



Scope of Work

Cherokee Nation Office Space Catoosa One Stop Shop (OSS) Phase 2

Project Objective

Install Network, Access Controls, and Cameras at the Cherokee Nation Office Space located at the Catoosa One Stop Shop (OSS) Phase 2 using the CNIT Network Construction Standards and Requirements (CNITNCSR).

Location – 701 W Rollins St., Catoosa, OK 74015

Specifications:

1. Network

This project will consist of approximately 92 data drops (Consisting of 2 Panduit Cat6 Cables P/N PUR6004BU-W, PER DROP), and 4 wireless access point (AP) drops, 4 Security Camera drops, and 1 Timeclock drop (each consisting of 1 Panduit Cat6 Cable P/N PUR6004BU-W, PER DROP). Contractor shall pull all network drops to the Network Room as indicated on floor plan. Contractor will terminate all cabling on walls using Panduit wall plates (P/N CFPL2IW-Y), and jacks (P/N CJ688TGBU) as consistent with the CNITNCSR. Contractor shall install a new Panduit rack (P/N R4P) next to the existing rack, 1 or 2 cable managers (P/N PRV12) depending on existing cable manager on existing rack and cable space, and doors (P/N PRD12) as per CNITNCSR, and terminate Panduit Cat6 cabling to Panduit patch panels (P/N UICMPPA48BLY). As consistent with the CNITNCSR, the contractor will also install J-Hooks for all cabling to run along a centralized path.

Contractor shall use Panduit cabling, jacks, faceplates, surface mount enclosures, patch panels, etc. as indicated in the CNITNCSR. Contractor shall adhere to all Panduit manufacturers design and installation standards for cabling and parts.

Contractor installing the cabling must be a Panduit Certified Installer and shall test and certify the completed cabling project. Contractor shall submit the certification test results of the finished project to Panduit for warranty and provide Cherokee Nation IT with this warranty.

2. Access Control

Contractor shall provide and install 1 HID Signo 20TKS-020002BL Card Reader and 1 Axis A1610 Network Door Controller p/n 02653-001 in order to control inner door of room “Vestibule” by any one of the following means:

- a. Electrified solenoid kit with REX installed in the push bars.
- b. Or, replace both push bars with electrified push bars wit REX.
- c. Or, Electrified latches on the mullion.

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Door sensors shall be installed in series for both doors.

3. Security Camera

Contractor shall provide and install 4 Axis Cameras model M3077-PLVE Network Camera p/n 02018-001. Exact location and orientation of cameras shall be coordinated with CNIT Security Systems Tech Doug Clark, W (918)453-5709, C (918)822-2467

All systems shall be tested and accepted by CNIT personnel before final payment.

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DATA MDF - NETWORK ROOM

Phase 2 Expansion Area

Access Control:
Provide 1 HID Signo 20TKS-020002BL card reader and
1 Axis A1610 Network Door Controller p/n 02653-001

- ◀ Data Jack - 2 cables
- ▶ 1 cable for Timeclock - owner provided, contractor installed
- ◀ 1 cable for WAP - owner provided, contractor installed
- Security Camera - contractor provided and installed

Cherokee Nation Information Technology

Network Construction Standards and Requirements Manual

INTRODUCTION

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

PART 1 – GENERAL

1) REQUIREMENTS

- a) Summary: Furnish and install complete with all accessories a Structured Cabling System (SCS). The SCS shall serve as a vehicle for transport of data, video and voice telephony signals throughout the network from designated demarcation points to outlets located at various desks, workstation, wireless access points (AP), cameras, access control equipment and other locations that support the infrastructure as indicated on the contract drawings and described herein.
- b) Submittals
 - i) Construction Documents
 - (1) Where or when a Project Manual is created for Construction Documentation, the Project Manual and Documentation, i.e. Divisions 25, 26, 27, and 28, shall reference this Document as to be the requirements of the Owner.
 - (a) Division 27 – Communications: Shall cover the networking, analog, paging, wireless access points and audio visual systems.
 - (b) Division 28 – Electronic Security Systems: Shall cover:
 - (i) Access Control Systems
 - (ii) Video Surveillance Systems
 - (iii) Personal Body Alarm Systems
 - (iv) Panic/Duress Alarm Systems
 - (v) Perimeter Detection Systems
 - (vi) Burglar Alarms and Fire Alarms systems and others are not covered in this document. This does not preclude them from following all applicable codes and standards,
 - (c) Integration with Other Systems
 - (i) In the project's programming stage, it is important to coordinate the systems listed above (who shall be called "Telecommunications") and the required infrastructure requirements related to these systems. This is especially critical for all design/build projects.
 - (ii) Where other Divisions need Communications or SCS, they can reference Divisionas 27 and 28.
 - (iii)
 - (2) Drawings – General Requirements
 - (a) Telecommunications construction drawings shall show all necessary cabling and equipment for the project. The telecommunications construction drawings shall be designed so that the contractor is able to use the proper combination of materials, techniques, and manpower to accomplish the overall installation.

- (b) Where integrated with the “E” series sheets, the A/E’s shall keep the Telecommunications drawings from overlapping or crowding to many systems. A minimum of two (2) separate the systems using the disciplines below.
- (c) The use of “COMMUNICATIONS” in the sheet titles is suggested. That designation, matches CSI Master Format description of construction discipline and is inclusive of voice, data (network), audiovisual and various distributed systems (paging, clocks, sound-masking, the systems listed above and etc.) “TELECOMMUNICATIONS”, “INFORMATION TECHNOLOGY” (or simply “TECHNOLOGY”), and “LOW-VOLTAGE SYSTEMS” are limited in scope and/or do not reflect bid document structure and construction industry terminology.
- (d) Where not integrated with “E” series sheets, telecommunications drawings should use a “Q” designation. “T” should not be used as this is reserved for the Tile sheet(s). Audiovisual may use “AV”.
- (e) Where the project includes work at multiple buildings, it is acceptable to include a building designator in the sheet number.
- (f) The first number following the discipline letter (e.g. “E” or “Q”) shall identify the discipline’s drawing type (i.e. floor plans, sections, elevations, schedules, details, etc.). Architects and Consulting Engineers (A/E’s) may use their own numbering plan for this numbering. The following outline is suggested:
 - (i) Title Sheet (T001), (if used).
 - (ii) Symbols & Abbreviations
 - (iii) Site Plans
 - (iv) Plans
 - (v) Enlarged Plans
 - (vi) Schematics/One-lines
 - (vii) Details
 - (viii) Schedules
- (g) The outline structure should be the same for all disciplines.
- (h) Terminology
 - (i) Edit drawings to use terminology consistent with what is used in the specification.
 - (ii) The meaning of all Acronyms used should be clearly explained on the Symbols & Abbreviations sheet.
 - (iii) In notes to avoid ambiguity as to contractor responsibilities restructure sentences to be more direct; e.g. using “active voice”. For example:
 1. Use “DEMOLISH” rather than “IS TO BE DEMOLISHED”.
 2. Use “COORDINATE” rather than “CONTRACTOR SHALL COORDINATE”.
 3. Use “PROVIDE [PRODUCT]” rather than “[PRODUCT] SHALL BE PROVIDED” or “CONTRACTOR SHALL SUPPLY AND INSTALL”.
 4. Use “DISCONNECT AND REMOVE [ITEM]” rather than “[ITEM] IS TO BE DISCONNECTED AND REMOVED”
- (i) Product Descriptions
 - (i) Only generic terms are to be used on drawings.
 - (ii) Manufacture and model number may be used ~in specifications~ as a basis-of-design example or where sole-source specification is allowed.
 - (iii) All pertinent performance and features must be included in the specification.
 - (iv) Technical content of the section will be the basis on which equals are determined. Features of a “basis-of-design” product not included in the technical language may not be considered.

- (j) Symbols and Abbreviations
 - (i) Include only symbols for equipment actually installed on the project. Edit out all other symbols.
 - (i) On Equipment Outlet symbol(s) include attributes necessary to clarify configuration, number of cables, mounting height/location, application, etc. as applicable.
- (d) Site Plans
 - (i) Show major pathway routes for telecommunications services including all underground or overhead services, duct banks, manholes, and other important feature. Include all conduit requirements from signal manholes to telecom entry points for services such as fire alarms reporting, security reporting, voice/data/video service, campus automation system connection, multi-conductor exterior lighting control, etc.
- (e) Floor Plans
 - (i) Show all Equipment Outlets (EO), Equipment Rooms (backboards, racks, and cable runway), major penetrations (floor and wall sleeves and conduits) and major cable pathways (cable tray, conduit).
 - (ii) Confirm that the required power circuits and telecommunications cabling provisions for security, and other miscellaneous systems required by project program are shown.
- (f) Equipment Room Enlarged Plans and Rack Elevations
 - (i) CNIT recommends that enlarged plans of Equipment Rooms be included. Show equipment rack placement, cable runway routing, cable tray and conduit entry points, grounding busbars, wall-mounted connectivity and equipment, etc.
 - (ii) Show Equipment Rack(s) to-scale and consider required clear space for access, door swing, etc.
 - (iii) CNIT recommends that Rack Elevation drawings be included. Show connectivity and equipment.
 - (iv) Include work by the contractor and space allocated for work by others”.
- (g) Schematics / One-line Diagrams (Risers)
 - (i) Provide one-line schematic (“riser”) diagrams to depict the telecommunications backbone cabling arrangement for a project. This applies to all new building distribution systems and additions/changes to existing building distribution systems.
- (h) Grounding and Bonding
 - (i) Detail the requirements of the grounding system in the drawings and specifications. References only to the NEC or TIA are not sufficient.
 - (ii) Include Grounding Schematic (riser) and applicable details. Coordinate preparation of the schematic with the electrical system designer. Grounding infrastructure is typically installed by the Division 26 contractor.
- (i) Construction Details
 - (i) Provide construction details on drawings to specify construction requirements.
 - (ii) Provide plan view, elevation and/or detail drawings to cover all telecommunications and other related low-voltage equipment, equipment rack elevations, Equipment Outlet faceplate configurations. Provide cross sections and details of the manholes and duct banks.
- (j) Equipment Schedules
 - (i) Sometimes used in Structured Cabling drawings to describe Equipment Outlet configurations.
 - (ii) Provide detailed schedules for Video Surveillance, [Card] Access Control and Audiovisual system devices.
- (k) Terminology

- (i) Undefined phrases on the drawings such as “properly seal”, “locations to be determined”, “by others”, and “as required” shall be avoided. Provide information adequate to clearly define technical requirements and contractor responsibilities to allow for accurate bidding.
 - (ii) Include all details, diagrams, schedules, etc. in the drawings, not in the specifications. Often just the drawings will be at the job site.
 - (iii) On each floor plan sheet, show graphic scale, compass point, room names and numbers, and key plan corresponding to the architectural drawings.
 - (iv) For large alteration projects, separate demolition drawings are required for all areas involved in the project. Remodeling project drawings shall indicate all removal and disconnection of existing telecommunications equipment, and shall indicate required repair of finishes.
 - (v) For areas such as telecommunications equipment rooms, larger scale plans shall be used for improved clarity.
 - (vi) For medium and large projects, provide separate floor plans for lighting, power, fire alarm systems, telecommunication systems, A/V systems, and security systems. Combining of systems drawings is allowed if clarity of design can be maintained. The drawings shall be combined on smaller projects.
 - (vii) The telecommunications drawings shall be coordinated and actively crosschecked with the drawings of all other disciplines. Consultant may be asked to provide a ¼” scale drawing of selected telecommunications equipment rooms, showing all disciplines equipment, to ensure that coordination is being achieved.
- ii) Product Data
- (1) Owner is providing a list of standard parts required for the contract. Any additional parts that are used requires the vendor/contractor to provide the manufacture’s catalog information showing any technical specifications, dimensions, colors and configurations.
 - (2) Submittals shall include all items called for in PART 2 – PRODUCTS of this document and provide the manufacturers cut sheets for the following:
 - (c) All balanced twisted pair cable.
 - (d) All connectors and required tooling.
 - (e) All termination system components for each cable type.
 - (f) All test equipment used for balanced twisted pair channels.
 - (3) A Performance Specification showing the manufacturer’s Guaranteed Published Channel Performance over the full swept frequency range.
 - (4) Technical data sheets shall include the physical specifications as well as the following electrical and transmission characteristics for balanced twisted pair channels:
 - (c) Mutual Capacitance
 - (d) Characteristic Impedance
 - (e) DC Resistance
 - (f) Insertion Loss (IL)
 - (g) Pair-to-Pair Near End Crosstalk (NEXT)
 - (h) Power Sum Near End Crosstalk (PSNEXT)
 - (i) ELFEXT (ELFEXT)
 - (j) Power Sum ELFEXT (PSELFEXT)
 - (k) Return Loss (RL)
 - (l) Propagation delay
 - (m) Delay Skew
- iii) Samples
- (1) Prior to installation, samples of cable and components shall be provided to the Owner, its

Consultants and Construction Manager for evaluation prior to Installation

- (c) Submit samples of each type of cable:
 - (i) Three (3) 24” long samples of each type of cable, copper (6e & 6a) and fiber (SM). For the copper, the sample cannot be from the same box/reel. Shall take from three separate boxes/reels.
 - (ii) Three (3) samples of each connector.
 - (iii) One each 100ft terminated copper of the 6e & 6a cable in a bag for test reference and permanent storage in the Main Closet. Each cable should be terminated as close to the lowest footage mark.
- iv) Manufacturer’s Instructions
 - Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
 - (1) Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
- v) Material Guarantee
 - (1) The wiring vendor/contractor (installer) shall guarantee at the time of the bid that all Category 6A and 6E cabling and components meet or exceed specifications (including installation) as referenced in 1.2.
 - (2) The successful wiring vendor/contractor (installer) shall insure that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor/contractor shall submit complete parts and part numbers to the Construction Manager prior to installation of equipment.
 - (3) Test Fiber optic cables upon receipt at Project site:
 - (c) Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - (d) Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in final documentation.
- vi) Quality Assurance
 - (1) For Cat 6a and 6e copper and Fiber optic the following shall be provided:
 - (c) System:
 - (i) The successful Bidder shall warrant that all materials and equipment furnished within the channel, under the contract are new, in good working order, free from defects, and in conformance with the Structured Cabling SYSTEM specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the Structured Cabling System acceptance date and remain in effect for a period of twenty-five year from that date. The successful Bidder shall agree to repair, adjust, and/or replace (as determined by the Purchaser to be in its best interest) any defective equipment, materials, or other parts of the Structured Cabling System at the successful Bidder's sole cost. The Purchaser shall incur no costs for service or replacement of parts within the channel during the warranty period of 25 years.
 - (ii) Selected vendor shall provide a Structured Cabling System warranty for a minimum of 25 years. The Structured Cabling System warranty shall guarantee the electrical performance to meet or exceed the requirements as outlined in documents TIA/EIA 568A and ISO DIS 11801 and offer a twenty five, (25) year warranty within the Structured Cabling SYSTEM Channel, beginning at acceptance by the Purchaser. The warranty shall include complete parts and labor replacement of defective products. The manufacturer shall warrant the product for a minimum of twenty, (20) years. The

Structured Cabling System warranty shall have provisions for replacing the contracting organization at no cost to the customer should the contractor lose his status as an authorized installer or otherwise not fulfill his obligation to the customer as outlined in the Structured Cabling System warranty program.

(iii) The successful Bidder shall warrant and supply evidence that the installation of materials and hardware shall be made in strict compliance with all applicable provisions of the National Electric Code, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

(d) Application:

(i) Minimum twenty (20) year application assurance: The application assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future for a minimum twenty (20) year period.

vii) Certifications

- (1) The successful vendor/contractor shall meet the current year Panduit Business Partner Agreement – Panduit Certified Installer (and/or Addendum), and shall provide a copy of the PCI certificate before awarding contract.
- (2) A copy of certification not less than 6 months from expiration for the vendors/installer Panduit Certified Copper and Fiber Technicians (PCT) shall be submitted upon awarding of contract before first cable is pulled and or installed.
- (3) If the successful vendor/contractor subcontracts the job (and so on), then each awarded vendor/installer shall comply with the same certifications as above.

2) STANDARDS AND CODE COMPLIANCE REFERENCES

a) Cherokee Nation hereby incorporates by reference the following industry standards as the minimum standards of installation for the structured cabling system described in this document:

i) TIA/EIA

- (1) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- (2) ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- (3) ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- (4) ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
- (5) TIA/EIA569A Commercial Building Standard for Telecom Pathways and Spaces
- (6) TIA/EIA606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- (7) TIA/EIA607 Commercial Building Grounding/Bonding Requirements
- (8) TIA/EIA942 Telecommunications Infrastructure Standard for Data Centers IEEE Std 802.3(tm)-2008 Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- (9) IEEE Std 802.3(tm) Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- (10) IEEE 802.3bc, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications. Amendment 2: Ethernet Organizationally Specific Type, Length, Value (TLVs).

b) National Fire Protection Association

- (1) NFPA 70, National Electric Code (NEC).
- (2) NFPA 70E, Standard for Electrical Safety in the Workplace.
- (3) NFPA 101, Life Safety Code

- (4) NFPA 241, Standard for Safeguarding Construction, Alteration and Demolition Operations.
- (5) NFPA 731, Standard for the Installation of Electronic Premises Security Systems.
- (6) NFPA 601, Standard for Security Services in Fire Loss Prevention.
- c) ISO/IEC· ISO/IEC 11801 Generic Cabling for Customer Premises
- d) BICSI ITSIM, Chapter. 4, "Pulling Cable."
- e) MasterFormat (August 2020), product of Construction Specifications Institute (CSI).

3) ADDITIONAL SUPPPORT

- a) Cherokee Nation Information Technology Network Construction Standards and Requirements Manual – this document.
- b) Notes, drawings and instructions from Owner as needed.
- c) Project Manual and or the Construction Documentation.
- d) Panduit Certification PLUSSM System Warranty Program, Panduit Warranty Guide.
- e) There is an invitation for the successful vendor/contractor to review an existing network to see and know how the Owner requires the network to look upon completion.

4) LIFE OF THIS MANUAL

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

5) COMPLIANCE WITH INTENT OF THIS MANUAL

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

6) CONFLICTS

- a) If a conflict exists between any of the above referenced installation standards listed in sections 2 and 3 above, the more stringent standard shall apply.
- b) If a conflict exists between any of the above referenced codes or standards listed in sections 2 and 3 above and this Manual, the requirements in this Manual shall apply.
- c) If a conflict exists and cannot be remediated by the above referenced codes, standards, and this Manual, **CNIT will have over all authority.**

PART 2 – DESIGN, PRODUCTS AND SYSTEM EQUIPMENT

1) SYSTEM REQUIREMEMNTS

- a) Expansion Capability: Provide spare conductor pairs in telecommunication cables, positions in cross-connect and patch panels, terminal strips to accommodate 20 percent future increase in the number of workstations shown on Drawings. All components and cabling shall be capable of 10G Bandwidth speed throughout the entire system.
- b) CNIT understands that products and equipment can be End of Life, replaced or have a long manufacturer lead-time. The contractor, vendor or bidder shall notify CNIT of the problem. Said providers can submit replacement part numbers with specifications and installation documentation from the manufacturer **OR** CNIT will provide a replacement part number with updated installation documentation if needed.
- c) Provider, contractor or vendor can submit a conformation of part descriptions, part numbers and quantities prior to ordering.

- d) All warrantees need to be registered in CN or CNIT name, not the contractor or vendor. System ID's and Names shall be provided at the time of bidding or architectural submissions.

2) IT ROOM/SERVER ROOM

- a) Server room shall be Air Conditioned with a separate unit on a separate thermostat.
- b) The HVAC shall be provided on a 24 hours-per-day, 365 days-per year basis. If a standby power source is available in the building, consideration should be given to connecting the HVAC system serving the telecommunications equipment room to the standby supply.
- c) The temperature and humidity shall be controlled to provide continuous operating ranges of 18deg C (64deg F) to 24 "C (75deg F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions
- d) A positive air pressure differential with respect to surrounding areas should be provided.
- e) Need 120v power receptacles on all walls with dedicated circuits. The rack vertical management shall have twist lock and quad receptacles as request by the owner and Drawings.
- f) Wall - A minimum of two walls should be covered with rigidly fixed 20 mm (3/4 in) A-C plywood, shall be void free, 2440 mm (8 ft) high, capable of supporting attached equipment. Plywood should be either fire-rated or covered with two coats of fire retardant paint.
- g) Equipment not related to the support of the equipment room (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed in; pass through, or enter the equipment room.
- h) No water sprinklers shall be installed in an IT/SERVER ROOM. A separate fire suppression system, based on one of the approved replacements for Halon, shall be installed in coordination with CN Risk Management. Appropriate safety signage and notifications shall be used according to the manufacturer, codes and standards.
- i) All IT rooms/server rooms shall have installed access control utilizing card readers per the Owners instructions, specifications and diagrams.

3) TELECOMMUNICATIONS EQUIPMENT ROOM (T-E-R)

- a) A telecommunications equipment room (T-E-R) is where the building entrance conduits terminate. It is usually located on the ground floor but may also be located in the basement. A T-E-R typically functions as the main cross-connect (MCC). It is the main telecommunications serving point for the building. It shall contain telecommunications equipment, much of it mounted on 19" - 4 post racks. Cables shall be spliced and terminated on the walls. It is important that the entrance conduits stub up in the T-E-R as close to a corner as possible.
- b) When designing the T-E-R floor space, allowance shall be made for non-uniform occupancy, throughout the building. The practice is to provide 0.07 m² (0.75 ft²) of equipment room space for every 10 m² (100 ft²) of work area space. The equipment room shall be designed to a minimum of 14 m² (150 ft²). See section 8.2 of TIA/EIA-569 pg.72 for more information. In the case of smaller buildings see annex B.3 of the TIA/EIA-569.
- c) In certain buildings, the T-E-R shall be further designated as a Node Room. A Node Room is used as a cabling hub not just for that building but for other buildings in that neighborhood of the campus. A Node Room requires additional space, air conditioning, and additional entrance conduits. It may require 30 amp outlets. In some cases, if a Node Rooms is designated in a building, a separate Telecommunications Room (TRS) on the same floor as the Node Room may be required.
- d) The CNITNG shall advise P&D and the architect in the initial planning stage if a Node Room has been designated.
- e) A Node Room shall house PBX telephone switching equipment, large wet- or dry-cell batteries, routers for campus wide area network (WAN), related local area network (LAN) switches, optical fiber cross connects and optical communications gear. Hence, it should be located so that it is accessible for the delivery of large equipment throughout its useful life. It shall be at least 10' from a potential source of

- electromagnetic interference (EMI) i.e. motors, transformers, photocopying equipment, etc..
- f) No water sprinklers shall be installed in a Node Room. A separate fire suppression system, based on one of the approved replacements for Halon, shall be installed in coordination with CN Risk Management. Appropriate safety signage and notifications shall be used according to the manufacturer, codes and standards.
 - g) All T-E-Rs shall have installed access control utilizing card readers per the Owners instructions and diagrams
- 4) TELECOMMUNICATIONS ROOMS (TRS)
- a) TRS are smaller than T-E-Rs. They are the cabling hubs for floors within a building. They also contain network electronics, typically mounted in 19" - 4 post racks. See table 7.2-1 of TIA/EIA. 569 pg. 66 for more information.
 - b) All TRSs shall have installed access control utilizing card readers per the Owners instructions, specifications and diagrams.
- 5) SECURITY EQUIPMENT ROOM (SER)
- a) Security equipment can be placed in any closet or room, unless:
 - i) Size and amount of equipment will overwhelm the closet or room listed above in sections 2-4.
 - ii) Need to secure the room from other sources. **Note:** will need its own network and shall follow the same standards as sections 2-4 listed above.
 - b) No security hardware shall be mounted as a bare board to the wall. The boards shall be mounted in a lockable:
 - i) Wall mount cabinet.
 - ii) Rack mount drawer.
 - iii) Manufactured case as a whole unit.
 - c) No water sprinklers shall be installed in a SER. A separate fire suppression system, based on one of the approved replacements for Halon, shall be installed in coordination with CN Risk Management. Appropriate safety signage and notifications shall be used according to the manufacturer, codes and standards.
 - d) The SER room does not have to be labeled as to the use of the room for security reasons as needed.
 - e) All SERs shall have installed access control utilizing card readers per the Owners instructions, specifications and diagrams
- 6) ELEVATOR PHONES
- a) Elevator phones are cabled to each elevator equipment room. There shall be at least one point of presence (POP) in the elevator equipment room that is cabled to the Main telecom room. There shall be a dedicated number of jacks on the POP so to accommodate all elevators in the building. Recommend that there be one phone block dedicated to Safety and Security to be easily identified.
- 7) CABLE TRAY
- a) Installation:
 - i) Cable tray shall be the Chatsworth part no. 10250-718, {Standard length is 9'11-1/2"}. Cable Tray shall be installed with side stringers facing up so that the ladder forms a U-shape.
 - ii) Cable Tray shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ). Cable Tray shall be supported every 5' or less in accordance with TIA-569-B. Cable Tray shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support Cable Tray within 2' on both sides of every change in elevation. Cable tray support shall use the Threaded Ceiling kit (11310-003) or a combination of Runway Support Bracket (11408-003)

with 5/8 All-Thread Rod on the outside, Ceiling Support Bracket (11406- 002), Threaded Rod I-Beam Clamps (10557-003), or appropriate hex nuts, split lock washers and plain washers through the bottom chord of the joists. Cable Tray splices shall be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.

- iii) Cable Tray shall be installed with a minimum clearance of 12" above the Cable Tray. Leave a minimum of 12" in between Cable Tray and ceiling/building truss structure. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the Cable Tray.
 - iv) Connections between tray sections shall be with the Butt-Splice kit (11301-001). If a redirection of up or down is required to go over or under utilities, use the Butt Swivel Splice kit (1 0487 -001). For the up or down movement of tray do not exceed more than 30 degrees so the cable shall lie on the tray. **The use of cut up tray sections/pieces on joints shall not be used. Manufacture parts shall be used for this purpose.**
 - v) Intersections (T or X shaped) shall be made using the Junction Splice Kit (11308-001), with Cable Runway Corner Bracket (11595-715) added to create a radius for the cable to lay on when making turns. For an L-turn use the Cable Runway E-Bend (10822-709).
 - vi) The cable tray is offset the length of the room to accommodate the rack, for all the cable to come off the track within 4 feet of the left hand wall when standing in the doorway.
 - vii) Cover the exposed ends of cable runway that do not terminate against a wall or the ceiling with Protective End Caps (10643-001) or an End Closing Kit (11700-709).
 - viii) The installer shall provide touch-up paint color-matched to the finish on the Cable Tray and shall correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component shall be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the Cable Tray system. Paint listed in parts list.
- b) Grounding
- i) Grounding shall be in accordance with the Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications J-STD-607 -A. Within the telecommunications room/s and throughout the building, the Cable Tray shall be bonded together, electrically continuous, and bonded to the Telecommunications Grounding Buss bar (TGB). Cable Tray and turns shall be bonded across each splice with a bonding kit (40164-001 or 025). Cable Tray shall be bonded to the TGB using an approved ground lug on the Cable Tray and a minimum #6 grounding wire. Remove paint from the Cable Tray where bonding/ground lugs contact the Cable Tray so that the lug shall contact bare metal. Use antioxidant joint compound in between the bare metal on the Cable Tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual Cable Tray sections and turns and through the bond to the TGB.
 - ii) **The use of cut up tray sections/pieces on joints shall not be used as a grounding bond between the joints. Manufacture parts shall be used for this purpose.**

8) MOUNTING ELEMENTS

a) Use the following charts to reference which equipment shall be used.

Chart 1

| Line item | P/N | Description | Qty |
|-----------|---------------|---|-----------|
| 1 | 4220W | Dell 42U enclosure, wide (4220W): 750mm wide x 1070mm deep | |
| 2 | PRV15 | Panduit Vertical Cable manager | |
| 3 | CMR4P84 | Panduit 4-Post rack | |
| 4 | PRD15 | Panduit Dual hinged door | |
| 5 | PREP | Panduit End Panel | |
| 6 | RGRB19U | Panduit ground bar | |
| 7 | GB2B0312TPI-1 | Panduit Telecommunications ground bar | |
| 8 | 10250-724 | Chatsworth Universal cable runway, Black – 24 Inch Wide | Reference |
| 9 | 11301-702 | Chatsworth Butt Splice Kit, 2" Stringer, Black | Reference |
| 10 | 10724-724 | Chatsworth Cable runway radius bend – 24inch Wide | Reference |
| 11 | 11309-701 | Chatsworth Foot kit, cable runway | Reference |
| 12 | 11421-724 | Chatsworth Wall angle support kit, cable runway – 24inch Wide | Reference |
| 13 | 31470-712 | Chatsworth Cable runway standoff support kit | Reference |
| 14 | 10506-702 | Chatsworth Cable runway elevation kit | Reference |
| 15 | 11302-701 | Chatsworth Junction-splice kit | Reference |
| 16 | 10723-724 | Chatsworth Cable runway radius bend | Reference |
| 17 | 11959-724 | Chatsworth Corner Bracket 24 inch Radius, | Reference |
| 18 | 11746-724 | Chatsworth Triangular Supports Bracket, steel | Reference |

Chart 2

| Line item | Qty | P/N | Description | Purpose | Notes |
|-----------|-----|-----------------|---|----------------------------------|--|
| 1 | | CJ6X88TGBU | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Blue | Closet A Zone | |
| 2 | | CJ6X88TGOR | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Orange | Closet B Zone | |
| 3 | | CJ6X88TGGR | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Green | Closet C Zone | |
| 4 | | CJ6X88TGRD | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Red | Closet D Zone | |
| 5 | | CJ6X88TGIW | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Off White | Closet E Zone | |
| 6 | | CJ688TGYL | Panduit Category 6, RJ45, 8-position, 8-wire universal module, Yellow | Camera Systems | |
| 7 | | CJ688TGVL | Panduit Category 6, RJ45, 8-position, 8-wire universal module, Violet | Multimedia | |
| 8 | | CJ6X88TGBU-24 | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Blue (24-Pk) | Closet A Zone | |
| 9 | | CJ6X88TGOR-24 | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Orange (24-Pk) | Closet B Zone | |
| 10 | | CJ6X88TGGR-24 | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Green (24-Pk) | Closet C Zone | |
| 11 | | CJ6X88TGRD-24 | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Red (24-Pk) | Closet D Zone | |
| 12 | | CJ6X88TGIG-24 | Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Int Gray (24-Pk) | Closet E Zone | |
| 13 | | CJ688TGYL-24 | Panduit Category 6, RJ45, 8-position, 8-wire universal module, Yellow (24-Pk) | Camera Systems | |
| 14 | | CJ688TGVL-24 | Panduit Category 6, RJ45, 8-position, 8-wire universal module, Violet (24-Pk) | Multimedia | |
| 15 | | PUC6AV04BU-EG | Panduit TX6A 10Gig UTP Copper Cable 23 AWG | Network / Phone / Wireless | |
| 16 | | PUR6004BU-UY | Panduit TX6000 Cat6 UTP riser copper cable | Camera Systems and Multimedia | |
| 17 | | UTP28X7BU | Cat 6a 10Gb UTP patch cable, 7ft, Blue, 28 AWG | Closet A network room connection | |
| 18 | | UTP28X14BU | Cat 6a 10Gb UTP patch cable, 14ft, Blue, 28 AWG | Closet A network room connection | |
| 19 | | UTP28X20BU | Cat 6a 10Gb UTP patch cable, 20ft, Blue, 28 AWG | Closet A network room connection | |
| 20 | | UTP28X7OR | Cat 6a 10Gb UTP patch cable, 7ft, Orange, 28 AWG | Closet B network room connection | |
| 21 | | UTP28X7GR | Cat 6a 10Gb UTP patch cable, 7ft, Green, 28 AWG | Closet C network room connection | |
| 22 | | UTP28X7RD | Cat 6a 10Gb UTP patch cable, 7ft, Red, 28 AWG | Closet D network room connection | |
| 23 | | UTP28X7 | Cat 6a 10Gb UTP patch cable, 7ft, Off White., 28 AWG | Closet E network room connection | |
| 24 | | UTP28X5YL | Cat 6a 10Gb UTP patch cable, 5ft, Yellow, 28 AWG | Security Cameras | |
| 25 | | UTP28X3YL | Cat 6a 10Gb UTP patch cable, 3ft, Yellow, 28 AWG | Security Cameras lamp posts | |
| 26 | | UTP28X3VL | Cat 6a 10Gb UTP patch cable, 3ft, Violet, 28 AWG | Multimedia | |
| 27 | | Vendor specific | Panduit Mini-Com Snap -On Modular furniture faceplates | Modular Furniture | Check Panduit's catalog. Shall have a label. Vendor specific faceplate. |
| 28 | | CBIW | Panduit Single gang faceplate frame accepts two 1/2 size module inserts or three 1/3 size module inserts. | Multimedia plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 29 | | CHS2IW-X | Panduit Two module space, 1/2 size, sloped insert accepts two Mini-Com modules | Multimedia plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 30 | | CHB2IW-X | Panduit 1/2 Blank Insert | Multimedia plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 31 | | KWPY | Panduit Stainless steel phone plate | Wall phones | The cable is terminated and left in the wall box. |
| 32 | | CFPL2IWY | Single gang, vertical faceplate accepts two Mini-Com modules | Network wall plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 33 | | CFPL3IWY | Single gang, vertical faceplate accepts three Mini-Com modules | Network wall plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 34 | | CFPL4IWY | Single gang, vertical faceplate accepts four Mini-Com modules | Network wall plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 35 | | CMBIW-X | Mini-Com blank module | Network wall plates | For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black) |
| 36 | | TTR-35RX0 | Panduit Tak-Tape (10 PK) | All network binding | |
| 37 | | EZDP44 | Fire Barrier CBL Pathway Single EZ Path W/WPLT Series 44 | | |
| 38 | | RGESD2-1 | Panduit Two-hole ESD port with 5/8" hole spacing | | |
| 39 | | 11310-003 | Chatsworth Threaded Ceiling Kit, Cable Runway | | |

| | | | | |
|----|-----------|---|--|--|
| 40 | 11421-712 | Chatsworth Wall Angle Support Kit, Cable Runway | | |
| 41 | 10250-712 | Chatsworth Universal Cable Runway – 12 inch wide | | |
| 42 | 10723-712 | Chatsworth Cable Runway Radius Bend 90-Degree Outside Bend – 12 inch Wide | | |
| 43 | 10724-712 | Chatsworth Cable Runway Radius Bend 90-Degree Inside Bend – 12 inch Wide | | |
| 44 | 11301-702 | Chatsworth Butt-Splice Kit | | |
| 45 | 11298-701 | Chatsworth Heavy Duty Junction-Splice Kit | | |
| 46 | 10642-001 | Chatsworth Protective End Caps For Runway | | |
| 47 | 10622-010 | Chatsworth Standard Busbar 4"Wx1/4"Hx10"L | | |
| 48 | 40164-001 | Chatsworth #6AWG Ground Strap | | |
| 49 | 10250-718 | Chatsworth Universal Cable Runway | | |
| 50 | 10723-718 | Chatsworth Cable Runway Radius Bend 90 degree Outside Bend | | |
| 51 | 10724-718 | Chatsworth Cable Runway Radius Bend 90 degree Inside Bend | | |
| 52 | 11421-718 | Chatsworth Wall Angle Support Kit, Cable Runway | | |
| 53 | 11304-000 | Chatsworth J-bolt Kit | | |
| 54 | 11301-001 | Chatsworth Butt-Splice Kit | | |
| 55 | 10506-706 | Chatsworth Cable Runway Elevation Kit 6" | | |
| 56 | 1201-701 | Chatsworth Cable Runway Radius Drop Stringer | | |
| 57 | 12100-718 | Chatsworth Cable Runway Radius Drop Cross Member | | |
| 58 | JMDWB-1-X | Panduit Drop Wire brackets for J-hooks | | |
| 59 | JMJH2-X20 | Panduit J Hook | | |
| 60 | RGTBSG-C | Panduit Green thread-forming bonding screw, #12-24 x 1/2" (pkg 100) | | |
| 61 | FSLR912 | Panduit Opti-Core 9um OS2 12 Fiber Indoor/Outdoor Armored Cable | | |
| 62 | FSLR996 | Panduit Opti-Core 9um OS2 96 Fiber Indoor/Outdoor Armored Cable | | |

9) UNSHIELDED TWISTED-PAIR CABLING AND FIBER OPTICS

- a) Backbone Fiber Cable:
 - i) Panduit Opti-Core 9um OS2 96 strand fiber indoor/outdoor interlocking armored cable, p/n FSLR996
 - ii) Comply with TIA/EIA 568-B.1 & 3, and 598-B
 - iii) NFPA 70
- b) Horizontal Copper cable:
 - i) For Security Cameras and Multimedia:
 - (1) NO. 23 AWG, 100 ohm, four pair. Panduit PUR6004BU-UY
 - (2) Comply with TIA/EIA-568-B.2 and ANSI/TIA-568-C.2, Category 6e
 - (3) NFPA 70, types CMG and CMP
 - ii) For Main Network:
 - (1) NO. 23 AWG, 100 ohm, four pair. Panduit PUR6X04BU-UY
 - (2) Comply with TIA/EIA-568-B.2 and ANSI/TIA-568-C.2, Category 6A
 - (3) NFPA 70, types CMG and CMP
- c) Cable Connecting Hardware: Comply with TINEIA-568-B.2, IDC type, using modules designed for punch-down caps or tools.
 - i) IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
- d) Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.
 - i) Number of Terminals per Field: One for each conductor in assigned cables plus 25 percent spare.
 - ii) Number of Jacks per Field: One for each four-pair UTP cable indicated.
- e) Jacks and Jack Assemblies: As referenced in Charts 1 and 2.
- f) Patch Cords: Factory made, four pair cables, to length as stated in parts reference, matching color to closet zone as referenced in Charts 1 and 2.

10) MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY

- a) Modular unit suitable for terminating single or multiple horizontal cables in one central location, providing an intermediary point between telecommunications closet and workstation.
 - i) NRTL listed as complying with UL 50 and UL 1863.
 - ii) Number of Terminals per Field: One for each conductor in assigned cables.
 - iii) Number of Connectors per Field:
 - (1) One for each four-pair UTP cable indicated.
 - (2) One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
- b) Mounting: Owner furnished Modular Walls and Furniture: As provide by modular furniture manufacturer. Reference Charts 1 and 2.

11) WORKSTATION OUTLETS

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIAIEIA-568-B.1.
- b) Workstation Outlets: Single, dual, triple or quad jack connector mounted in a single or multi-gang faceplate as shown in the prints.
- c) Jacks shall be the color of the Closet/ Zone they are in. See PART 3, Section 6)b)i).
 - i) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Part Reference.
 - ii) Legend: Contractor printed labels showing Closet then cable number, i.e. A001, A002, B101, C125.

12) MULTIMEDIA OUTLET

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIAIEIA-568-B.1.
- b) Workstation Outlets: dual connector mounted in a single faceplate as shown in the prints.

- i) Jacks shall be the color of Violet. See PART 3, Section 6)b)i).
- ii) Patch cables shall be the color of Violet. See Charts 1 and 2.
- iii) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 Part Reference.
- c) Legend: Contractor printed labels showing Closet, M (for MultiMedia) then cable number, i.e. AM01.

13) SECURITY CAMERA OUTLETS

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.
- b) Jacks shall be the color of Yellow. See PART 3, Section 6)b)i).
- c) Patch cables at patch panel and camera end shall be the color of Yellow. See Charts 1 and 2
- d) Legend: Contractor printed labels showing Closet, S (for Security) then cable number, i.e. AS01.
- e) Outlets shall be either in the following configurations according to drawings.
 - i) If internal wall mount, then the terminated jack shall be placed on the top plate of the nearest wall in a:
 - (1) Single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (2) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - ii) If external wall mount, then the terminated jack shall be placed on or in the internal inside wall close to the camera mount in a single ganged box with:
 - (1) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2.
 - iii) If ceiling tile mounted:
 - (1) The terminated jack shall be placed on top plate of the nearest wall in a:
 - (a) Single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (b) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (2) If the ceiling tile area is a large area i.e. waiting area, conference room, gymnasium, then paragraphs iv) (1) & (2) below can be applied.
 - iv) If solid ceiling:
 - (1) The terminated jack shall be placed on the nearest:
 - (a) Cable tray closest to the equipment, or
 - (b) Top plate of the nearest accessible wall. or
 - (c) Transition from ceiling tile to solid ceiling. The single or multi ganged box or surface mount box can be mounted to the framework or support.
 - (2) The terminated jack shall be placed:
 - (a) In a single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (b) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (3) If the solid ceiling area is a large area i.e. waiting area, conference room, gymnasium, then properly sized ceiling hatches to accommodate the installer/technician shall be installed:
 - (a) Starting at the cable tray supplying the space.
 - (b) Spaced every 28 feet apart.
 - v) The communications contractor or sub-contractor/s per owner instructions shall install security Cameras (SC), which shall be provided by the owner. Installation shall follow manufacturers and owners instructions.

14) WIRELESS ACCESS POINT OUTLETS

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.
- b) Jacks will be the same color of data drops from the Closet where the cabling originates.
- c) Outlets shall be either in the following configurations according to drawings.
 - i) If internal wall mount, then the terminated jack shall be placed on the top plate of the nearest wall in a:
 - (1) Single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (2) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - ii) If external wall mount, then the terminated jack shall be placed on or in the internal inside wall close to the camera mount in a single ganged box with:
 - (1) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2.
 - iii) If ceiling tile mounted:
 - (1) The terminated jack shall be placed on top plate of the nearest wall in a:
 - (a) Single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (b) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (2) If the ceiling tile area is a large area i.e. waiting area, conference room, gymnasium, then paragraphs iv) (1) & (2) below can be applied.
 - iv) If solid ceiling:
 - (1) The terminated jack shall be placed on the nearest:
 - (a) Cable tray closest to the equipment, or
 - (b) Top plate of the nearest accessible wall. or
 - (c) Transition from ceiling tile to solid ceiling. The single or multi ganged box or surface mount box can be mounted to the framework or support.
 - (2) The terminated jack shall be placed:
 - (a) In a single or multi ganged box with faceplate: Flush, high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 - DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (b) Single or multi surface mount box – DO NOT MIX JACKS OF DIFFERENT COLORS.
 - (3) If the solid ceiling area is a large area i.e. waiting area, conference room, gymnasium, then properly sized ceiling hatches to accommodate the installer/technician shall be installed:
 - (a) Starting at the cable tray supplying the space.
 - (b) Spaced every 28 feet apart.
- d) Legend: Contractor printed labels showing Closet, AP (for Access Point) then cable number, i.e. AAP01, with same label utilizing the last portion of the data patch panel.
- e) The communications contractor or sub-contractor/s per owner instructions shall install the wireless access points, which shall be provided by the Owner. Installation shall follow manufacturers and owners instructions.

15) GROUNDING AND BONDING

- a) Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.
- b) Reference Charts for what type of hardware is to be used in each Closet.
- c) Reference Manufacturer instructions on what and how grounding should be done if not referenced in this section.
- d) Reference drawings for location of hardware on equipment racks.

e) Reference Part 2, section 7b), Cable Tray Grounding.

16) IDENTIFICATION PRODUCTS

- a) Reference Steps 11-14 above for labeling legend.
- b) Adhesive-Backed Cable Labels: Use a label-making machine or printer to construct adhesive-backed label tabs from plastic or paper strips. Labels shall be over laminating type in order to protect type-face information with clear Mylar film. Handwritten labels are prohibited
- c) Four-pair UTP cable shall have labels affixed directly to cable jacket:
 - i) Within 3 inches from jack all outlets listed in steps 8-10.
 - ii) Within 6 inches from jack at patch panels
 - iii) Within 6 inches from entry into blocks.
- d) Fiber Optic Cables:
 - i) Shall have labels affixed to a label carrier that protects the cable and allows the re-positioning and rotation of the identification label.
 - ii) Warning Label shall be affixed along the consistent distance apart identifying that the cable is an optical fiber.
- e) Wiring Block Labels: Cardboard-like strips or adhesive labels that slip inside or onto clear plastic designation strips or label holders located on protector panels and wiring blocks
- f) Telecommunications Outlet (TO) Labels/Workstations: Use a label-making machine to construct label tabs from plastic or paper strips or adhesive labels. Handwritten labels are prohibited.

17) CONDUIT SIZING SCHEDULE

| | | | | |
|------------------------------------|---|-------------------------------|-------------------------------|-------------|
| SCHEDULE 0 – Conduit Trade Size | SCHEDULE 1 - Max Number of Cables based upon allowable fill. | | | |
| | SCHEDULE 2 - Cable outside Diameter, mm (in), [a=Category 3, 6e] or [b=6A, 10Gig] | | | |
| | SCHEDULE 3 - 6.1 (.24) [a] | SCHEDULE 4 - 7.9 (.31) [b] | SCHEDULE 5 - 9.4 (.37) [b] | SCHEDULE 6 |
| SCHEDULE 7 - 27 (1 ") | SCHEDULE 8 - 4 | SCHEDULE 9 - 2 | SCHEDULE 10-2 | SCHEDULE 11 |
| SCHEDULE 12 - 35 (1-1/4") | SCHEDULE 13-5 | SCHEDULE 14-4 | SCHEDULE 15 - 3 | SCHEDULE 16 |
| SCHEDULE 17 - 41 (1-1/2") | SCHEDULE 18-6 | SCHEDULE 19-4 | SCHEDULE 20 - 4 | SCHEDULE 21 |

For other sizes, refer to TIA/EIA569A Conduit Sizing Chart.

18) CONDUIT RUNS

- a) Conduits from any Telecommunication closet, cable tray, horizontal pathway is not allowed except in the following:
 - i) Conduit can be from the TO to the top of the wall with a minimum of 4 inches exposed. Preferred is 1 foot above the wall with 90-degree bend so that the cable repair margin can be Velcro wrapped into the bend of the conduit. All exposed ends of conduits shall have a EMT screw connector with plastic bushing to protect the cable from nicks.
 - ii) A 2-inch conduit is required to each wall-mounted box that supports a multi-user telecommunications outlet assembly (MUTOA). A MUTOA is a special type of telecommunications

outlets that can support up to 12 voice/data jacks. It is suitable for use in locations where there is a cluster of machines where each one is within 15 feet from the MUTOA.

- iii) Flexible conduits such as metallic flexible conduit are not to be used as pathways for telecommunications cables to avoid sheath damage to the cables. Therefore, the use of flexible conduits as pathway for telecommunications cables shall be avoided at all times.
- iv) Minimize the amount of turns/curve in the conduit from the top of wall to the gang box. If under a window or opening, reroute conduit to place straight down next to window or opening.

19) SYSTEM EQUIPMENT

- a) Network room equipment such as router, switches, backup battery systems, etc. shall be specified and designed by CNIT or a representative of CNIT. CNIT will provide a spreadsheet with the names, part numbers, quantity and description along with a rack configuration of how it shall be installed at the time of bidding or architectural submissions. CNIT will install this equipment unless noted, with contractor installing the other equipment per documentation and this manual.
 - i) Brands used:
 - (1) Cisco
 - (2) Palo Alto Networks
 - (3) APC battery backups.
 - b) Physical Security equipment shall be specified and designed by CNIT or a representative of CNIT. CNIT will provide a spreadsheet with the names, part numbers, quantity, and description along with a design of how installation shall be done at the time of bidding or architectural submissions. Access control designs will include installation drawings, wiring schedule, manufacturer installation manuals that shall be followed by the installer. If corrections are required and reporting procedures have been followed, then notations shall be made, and final drawings and schedule shall be submitted for acceptance of the system. CNIT or a contractor can install this equipment per documentation and this manual.
 - i) Cherokee Nation physical security is a Genetec solution. Cherokee Nation prefers a Genetec certified partner when it comes to a vendor or contractor. System ID's and Names shall be provided at the time of bidding or architectural submissions.
 - ii) Brands used:
 - (1) Axis Communications
 - (2) Bosch Security
 - (3) Altronix
 - (4) LifeSafety Power, Inc
 - (5) Mercury Security (part of HID Global)
 - (6) HID Global
 - iii) Equipment not specified above that supports the door hardware for access control, the A/E's, vendors and contractors will provide the description, part numbers and any support information to CNIT. CNIT, from this information will inform the above what equipment will be needed to support the access control, i.e. the above mentioned power supplies can replace the door hardware vendors power supply, unless proof can be made by the vendor that such cannot be done.
 - iv) CNIT does not recommend the mounting of any access control support equipment above the door. Equipment shall be mounted in the IT rooms supporting the access control room. Design of the IT rooms shall account for size requirements to accommodate such equipment.
 - c) Paging System shall be of a Valcom system that shall be specified and designed by CNIT or a representative of CNIT. CNIT will provide a spreadsheet with the names, part numbers, quantity, and description along with a design of how it shall be installed at the time of bidding or architectural submissions. Paging system designs will include installation drawings, wiring schedule. CNIT will install this equipment in the network rooms with contractor installing the rest of the equipment where

needed.

- d) This section excludes building security alarm systems, fire alarm systems, etc..

PART 3 – EXECUTION

1) INSTALLATION STANDARDS

- a) Reference Part 1 – GENERAL,
 - i) Section 2) STANDARDS AND CODE COMPLIANCE REFERENCES
 - ii) Section 3) ADDITIONAL SUPPORT
 - iii) Section 4) COMPLIANCE WITH INTENT OF THIS MANUAL
 - iv) Section 5) CONFLICTS.

2) APPLICATION OF MEDIA

- a) Backbone Cable for Data Service: 12 strand OS2 single mode fiber cable for runs between equipment rooms and wiring closet and for runs between closets.
- b) Backbone Cable for Multimedia Service: UTP Category 6e cable to be run from Closet “A” Multimedia panel to each of the other closet multimedia patch panels, i.e. A to B, A to C, A to D, A to E. The cable shall be terminated as the last port on the patch panel, i.e 21, 22, 23, 24.
- c) Backbone Cable for Telecommunications to run from Telecom Entrance Room to each closet, terminated at the Telecom patch panel, reference locations on drawings.
- d) Horizontal Cable for Data Service: 10Gig UPT Category 6A cable for runs between wiring closets and workstation outlets.
- e) Horizontal Cable for Security Cameras:
 - i) UTP Category 6e cable for runs between wiring closets and equipment. Starting at port 1 on Security Camera patch panel.
 - ii) Fiber Optic 6-fiber cable for runs from closet to lamp posts in parking lot. Terminating in fiber box.
- f) Horizontal cable for Multimedia Service: UTP Category 6e cable for runs between wiring closets and equipment. Starting at port 1 on Multimedia patch panel.

3) WORKMANSHIP

- a) Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer’s specifications and printed instructions.
- b) The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.
- c) Trash and Materials
 - i) Trash shall be kept cleared from the work areas daily.
 - ii) Materials shall be kept in a neat and workmanship like manner.
- d) Salvage Materials
 - i) Remove and recycle unused, undocumented and otherwise "abandoned" cables prior to the completion of the project.
 - ii) "Abandoned Cable" is defined per NEC 2008 Articles: 640, 645, 725, 760, 770, 800, 820 and 830. Further definition is contained in NFPA-75, NFPA-76 and NFPA-90A.
 - iii) Disconnect abandoned Telecommunications Outlets and remove
 - iv) Remove cabling and communications devices in walls, floors, and ceilings scheduled for removal per drawing.
 - v) Provide blank cover for abandoned Telecommunications Outlets that are not removed.
 - vi) Schedule work with Owner and other contractors.

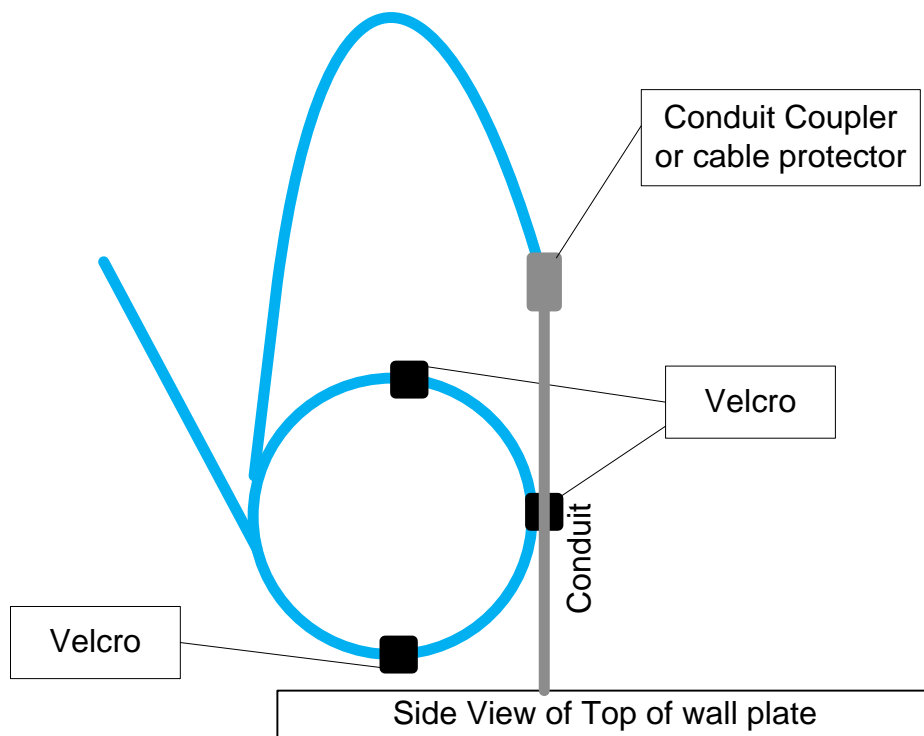
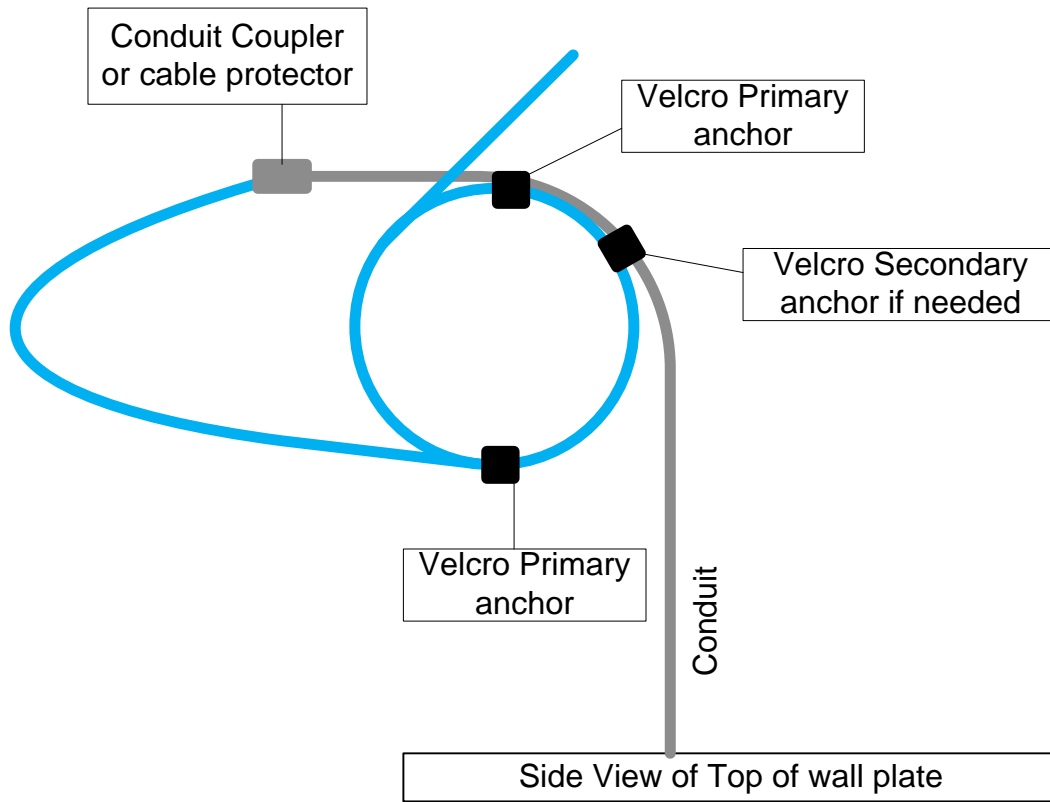
- vii) If salvaged materials are to be re-used or otherwise returned to the Owner:
 - (1) Be sure the items to be removed from service and turned over to the Owner are identified on the drawings.
 - (2) Except where noted on the project drawings, materials removed shall become the property of and shall be disposed/recycled by the Contractor.
- e) Maintain materials and equipment to be turned over to the Owner and/or reused in conditions equal to that existing before work began. Repair or replace materials or equipment damaged by the Contractor at no additional cost to the Owner.
- f) The primary vendor/contractor or subcontractor shall have the following personnel on site during install:
 - i) Primary supervisor:
 - (1) Has no limit to subcontractor supervisors to manage.
 - (2) Primary supervisor can have an assistant supervisor who shall supervise as follows:
 - (a) If the assistant supervisor is a Panduit Certified Copper and Fiber Technicians (PCT), the assistant supervisor can also have up to a maximum of four non-certified PCT's.
 - (b) A PCT can have up to a maximum of 4 non-certified PCT's.
 - ii) Supervisor for every 4 PCT.
 - (1) If the supervisor is a PCT, the supervisor can also have up to a maximum of four non-certified PCT's.
 - (2) A PCT can have up to a maximum of 4 non-certified PCT's.
 - iii) If subcontracted, each supervisor is responsible to the primary site vendor/contractor.
- g) Inspection
 - i) The Contractor shall allow Owner, its Consultants, Construction Manager, CNIT, their agents and the manufacturer's agent to inspect, observe and evaluate workmanship, and can have problems corrected or work halted until corrected.
 - ii) On-going inspections shall be performed during construction by the project manager Owner, its Consultants, Construction Manager, CNIT, and their agents.

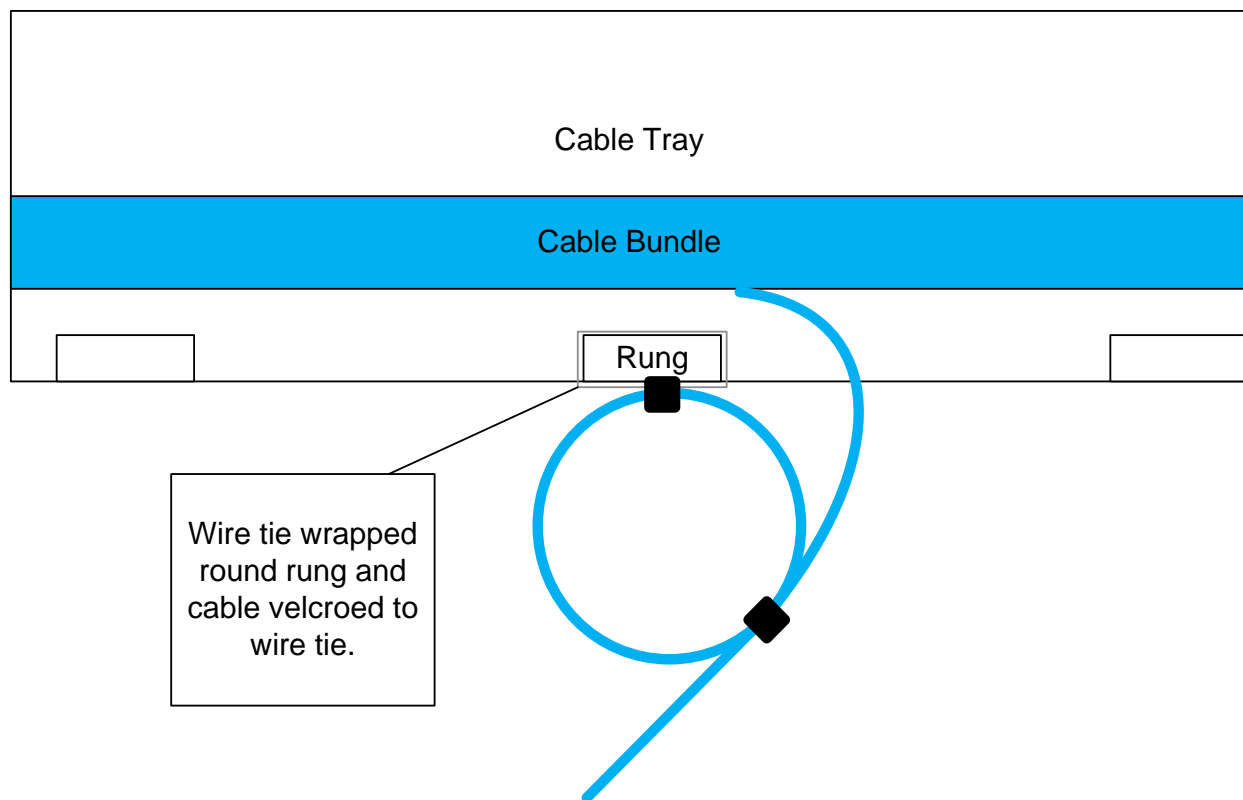
4) INSTALLATION

- a) Comply with:
 - i) Reference Part 1 –General,
 - ii) Section 2) STANDARDS AND CODE COMPLIANCE REFERENCES,
 - iii) Section 3) ADDITIONAL SUPPPORT,
 - iv) Section 4) COMPLIANCE WITH INTENT OF THIS MANUAL
 - v) Section 5) CONFLICTS.
- b) The path for the cable tray shall be clear of obstructions, such as HVAC ducts, large pipes and structural beams within the building. Use of enclosed tray and conduits is not allowed. Elevations of trays shall be minimized as to not have a stair step effect. Where fire or smoke barriers are penetrated by the ladder tray, they shall be fire stopped to maintain the rating of the barrier. Alternatively, EZ- Path Systems may be used through the penetrations. The number of sleeves required depends on the number of cables and size of tray. Use 50% fill ratio to determine the number of sleeves. Two additional spare sleeves should be installed to accommodate future cable placement.
- c) Place cable trays above drop ceilings in corridors. Do not place them above offices, patient/treatment rooms or inaccessible spaces. There shall be at least 4 inches of vertical space between the suspended ceiling tile and the bottom of the cable tray; 12 inches of vertical clearance from the top of the cable tray to the true ceiling; and 2' total side clearance (i.e. if the cable tray is wall mounted and there is no clearance on one side, then minimum clearance on the other side should be 2'.

- d) It is desirable that the cable tray originates from the TR. If the TR is surrounded with smoke or fire rated walls then EZ-Path systems shall be installed through the walls and the cable tray attached below them on either side of the wall.
- e) Access ceiling panels shall be installed at 5-foot interval if cable tray is passing through a hard or solid ceiling. The panels should be within 1-1/2 feet from the cable tray. They shall not be mounted directly underneath the cable tray. Trays shall not change level or change direction if placed above a hard or solid ceiling.
- f) All metallic cable trays shall be grounded but should not be used as grounding conductor for equipment.
- g) Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- h) Wiring within Wiring Closets and Enclosures:
 - i) A minimum of two walls should be covered with rigidly fixed 20 mm (3/4 in) A-C plywood, Shall be void free, 2440 mm (8 ft) high, capable of supporting attached equipment. Plywood should be either fire-rated or covered with two coats of fire retardant paint.
 - ii) Mount patch panels, terminal strips, and other connecting hardware on floor-mounted racks. Reference drawings for placement.
- i) Horizontal Fiber Optic to the parking lot lampposts:
 - i) Pull shall be from the rack mount fiber box designated for security systems to the lamppost.
 - ii) Terminate each fiber at rack end and mount into fiber box.
 - iii) At lamp post leave the equivalent of twice the pole height inside the base opening. Do not terminate cable. Seal cable with weather proof tape.
 - (1) Cable can be terminated and tested by owner, the vendor/contractor or subcontractor.
- j) Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated cross-connects, patch panels, workstations or locations as indicated in the Drawings.
- k) Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- l) Lacing/tie wraps shall be accomplished by Velcro strapping. The strap shall be able to be rotatable without slipping. **NO WIRE TIES SHALL BE USED ON ANY CABLE OR CABLE BUNDLES.**
- m) Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- n) Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Use lacing bars and distribution spools.
- o) Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- p) Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
- q) In the communications equipment room, install a 3-5 foot long service loop on each end of cable neatly stored inside the Vertical management.
- r) Pulling Cable: Comply with BICSI ITSIM, Chapter. 4, "Pulling Cable." Monitor cable pull tensions.
- s) Only anchor the cable bundles at the network room cable trays starting at the top when it comes down into the room down to the racks.
- t) When cable drops come off the tray it shall go between the rungs. No cable shall come over the top and bent over the edge. If the cable is to be pulled through the red iron, the cable shall go through the bottom of the cable tray between the rungs then up to the red iron. The only time cable shall go over the edge of the cable tray is if another tray is connected at an angle to that tray and the cable is changing directions.

- u) When the cable is installed there shall be a minimum of 3ft of cable at drop location end for repair margin. If the drop is within 10ft of the cable tray, the repair margin can be anchored under the cable tray to one of the rungs. If more than 10ft then the repair margin shall be anchored to the drops conduit above the wall. If there is not enough conduit then the margin can be anchored to the nearest red iron. Do not anchor to an electrical conduit. See drawings. When anchoring to the cable tray, wrap a plastic wire tie around the rung with the ratchet head below the rung. Then secure the repair margin to the wire tie with Velcro. See drawings on pages 18-19.





- v) Separation from EMI Sources:
- i) NO CONDUITS, POWER CABLE/CONDUCTORS OR EQUIPMENT SHALL BE LAID IN, THROUGH OR ACROSS THE TOP (WITHIN 12 INCHES) THE CABLE TRAY. IF CONDUITS, POWER CABLE/CONDUCTORS OR EQUIPMENT ARE UNDER THE TRAY, STEPS ii-vi BELOW SHALL BE FOLLOWED.
 - ii) Comply with BICSI TDMM and TIA/EIA-5 69-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - iii) Separation between open communications cables, cables in nonmetallic raceways or fiber optic cable in armored cable and unshielded power conductors and electrical equipment shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 6 inches.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - iv) Separation between communications cables in grounded metallic raceways/conduit and unshielded power lines or electrical equipment shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 6 inches.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - v) Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 1 inch.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 - vi) Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

vii) Separation between Communications Cables and Fluorescent Fixtures:

- (1) A minimum of 6 inches if cable is running perpendicular (90deg) to the fixture.
- (2) A minimum of 2ft if running parallel to the fixture (including cable tray). If less than, reroute cable from another direction or have fixture moved.

5) GROUNDING

- v) Grounding shall be in accordance with the Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications J-STD-607 -A. Within the telecommunications room, Cable Tray should be bonded together, electrically continuous, and bonded to the Telecommunications Grounding Bus bar (TGB). Cable Tray and turns shall be bonded across each splice with a bonding kit (40164-001 or 025). Cable Tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the Cable Tray and a minimum #6 grounding wire. Remove paint from the Cable Tray where bonding/ground lugs contact the Cable Tray so that the lug shall contact bare metal. Use antioxidant joint compound in between the bare metal on the Cable Tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual Cable Tray sections and turns and through the bond to the TGB.
- w) Reference NFPA 70 (latest Edition) Article 250 for other grounding requirements.
- x) Grounding of patch panels, fiber boxes or equipment brackets to the racks can be accomplished by one Panduit bonding screw (reference Charts 1 and 2) on each side securing the bracket to the rack. Use of antioxidant paste is required.

6) IDENTIFICATION

- a) Comply with TINEIA-606-A.
 - i) Administration class for this Project shall be Class 4.
 - ii) Color-code cross-connect and telecom fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- b) Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
 - i) Jacks shall be the color of the Closet/ Zone they are in. See Drawings.
 - (1) Closet "A" – Blue
 - (2) Closet "B" – Orange
 - (3) Closet "C" – Green
 - (4) Closet "D" – Red
 - (5) Closet "E" – Off White
 - (6) Security Cameras – Yellow
 - (7) Multimedia – Violet
- c) Reference PART 2 – DESIGN AND PRODUCTS, Section 16.
- d) Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
- e) Label each terminal strip and screw terminal in each cabinet, rack, or panel if applicable.
- f) Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- g) Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal

positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

7) FIELD QUALITY CONTROL

- a) Perform the following field tests and inspections and prepare test reports following the Standards and Code Compliance References for the following:
 - i) Category 6a UTP Cabling Tests:
 - (1) Test instruments shall meet or exceed applicable requirements as defined in the TIA Cat 6A Standard. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DSX-5000 as owner can except all test reports in the LinkWare file format. The tester shall have current calibration sticker attached and a copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - (3) Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 - (4) Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with guaranteed channel performance up to 500MHz.
 - (5) Alien Crosstalk shall not be required.
 - ii) Category 6a UTP Cabling Tests:
 - (1) Test instruments shall meet or exceed applicable requirements as defined in the TIA Cat 6A Standard. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DSX-5000 as owner can except all test reports in the LinkWare file format. The tester shall have current calibration sticker attached and a copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - (3) Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 - (4) Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with guaranteed channel performance up to 500 MHz.
 - iii) Back Bone Fiber Cable
 - (1) Test instruments shall meet or exceed applicable requirements. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DSX-5000 as owner can except all test reports in the LinkWare file format. The tester shall have current calibration sticker attached and copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components. Inspect cabling terminations in communications equipment rooms for compliance with color-coding.
 - (3) Optical Fiber Cable Tests:
 - (a) Field-test instruments shall have the latest software and firmware installed.
 - (b) Link and channel test results from the optical loss test set (OLTS) and optical time domain reflectometer (OTDR) shall be recorded in the test instrument upon completion of each

- test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
- (c) Fiber end-faces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting single mode fibers. 400X magnification may be used for detailed examination of single mode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.
 - (i) If possible it is preferable that the end-face images be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.
 - (d) Testing shall be performed on each cabling segment (connector to connector).
 - (e) Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per the owner's instructions.
 - (f) Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.
 - (g) Optical loss testing
 - (i) Backbone link
 1. Singlemode backbone links shall be tested at 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.
 2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526- 1 4A, Method B and ANSI/TIA/EIA-526-7, Method A. 1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 - (h) Optical Time Domain Reflectometer (OTDR) Testing
 - (i) Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
 - (ii) Backbone singlemode: 1300 nm
 - (iii) Each fiber link and channel shall be tested in one direction.
 - (iv) A launch cable shall be installed between the OTDR and the first link connection.
 - (v) A receive cable shall be installed after the last link connection.
 - (i) Magnified Endface Inspection
 - (i) Fibers shall be inspected at 200X or 400X magnification. The 200X magnification is suitable for inspecting singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers.
 - (j) Length Measurement
 - (i) The length of each fiber shall be recorded.
 - (ii) It is preferable that the optical length be measured using an OLTS or OTDR.
 - (k) A Fail or Fail* result shall be diagnosed corrected and retested.
 - (i) If not correctable, the installation contractor shall then remove, replace cabling and retest. The cost shall be borne by the installation contractor
 - (ii) If the results above reveals the same Fail or Fail* result, then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If the results is determined to be not correctable by the

manufacture's agent, technician or engineer, the installation contractor shall repeat 100% removal, reinstallation and testing under supervision of the manufacture's agent, technician or engineer. The cost shall be borne by the installation contractor.

iv) Horizontal Fiber Optic to the parking lot lampposts.

(1) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components. Inspect cabling terminations in communications equipment rooms for compliance with color-coding.

(2) Visual light test connection with bright light or visible light.

(a) If not visible, terminate cable and test as afore mentioned "iii) Back Bone Fiber Cable" to trouble shoot. If it fails, the installation contractor shall diagnose, correct, and retest.

(i) If not correctable, the installation contractor shall then remove, replace cabling and retest. The cost shall be borne by the installation contractor

(ii) If the results above reveals the same Fail or Fail* result, then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If the results is determined to be not correctable by the manufacture's agent, technician or engineer, the installation contractor shall repeat 100% removal, reinstallation and testing under supervision of the manufacture's agent, technician or engineer. The cost shall be borne by the installation contractor.

(3) Cable shall be final tested by Owner at a later date.

v) Cable Samples, the Cat 6a & Cat 6e cable shall be tested and added to documentation and warranty.

(1) Use the samples to check verification of manufacturer recommendations for setting the testers.

- b) Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals). A copy of the certification shall be attached to final documentation.
- c) One hundred percent of the installed cabling links shall pass the requirements of the standards mentioned above except as noted. Any failing link shall be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- d) The tester interface adapters shall be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the Manufacturer. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
- e) The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section I.2.2 of ANSI/TIA/EIA-568-B.2). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter shall Pass or Pass*.
- i) A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer shall provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.

- ii) A Fail or Fail* result shall be diagnosed corrected and retested.
 - (1) If not correctable, the installation contractor shall then remove, replace cabling and retest. The cost shall be borne by the installation contractor
 - (2) If the results above reveals the same Fail or Fail* result, then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If the results is determined to be not correctable by the manufacture's agent, technician or engineer, the installation contractor shall repeat 100% removal, reinstallation and testing under supervision of the manufacture's agent, technician or engineer. The cost shall be borne by the installation contractor.
- f) Additional Requirements:
 - i) A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
 - ii) At an agreed time a representative of the end-user shall select a random sample of 10% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored in a separate documentation that shall be attached with final documentation (but does not have to be submitted for warranty). The results obtained shall be compared to the data provided by the installation contractor. If more than 3% of the sample results differ in terms of the pass/fail determination:
 - (1) The installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.
 - (2) If more than 30% of the sample results differ in terms of the pass/fail determination, then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If the results is determined to be not correctable by the manufacture's agent, technician or engineer, the installation contractor shall repeat 100% removal, reinstallation and testing under supervision of the manufacture's agent, technician or engineer. The cost shall be borne by the installation contractor

8) TEST RESULTS DOCUMENTATION

- a) The test results/measurements shall be transferred into a WindowsTM-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee shall be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used. Owner prefers that the test results/measurements be in the LinkWare file format.
- b) The database for the completed job shall be stored and delivered on digital media including the software tools required to view, inspect, and print any selection of test reports.
- c) A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information
 - i) The identification of the link in accordance with the naming convention defined in the overall system documentation
 - ii) The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 - iii) The date and time the test results were saved in the memory of the tester.
- d) General Information to be provided in the electronic data base with the test results information for each link:
 - i) The identification of the customer site as specified by the end-user
 - ii) The name of the personnel performing the test
 - iii) The identification of the link in accordance with the naming convention defined in the overall system documentation

- iv) The overall Pass/Fail evaluation of the link-under-test
 - v) The name of the standard selected to execute the stored test results
 - vi) The date and time the test results were saved in the memory of the tester
 - vii) The brand name, model and serial number of the tester
 - viii) The identification of the tester interface
 - ix) The revision of the tester software and the revision of the test standards database in the tester
 - x) The test results information shall contain information on each of the required test parameters that are listed.
- e) For all copper (Cat 6a & Cat 6e)
- i) The cable type and the value of Nominal Velocity of Propagation (NVP) used for length calculations
 - ii) In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for shall contain the following information:
 - (1) For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program shall be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software shall also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
 - (2) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1) and the test limit value.
 - (3) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
 - (4) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
 - (5) Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.
 - (6) Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
 - (7) NEXT, Attenuation Crosstalk Ratio Far-end (ACR-F): Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
 - (8) PS NEXT and Power Sum Attenuation to Crosstalk Ratio, Far-end (PS ACR-F): Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
 - iii) Between-Link (Between-Channel) Test Results Data
 - iv) A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report shall contain:
 - (1) PS ANEXT results at each frequency for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS ANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center) where the worst case PS ANEXT margin is less than 2 dB, the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.
 - (2) Power Sum Attenuation to Alien Crosstalk Ratio Far-end PS (AACR-F) results at each frequency tested for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACR-F only needs to be measured and tested from one end of the link or channel.

- f) Fiber tests:
 - i) The fiber identification number.
 - ii) The length for each optical fiber.
 - (1) Optionally the index of refraction used for length calculation when using a length capable OLTS.
 - iii) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
 - iv) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
 - v) The length for each optical fiber as calculated by the OTDR.
 - vi) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.
 - vii) A picture or image of each fiber end-face if done.
 - viii) A pass/fail status of the end-face based upon visual inspection.

9) CONSTRUCTION REVIEW

- c) The following shall be examined and shall comply satisfactorily in all instances.
 - i) Design documentation complete.
 - ii) All cables properly labeled, from end-to-end.
 - iii) All terminated cables properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage.
 - iv) The cable type suitable for its pathway.
 - v) The cables bundled in parallel.
 - vi) The pathway manufacturer's guidelines have been followed.
 - vii) All cable penetrations installed properly and fire stopped according to code.
 - viii) The Contractors avoided excessive cable bending.
 - ix) Potential EMI and Radio Frequency Interference (RFI) sources have been considered.
 - x) Cable Fill is correct.
 - xi) All hanging supports are within 1.5 meters (5 feet).
 - xii) Hanging cable exhibit some sag.
 - xiii) IDF room terminations are compatible with applications equipment.
 - xiv) Patch Panel instructions have been followed:
 - (1) Jacket removal point
 - (2) Termination positions
 - (3) All pair terminations tight with minimal pair distortions
 - (4) Twists maintained up to Index Strip
 - xv) Modular Panel instructions have been followed:
 - (1) Cable dressing first
 - (2) Jackets remain up to the Connecting Block
 - (3) All pair terminations tight and undistorted
 - (4) Twists maintained up to the Connecting Block
 - xvi) Connectors are properly turned right side up in the Jack Panels without cables wrapped or twisted around the Mounting Collars.
 - xvii) The correct outlet connectors have been used
 - xviii) Outlets have been wired correctly (T568B)
 - xix) The cable jacket maintained up to the Jack.
 - xx) Identification markings uniform, permanent and readable.

- d) The Owner, its Consultants, Construction Manager, CNIT, and their agents shall review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.
- e) The contractor shall inspect and test completed communications installations to demonstrate specified performance levels including the following:
 - i) Furnish all instruments and personnel required for the inspections and tests.
 - ii) Perform tests in the presence of the Engineer and Owner when required.
 - iii) Demonstrate that the system components operate in accordance with the Contract Documents.
- f) Review, observation, assistance, and actions by the Owner, its Consultants, Construction Manager, CNIT, and their agents shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The Owner, Consultants, its Construction Manager, CNIT, and their agents review and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.
- g) The fact that Owner, its Consultants, Construction Manager, CNIT, and their agents does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the contractor makes the necessary corrections.
- h) Regardless of when discovery and rejection are made, and regardless of when the contractor is ordered to correct such work, the contractor shall have no claim against the Owner, its Consultants, Construction Manager, CNIT, and their agents for an increase in the Subcontract price, or for any payment on account of increased cost, damage, or loss.

10) DEFINITION OF ACCEPTANCE

- a) System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
 - i) The complete system has successfully completed all testing requirements.
 - ii) All punch list items have been corrected and accepted.
 - iii) All submittals and documentation have been submitted, reviewed, and approved. Including:
 - (1) A list of the documentation submitted to Panduit for the CERTIFICATION PLUSSM SYSTEM WARRANTY PROGRAM according to the Panduit Warranty Guide.
 - (a) A copy of the E-form, or Fax is acceptable. Or
 - (b) If mailed, a copy of the package tracking number is acceptable.
 - (2) Verification of delivery shall be done by Owner, its Consultants, CNIT, and their agents with Panduit. If:
 - (a) Verified as delivered then acceptance can continue.
 - (b) Verified as NOT delivered, then the acceptance is not complete.