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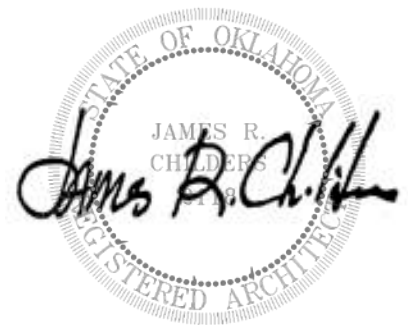
# Cherokee Nation Entertainment TAHLEQUAH CASINO

Tahlequah, Oklahoma

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April 20<sup>th</sup>, 2018



JAMES R. CHILDERS ARCHITECT, INC.

## TABLE OF CONTENTS

### DIVISION 32 – EXTERIOR IMPROVEMENTS

32 1216	ASPHALT PAVING
32 1313	CONCRETE PAVING
32 1373	CONCRETE PAVING JOINT SEALANTS
32 1723	PAVEMENT MARKINGS
32 3113	CHAIN LINK FENCES AND GATES

**SECTION 32 1216**  
**ASPHALT PAVING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Recycled Hot-mix asphalt paving.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 Specification Sections, apply to this Section.

**1.3 RELATED SECTIONS**

- A. Section 00 3100: Available Project Information.
- B. Section 31 1000: Site Clearing.
- C. Section 31 2000: Earth Moving.
- D. Section 32 1723: Pavement Markings.

**1.4 REFERENCED STANDARDS**

- A. Latest version or edition shall apply unless otherwise noted.
  - 1. ASTM International
    - a. D3666, Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
  - 2. The Asphalt Institute, "Asphalt Paving Manual," Manual Series No. 8, Third Edition, April 1978.
  - 3. American Association of State Highway and Transportation Officials (AASHTO)
    - a. T 209, Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA).
  - 4. Oklahoma Department of Transportation (ODOT), *Standard Specifications for Highway Construction* (ODOT Specifications).
    - a. Section 411 and 708, Plant Mix Asphalt Concrete Pavement.
    - b. Section 303 and 703.01, Mineral Aggregate Base Materials.

**1.5 DEFINITIONS**

- A. Geotechnical Report: *Report of Subsurface Exploration and Geotechnical Evaluation, Cherokee Springs Casino, Tahlequah, OK*, prepared by Building & Earth (Building & Earth Project No. OK170293), dated January 17, 2018.
- B. Geotechnical Engineer: Building & Earth, 1403 South 70<sup>th</sup> East Avenue, Tulsa, Oklahoma 74112, Phone 918.439.9005, www.buildingandearth.com.
- C. Geotechnical Testing Agency: to be appointed by Contractor. Geotechnical Testing Agency shall be qualified per requirements of ASTM E329 and ASTM D3740 for testing indicated. Documentation of said qualifications shall be submitted to Engineer for review and approval prior to performance of work.

**1.6 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Material Certificates: For each paving material, from manufacturer.
- C. Material Test Reports: For each paving material.

## **1.7 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Oklahoma Department of Transportation for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

## **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the requirements of Section 402 of ODOT Specifications.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Paving recommendations provided in the Geotechnical Report have indicated the use of materials meeting the requirements of ODOT Specifications. Specific section numbers of the referenced document have been provided below as appropriate. The Contractor shall be required to retain and review said document to ensure all material requirements are met.

### **2.2 AGGREGATES**

- A. Coarse Aggregate: ODOT Specifications, Section 708. Per requirements for Type A and B.
- B. Fine Aggregate: ODOT Specifications, Section 708. Per requirements for Type A and B.
- C. Mineral Filler: ODOT Specifications, Section 708. Per requirements for Type A and B.

### **2.3 ASPHALT MATERIALS**

- A. Asphalt Binder: ODOT Specifications, Section 708.
- A. Asphalt Cement: ODOT Specifications, Section 708.
- A. Prime Coat: ODOT Specifications, Section 708.03.
- B. Tack Coat: ODOT Specifications, Section 708.03.
- C. Water: Potable.

### **2.4 AUXILIARY MATERIALS**

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Sand: ODOT Specifications, Section 708. Per requirements for Type A and B.

### **2.5 MIXES**

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant complying with the following requirements:
  - 1. Base Course: ODOT Specifications, HMAC Binder Course (Superpave "S3").
  - 2. Surface Course: ODOT Specifications, HMAC Binder Course (Superpave "S4").

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment 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 (5 km/h).
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 25 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Testing Agency, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

### **3.2 SURFACE PREPARATION**

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. 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.
1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate as specified by ODOT Specifications, Section 408. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  2. Protect primed substrate from damage until ready to receive paving.

### **3.3 PREPARATION OF ASPHALTIC CEMENT**

- A. The asphaltic cement shall be heated at the paving plant to a temperature of two hundred seventy-five degrees F (275°F) to three hundred twenty-five degrees F (325°F).

### **3.4 PREPARATION OF MINERAL AGGREGATES**

- A. The mineral aggregates shall be dried and heated at the paving plant so that when delivered to the mixer they shall be at as low a temperature as is consistent with proper mixing and laying, and in no case to exceed three hundred twenty-five degrees F (325°F). Aggregates may be fed simultaneously into the same drier but in such case, immediately after heating, they shall be screened into the bin sizes specified. Oversize material, crushed after passing through the drier shall not be incorporated into the mixer without again being heated and dried.

### **3.5 PREPARATION OF BITUMINOUS MIXTURE**

- A. The hot aggregate prepared as prescribed above shall be accurately measured and conveyed into a mixer in the proportionate amounts of each aggregate required to meet the specified grading.
- B. The mixture shall be made by first charging the mixer with the mineral aggregate and filler and mixing these dry for a period of from five (5) to twenty (20) seconds after which the asphaltic cement shall be added and the mixing continued for a period of not less than thirty (30) seconds, or longer, if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.

### **3.6 LOADING AND TRANSPORTATION OF MIXTURE**

- A. The mixture shall be transported from the paving plant to the work in tight vehicles with metal bottom previously cleaned of all foreign materials. When directed by the Engineer the vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles used for hauling mixtures may be lightly lubricated with a thin oil or soap solution just before loading, but excess of lubricant will not be permitted. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight unless artificial light satisfactory to the Engineer is provided.

### **3.7 TACK COAT**

- A. Before the asphaltic mixture is laid, the surface upon which it is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer, and if indicated on the plans, shall be given a uniform tack coat application with asphalt of the type shown herein. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at the rate of not to exceed 0.10 gallon per square yard of surface. All contact surfaces of curbs and gutters, manholes and other structures shall be painted with a thin uniform coat of asphaltic material used for the tack coat or in case no tack coat is shown on the plans, curbs and other structures shall be painted with a thin uniform coating of emulsified asphalt.

### **3.8 PLACING ASPHALTIC MIXTURE**

- A. The asphaltic mixture shall be laid at a temperature from two hundred twenty-five degrees F (225°F) to three hundred degrees F (300°F) and only upon an approved base which is dry. The mixture shall be delivered on the job at a minimum workable temperature that will produce the density herein specified after final compaction.
- B. When existing paving is to be resurfaced to a crown section not conforming to that of the original paving, the asphaltic concrete leveling course shall be placed in lifts beginning at the point on the existing slab requiring the greatest addition of material and by the addition of successive lifts of material, gradually shaping the crown to conform to that required in the finished slab. The last increment of material shall consist of a uniform thickness of an asphaltic concrete wearing surface.
- C. When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated, when authorized by the Engineer, provided a satisfactory surface can be obtained by other approved methods.
- D. Immediately after any course is screeded, and before compaction is started, the surface shall be checked, and any inequalities adjusted, all fat sandy accumulation from the screen removed by a lute, and all fat spots in any course removed and replaced with satisfactory material. Irregularities in alignment and grade along the outside edge shall also be corrected by the addition or removal of mixture before the edge is compacted.
- E. The mixture shall be distributed into place by means of shovel and lute in a loose layer of uniform density and correct depth. Shovelers and rakers shall work skillfully together so that the finished product will require a minimum amount of rework after the first compactive effort.
- F. Placing of mixture shall be as continuous as possible and the roller shall pass over the unprotected edge of the fresh laid mixture only when the laying of this course is to be discontinued for such length of time as to permit the mixture to become chilled.
- G. Thickness of compacted course shall be not more than eight inches (8") in depth. Thickness will be reduced by the Engineer, if the required densities cannot be obtained.
- H. Forms will not be required when the finishing machine is of such type as not to require forms for grade control. When forms are required they shall have a thickness equal to the compacted surface course and shall remain in place until final surface finishing, other than rolling, has been completed.
- I. In placing a level-up course with the spreading and finishing machine, the forms, binder twine or cord, shall be set to line and grade established by the Engineer. When directed by the Engineer, level-up shall be spread with an approved motor patrol grader.
- J. Fillets, spandrels and other large areas which cannot be laid with a machine shall be placed in accordance with Section W-IV, "Fillets, Spandrels and other Large Handworked Areas", in the Asphalt Paving Manual.

### **3.9 JOINTS**

- A. Longitudinal and transverse joints shall be made in such a manner that a smooth, strong, neat union is obtained, between the respective lanes or lane ends. They shall be made by the methods and procedures outlined in Section W-III, "Joints" of the Asphalt Paving Manual or

some other method acceptable to the Engineer. Longitudinal joints shall conform to the tolerances defined in Section W-III 1-a (3) or Section W-III b (3) "Alignment", of the manual.

- B. Transverse or longitudinal joints accumulating mud, dust, or foreign matter shall be trimmed back to the satisfaction of the Engineer so that a proper bond of asphaltic concrete will be obtained. Longitudinal joints with an undue dust film shall be tacked with an approved tack coat before the adjoining lane is placed.
- A. Joints with PC Concrete such as curbs, gutters, and pavements shall be made to conform to Section W-III, "Asphaltic Concrete to Portland Cement Joints" in the Asphalt Paving Manual. Joints with manholes, valve boxes and inlet grates shall be made to conform to sections as shown on the sheet of details.

### **3.10 COMPACTION**

- A. Rolling shall be done in such a manner that a surface will be obtained meeting the tolerance for smoothness and density requirements specified and all roller marks shall be eliminated.
- B. The target density for compaction shall be 94 percent of the maximum theoretical density shown on the latest laboratory mix design report for the percent asphalt content recommended except in situations as described below. Tests to establish the maximum theoretical density of the plant mixture shall be performed as often as necessary to ensure an accurate value is used in the calculation of roadway density.
- C. The average roadway density shall be not less than the target density.
- D. Individual roadway densities more than two percent (2%) below the target densities will not be accepted. It is the intent that the contractor achieve uniform compaction at or above the target density. The difference from the high to low percent density tested shall not exceed four percent (4%).
- E. When Type B, M or D asphalt concrete is placed on an existing surface that has not received fullwidth milling, in a plan thickness of 2" or less, the average target density shall be ninety-three percent (93%) of maximum theoretical density.
- F. When the existing surface has been milled full-width, or if a leveling course has been placed prior to the overlay, the average target density shall be ninety-four (94) percent of maximum theoretical density, (Type B, M or D).
- G. When Type E asphalt concrete is placed, the minimum density shall be ninety-one (91) percent of maximum theoretical density. In the interest of appearance and practicality, density tests on the pavement may be waived by the Engineer for resurface courses.
- H. A self-propelled pneumatic roller may be required by the Engineer to obtain the specified density and surface texture.

### **3.11 TESTING AND CORRECTING SURFACE**

- A. The riding qualities of the finished surface shall be satisfactory to the Engineer. In case of dispute, the remaining provisions of the standard specifications shall apply.
- B. For the purpose of testing the finished surface, a ten (10) foot straightedge shall be available on the work. Depressions which may develop after the first rolling shall be remedied by loosening the surface depressions not being noticeable until the final compaction has been made, the surface course shall be removed and sufficient new material laid to form a true even surface.
- C. The finished pavement surface shall show no deviation from the general surface in excess of one sixteenth inch (1/16") per foot as measured in the following manner:
  - 1. A ten (10) foot straightedge shall be placed parallel to the centerline of the roadway so as to bridge any depressions.
  - 2. Ordinates measured from the face of the straightedge to the surface of the pavement shall not exceed one-sixteenth inch (1/16") for each foot in distance from the nearest point of contact with a maximum permissible variation of three-sixteenths inch (3/16").
  - 3. Such portions of the completed pavement as are defective in finish, density, or composition, or that do not comply in all respects with the requirements of these

specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

- D. Prior to the acceptance of the pavement, the pavement shall be flooded with a sufficient quantity of water to show if areas of ponding exist. All areas of ponding in excess of one-fourth inch (1/4") in depth and any length of curb and gutter that ponds in excess of one-fourth inch (1/4") in depth shall be removed and replaced by the Contractor and at the Contractor's expense.
1. The water may be applied by tank truck or with fire hose if a fire hydrant is available. The water shall be applied as directed by the Engineer and all expenses borne by the Contractor.
  2. When it is necessary to remove and replace a section of curb and gutter any remaining portion of the curb and gutter adjacent to joints that is less than ten (10) feet in length shall also be removed and replaced by the Contractor and at the Contractor's expense.

### 3.12 TESTING

- A. Description: It is the intent of this specification that the pavement shall be constructed strictly in accordance with the thickness recommended in the Geotechnical Report. Where any pavement is found not so constructed, the following rules relative to core drilling pavement and replacement of the faulty pavement shall govern.
1. General: The asphaltic pavement base and surface coarse will be accepted by the engineer on a "Lot" by "Lot" base. A "Lot" is considered to be 2,000 tons or part thereof or one (1) day of plant production.
  2. Acceptance Testing: The acceptance testing of a "Lot" will be performed by a qualified testing laboratory approved by the Engineer.
  3. Tests results reports: Tests reports shall be emailed on a daily basis to the Engineer
  4. Asphaltic Concrete Mix Design: Asphaltic concrete mix design and initial job-mix formula are the responsibility of the Contractor and shall be submitted to the Engineer for approval. A new mix design is required should the material source change or results with the job-mix formula prove unsatisfactory.
  5. Sampling and Testing: Sampling and testing of the asphaltic concrete at the job site shall be in accordance with the following schedule:
    - a. Asphalt extraction and gradation: one (1) per 1,000-tons asphalt pavement
    - b. Roadway density of asphalt mix: four (4) per 2,000-tons asphalt pavement or as directed by Engineer.
    - c. Hveem stability test and density of molded specimen: one (1) per 2,000-tons asphalt pavement.
    - d. Maximum theoretical specific gravity of asphalt mix: one (1) per 2,000-tons asphalt pavement.
    - e. In all cases, it is the responsibility of the contractor to notify the testing laboratory one (1) day in advance of the work that is to be performed. It is the responsibility of the Contractor to prove the acceptability of a "Lot" that does not have the required testing. The Engineer reserves the right to request the removal of "Lots" that do not have the required testing.
  6. Acceptance: Acceptance of all asphaltic concrete lifts (new construction and overlays) shall be based on density per the following schedule:
    - a. Greater than 1-1/2 inches in thickness:
      - 1) The target density of each lot shall be 94 percent (unless specified otherwise by the Engineer) of the maximum Theoretical Specific Gravity at the Job Mix Formula asphalt content determined by the most recent specific gravity of the bituminous paving mixture in accordance with the AASHTO T 209. The roadway density of each lot will be the average of tests on three



- (3) separate specimens taken within the limits of the area represented by the lot. The locations and times of the test specimens collection shall be established by the engineer or his/her representative.
    - 2) The approved testing laboratory shall cut test specimens for each lot from the pavement by sawing or coring a specimen having a minimum size of four (4) inches on the cut side or diameter. The cost of cutting specimens and satisfactorily repairing the specimens area shall be paid by the Contractor. Repairing the specimen area with asphalt will be the responsibility of the contractor. Density may be on the specimens or through use of nuclear density gauges. The use of a nuclear density gauge or testing on the specimens shall be at the discretion of the Engineer.
    - 3) Acceptance will be based on tests by the approved testing laboratory and the decision of the Engineer. The minimum density of 92 percent and maximum density of 96 percent are the acceptable levels of density (unless otherwise specified by the Engineer).
  - b. All Lifts Less Than 1-1/2 inches in Thickness: The acceptance of asphaltic concrete lifts that are less than 1-1/2 inches in thickness will be at the discretion of the Engineer.
- B. Core drilling pavement: All pavements shall be cored and measured for thickness at (minimum of three) such points as the Engineer may select in each lot of paving.
  1. Should any core show a deficiency of more than 0.25 inches check cores shall be taken each way in the lane so deficient, as directed by the Engineer, until the thickness of the pavement is not more than 0.25 inch deficient.
  2. All costs in connection with core drilling the pavement and refilling the core holes shall be borne by the Contractor. Core holes shall be filled in an acceptable manner with material matching the pavement from which the cores were cut. The coring of the pavement shall be performed by an Owner approved testing lab.
  3. Paving installed by the Contractor that is not within 10% of the total thickness recommended by the Geotechnical Report shall be removed and replaced at the Contractor's expense.
  4. No additional payment over the contract unit price will be made for any slab the average thickness of which, determined as hereinafter provided, exceeds the thickness shown on the plans.
  5. The thickness of the slab will be determined by average of 9 point gage jig measurement of the thickness of adjacent cores, and the average thickness determined from each pair of adjacent cores shall apply to the length of lane between those cores. The last deficient core and the first core of satisfactory thickness shall be averaged to determine what deduction in payment will be made from the length of lane laying between them.
  6. If the Contractor believes that the cores and measurements taken are not sufficient to indicate fairly the actual thickness of pavement, he may request that additional cores and measurements be taken. The cost of additional cores and measurements will be paid by the Contractor. Cores will not be spaced closer than ten (10) feet.

### **3.13 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 milled materials to accumulate on-site.

END OF SECTION 32 1216

**SECTION 32 1313  
CONCRETE PAVING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Driveways.
  2. Parking lots.
  3. Curbs and gutters.
  4. Walks.
  5. Wheel stops.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 Specification Sections, apply to this Section.

**1.3 RELATED SECTIONS**

1. Section 31 2000: Earth Moving.
2. Section 32 1373: Pavement Joint Sealants.
3. Section 32 1723: Pavement Markings.

**1.4 REFERENCED STANDARDS**

- A. Latest version or edition shall apply unless otherwise noted.
1. American Association of State Highway and Transportation Officials (AASHTO)
    - a. M 31, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.*
    - b. M 45, *Standard Specification for Aggregate for Masonry Mortar.*
    - c. M 53, *Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.*
    - d. M 80, *Standard Specification for Coarse Aggregate for Hydraulic Cement Concrete.*
    - e. M 85, *Standard Specification for Portland Cement.*
    - f. M 302, *Standard Specification for Slag Cement for Use in Concrete and Mortars.*
    - g. M 240, *Standard Specification for Blended Hydraulic Cement.*
    - h. T 2, *Standard Method for Sampling of Aggregates.*
    - i. T 11, *Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing.*
    - j. T 21, *Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete.*
    - k. T 26, *Standard Method of Test for Quality of Water to Be Used in Concrete.*
    - l. T 27, *Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.*
    - m. T 71, *Standard Method of Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.*
    - n. T 96, *Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.*
    - o. T 103, *Standard Method of Test for Soundness of Aggregates by Freezing and Thawing.*
    - p. T 112, *Standard Method of Test for Clay Lumps and Friable Particles in Aggregate.*

- q. T 113, *Standard Method of Test for Lightweight Pieces in Aggregate.*
- r. T 161, *Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing.*
- 2. American Concrete Institute (ACI)
  - a. 117, *Specification for Tolerances for Concrete Construction and Materials.*
  - b. 211, *Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.*
  - c. 301, *Specifications for Structural Concrete.*
  - d. 306, *Cold Weather Concreting.*
  - e. CP-1, *Technical Workbook for ACI Certification of Concrete Field Testing Technician-Grade 1.*
- 3. American Society of Testing and Materials (ASTM) International
  - a. A 780, *Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.*
  - b. C 171, *Standard Specification for Sheet Materials for Curing Concrete.*
  - c. C 172, *Standard Practice for Sampling Freshly Mixed Concrete.*
  - d. C 881, *Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.*
  - e. C 1077, *Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.*
  - f. E 329, *Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.*
- 4. Concrete Reinforcing Steel Institute (CRSI)
  - a. *Manual of Standard Practice.*
- 5. Oklahoma Department of Transportation (ODOT), *Standard Specifications for Highway Construction* (ODOT Specifications).
  - a. Section 414 and 701, Portland Cement Concrete Pavement.
  - b. Section 303 and 703.01, Mineral Aggregate Base Materials.

## 1.5 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.

## 1.6 ACTION SUBMITTALS

- A. Other Action Submittals:
  - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Applied finish materials.
  - 4. Bonding agent or epoxy adhesive.
- B. Material Test Reports: For each of the following:
  - 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

- C. Field quality-control reports.

## **1.8 QUALITY ASSURANCE**

- A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301 unless otherwise indicated.

## **1.9 PROJECT CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## **PART 2 - PRODUCTS**

### **2.1 FORMS**

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### **2.2 STEEL REINFORCEMENT**

- A. Reinforcing Bars: for concrete reinforcement and dowel bars used in the work.
  - 1. Billet Steel: Grade 40 per AASHTO M 31.
  - 2. Axle Steel: Grade 40 per AASHTO M 53.
- B. 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 specified, 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.
- C. Zinc Repair Material: ASTM A 780.

### **2.3 CONCRETE MATERIALS**

- A. Portland cement: Shall conform to the requirements of AASHTO M 85 or AASHTO M 240. Type I, Type I (SM), Type I (PM), and Type IP shall be used in concrete for general concrete construction. Type II shall be used in concrete exposed to moderate sulphate action or moderate heat of hydration. Type III may be used when high early strength concrete is required. Unless otherwise approved by the Engineer, the product of only one mill of any one brand and type of portland cement shall be used on any structure or adjacent structures. Provide suitable means of storing and protecting the cement against dampness.
  - 1. Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used. All methods of sampling and testing shall be in accordance with the requirements of AASHTO M 85 or AASHTO M 240.
- B. Water: All water used in mixing or curing Portland cement concrete or cement treated base shall be clean and practically free from oil, salt, acid, alkali, organic matter, or other substances

injurious to the finished product. Water from city water supply may be accepted without being tested. Water from doubtful sources shall not be used until tested and approved. When required by the Engineer, the quality of the mixing water shall be determined in accordance with AASHTO T 26. When tests are made comparing the water with water of known satisfactory quality, any indication of unsoundness, marked change in time of set, or reduction in mortar strength shall be sufficient cause for rejection of the water under test

- C. Fine Aggregate: This specifications cover the quality and size of fine aggregates for Portland cement concrete pavements or bases, and incidental structures. Mortar sand shall meet the requirements of AASHTO M 45.
1. General Requirements. Fine aggregate shall consist of natural sand, or, subject to approval, combinations of manufactured sand and natural sand, having hard, strong, durable particles, and it shall conform to these Specifications. Mix and store fine aggregate from different sources in separate stockpiles; in addition, do not use them alternately in the same class of construction or mix without permission from the Engineer or as provided herein for manufactured sand. When manufactured sand is approved for use in combination with natural sand, at least 50 percent of the total fine aggregate by mass shall be natural sand. Store and batch the two materials separately. Each of the materials shall conform to the requirements of these Specifications, except that the mortar strength test shall be made on the blend of materials proposed for use.
  2. Deleterious Substances. The amount of deleterious substances shall not exceed the following limits: Clay lumps and friable particles 3%, Coal and Lignite 0.25%
  3. Organic Impurities. All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength test as specified below. Should the aggregate show a darker color than that of samples originally approved for the work, its use shall be withheld until tests satisfactory to the Engineer have been made to determine whether the increased color is indicative of an injurious amount of deleterious substances. NOTE: A fine aggregate failing in the test may be used provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 and 28 days calculated in accordance with Section 10 of AASHTO T 71 is not less than 95 percent.
  4. Gradation. Fine aggregate shall be well graded from coarse to fine, and when tested by means of laboratory sieves. Gradation shall meet the following requirements:
    - a. Sieve size: 3/8-in, percent passing: 100%.
    - b. Sieve size: No. 4, percent passing 95-100%.
    - c. Sieve size: No. 8, percent passing 80-100%.
    - d. Sieve size: No. 16, percent passing 50-85%.
    - e. Sieve size: No. 30, percent passing 25-60%.
    - f. Sieve size: No. 50, percent passing 5-30%.
    - g. Sieve size: No. 100, percent passing 0-10%.
  5. The gradation requirements given above represent the extreme limits which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. For the purpose of determining the degree of uniformity, determine a fineness modulus (See Note). Determination shall be made from a representative sample obtained by the Engineer from the Contractor's proposed source.
    - a. Fine aggregates will be rejected from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample.
    - b. NOTE: The fineness modulus of an aggregate is determined by adding the total percentages of material in the sample that are coarser than each of the following

sieves (cumulative percentages retained), and dividing the sum by 100; No. 100 (150 µm), No. 50 (300 µm), No. 30 (600 µm), No. 16(1.18 mm), No. 8 (2.36 mm), No. 4 (4.75 mm), 3/8 inch (9.5 mm), 3/4 inch (19.0 mm), 1 1/2 inch (37.5mm), and larger increasing at the ratio of 2 to 1.

6. Methods of Sampling and Testing. Sampling and testing of fine aggregate shall be in accordance with the following AASHTO Methods:
    - a. Sampling T 2
    - b. Friable particles T 112
    - c. Coal and lignite T 113
    - d. Amount of passing a No. 200 sieve T 11
    - e. Organic impurities T 21
    - f. Mortar-making properties T 71
    - a. Sieve analysis T 27
- D. Coarse Aggregate: This specification covers the quality and size of coarse aggregate for use in portland cement concrete pavements or bases and incidental structures.
1. General Requirements. Coarse aggregate shall be a gravel or crushed stone which shall conform to the requirements of AASHTO M 80, Class A, except as modified by these Specifications. Coarse aggregate shall produce Class A concrete with a durability factor of 50 or more. The durability factor will be determined after 350 cycles of alternate freezing and thawing in accordance with AASHTO T 161, Procedure A. The Los Angeles Abrasion percent wear shall be limited to a maximum of 40 percent after 500 revolutions when tested in accordance with AASHTO T 96. The sodium sulfate soundness requirement shall not apply. Use only coarse aggregate shall consisting of clean, tough, durable particles, practically free from clay, shale, coatings of any character, disintegrated or soft pieces, conglomerates, mud balls, sticks, salt, alkali, or vegetable matter. Crushed stone or crushed gravel from different sources may be combined in the mix when stored and batched separately in recommended proportions, upon written permission of the Engineer. At least 70 percent of all aggregate retained on the No. 4 (4.75 mm) sieve in the combined mix shall be crushed stone or mechanically crushed gravel having two or more fractured faces and shall contain not more than 15 percent of flat and elongated pieces. (A flat and elongated piece is one in which the length is greater than five times the average thickness).
  2. Gradation. The coarse aggregate shall be well graded as follows:
    - a. No. 357:
      - 1) Sieve size 2-1/2-in., percent passing 100%.
      - 2) Sieve size 2-in., percent passing 95-100%.
      - 3) Sieve size 1-in., percent passing 35-70%.
      - 4) Sieve size 1/2-in., percent passing 10-30%.
      - 5) Sieve size No. 4, percent passing 0-5%.
      - 6) Sieve size No. 200, percent passing 0-1.5%.
    - b. No. 57
      - 1) Sieve size 1-1/2-in., percent passing 100%.
      - 2) Sieve size 1-in., percent passing 95-100%.
      - 3) Sieve size 1/2-in., percent passing 25-60%.
      - 4) Sieve size No. 4, percent passing 0-10%.
      - 5) Sieve size No. 8, percent passing 0-5%.
      - 6) Sieve size No. 200, percent passing 0-2%.

- c. No. 67
  - 1) Sieve size 1-in., percent passing 100%.
  - 2) Sieve size 3/4-in., percent passing 90-100%.
  - 3) Sieve size 3/8-in., percent passing 20-55%.
  - 4) Sieve size No. 4, percent passing 0-10%.
  - 5) Sieve size No. 8, percent passing 0-5%.
  - 6) Sieve size No. 200, percent passing 0-2%.
- d. No. 7
  - 1) Sieve size 3/4-in., percent passing 100%.
  - 2) Sieve size 1/2-in., percent passing 90-100%.
  - 3) Sieve size 3/8-in., percent passing 40-70%.
  - 4) Sieve size No. 4, percent passing 0-15%.
  - 5) Sieve size No. 8, percent passing 0-5%.
  - 6) Sieve size No. 200, percent passing 0-2%.
- e. No. 8
  - 1) Sieve size 1/2-in., percent passing 100%.
  - 2) Sieve size 3/8-in., percent passing 85-100%.
  - 3) Sieve size No. 4, percent passing 10-30%.
  - 4) Sieve size No. 8, percent passing 0-10%.
  - 5) Sieve size No. 16, percent passing 0-5%.
  - 6) Sieve size No. 200, percent passing 0-2%.
- 3. Furnish coarse aggregate for Class A concrete in the No. 57 size only except as noted below
- 4. Furnish coarse aggregate for massive Class A concrete in the No. 357 size. Coarse aggregate for Class C concrete may be either No. 57 or No. 357.
- 5. Furnish coarse aggregate for thin section concrete in the No. 7 size.
- 6. Coarse aggregate for Class AA or P concrete shall be furnished in the No. 67 size. No. 7 or No.
- 7. Coarse aggregate may be used in Class P concrete if either the specified 28-day compressive strength is in excess of 6000 psi (41.4 MPa) or permeability limits are specified.

## 2.4 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
  - 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. BASF Construction Chemicals, LLC; Confilm.

## 2.5 RELATED MATERIALS

- A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed 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.

- B. 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, of grade complying with requirements, and of the following types:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.6 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
  - 1. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, for each class of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  - 1. Class AA
    - a. Compressive Strength (28 Days): 4,000-psi
    - b. Maximum Cement Content: 611-lb/yd<sup>3</sup>
    - c. Minimum 28-day Air Content: 6.5%  $\pm$  1.5%
    - d. Water-Cement Ratio at Point of Placement: 0.44.
    - e. Slump Limit: 2 inches, plus or minus 1 inch.
  - 2. Class A
    - a. Compressive Strength (28 Days):
      - 1) 3,500-psi for rigid vehicular pavements.
      - 2) 3,000-psi for all other civil improvements.
    - b. Maximum Cement Content: 564-lb/yd<sup>3</sup>
    - c. Minimum 28-day Air Content: 6%  $\pm$  1.5%
    - d. Water-Cement Ratio at Point of Placement: 0.48.
    - e. Slump Limit: 2 inches, plus or minus 1 inch.
  - 3. Class AP
    - a. Compressive Strength (28 Days): 3,000-psi
    - b. Maximum Cement Content: 470-lb/yd<sup>3</sup>
    - c. Minimum 28-day Air Content: 6%  $\pm$  1.5%
    - d. Water-Cement Ratio at Point of Placement: 0.48.
    - e. Slump Limit: 2 inches, plus or minus 1 inch.
  - 4. Class C
    - a. Compressive Strength (28 Days): 2,400-psi
    - b. Maximum Cement Content: 395-lb/yd<sup>3</sup>
    - c. Minimum 28-day Air Content: 6%  $\pm$  1.5%
    - d. Water-Cement Ratio at Point of Placement: 0.62.
    - e. Slump Limit: 3 inches, plus or minus 1 inch.



- C. Cementitious Materials: Use fly ash, ground granulated blast-furnace slag, as needed to reduce the total amount of portland cement which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. November through March: Fly ash meeting the requirements of this section may be substituted for up to 15% of the required cement. Ground granulated blast furnace slag meeting the requirements of AASHTO M 302 Grade 100 or Grade 120 may be substituted for up to 25% of the required cement. A combination of up to 25% ground granulated blast furnace slag and up to 15% fly ash may be substituted for up to 40% of the required cement.
  2. April through October: A combination of up to 25% ground granulated blast furnace slag and up to 20% fly ash may be substituted for up to 45% of the required cement.
  3. Substitution shall be by weight: 1.0 pound (1 kg) for each 1.0 pound (1 kg) of cement. The concrete mix design shall be appropriately adjusted. These substitutions will not be allowed for high early strength concrete, Class P concrete or concrete containing Type IP, Type I (PM), or Type I (SM) cement. If the specified minimum cement content is satisfied, additional fly ash or ground granulated blast furnace slag, or silica fume complying with ASTM C 1240, may be added to the mix when approved as part of the mix design.
- D. Water Cement Ratio. Using the weight in pounds of each material, calculate the water-cement ratio (W/C) by the following equation:  $W/C = \text{Water} / (\text{Cement} + \text{Fly Ash} + \text{Blast Furnace Slag} + \text{Silica Fume})$  The water actually used is determined by the water measured into the batch plus the free water on wet aggregate minus the water absorbed by dry aggregate plus water in any admixture solutions and shall not exceed the limit specified.
- E. Slump. The slump shall be as shown, or as specified in the contract documents, or as approved by the Engineer, and the consistency required shall be that which will provide satisfactory workability for the type work being done. Slump tests will be made during the progress of the work as a measure of uniformity of the consistency of the concrete. If using a high-range water reducing admixture, limit the slump to a maximum of 9 inches (230 mm).
- F. Compressive Strength. Compressive strength is based on the average of three test cylinders. When the class of concrete is not expressly indicated on the Plans, the following requirements shall govern:
1. Class AA. Use Class AA concrete in superstructure items, such as bridge floors, approach slabs, reinforced concrete piles, drilled shaft foundations, parapet walls, concrete rail and handrails.
  2. Class A. Use Class A concrete for pavements and in substructures items, such as pier caps, columns, abutments, retaining walls, box culverts, and all reinforced concrete not requiring Class AA concrete.
  3. Class AP. Use Class AP concrete in shoulders, merge areas and gore areas for PCC pavements, unless otherwise directed by plan notes.
  4. Class C. Use Class C concrete for soil erosion control structures.

## 2.8 CONCRETE MIXING

- A. Base the mix design on absolute volume for the class of concrete specified and the consistency suitable for satisfactory placement of the concrete. Design and produce concrete mixtures that conform to the Class of Concrete in this section and base the mix design on absolute volume. Proportion the coarse and fine aggregate in accordance with ACI 211.1. Use the least amount of sand and mixing water which will ensure concrete of the required workability for placement conditions. Meet the minimum strength within 72 hours of placement for high early strength concrete. Submit the mix design at least 14 days before production to the Engineer. Include at least the following information with each mix design:
1. Project identification
  2. Name and address of contractor and producer

3. Mix design designation
  4. Intended use of the mix design
  5. Expected travel time from batch to placement
  6. If the concrete will be pumped or not
  7. Aggregate sources, gradation, moisture content, saturated surface dry batch mass, LA abrasion (AASHTO T 96), and freeze thaw durability (AASHTO T 103).
  8. Fineness modulus of fine aggregate.
  9. Cement type and source
  10. Type of cement replacement, if used, and source
  11. Type of admixtures and sources
  12. Material proportions
  13. Air content
  14. Slump
  15. Water / cement ratio
  16. Strengths at 7 and 28 days
  17. Strengths at 72 hours for high early strength concrete.
- B. Do not place any concrete until the mix design is approved. Submit new mix designs if the mix design is rejected by the Engineer, the source of any material changes, or the mix design produces unacceptable workability or production test results.

## **2.9 EXAMINATION**

- A. Examine exposed subgrades and/or aggregate base surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subgrade surface below concrete paving to identify soft pockets and areas of excess yielding. Proof-rolling activities shall be completed per the requirements of the Geotechnical Investigation.
  1. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1-inch according to requirements in Section 31 2000 "Earth Moving."

## **2.10 PREPARATION**

- A. Remove loose material from compacted subgrade or aggregate base surface immediately before placing concrete.
- B. Proceed with installation only after all subgrades have been prepared per the requirements of Section 31 2000 "Earth Moving" and all unsatisfactory conditions have been corrected.

## **2.11 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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.

## **2.12 STEEL REINFORCEMENT**

- A. 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.

## **2.13 JOINTS**

- A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt 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, 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. During concrete placement, protect top edge of joint filler 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, to match jointing of existing adjacent concrete paving:
  - 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 grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
  - 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, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
  - 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

## 2.14 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subgrade or aggregate base surface and steel 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 concrete during delivery or at Project site. 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. Screed paving surface with a straightedge and strike off.
- I. 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.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) 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
- M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in 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.
4. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## **2.15 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-retaining-cover curing as follows:
  1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, 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 occurring during installation or curing period using cover material and waterproof tape.

## **2.16 PAVING TOLERANCES**

- A. Comply with tolerances in ACI 117 and as follows:
  1. Elevation: 3/4 inch (19 mm).
  2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
  3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
  4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
  5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
  6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
  7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
  8. Joint Spacing: 3 inches (75 mm).
  9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
  10. Joint Width: Plus 1/8 inch (3 mm), no minus.

## **2.17 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner shall engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to schedules provided by Geotechnical Engineer, Testing Agency, and/or Owner.
- C. Test results shall be reported in writing to Engineer, 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.
- D. 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.

- E. 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 Engineer.
- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

**2.18 REPAIRS AND PROTECTION**

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 32 1313**

**SECTION 32 1373**  
**CONCRETE PAVING JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Joint fillers and sealers for Portland cement concrete.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 Specification Sections, apply to this Section.

**1.3 RELATED SECTIONS**

1. Section 32 1313: Concrete Paving.

**1.4 REFERENCED STANDARDS**

- A. Latest version or edition shall apply unless otherwise noted.
1. American Association of State Highway and Transportation Officials (AASHTO)
    - a. M 33, *Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)*.
    - b. M 153, *Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction*.
    - c. M 213, *Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)*.
    - d. M 200, *Standard Specification for Epoxy Protective Coatings*.
    - e. M 220, *Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements*.
  2. American Society of Testing and Materials (ASTM) International
    - a. C 501, *Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser*.
    - b. C 579, *Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes*.
    - c. C 793, *Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants*.
    - d. C 882, *Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear*.
    - e. C 884, *Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay*.
    - f. C 1193, *Standard Guide for Use of Joint Sealants*.
    - g. D 570, *Standard Test Method for Water Absorption of Plastics*.
    - h. D 638, *Standard Test Method for Tensile Properties of Plastics*.
    - i. D 792, *Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement*.
    - j. D 1475, *Standard Test Method For Density of Liquid Coatings, Inks, and Related Products*.
    - k. D 2240, *Standard Test Method for Rubber Property—Durometer Hardness*.
    - l. D 2393, *Test Method for Viscosity of Epoxy Resins and Related Components*.

- m. D 3569 (modified), Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.
  - 1) Modifications: Clean two 1x1x3 inch concrete test blocks, hold under running tap water, and scrub with a brush for approximately 30 seconds. Allow blocks to dry for 24 hours at room temperature. Assemble blocks with 1x3 inch surface facing with 1/2 x 1/2 x 1 inch Teflon spacers. Hold in place with a clamp. Without touching the surface with your fingers, insert backer rod closed cell 1/2 inch diameter x 1 inch. Inject sealant to fill the cavity with no air entrapment. Allow the sealant to flow to a smooth surface, and do not strike off. Allow it to cure at 77°F and 45-55% relative humidity. After 21 days, remove the clamp and Teflon spacers and pull the test specimens at 2 inches per minute.
- 3. Oklahoma Department of Transportation (ODOT, OHD)
  - a. L-3, *Methods of Test for Skin-Over Time of Silicone Sealants.*
  - b. L-4, *Methods of Test for Non-volatile Content of Silicone Sealants.*
  - c. L-6, *Methods of Test for Non-volatile Content of Silicone Sealants.*
  - d. L-21, *Method of test for Cold Applied, Two Component, Polymer Type Joint Sealing Compounds.*
- 4. United States Department of Defense (MIL)
  - a. S 8802, *Sealing Compound, Temperature-resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-adhesion.*

#### 1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Contractor shall submit to joint-sealant manufacturers, information regarding materials that will contact or affect joint sealants.
  - 1. Testing will not be required if joint-sealant manufacturers submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

#### 1.6 MATERIAL CERTIFICATIONS

- A. General Requirements: The Contractor shall be responsible for obtaining all certifications and arranging for their delivery to the proper destinations as required by this specification. A responsible representative of the company that issues the certification shall sign materials certifications. The official company title of the signer must be clearly shown immediately beneath the Contractor's signature.
- B. All certifications shall be furnished in duplicate and each copy shall show the following information:
  - 1. Project Number
  - 2. Name of Contractor
  - 3. Identification Markings on Shipment
  - 4. Quantity of Material Represented by the Certification
- C. When certified mill tests are submitted as a Type A certification the quantity information need not be furnished provided that the identifying heat number is permanently rolled, stamped or otherwise permanently affixed to each individual piece of material in the shipment covered by the certification.
- D. Types of certifications
  - 1. Unless otherwise specified, a certification shall be one of the following types:
    - a. Type A Certification: shall be prepared by the manufacturer and shall consist of a certified copy of a report covering tests conducted by an approved laboratory.



Such tests shall have been conducted on samples obtained from the lot or lots of material in the shipment.

- b. Type B Certification: shall consist of a certification prepared by the manufacturer and shall show the limits of test values as determined by an approved manufacturer's laboratory, a qualified commercial laboratory or other approved laboratory.
- c. Type C Certification: shall be prepared by the manufacturer and shall certify that the material in the shipment conforms to the same formula and/or is essentially the same as the material previously approved by the City Engineer.
- d. Type D Certification: shall be prepared by the manufacturer and shall state that the materials meet the applicable Specifications. These Specifications shall be listed by number, section reference or other appropriate identification acceptable to the City Engineer.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

## **1.8 PROJECT CONDITIONS**

- A. Do not proceed with installation of joint sealants under environmental conditions that do meet the sealant manufacturer's requirements.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General:
  - 1. 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. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.
- B. Preformed Expansion Joint Filler (Bituminous Type)
  - 1. This joint filler shall conform to the requirements of AASHTO M 33. Do not use this type filler in joints for which the Plan detail requires a sealer. Submit a Type A Certification from the manufacturer for each lot or shipment of materials.
- C. Preformed Expansion Joint Fillers (Nonextruding and Resilient Types)
  - 1. Non-bituminous Joint Filler: per AASHTO M 153.
  - 2. Bituminous Joint Filler: per AASHTO M 213, except that the maximum permissible load to compress the test specimen to 50 percent of its thickness before testing shall be 1500 psi (10.34 MPa). Compliance with the asphalt content requirement is waived providing the material meets all other physical requirements as specified.
  - 3. Submit a Type A Certification from the manufacturer for each lot or shipment of materials.
- D. Preformed Elastomeric Compression Joint Sealer.
  - 1. Description: preformed elastomeric compression joint sealers for use in portland cement concrete pavements and concrete bridge floors.
  - 2. Materials
    - a. Preformed Joint Seals: The joint seals shall be manufactured from an elastomeric material that is resistant to heat, oil, jet fuel and ozone. The material shall be compatible with concrete and shall conform to the physical requirements of

AASHTO M 220. All tests will be made on samples taken from the preformed joint sealer.

- b. Shape and Dimensions: The molded joint seals shall be of cross sectional dimensions, lengths and tolerances shown on the Plans. The sealer shall be one piece for the full length of the transverse joint and in practical lengths for longitudinal joints. Elongation of the joint material of more than 2 percent during placement will require the preformed elastomeric compression joint sealer to be removed and replaced.
- c. Submittals: Submittal information regarding each size of sealer to be used shall be submitted by the Contractor to the Engineer for review and approval.
- d. Inspection: Representative sections of each lot shall be subject to surface and dimensional inspection by the Engineer to determine visual compliance with applicable requirements of this Specification which do not require physical tests.
- e. Lubrication Adhesive: Any lubricant adhesive used shall be compatible with the sealer and the concrete and relatively unaffected by the normal moisture in the concrete. The lubricant adhesive shall be a compound consisting of the same base polymer as the sealer, blended with a suitable volatile solvent. It shall maintain a suitable consistency at the temperature at which the seal is installed.
- f. Certification: A Type A Certification shall be submitted by the manufacturer for each lot or shipment of materials. Any cracking visible after recovery testing is basis for rejection.

E. Polymer Type, Two Component Cold Applied Machine Extruded and Pourable Joint Sealer.

1. Description: two-component, polymer- type, rubberlike, cold applied joint sealing compounds for use in portland cement concrete pavements and bridge floors. When recommended by the manufacturer, use a primer in accordance with the manufacturer's recommendation. The shape of the joint and joint sealer shall be as shown on the Plans.
2. Materials: Materials meeting Federal Specifications SS-S-200 may be used. Use the bond breaker recommended by the materials manufacturer as shown on the ODOT standard drawings.
3. Acceptance: Furnish a Type A Certification with each shipment or lot.
4. Packaging: Package the joint sealer in sealed containers identified by the name of the manufacturer, the manufacturer's lot number, and the date of manufacture, and bearing instructions for mixing and application. Containers including the curing agent shall be marked A, and the container including the polymer shall be marked B. If a primer is required by the manufacturer, it must be so stated on containers A and B. Give proper instructions for use of the primer on its container.
5. Tests: Tests shall be made in accordance with OHD L-21.

F. Machine Extruded Joint Sealer.

1. General: The joint sealer shall be a modified polysulfide or polyurethane polymer consisting of 2 components to be machine mixed and machine extruded directly into the joints. The polysulfide components shall be mixed at a 1:1 ratio by volume and the polyurethane components shall be mixed in accordance with the manufacturer's recommendations. Upon being opened, component B shall not exhibit more than a slight degree of skinning.
2. Properties of Laboratory Mixed Material:
  - a. Penetration at 77°F (25°C): 0.50 to 1.20 mm.
  - b. Penetration at 158°F (70°C): 1.5 times the penetration at 25°C.
  - c. Cold Flow, 3 minutes: minimum of 19.1 mm.
  - d. Cold Flow, 40 minutes: maximum of 12.7 mm.

- e. Resilience, 77°F (25°C)
    - 1) 70% minimum.
    - 2) 60% minimum if penetration at 77°F is 0.90 to 1.20 mm.
  - f. Resilience of oven aged sample, 7 days
    - 1) 70% minimum.
    - 2) 60% minimum if penetration at 77°F is 0.90 to 1.20 mm.
  - g. Resilience at 158°F (70°C)
    - 1) 60% minimum.
    - 2) 50% minimum if penetration at 77°F is 0.90 to 1.20 mm.
  - h. Bond to concrete, 100% extension, at -20°F
    - 1) Sample to be cured for 24 hours at 77°F (25°C); then oven aged for 7 days at 158°F±2°F (70 ± 1°C).
    - 2) Dry: No failure.
    - 3) Wet: No failure.
  - i. Nonvolatile content: 88% minimum.
- G. Pourable Joint Sealer.
- 1. General: The joint sealer shall be a polymeric material consisting of two components to be uniformly mixed and poured directly into the joints. The mass of component A in the mixture shall be not less than 10 percent of the mass used of component B. Upon being opened, neither component shall exhibit more than a slight degree of skinning.
  - 2. Properties of Laboratory Mixed Material
    - a. Viscosity, 5 minutes after mixing: 2.00 to 3.50 Pa·s
    - b. Application time (Pot life or time to reach 20.00 Pa·s) at 77°F: 1-hr minimum
    - c. Penetration at 77°F after 24 hours aging: maximum 1.50 mm.
    - d. Penetration at 77°F after 96-hours of aging at 77°F (25°C): 0.50 to 1.20 mm.
    - e. Penetration at 158°F (70°C) after 96-hours of aging at 77°F (25°C): 1.5 times the penetration at 25°C.
    - f. Resilience at 77°F (25°C) after 96-hours of aging at 77°F (25°C)
      - 1) 70% minimum
      - 2) 60% minimum if penetration at 77°F is 0.90 to 1.20 mm
    - g. Resilience at 158°F (70°C)
      - 1) 60% minimum
      - 2) 50% minimum if penetration at 77°F is 0.90 to 1.20 mm
    - h. Resilience for oven-aged sample (7-days)
      - 1) 70% minimum
      - 2) 60% minimum if penetration at 77°F is 0.90 to 1.20 mm
    - i. Bond to concrete, 100% extension, at -20°F
      - 1) Sample to be cured for 24 hours at 77°F (25°C); then oven aged for 7 days at 158°F±2°F (70 ± 1°C).
      - 2) Dry: No failure.
      - 3) Wet: No failure.
    - j. Nonvolatile content: 88% minimum.
- H. Hot Poured Joint Sealer.

1. Description: Joint sealers furnished shall be of the hot poured type which readily bonds to concrete surfaces.
  2. Materials
    - a. Sealer: Joint sealers used under these Specifications shall meet the requirements of Federal Specification SS-S-1401. The sealant material shall be heated for application to the temperature within the range recommended by the manufacturer unless otherwise established by the Engineer.
    - b. Safe Heating Temperature: The safe heating temperature shall be set forth by the manufacturer and documented in submittals sent to the Engineer for approval. The safe heating temperature shall also be shown on all containers and packages in each shipment received at the job site.
    - c. Acceptance. Hot poured joint sealer furnished under these Specifications will be accepted for use upon receipt of a Type C Certification. Sealer materials damaged by excessive or prolonged heating will be rejected.
    - d. Backer Rod. When shown on the Plans, the use of a backer rod of the size and dimensions shown shall be required. The backer rod shall be compatible with the joint sealant.
- I. Low Modulus Silicone Joint Sealant.
1. Description: low modulus silicone joint sealant and expanded polyethylene backer rod for use in sealing portland cement concrete pavement joints. The silicone sealant shall be furnished in a one part silicone formulation. Acetic acid cure sealants are not acceptable.
  2. Materials
    - a. Backer Rod: The backer rod shall be of the size and dimensions shown on the Plans. The backer rod shall be compatible with the joint sealant, and no bond or reaction shall occur between the rod and the sealant.
    - b. Silicone Sealant: The silicone sealant shall meet the color, toxicity, stability, and durability requirements of the current Federal Specification TT-S-001543 for Class A sealants and the following test requirements:
      - 1) Appearance: Smooth, non-grainy, homogeneous mixture, Test Method MIL S 8802.
      - 2) Extrusion Rate: 200 g/minute minimum, Test Method MIL S 8802.
      - 3) Tack Free Time at 77°F (25°C) and 45-55% relative humidity: 5 hours, Test Method MIL S 8802.
      - 4) Specific Gravity: 1.26-1.34 per ASTM D 792, Method A.
      - 5) Elongation: 500% minimum per ASTM D 3569 (modified) Section 13.
      - 6) Modulus @ 50%, 10-psi maximum per ASTM D 3569 (modified) Section 13.
      - 7) Modulus @ 100%, 15-psi maximum per ASTM D 3569 (modified) Section 14.
      - 8) Modulus @ 150%, 20-psi maximum per ASTM D 3569 (modified) Section 14.
  3. Storage and Shelf Life: Storage and use of the joint sealant shall be in accordance with the manufacturer's recommended practices.
  4. Acceptance: The sealant shall be accepted on the basis of the manufacturer's Certification. Furnish a Type A Certification for the test requirements listed below. Furnish a Type D Certification to comply with current Federal Specification TT-S-001543 in accordance with this specification. Provide submittals regarding the joint sealant to the Engineer for review and approval prior to use.
- J. Rapid Cure Joint Sealant and Elastomeric Mortar.

1. Description: Rapid cure joint sealant and elastomeric mortar for use in expansion joints in bridge decks.
2. Materials
  - a. Joint Sealant: Joint sealer shall be a self-leveling, rapid cure silicone joint sealant that cures to a low-modulus rubber upon exposure to atmospheric moisture. Rapid cure is defined as the development of sufficient integrity within the silicone in 8 hours or less to accommodate highway traffic and movements associated with bridges. Deliver each lot or batch of sealing compound to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, and batch or lot number, and shall be accompanied by the manufacturer's Certification. Petroleum products shall not be deleterious to the sealant. Joint sealant shall meet the following requirements
    - 1) As supplied:
      - a) Extrusion Rate: 200 g/minute minimum, Test Method MIL S 8802
      - b) Specific Gravity: 1.25 - 1.35 per ASTM D 1475.
    - 2) As Installed (at 77°F (25°C) and 46-54% relative humidity):
      - a) Accelerated Weathering: No cracks or blisters at 5,000 hours or bond loss per ASTM C 793.
      - b) Skin-over time: 20 minutes maximum 20 per OHD L-3.
      - c) Non-volatile content: 93% minimum per OHD L-4
      - d) Joint Elongation: 600%, minimum per ASTM D 3569 (modified).
      - e) Joint Modulus at 100%: 3-12 psi per ASTM D 3569 (modified).
  - b. Elastomeric Mortar: The binder material shall be a two-component, rapid curing liquid polymer that cures to a dense, semi-flexible polymer resistant to chemicals, weather, abrasion and impact. The binder material shall be compatible with the sealant, as determined by the sealant manufacturer. The binder shall be cured in the "neat" to form the primer between the elastomeric mortar and the existing surfaces and shall be mixed with aggregate to form the polymer based mortar. Aggregate for the elastomeric mortar shall be compatible with the liquid polymer (binder material), as determined by the manufacturer. Properties for the binder material shall conform to the following requirements:
    - 1) Combined Liquid Components
      - a) Mixing ratio shall be 1:1 by volume.
      - b) Viscosity at 75°F ± 2°F (23.9°C ± 1.1°C), Brookfield Model LVT, Spindle No. 2, 30 RPM: 0.9 - 2.0 Pa·s per ASTM D 2393.
      - c) Gel Time: 25 - 60 minutes per AASHTO M 200.
      - d) Elongation: 40 – 55% per ASTM D 638 Test Method Type I, Molded Specimens, 1/4 inch (6.4 mm) thickness; speed of testing shall be 0.2 inch ± 0.05 inch (5.1 mm ± 1.3 mm).
      - e) Tensile Strength: minimum 900 psi (6.21 MPa) per ASTM D 638.
      - f) Shore D Hardness at 77°F (25°C) after 7 day cure: 45 - 75 per ASTM D 2240.
    - 2) Properties for the elastic mortar shall conform to the following:
      - a) Absorption: 1% maximum per ASTM D 570.
      - b) Compressive Strength at 24 hours: 2,500 psi (17.24 MPa) minimum per ASTM C 579, Method B.
      - c) Bond Shear Strength: 750 psi (5.17 MPa) minimum per ASTM C 882.

- d) Abrasion Resistance Wear Index per Taber H-22: 1.5 maximum per ASTM C 501.
  - e) Compressive Stress: 350 psi (2.41 MPa) minimum per OHD L-6.
  - f) Resilience: 70% minimum per OHD L-6
  - g) Thermal Compatibility: Pass per ASTM C 884.
- c. General Use Procedure. Mixing and application time shall be as recommended by the manufacturer. No modification of the elastomeric mortar should be attempted without first consulting the manufacturer.
  - d. Acceptance and Sampling. The sealant and elastomeric mortar shall be accepted on the basis of the manufacturer' s Certification and acceptable performance on the project. A Type A Certification shall be furnished for the joint sealant, except a Type B Certification shall be furnished for the Accelerated Weathering Test. A Type B Certification will be furnished for elastomeric mortar, except a Type A Certification will be furnished for the binder material. Product information for the rapid cure joint sealant, and the binder material and aggregate for the elastomeric mortar, shall be submitted by the Contractor to the Engineer for evaluation.
  - e. Primer: Primer shall be applied as detailed in the plans prior to installation of the sealant or as specified by the sealant manufacturer.
  - f. Alternate Joint Products. When alternate expansion joint systems are specified on the plans, the Contractor may use the alternate joint system in place of the nosing and sealant specified above. Sealants and nosing material may be considered as an equal alternate to the above specified materials provided that they successfully complete a 3-year trial installation and evaluation in the State of Oklahoma as determined by the Engineer.

## **2.2 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## **2.3 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

## **2.4 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. Joint-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 joint-sealant backings of kind indicated to support joint 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 joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
  - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place joint sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

## **2.5 CLEANING**

- A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

## **2.6 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 in repaired areas are indistinguishable from the original work.

## **2.7 PAVEMENT-JOINT-SEALANT SCHEDULE**

- A. To be provided by Contractor for review and approval by Engineer prior to installation.

**END OF SECTION 32 1373**

**SECTION 32 1723  
PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes painted markings applied to asphalt and concrete pavement.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 Specification Sections, apply to this Section.

**1.3 REFERENCED STANDARDS**

- A. Latest version or edition shall apply unless otherwise noted.
  - 1. American Association of State Highway and Transportation Officials (AASHTO)
    - a. M 248, *Standard Specification for Ready-Mixed Traffic Paints*.
  - 2. Federal Specification (FS)
    - a. TT-P-1952, *Safety Coatings*.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include technical data and tested physical and performance properties.

**1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the IHS CO/COTR for pavement-marking work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

**1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for alkyd materials, and not exceeding 95 deg F (35 deg C).

**PART 2 - PRODUCTS**

**2.1 PAVEMENT-MARKING PAINT**

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
  - 1. Color: As indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

**3.2 PAVEMENT MARKING**

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for a minimum of 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 15 mils (0.4 mm).



1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

**3.3 PROTECTING AND CLEANING**

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION 32 1723**

**SECTION 32 3113**  
**CHAIN-LINK FENCES AND GATES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Chain-link fences.
  - 2. Chain link gates: swing.

**1.3 RELATED SECTIONS**

- A. Section 32 1313: Concrete Paving.

**1.4 REFERENCED STANDARDS**

- A. Latest version or edition shall apply unless otherwise noted.
  - 1. American Association of State Highway and Transportation Officials (AASHTO)
    - a. M181, Standard Specification for Chain-Link Fence.
    - b. M280, Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire.
  - 2. American Society of Testing and Materials (ASTM)
    - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - b. A121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
    - c. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coates (Galvanized) Welded, for Fence Structure.
    - d. F567, Standard Practice for Installation of Chain-Link Fence.
    - e. F626, Standard Specification for Fence Fittings.
  - 3. Chain Link Fence Manufacturers Institute (CLFMI)
    - a. Product Manual.

**1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
  - 1. Fence and gate posts, rails, and fittings.
  - 2. Chain-link fabric, reinforcements, and attachments.
  - 3. Gates and hardware.
- B. Warranty: Sample of special warranty.

**1.6 QUALITY ASSURANCE**

- A. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review required testing, inspecting, and certifying procedures.

**1.7 PROJECT CONDITIONS**

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

**1.8 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 CHAIN-LINK FENCE FABRIC**

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Meeting the requirements of AASHTO M181. Fabric shall be one of the following types:
    - a. Zinc coated (galvanized) steel wire.
    - b. Aluminum coated steel wire.
    - c. Aluminum alloy.
    - d. Vinyl coated or PVC plastic coated galvanized steel wire fabric.
  - 3. Unless otherwise indicated on the Construction Drawings, fabric shall be 9-gauge (3.76-mm diameter).
  - 4. Mesh Size: 2 inches (50.8-mm).
  - 5. Selvage: Knuckled at both selvages.
  - 6. In the event that proposed fencing work is intended to extend or modify existing fencing, fabric type shall match that of existing, adjacent installation to remain.

### **2.2 FENCE FRAMING**

- A. Posts and Rails: Comply with Construction Drawings for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness indicated.
  - 1. Pipe for round posts shall be Grade I steel posts or Grade II steel posts meeting the requirements of AASHTO M181.
  - 2. Grade I steel posts shall be pipe meeting the requirements of ASTM A53 or F1083 with a minimum of 1.8-ounce / ft<sup>2</sup> zinc coating. Hydrostatic testing shall be waived on pipe used for fence posts. All pipe shall be furnished with plain ends
  - 3. Grade II steel posts shall be round pipe or tubing manufactured by cold rolling and electric resistance welding of steel strip. Exterior and interior corrosion resistance coating shall conform to the requirements of AASHTO M181. This applies to material used in construction of rails (braces and top rails) and gate frames.
  - 4. The pipe (or tubing) shall be tested to determine the tensile and yield strengths, and the following criteria shall be met:
    - a. The product of the section modulus multiplied by minimum yield strength in psi shall be equal to or be exceeded by the product of the section modulus of the Grade II pipe multiplied by its tested yield strength in psi.
    - b. Steel used in Grade II pipe shall have a minimum 50,000-psi yield strength. The outside diameters of the substituted pipes shall be within 0.1 inch of the Schedule 40 pipe and the section modulus of the Grade 2 (cold-formed process) pipe shall be determined by the formula:  $SM = B (OD^4 - ID^4)/(32 \times OD)$  where: SM = Section Modulus, OD = Outside Diameter, ID = Inside Diameter, and B = 3.1416 (a constant).

Thickness measurement of the pipe shall be made with micrometers accurate to 0.0004 inch (0.01 mm).

### **2.3 TENSION WIRE**

- A. Tension wire used in construction of proposed fencing shall meet the requirements of AASHTO M181, Class 1, with a minimum zinc coating mass/unit area of 0.8-oz/ft<sup>2</sup>.

### **2.4 BARBED WIRE**

- A. Zinc coated steel (galvanized) barbed wire shall consist of two strands of 12-1/2 gage (2.51-mm diameter) steel wire twisted in the same direction, or in alternate directions, with 14 gage (2.03-mm diameter) full or half-round 4 point barbs spaced 5-in apart, with a Class 1 zinc coating on the 12-1/2 gage (2.51-mm diameter) wire. Also acceptable is wire consisting of two strands of 15-1/2 gage (1.70-mm diameter) steel wire twisted in alternate directions, with 16-1/2 gage (1.47-mm diameter) full round 4 point barbs spaced 5-in apart.
  - 1. Coating: Coating shall be a Class 3 zinc coating on 15-1/2 gage (1.70-mm diameter) wire. Wire shall meet all requirements of AASHTO M280.
- B. Aluminum coated steel barbed wire shall consist of two strands of 12-1/2 gage (2.51-mm diameter) steel wire twisted in the same or in alternate directions, with 14 gauge (2.03-mm diameter) full or half-round 4 point barbs spaced 5-in apart. The wire may be furnished with aluminum coated steel wire barbs, or with aluminum alloy barbs. The strands (main wires) shall be aluminum coated steel barbed wire meeting the requirements of ASTM A121. Any barbed wire furnished shall have a minimum assembly break strength of 950-lbs.

### **2.5 POST TIES AND WIRE TIES**

- A. Minimum 12 gauge (2.69-mm diameter) with 0.8-oz/ft<sup>2</sup> zinc coating, or aluminum wire as shown.

### **2.6 SWING GATES**

- A. General: Comply with requirements of Construction Drawings leaf width and fabric height.
- B. Pipe and Tubing: Comply with requirements of Construction Drawings.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Hardware:
  - 1. Hinges: 360-degree inward and outward swing.
  - 2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  - 3. Lock: per Owner requirements. Procurement shall be responsibility of Contractor unless otherwise noted in the Contract Documents.
  - 4. Closer: Comply with requirements of Construction Drawings.

### **2.7 FITTINGS**

- A. General: Comply with ASTM F626.
- B. Post Caps: Provide for each post as required by Construction Drawings
  - 1. Provide line post caps with loop to receive tension wire and, where required, top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Aluminum Alloy 6063 not less than 6-in long.
  - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Aluminum Alloy 6063.
- F. Tension Bars: Aluminum, length not less than 2-in shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post.

- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Finish:
  - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc coating.
    - a. Polymer coating over metallic coating.
  - 2. Aluminum: Mill finish.

## **2.8 POLE FOUNDATIONS**

- A. Class A Concrete complying with Section 32 1313.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading is completed unless otherwise permitted by the Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500-ft or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### **3.3 GENERAL**

- A. Perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment. Removal and proper disposal of existing fencing as required to complete the indicated scope of work shall be the responsibility of the Contractor.
- B. At locations where breaks in a run of fencing are required, or at intersections with existing fences, make appropriate adjustment in post spacing. Cross fencing connections shall include an end post approximately perpendicular to the right-of-way fence, or at an angle dictated by the route of the cross fence.
- C. Offset Control: Exercise adequate plumb and offset (alignment) control to assure a smooth profile and alignment. In shallow depressions, use extra length posts and barbed wire fans to maintain a smooth top-of-fence profile. Strengthened fence construction and the use of movable water gates may be necessary in installations over deep ravines. Under no circumstances shall swales or ravines subject to periodic water flow be filled to facilitate fence construction. Adequate provision for drainage must be maintained.
- D. Aligning Posts. Set the tops of all posts approximately to the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the Engineer or under the conditions specified herein or on the Construction Drawings.
- E. Attach wire or fencing of the size and type required to the posts and braces in the manner indicated. Stretch all wire taut and install it to the required elevations.
- F. Grounding the Fence. At each location where an electric transmission, distribution, or secondary line crosses any proposed fence installation. Ground the fencing in accordance with the following:
  - 1. Install a galvanized or copper-coated steel ground rod 8-ft long having a minimum diameter of 0.5-in directly below the point of crossing. Drive the rod vertically until the top is 6-in below the ground surface. Use a No. 6 solid copper conductor or equivalent to connect each fence element to the grounding rod.
  - 2. Braze or fasten the connections with approved non-corrosive clamps.
  - 3. When a power line runs parallel or nearly parallel to and above the fence, ground the fence at each end and gate post and at intervals not to exceed 1500-ft.

- G. Provide the abutting property owners with the equivalent property protection given by any existing fences. The Contractor shall be responsible for the maintenance of all fences and gates that he constructs during his construction operations.

### **3.4 CONCRETE FOOTINGS**

- A. When the Construction Drawings require that posts, braces, or anchors be embedded in concrete, install temporary guys, or braces, as may be required, to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, do not install materials on posts or place strain on guys and bracing that are set in concrete until five days after the placing of the concrete.

### **3.5 DRIVEN POSTS**

- A. Instead of being set in concrete footings or tamped in earth holes, line posts may be driven with the approval of the Engineer. For the driving option, wooden line posts shall be sharpened by the supplier prior to preservative treatment, and the top shall be protected.
  - 1. Splitting or damage to the post top as a result of the driving operation will be cause for rejection. Field sharpening or taper dressing will not be allowed. Metal posts shall have a fitted impact head to minimize deformation or damage to the galvanized or painted finish.
  - 2. After driving the metal posts, clean any deformed and/or damaged tops and paint them with a zinc-rich paint.
  - 3. Severely deformed or poorly painted tops will be cause for rejection.
- B. Installations in earth and soft rock (softer than medium sandstone):
  - 1. Driven posts shall reach the minimum embedment as shown on the Construction Drawings unless refusal of the post is reached. Refusal is defined as 1-in or less entry per minute of driving with a 60-lb hammer using mechanical or pneumatic means, delivering a minimum of 60 blows per minute.
    - a. If refusal is encountered at 24-in or deeper, the post may remain and be top cut for profile control.
    - b. If refusal is encountered at less than 24-in depth, the post shall be pulled and a concrete footing, of the dimensions as shown on the Construction Drawings for earth installations, shall be installed.
- C. Medium to hard rock (medium sandstone or harder) at the Surface:
  - 1. A hole of the diameter and depth for footings in rock, as shown on the Construction Drawings for the type of post being used, shall be drilled. The post shall then be inserted, plumbed, and braced, and the hole filled with Class A Concrete per Section 32 1313.
- D. Medium to hard rock is encountered under a layer of earth:
  - 1. At any depth less than the minimum driven embedment (as shown on the Construction Drawings) at which rock is encountered, the earth shall be augered and treated like a regular concrete-embedded earth footing.
    - a. Drill a hole of the diameter for footings in rock (as shown on the Construction Drawings for the type of post being used) shall to a depth which will yield the total minimum earth embedment, or the minimum rock embedment, whichever occurs first.
    - b. Half fill the rock hole with Class A Concrete. Insert, plumb, and brace the post; and fill the remainder of the rock hole with Class A Concrete. Concrete for earth footing may be immediately placed above the grouted hole.
- E. The intent is for all driven posts to be firmly in the earth a minimum of 24-in where driving has been refused, or the minimum earth embedment as shown on the Construction Drawings, unless rock is encountered. The minimum rock embedment shall be required unless the total minimum earth embedment is reached prior to the rock embedment being reached. When these conditions have been fully satisfied, the post may be top cut for profile control.

### **3.6 FENCE INSTALLATION**

- A. Post Excavation: Drill or hand-excavate holes for posts to receive concrete footings to the diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- D. Line Posts: Space line posts uniformly at not more than 96-in on center. Set in concrete footings or drive to required depth per the requirements of the Construction Drawings and Specifications.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
  - 1. Locate horizontal braces at mid height of fabric 72-in or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Tension shall be slightly above that recommended by the wire manufacturer for the season of the year in which fence construction is taking place. Fasten fabric to tension wire per Construction Drawings. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
  - 1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire per Construction Drawings.
- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Install and secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Spacing between finish grade or surface and bottom selvage shall be per Construction Drawings. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15-in on center
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
  - 1. Maximum Spacing: Tie fabric to line posts at 12-in on center and to braces at 24-in on center
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

### **3.7 GATE INSTALLATION**

- A. Install gates level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### **3.8 ADJUSTING**

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

**END OF SECTION 32 3113**