

- A. Provide in accordance with Contract Closeout Procedures:
 - 1. Factory finish: 15 years warranty against cracking, peeling, and blistering under normal use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Ameristar; www.ameristar.com.
 - a. Ameristar PermaCoat PC-40 Fence Pipe (commercial weight)
 - 2. Approved equal.

2.02 MATERIALS – CHAIN LINK STEEL FRAMEWORK

- A. Color: the framework shall be Black in accordance with ASTM F934.
- B. The steel material used to manufacture Fence Pipe shall be zinc-coated steel strip, galvanized by the hot-dip process conforming to the criteria of ASTM A653/A653M and the general requirements of ASTM A924/A924M.
- C. The zinc used in the galvanizing process shall conform to ASTM B6. Weight of zinc shall be determined using the test method described in ASTM A90 and shall conform to the weight range (external and internal) of ASTM F1043, Type B.
- D. The framework shall be manufactured in accordance with commercial standards to meet the strength (50,000 psi minimum yield strength) and coating requirements of ASTM F1043, Group IC, Electrical Resistance Welded Round Steel Pipe, heavy industrial weight.
- E. The exterior surface of the electrical resistance weld shall be recoated with the same type of material and thickness as the basic zinc coating.
- F. The manufactured framework shall complete thermal stratification coating process (multi-stage, high-temperature, multi-layer) including, as a minimum, a six-stage pretreatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish.
- G. The material used for the base coat shall be a (gray color) thermosetting epoxy; the minimum thickness of the base coat shall be two (2) mils. The material used for the finish coat shall be a thermosetting “no-mar” TGIC polyester powder; the minimum thickness of the finish coat shall be two (2) mils. The stratification coated pipe shall demonstrate the ability to endure a salt-spray resistance test in accordance with ASTM B117 without loss of adhesion for a minimum exposure time of 3,500 hours. Additionally, the coated pipe shall demonstrate the ability to withstand exposure in a weather-ometer apparatus for 1,000 hours without failure in accordance with ASTM D1499 and to show satisfactory adhesion when subjected to the cross-hatch test, Method B, in ASTM D3359. The polyester finish coat shall not crack, blister or split under normal use.
- H. The strength of Fence Pipe shall conform to the requirements of ASTM F1043; the minimum weight shall not be less than 90% of the nominal weight. The strength of line, end, corner and pull posts shall be determined by the use of 4' or 6' cantilevered beam test. The top rail shall be determined by a 10' free-supported beam test. An alternative method of determining pipe strength is by the calculation of bending moment. Conformance with this specification can be demonstrated by measuring the yield strength of a randomly selected piece of pipe from each lot and calculating the section modulus. The yield strength shall be determined according to the methods described in ASTM E8. For materials under this specification, the 0.2 offset method shall be used in determining yield strength. Terminal posts, line posts and top/bottom rails shall be precut to specified lengths.

2.03 MATERIAL – FENCE FABRIC

- A. Color: The coating color for the fence fabric shall be Black. Reference ASTM F668 and ASTM F934.
- B. The material for chain link fence fabric shall be manufactured from galvanized steel wire. The weight of zinc shall meet the requirements of ASTM F668, Table 4. Galvanized wire shall be PVC-coated to meet the requirements of ASTM F668.
- C. Selvage: Top and Bottom edges shall be knuckled.
- D. Wire Size: The size of the steel wire core shall be 0.148; the finished size of the coated wire shall be 6 gauge.
- E. Fabric Extrusion Type: Class 2A.
- F. Height: reference Drawings.
- G. Mesh Size: two inches.

2.04 MATERIAL – FENCE FITTINGS

- A. Color: The coating color for the fence fittings shall be Black. Reference ASTM F668 and ASTM F934.
- B. The material for fence fittings shall be manufactured to meet the requirements of ASTM F626. The coating for all fittings shall be the same color coating system required for the framework. All fasteners shall be galvanized steel.

2.05 MATERIAL – CHAIN LINK GATES

- A. Color: The coating color for the gates shall be Black. Reference ASTM F668 and ASTM F934.
- B. Swing gates shall be manufactured and coated to match the fence, and meet the requirements of ASTM F900.
- C. Nominal size: reference Drawings.
- D. Hardware: Equip gates with manufacturer's standard hardware required for functional operation.
- E. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to [6 feet] [1829 mm] height and 1 additional hinge for each additional [24 inches] in height or fraction thereof.
- F. Latch: [3/4 inch] slide bolt to accommodate padlock.
- G. For double gates provide padlockable, center cane bolt assembly with manufactured strike plate.
- H. Wheels: at sliding gates, and swing gates greater than 4' wide, provide gate wheel assembly.

2.06 ACCESSORIES

- A. Privacy Slats: PDS Bottom Lock Fence Slats by Pexco
 1. Height and width to match fence fabric.
 2. Color as selected by Architect from manufacturer's full range through sampling.
 3. Install per manufacturer's requirements.

PART 3 EXECUTION

3.01 FENCE INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Confirm fabric placement side prior to installation.
- C. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves.
- D. Do not stretch fabric until concrete foundation has cured 28 days.
- E. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.
- F. Position bottom of fabric 2 inches (50 mm) above finished grade.

- G. Fasten fabric to top rail, line posts, braces, and bottom rail with tie wire at maximum 15 inches (380 mm) on centers.
- H. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

3.02 GATE INSTALLATION

- A. Gate posts shall be spaced according to approved shop drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.
- B. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Position: 1 inch (25 mm).
- C. Do not infringe on adjacent property lines.

3.04 CLEANING

- A. The Contractor shall clean the jobsite of excess materials.
- B. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION

**SECTION 32 3119
ANTI-CLIMB WELDED WIRE FENCING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Welded wire mesh, modular fencing panels including tubular steel posts and gates.

1.02 RELATED WORK

- A.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM) Publications:
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
 - 3. ASTM D523 - Test Method for Specular Gloss.
 - 4. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
 - 5. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
 - 6. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 - 7. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 - 8. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 9. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
 - 10. ASTM F2453/F 2453M - Standard Specification for Welded Wire Mesh Fence Fabric

1.04 SUBMITTALS

- A. Provide in accordance with Section 01 3300 - Submittal Procedures:
- B. Product data for components and accessories.
- C. Shop drawings showing layout, dimensions, spacing of components, and anchorage and installation details.
- D. Color samples: provide manufacturer's full range on suitable substrate.
- E. Copy of warranty specified in Paragraph 1.4 for review by Architect.

1.05 WARRANTY

- A. Provide in accordance with Contract Closeout Procedures:
- B. Factory finish: 20 years warranty against cracking, peeling, and blistering under normal use.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Wireworks Anti-climb, by Ameristar Fence Products, 1555 N. Mingo Road, Tulsa, Oklahoma, 74116; 800-321-8724.
- B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with project substitution procedures.

2.02 MATERIALS

- A. Steel material for fence posts shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.60 oz/ft², Coating Designation G-60. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

- B. Steel wire mesh fence panels shall be manufactured to meet ASTM F2453. Fence panels shall be pre-galvanized steel wire, welded at each crossing to form rectangles. Standard panel offering shall be 10.5ga. (0.128 inches) vertical wires spaced at 3 inches; horizontal 10.5ga. (0.128 inches) wires shall be spaced at .5 inches. Optional panel offering shall be 8ga. (0.162 inches) vertical wires spaced at 3 inches; horizontal 8ga. (0.162 inches) wires shall be spaced at .5 inches. The cold rolled wire shall have a tensile strength of at least 74,000 psi and 68,000 psi shear strength. Wire strand shall be galvanized before welded (GBW), .50 ounces per square foot zinc coating conforming to the ASTM A641.
- C. The cross-sectional shape of the rails shall conform to the manufacturer's Impasse II™ C-rail design, a nominal 2" x 2" x 11 Ga. Tamperproof fasteners shall be used to fasten each wire mesh retaining bracket to rail at intervals not exceeding 18 inches. Posts shall conform to the manufacturer's Impasse II™ I-Beam design with a nominal 3" x 2.75" x 12 Ga. up to 8-foot height, and 4" x 2.75" x 11 Ga. up to 10-foot height.

2.03 FABRICATION

- A. Wire mesh panels and posts shall be precut to specified lengths. Panel width shall be no greater than 96" wide.
- B. The manufactured fence system (i.e., panels, brackets, posts, gates, and hardware) shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (specify Black, Bronze, White, Desert Sand, Green, or Brown). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
- C. Swing gates shall be fabricated using 2" x 12ga square rails and gate ends. Gates that exceed 6' in width will have a 2" sq. x 12ga. intermediate upright. All rail, upright, and gate end intersections shall be joined by welding. Steel gussets (1/4" x 2") shall be welded at each rail to gate end intersection and rail to intermediate intersections (4 gussets per gate bay). Gusset shall be punched to accept gate trussing cable and turnbuckle.
 - 1. Nominal size: reference drawings.
 - 2. Hardware: Equip gates with manufacturer's standard hardware required for functional operation.
 - 3. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to [6 feet] [1829 mm] height and 1 additional hinge for each additional [24 inches] in height or fraction thereof.
 - 4. Latch: [3/4 inch] slide bolt to accommodate padlock.
 - 5. For double gates provide padlockable, center cane bolt assembly with manufactured strike plate.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to fabrication, field verify required dimensions.
- B. Install fencing in accordance with manufacturer's installation instructions and approved shop drawings.
- C. Cast concrete footings in accordance with Section 03 3000 - Cast-in-Place Concrete and as detailed on approved shop drawings.
- D. If required, core drill concrete for embedment of fence posts. Hole shall be [2 inches] minimum greater than post width.

3.02 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus 1/4". Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete

footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application. Typical wind load data in Table 4 is to be used as a guideline. Table 4 is not to be used for specific application without engineering evaluation.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.
- B. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

3.06 (TABLE 1) MINIMUM SIZES FOR WIREWORKS PLUS POSTS

- A. Up to 6' Panel Height = 2" Sq. x 16 Ga. Fence Posts
- B. 8' Panel Height = 2.5" Sq. x 16 Ga. Fence Posts
- C. Gate Leaf up to 4':
 - 1. Up to & Including 6' Gate Height = 2-1/2" x 12 Ga.
 - 2. Over 6' Up to & Including 8' Gate Height = 3" x 12 Ga
- D. Gate Leaf 4'1" to 6':
 - 1. Up to & Including 6' Gate Height = 3" x 12 Ga
 - 2. Over 6' Up to & Including 8' Gate Height = 3" x 12 Ga
- E. Gate Leaf 6'1" to 10':
 - 1. Up to & Including 6' Gate Height = 4" x 11 Ga
 - 2. Over 6' Up to & Including 8' Gate Height = 6" x 3/16"
- F. Gate Leaf 10'1" to 16':
 - 1. Up to & Including 6' Gate Height = 6" x 3/16"
 - 2. Over 6' Up to & Including 8' Gate Height = 6" x 3/16"

3.07 (TABLE 2) COATING PERFORMANCE REQUIREMENTS

- A. Adhesion
 - 1. D3359 – Method B
 - 2. Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
- B. Corrosion Resistance
 - 1. B117, D714 & D1654
 - 2. Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
- C. Impact Resistance

1. D2794
 2. Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
- D. Weathering Resistance
1. D822 D2244, D523 (60° Method)
 2. Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

3.08 (TABLE 3) WIREWORKS POST SPACING

- A. Post Size: 2" = 96-1/2" O.C.
- B. Post Size: 2-1/2" = 96-1/2" O.C.

3.09 (TABLE 4) WIREWORKS PLUS WIND LOADING

- A. 4' Height, 8' Panel Length, 2" Sq. x 16 Ga. Post Size, 68.8 Wind Load Capacity Factor (PSF), 161.8 Wind Load Capacity (MPH)
- B. 6' Height, 8' Panel Length, 2" Sq. x 16 Ga. Post Size, 30.6 Wind Load Capacity Factor (PSF), 107.9 Wind Load Capacity (MPH)
- C. 8' Height, 8' Panel Length, 2-1/2" Sq. x 16 Ga. Post Size, 27.6 Wind Load Capacity Factor (PSF), 102.4 Wind Load Capacity (MPH)
- D. Note: Mph values shown are provided for information only. They are calculated according to ANSI/ASCE 7-05, "American Society for Civil Engineers Minimum Design Loads for Buildings and Other Structures", Exposure Category C (open terrain with scattered obstructions having lengths, generally less than 30 feet), based on post setting in 36" deep concrete footer in soil assumed to be of mid-range strength and compaction. Since specified project conditions such as jurisdictional building codes, elevation of installation, post base/footer design, soil strength, etc., may change from project to project, a structural engineering evaluation, unique to applicable requirements and conditions, should be performed. Consult with your Ameristar Service Representative for an estimate on Engineering Analysis and P.E. Certification.

END OF SECTION

SECTION 32 3120 STEEL PRIVACY GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Welded steel gates fabricated with infill panels, posts, and hardware.
- B. Related sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings for support of fence posts.

1.02 REFERENCES

- A. ASTM International(ASTM):
 - 1. ASTM A36 – Carbon Structural Steel.
 - 2. ASTM A121 – Metallic-Coated Carbon Steel Barbed Wire.
 - 3. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 5. ASTM B117 - Operating Salt Spray (Fog) Apparatus.
 - 6. ASTM D822 - Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - 7. ASTM D2794 - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 8. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.03 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 - Submittal Procedures:
 - 1. Product data for components and accessories.
 - 2. Shop drawings showing layout, dimensions, spacing of components, anchorage, and installation details.
 - 3. Sample: 8" by 10" sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
 - 4. Copy of warranty specified in Paragraph 1.04 for review by Architect.

1.04 WARRANTY

- A. Provide in accordance with Section 01 77 00 - Closeout Procedures:
 - 1. Factory finish: 20-year warranty against cracking, peeling, and blistering under normal use.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Ametco Manufacturing Corporation; www.ametco.com
- B. Approved equal.

2.02 MATERIALS

- A. Steel bar stock: ASTM A36.
- B. Steel tubing: ASTM A500, Grade B.
- C. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

2.03 GATE SYSTEM

- A. Type: Ornamental steel system consisting of modular infill fencing panels supported by steel posts and gates and gate hardware.

2.04 GATES

- A. Provide gates of type and size indicated on Drawings. Equip gates with manufacturer's hardware as required for complete functional operation.
- B. Type: Hinged swinging [single] [double] gate.

1. Construction: Welded frame fabricated from 2" by 2" steel tubing.
2. Dimensions: reference Drawings.
3. Hardware:
 - a. Hinges: Heavy duty type, size as determined by manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof.
 - b. Latch: 3/4 inch diameter slide bolt to accommodate padlock.
 - c. For double gates provide padlockable, 5/8 inch diameter center cane bolt assembly and strike, and embedment sleeve.
4. Gate Posts: 5" by 5" steel tubing.
5. Infill Panels:
 - a. Shadow 100: galvanized steel, louver, 100% direct visual screening, high security

2.05 FACTORY FINISH

- A. Gate system (posts, frame, infill panels, and hardware) shall receive factory finish.
- B. Steel fence panels and posts shall be hot-dip galvanized to 1.25 ounces per square foot minimum zinc coating in accordance with ASTM A123. Standard size components shall receive polyester powder coating. Large gate panels shall be coated with 2-part polyurethane coating.
- C. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
 1. Minimum hardness measured in accordance with ASTM D3363: 2H.
 2. Direct impact resistance tested in accordance with ASTM D2794: Withstand 160 inch-pounds.
 3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than [3/16 inch] [5 mm] undercutting.
 4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.
- D. Polyurethane coating: 1.0 mil dry film thickness of coating of steel test panel cured 30 minutes at 180 degrees F and aged 14 days shall resist the following test conditions without failure:
 1. 5 percent salt spray for 500 hours.
 2. 100 percent relative humidity for 1000 hours.
 3. Water immersion for 100 hours.
 4. 20 double rubs with cloth saturated with either lacquer thinner, acetone, MEK, gasoline, or xylene.
 5. Exposure to lubricating oils, hydraulic fluids, and cutting oils.
 6. 16 cycles of 24 hours at 100 percent humidity, 24 hours at 10 degrees F, and 24 hours at 77 degrees F.
 7. Hardness: H to 2H.
 8. Flexibility: [1/8 inch] [3 mm] conical mandrel.
- E. Color: Selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to fabrication, field verify required dimensions.
- B. Cast concrete footings in accordance with Section 03 30 00 - Cast-in-Place Concrete as detailed by manufacturer in approved shop drawings.
- C. Provide setting holes for embedment of gate posts. Hole shall be 2 inches minimum greater than post width.

3.02 INSTALLATION

- A. Install gates in accordance with manufacturer's installation instructions and approved shop drawings.

- B. Install gate posts plumb and level. Temporarily brace posts with 2 by 4 wood supports until concrete is set.
- C. Do not install bent, bowed, or otherwise damaged infill panels. Remove damaged components from site and replace.
- D. Secure infill panels per manufacturer's requirements.
- E. Install gates and adjust hardware for smooth operation.
- F. Provide concrete center foundation depth and drop rod retainers at center of double swinging gate openings.
- G. After installation, test gate. Open and close a minimum of five times. Correct deficiencies and adjust.
- H. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION

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**SECTION 32 3132
COMPOSITE FENCES AND GATES**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Modular fence system.
 - 2. Accessories
- B. Related Sections:
 - 1. Section 03 3000: Cast-In-Place Concrete, for post footings.

1.02 REFERENCE STANDARDS:

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 501.1-05 Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.

1.03 SUBMITTALS

- A. Product Data: manufacturer's standard specifications, and descriptive literature for main products; and any accessory items, including:
 - 1. Specification data product information sheets.
 - 2. Catalog cut-sheets.
 - 3. Color charts.
 - 4. Sample warranty forms.
- B. Shop Drawings: graphic information specifically prepared for this Project, including:
 - 1. Dimensioned plans, elevations, and construction details indicating full extent of modular fence and gate work complete with accessories, and hardware.
 - 2. Verified field dimensions.
- C. Samples:
 - 1. Color samples prepared on same material as specified products.
- D. Manufacturer's Instructions, including:
 - 1. Delivery, storage and handling.
 - 2. Preparation and Installation.
 - 3. Maintenance.
- E. Product Warranty: Perimtec standard 20-year warranty.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: specialized in installation of manufactured fence and gates required for this Project.
- B. Installation Documents: maintain manufacturer's installation instructions, approved submittals, and related documents on-site throughout construction period to confirm proper installation.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle manufactured fences and gates in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MODULAR FENCE AND GATE SYSTEM

- A. Manufacturer:
 - 1. FenceTrac Fence Systems, <https://www.fencetrac.com>
 - 2. Approved equal.
- B. Product: Luxecore Premium Composite Fencing
 - 1. Board style: Cellular PVC core encased in ASA (acrylic-styrene-acrylonitrile)
 - a. Tongue and groove
 - b. Board length: 6 feet.

- c. Board width: 6 inches.
- d. Board thickness: 1 inch.
- e. Fence height: reference drawings.
- f. Color: As selected by Architect from manufacturer's full range.
- g. Panel configuration: Level Height.
- h. Field cut to match degree of slope.
- i. Installation method: set posts per manufacturer's requirements.
- 2. Steel Frame Components:
 - a. Top Trac
 - b. Bottom Trac
 - c. Post Mount Trac siderails
 - d. Posts.
 - e. Swing gates: Fabricated to match fence panels with addition of triangular braces at corners; pre-assembled. Kits for field assembly and fitting.
 - 1) Gate sizes: reference drawings.
 - 2) Gate hardware: as recommended by manufacturer for commercial use.
- 3. Steel Frame Finish: durable textured matte black powder coat finish consisting of a multi-stage pre-treatment/wash (with zinc phosphate) followed by a duplex cathodic electrocoat system consisting of TGIC polyester powder coat, providing an industrial, weather-resistant finish.

2.02 ACCESSORIES

- A. Post Footings: Reference Section 033000 - Cast-In-Place Concrete.
- B. Fasteners: Type and size as required by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions of work previously installed under other sections or contracts are acceptable for installation of modular fence and gate work in accordance with manufacturer's instructions and approved submittals.
 - 1. Notify Architect of unacceptable conditions upon discovery.
 - 2. Proceed with preparation and installation only after unacceptable conditions have been corrected.

3.02 PREPARATION

- A. Prepare site to receive modular fence and gate work in accordance with manufacturer's instructions, and approved submittals.

3.03 INSTALLATION

- A. Install modular fence and gate work in accordance with manufacturer's instructions, and approved submittals.

3.04 CLEANING

- A. Clean-up packaging, waste material, and construction debris daily during installation; legally dispose of in accordance with authorities having jurisdiction.
- B. Upon completion, remove surplus materials, remaining debris, tools and equipment.

3.05 PROTECTION

- A. Protect installed products from damage during subsequent construction.
- B. Repair damage to adjacent materials caused by installation of modular fence and gate work.

END OF SECTION

**SECTION 32 8423
UNDERGROUND SPRINKLERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive analysis by a qualified professional irrigation designer, using performance requirements and design criteria indicated.
- B. Perform work required to complete an automatic irrigation system for Project site.
- C. Irrigation zone control shall be automatic operation with controller and automatic control valves.

1.02 SUMMARY

- A. Work Includes:
 - 1. Water meter (per local jurisdiction requirements).
 - 2. Piping and all required utility hook-ups.
 - 3. Sprinkler heads and dripline.
 - 4. Sprinkler controller, reference drawings for location.
 - 5. Automatic control valves with boxes.
 - 6. Backflow preventer (located in building) with drain—coordinate with plumbing.
 - 7. Automatic rain and freeze shutoff devices.
 - 8. Flow meter.
 - 9. Provide complete irrigation system including trenching and backfilling for all pipes, drain valves and pits, providing mains, laterals, risers, fittings, sprinkler heads, driplines, control valves, controllers, electric wiring, and necessary specialties and accessories.
 - 10. Provide sleeves beneath parking areas, walkways, roads, and driveways where required.
 - 11. Other irrigation components, as described in this specification.

1.03 REFERENCE STANDARDS

- A. ASTM B32 - Standard Specification for Solder Metal; 2020.
- B. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- C. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- D. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.
- E. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- F. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with site backfilling, landscape grading and delivery of plant life.
- B. Verifications: Verify location and available water pressure for irrigation connection.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used. Include zoning chart showing each irrigation zone and its control valve.
- C. Record Documents: Record actual locations of all concealed components piping system.
- D. Operation and Maintenance Data:

1. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
 2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
- E. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Sprinkler Heads: Two of each type and size.
 3. Extra Valve Keys for Manual Valves: Two.
 4. Extra Valve Box Keys: Two.
 5. Extra Valve Marker Keys: Two.
 6. Wrenches: Two for each type head core and for removing and installing each type head.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for piping and component requirements.
- B. It shall be the Contractor's responsibility to obtain all required inspections, permits and fees required by authorities having jurisdiction at no additional cost to the Owner.

1.08 COORDINATION

- A. It shall be the responsibility of the Contractor to coordinate irrigation components with existing conditions. Any sprinkler heads that do not provide the proper water coverage or provide the necessary overlap of sprays will be adjusted or additional heads added as required for complete coverage. Any conflicts or required adjustments will be promptly executed at no additional cost to the Owner.
- B. Coordinate irrigation work with the site work progress throughout construction. Coordinate with other trades as required, including installation of sleeves and connection to site water line.

1.09 GUARANTEE AND REPLACEMENT

- A. For a period of one year after the Owner's final acceptance, the Contractor shall replace and install, immediately and without additional cost to the Owner, all equipment or components which proves defective in material, workmanship or installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable code for piping and component requirements.

2.02 IRRIGATION SYSTEM

- A. Electric solenoid controlled underground irrigation system, with low point self drain.
- B. Manufacturers:
1. Rain Bird Sales, Inc: www.rainbird.com.
 2. Approved equal.
 3. Substitutions: See Section 01 6000 - Product Requirements.

2.03 PIPE MATERIALS

- A. Mainline piping above ground shall be copper tube, Type K, drawn temper; copper tube fittings; soldered joints.
- B. All piping from the supply to backflow preventer shall be Schedule 40 PVC 1120-1220, conforming to ASTM D-1785 and D-2672.
- C. Piping 2-1/2" in diameter and larger shall be: PVC 1120-1220 SDR 21.0, Class 200 rubber gasket joint pipe, conforming to ASTM D-1784 and ASTM D-2241. Rubber gasket shall conform to ASTM D-3139 and shall be provided by pipe manufacturer.

- D. Piping 3/4" inch through 2" diameter shall be: PVC 112D-122D, SDR 21.0, Class 200 belled end solvent weld, and conforming to ASTM D 2241-73.
- E. Fittings for PVC Pipe:
 - 1. Fittings for PVC pipe 3" and larger shall be Harco or equal, IPS Ductile Iron gasket joint type.
 - 2. Fittings for PVC pipe 2" and larger that is under continuous pressure shall be Harco or similar IPS Ductile Iron Gasket joint type.
 - 3. Other fittings for PVC pipe shall be Schedule 40 PVC as manufactured by Spears, Dura or equal.
 - 4. Threaded PVC nipples shall be Schedule 80 as manufactured by Spears, Dura, or equal.
- F. Sleeve Material: Schedule 80 PVC; twice the diameter of the pipe to run inside it.

2.04 OUTLETS

- A. Rotors
 - 1. Manufacturers:
 - a. Rainbird; Product - 5004, Falcon 6504 or 8005 series.
 - b. Approved equal.
- B. Spray Heads
 - 1. Manufacturers:
 - a. Rainbird; Product - RD1800 series with high efficiency nozzles.
 - b. Approved equal.
- C. Drip
 - 1. Manufacturers:
 - a. Rainbird; Product - XFS-CV series dripline.
 - b. Approved equal.
- D. Quick Coupler: Brass 1-Piece Body, stainless steel spring, locking rubber cover.
- E. Garden Hose
 - 1. Manufacturers:
 - a. Reelcraft; Product - 4NB26/ A5835 OLBSW23
 - 1) Spring Return Hose Reel: 35 ft (1/2 in I.D.), 3/4 in FGHT x 3/4 in FNH
 - b. Approved equal.

2.05 VALVES

- A. Manufacturers:
 - 1. Rainbird; Product - PEB series.
 - 2. At Drip Irrigation: Rainbird; Product - Wide Flow Commercial Control Zone Kit with Scrubber Valve and Pressure Regulating Basket Filter.
 - 3. Approved equal.
- B. Ball Valves: Spears Schedule 80 series 2339 True Union Ball Valves, or approved equal.
- C. Backflow Preventer: Bronze body construction, reduced pressure zone type 975XL by Wilkins, or approved equal.
- D. Valve Box and Cover: by Carson, or approved equal.
 - 1. Cover color: green.
 - 2. Covers shall be mechanically fastened.
 - 3. Covers shall be engraved with corresponding labels (i.e. 'Irrigation Control Valve').
 - 4. Valve Box and Cover at concrete: by Oldcastle Infrastructure, or approved equal.
 - a. Christy G12
 - 1) Cover: 13" Diameter
 - 2) Body: 20" Diameter
 - 3) Height: 12"
 - b. Covers shall be mechanically fastened.
 - c. Covers shall be engraved with corresponding labels (i.e. 'Irrigation Control Valve').

- E. Drain Valves: Rainbird 16A-FDV, King Drains, or approved equal.

2.06 CONTROLS

- A. Manufacturers:
 - 1. Rainbird.
 - 2. Approved equal.
- B. Controller: ESP-ME3 Series Controller.
 - 1. LNK WiFi module
 - 2. WR2-RFC rain and freeze sensor combo with bracket
 - 3. FG100 flow sensor
- C. Controller Housing:
 - 1. LXMM (PED) metal wall or pedestal mount case
- D. Wire Conductors: Color coded.
 - 1. System wiring shall be UF/UL direct burial copper wire. Insulation shall be a minimum of 4/64" thick ICC-100 compound. Sizes 14, 12, 10, and 8 shall be solid copper. Minimum size on all installations shall be 14 gauge. Wiring from controller to valves shall be one continuous run free of splices unless over 500 feet. Splices in runs over 500 feet shall be made using 3M Scotchlok #3570 splice kits and be contained in appropriate valve box. All wire connections and splices shall be contained in a valve box. Underground tracing wire shall be 14 gauge Brown UF/UL solid copper wire. Tracer wire shall be installed in all MAIN line and SUBMAIN line trenches where 24 volt valve control wiring is not installed. All tracer wire runs shall be continuous runs with no wire splices under 500 feet. Splices over 500 feet shall be made using 3M Scotchlok #3570 splice kits.

2.07 OTHER MATERIALS

- A. Provide other materials, not specifically described, but required for a complete and proper installation, as selected by the Contractor and subject to approval by the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify location of existing utilities.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Field test and verify water pressure at the site prior to beginning installation.

3.02 DEMOLITION

- A. Backfill, fine grade, and sod areas disturbed by demolition work.

3.03 PREPARATION

- A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.
- B. Layout and stake locations of system components.
- C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.04 TRENCHING

- A. Trench to accommodate grade changes and slope to drains.
- B. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.05 INSTALLATION

- A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.
 - 1. Piping:
 - a. Minimum coverage for all laterals is 12 inches.
 - b. Minimum coverage for all sleeves, main lines and control wires is 18 inches.
 - c. Install thrust blocks of 3,000 psi concrete where the irrigation main changes direction at ells and tees, where main line terminates, and under gate valves.

2. Outlets:
 - a. Set lawn heads flush with grade. Allow for turfgrass height so that spray is not restricted.
 - b. Where sprinkler heads are adjacent to walks or curbs, allow 2-inch space between head and paving for edging operations.
 - c. 18-inch long poly pipe at spray heads.
 - d. 12-inch long schedule 80 quadruple rigid arm swing at rotor heads.
 - e. Set driplines 3" below finish elevation of planting soil.
3. Controller:
 - a. Hard wire 120 volt, 20-amp breaker panel to controller within conduit.
 - b. Affix zone number wire labels to all station wires inside the controller box.
 - c. Locate per drawings.
4. Valves:
 - a. Set at depth of pressure piping and equipment with valve access box.
 - b. Valve Box:
 - 1) Mount flush and level with grade using extensions as required. No portion of valve box shall rest on pipe of valve.
 - 2) Boxes shall have 4" depth of clean #57 aggregate to serve as box base.
 - 3) Backfill box with 4-6" of clean #57 aggregate to provide clean installation without soil.
 - 4) Irrigation valves, or other buried irrigation apparatus, shall be accessible.
 - c. Automatic Drain Valves: Provide 1-cubic foot of clean #57 aggregate at each automatic drain valve. Install at low points of each zone. Install at 45-degree angle per manufacturer's instructions.
- B. Connect to utilities.
- C. Set outlets and box covers at finish grade elevations.
- D. Provide for thermal movement of components in system.
- E. Slope piping for self drainage to gravel filled well point.
- F. Use threaded nipples for risers to each outlet.
- G. Control Wiring:
 1. Install control wires with sprinkler mains and laterals in common trenches. Tape wiring to the side of pipe in same trench. Provide 5' looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10' intervals.
 2. Control wire line splices will be allowed only on runs of more than 500'. Splices to be made in valve boxes with 15" of slack.
 3. Make electrical splices waterproof.
- H. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.06 FIELD QUALITY CONTROL

- A. Upon completion of the installation, the entire system shall be tested and adjusted for proper operation and distribution of the system. Obtain complete coverage with wind velocity not more than six miles per hour. Each zone shall be tested. Contractor shall make all requested adjustments and repairs, including addition of heads if necessary for coverage. Re-inspections will be held as necessary until all modifications have been satisfactorily made.
- B. Pressure Testing:
 1. Flush piping clear of dirt and foreign matter.
 2. Test on pressure lines shall be completed prior to final backfilling.
 3. Fittings and couplings must be open to visual inspection for the full period of the test.
 4. Do not test until the last solvent welded joint has set and cured for eight hours.
 5. Control valves shall be closed.
 6. Expel air from piping before testing.

7. Test duration: Eight hours minimum. System shall be subject to full line pressure.
Should any leaks occur, repair defect and re-test for full duration of test.

3.07 BACKFILLING

- A. Backfill in lawn areas using approved topsoil.
- B. Backfill shall leave no depressions. Sod all trenches per Section 32 9223.
- C. Should depressions develop after completion of the work, the Contractor shall be responsible for additional topsoil or other work to correct depressions.
- D. Where trenches are under paved areas, backfill trenches in six inch lifts and mechanically compact each layer to 95 percent standard proctor density.

3.08 SYSTEM STARTUP

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Adjust control system to achieve time cycles required.
- C. Adjust head types for full water coverage as directed.

3.09 CLOSEOUT ACTIVITIES

- A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.
- B. Submit operation and maintenance data and maintenance materials per 1.05 above.

3.10 RECORD DRAWINGS

- A. Reproducible record drawings shall be provided to the Owner prior to date of substantial completion. Drawings shall accurately show location of system components, including heads, main and lateral piping, valves, controller, backflow preventer, and meter.
- B. Provide 2 laminated copies of irrigation zones, to be placed in a sleeve inside controller box. Color-code to identify the extent of each zone.

3.11 CONTRACTOR'S RESPONSIBILITY

- A. The Contract specifications do not set forth every item or detail required to complete this work. This shall not be construed as relieving the Contractor from furnishing all labor, materials, equipment, service, or transportation necessary to obtain an operable irrigation system, efficiently performing the function for which it was designed.

3.12 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide one complete spring start-up and a fall shutdown by installer, at no extra cost to Owner.

END OF SECTION

SECTION 32 9223 SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Sod installation.
- E. Maintenance.

1.02 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.03 REFERENCE STANDARDS

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Certificate: Certify grass species and location of sod source.

1.05 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Project location.
- B. Installer Qualifications: Company approved by the sod producer.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sod in rolls. Protect exposed roots from dehydration.
- B. Protect exposed roots from dehydration.
- C. Do not deliver more sod than can be laid within 24 hours.

1.08 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: TPI, Certified Turfgrass Sod quality; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft (100 sq m). Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 1. Bermuda Grass Type 'Astro'.
- B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- C. Fertilizer: Recommended for specified grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated

by analysis.

- D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.02 ACCESSORIES

- A. Herbicide: Pre and Post Emergent Herbicide effective for controlling the germination or growth of weeds.

2.03 SOURCE QUALITY CONTROL

- A. Provide analysis of topsoil fill under provisions of Section 01 4000.
- B. Submit topsoil testing analysis for review:
 - 1. Analyze to ascertain percentage of nitrogen, phosphorus, potash soluble salt content, organic matter content, and pH value.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Scarify subsoil to a depth of 6-inches.
- B. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels profile and contours. Make change in grade gradual. Blend slopes into level areas.
- C. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil.

3.03 PLACING TOPSOIL

- A. Spread approved topsoil to a minimum compacted depth of six inches over area to be sodded. Prepare until smooth.
 - 1. Existing topsoil excavated and stockpiled on-site may be utilized.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material while spreading.
- D. Grade to eliminate rough, low, or soft areas, and to ensure positive drainage away from structures.
- E. Finish ground level firm and sufficient to prevent sinkage pockets when irrigation is applied.

3.04 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions at a rate of 3 lb./100 square feet.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.05 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Remove and dispose of plastic net backing.
- C. Lay sod immediately after delivery to site to prevent deterioration. Sod pallet time shall not exceed 24 hours.
- D. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches (300 mm) minimum. Do not stretch or overlap sod pieces.
- E. Where new sod adjoins existing grass areas, align top surfaces.
- F. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1 inch (25 mm) below top of hard surface.

- G. Water sodded areas immediately after installation. Saturate sod to 3 inches (76 mm) of soil which is approximately 1-inch of water per day for the first 2-3 weeks.
- H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.06 MAINTENANCE

- A. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
- B. Contractor shall water (irrigated and non-irrigated) sodded areas as required until grass is well established and exhibits a vigorous growing condition.
- C. Mowing:
 - 1. Astro Bermuda:
 - a. Mow grass at regular intervals to maintain at a maximum height of 2-inches. Do not cut more than 1/3 of grass blade at any one mowing.
 - b. Mow every 5-7 days during the active growing season.
- D. Neatly trim edges and hand clip where necessary.
- E. Roll surface to remove irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions for the specified turfgrass type. Remedy damage resulting from improper use of herbicides.
- G. Immediately replace sod to areas that show deterioration or bare spots.
- H. Watering Post Establishment:
 - 1. Apply 1-inch of water in a single application about once per week during hot and dry conditions. To promote a deep, durable root system, deep soaking water applications are preferred over short and frequent shallow water applications.

END OF SECTION

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SECTION 32 9300 PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Planting soil: Landscape Bed Planting Soil, Topsoil, Garden Soil.
- C. Soil amendment materials.
- D. New trees, plants, and ground cover.
- E. Mulch.
- F. Accessories.
- G. Maintenance.
- H. Tree pruning.

1.02 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.03 REFERENCE STANDARDS

- A. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.
- B. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submit list of plant life sources.
- C. Plant Materials: Include quantities, sizes, and quality of plant materials.
- D. Submit product data/ cutsheets for planting soil, mulch, fertilizer, and accessories.

1.05 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with five years documented experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants with five years documented experience.
- C. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
- D. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.
- E. Tree Pruning: Conform to ANSI A300 Part 1.
- F. Maintenance Services: Performed by installer.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- B. Protect and maintain plant life until planted.
- C. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.08 FIELD CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F (2 degrees C) or rise above 90 degrees F (32 degrees C).
- B. Do not install plant life when wind velocity exceeds 30 mph (48 k/hr).
- C. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- D. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Owner's written permission.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty.
- C. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.
- D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

1.10 MAINTENANCE

- A. Reference Part 3 of this section.

PART 2 PRODUCTS

2.01 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.
- B. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- C. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.02 SOIL MATERIALS

- A. Landscape Bed Planting Soil: Planting Mix by Gem Dirt (or approved equal).
- B. Garden Soil: Garden Mix soil by Gem Dirt (or approved equal)
- C. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0.

2.03 SOIL AMENDMENT MATERIALS

- A. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.
- B. Herbicide: Pre and Post Emergent Herbicide effective for controlling the germination or growth of weeds within planted areas.
- C. Pesticide: Registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific pest and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.04 MULCH MATERIALS

- A. Organic Mulching Material: Double shredded hardwood mulch (natural color), free of growth or germination inhibiting ingredients.
 - 1. Approved Products:
 - a. Jemasco, Inc.
 - b. Approved equal.

2.05 ACCESSORIES

- A. Root Ball Stabilization Devices: Below grade stabilization systems to secure each new tree by root ball; sized per manufacturer's instructions.
 - 1. Approved Products:
 - a. Foresight Products, LLC; Duckbill Rootball Fixing System.
 - b. Approved equal.
- B. Pine Tree Stabilization: at pine trees, secure each new tree with t-post (three each equally spaced) and guy wire with nylon tree strap.
- C. Edging: As indicated per drawings.
- D. Tree Protector: by Arborgard, or approved equal; grey

2.06 SOURCE QUALITY CONTROL

- A. Provide analysis of topsoil; comply with requirements of Section 01 4000.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt, organic matter, and pH value.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared subsoil and landscape beds are ready to receive work.
- B. Saturate soil with water to test drainage.
- C. Verify that required underground utilities are available, in proper location, and ready for use.
- D. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- E. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 3 inches (75 mm) where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 PLACING PLANTING SOIL

- A. Place planting soil during dry weather and on dry unfrozen subgrade.

- B. Remove vegetable matter and foreign non-organic material from soil while spreading.
- C. Grade planting soil to eliminate rough, low or soft areas, and to ensure positive drainage.
- D. Install soil into pits and beds intended for plant root balls at depth per Drawings.

3.04 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
- D. Lightly water to aid the dissipation of fertilizer.

3.05 PLANTING

- A. Excavate two-three times as wide as root ball diameter.
 - 1. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 2. Maintain supervision of excavations during working hours.
 - 3. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
 - 4. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- B. Place plants as indicated for review and final orientation by Architect.
- C. Relocate plants as directed for approval.
- D. Set plants vertical.
- E. Remove non-biodegradable root containers.
- F. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth as indicated on drawings under each plant. Remove burlap, ropes, and wires, from the root ball.
- G. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch (150 mm) layers. Maintain plant life in vertical position.
- H. Saturate soil with water when the pit or bed is half full of planting soil and again when full.

3.06 MULCHING

- A. Apply three inch (four inch at trees) minimum thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.07 INSTALLATION OF ACCESSORIES

- A. Edging: Provide and install edging per drawings and manufacturer's instructions.
- B. Wrap tree trunks with tree protectors.

3.08 PLANT SUPPORT

- A. Root Ball Stabilization: Install root ball stabilization system sized and positioned as recommended by manufacturer and according to manufacturer's written instructions.

3.09 TREE PRUNING

- A. Prune trees as recommended in ANSI A300 Part 1.
- B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.10 CLEAN UP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- D. Disposal: Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.11 MAINTENANCE

- A. Maintain plant life for three months after Date of Substantial Completion.
- B. Cultivate and weed plant beds and tree pits.
- C. Remove dead or broken branches and treat pruned areas or other wounds.
- D. Immediately remove clippings after trimming.
- E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- F. Control insect damage and disease. Apply pesticides in accordance with manufacturers instructions.
- G. Remedy damage from use of herbicides and pesticides.
- H. Replace mulch when deteriorated.
- I. Repair or replace accessories when required.

END OF SECTION

SECTION 33 4100
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Drains & pipes.
 - 2. Precast concrete manholes.

1.03 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited.
- B. EPDM: Ethylene-propylene-diene-monomer rubber.
- C. LLPE: Linear low-density, polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt tight, unless otherwise indicated.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Catch Basins
 - 2. Pipe and fittings
 - 3. Manholes
 - 4. Stormwater Inlets
 - 5. Trench Drains
 - 6. End Sections/Headwalls
 - 7. Pond Outlet
- B. Shop Drawings: For the following:
 - 1. Catch Basins, Pond Outlet, Headwalls, Trench Drains and Stormwater Inlets. Include plans, elevations, sections, reinforcement, details, and frames, covers, and grates.
- C. Field quality-control test reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes, catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.02 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 - 2. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
- C. Corrugated PE Pipe and Fittings NPS 56 and NPS 60: AASHTO MP7, Type S, with smooth waterway for coupling joints.
 - 1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.03 CPP PIPE AND FITTINGS

- A. CPP Sewer Pipe and Fittings: ASTM F2881, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.
 - 1. HP Storm – Dual Wall – PP Pipe by ADS or approved equal.
- B. Polypropylene compound shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

2.04 PVC PIPE AND FITTINGS

- A. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40, socket-type fittings.
- B. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. PVC Sewer Pipe and Fittings, NPS 18 (DN 450) and Larger: ASTM F 679, T-[1] [2] wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- D. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.05 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot or groove and tongue ends.
 - 1. Gasketed joints with ASTM C 443, rubber gaskets, “omni-flex” or equal
 - 2. Class III, Wall A.

2.06 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.07 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 1. Top-Loading Classification(s): Extra-heavy duty.
 - 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.08 PIPE OUTLETS

- A. Headwalls: Cast-in-place reinforced concrete, with apron and tapered sides.

2.09 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 3. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
 - 4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 6. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 - 7. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
 - 8. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 - 10. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.10 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.11 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 - 3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
 7. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
 8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- B. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Bottom, Walls, and Top: Reinforced concrete.
 2. Channels and Benches: Concrete.
 3. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.

2.11 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

2.12 PIPING INSTALLATION

- A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

2.13 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

2.14 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

2.15 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

2.16 DRAINAGE SYSTEM INSTALLATION

- A. Assemble and install components according to manufacturer's written instructions.
- B. Install with top surfaces of components, except piping, flush with finished surface.
- C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- D. Embed channel sections and drainage specialties in 4-inch (102-mm) minimum concrete around bottom and sides.
- E. Fasten grates to channel sections if indicated.
- F. Assemble channel sections with flanged or interlocking joints.
- G. Embed channel sections in 4-inch (102-mm) minimum concrete around bottom and sides.

2.17 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:

- a. Alignment: Less than full diameter of inside of pipe is visible between structures.
- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
- c. Crushed, broken, cracked, or otherwise damaged piping.
- d. Infiltration: Water leakage into piping.
- e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Re-inspect and repeat procedure until results are satisfactory.

2.18 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

PART 3 EXECUTION

3.01 EARTHWORK

- B. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.02 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

3.03 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

3. Install piping with 36-inch minimum cover.
4. Install piping below frost line.
5. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.04 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 1. Join corrugated PE piping according to CPPA 100 and the following:
 - a. Use silt tight couplings for Type 1, silt tight joints.
 2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
 3. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 4. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints and proper tolerances for the Omni-flex gaskets.
 5. Join dissimilar pipe materials with nonpressure-type flexible couplings.
- C. Join dissimilar pipe materials with pressure-type couplings.

3.05 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.06 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 1. Use light-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
 2. Use medium-duty, top-loading classification drains in paved foot-traffic areas.
 3. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
 4. Use extra-heavy-duty, top-loading classification drains in roads areas.
- B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.

3.07 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections according to ASTM C 891.
- C. Construct cast-in-place manholes as indicated.
- D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

- E. Install FRP manholes according to manufacturer's written instructions.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.08 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.09 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.10 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.11 STORMWATER DISPOSAL SYSTEM INSTALLATION

- A. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill according to piping manufacturer's written instructions.

3.12 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
 - 1. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- B. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.13 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use warning tape over piping and over edges of underground structures.

3.14 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
 - d. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - e. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.15 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water as required.

END OF SECTION