

Project Manual

Bid Package 02

Volume 02

ASI 04

Cherokee Nation WILMA P. MANKILLER HEALTH CENTER EXPANSION

Stilwell, Oklahoma

June 08, 2020



Tel: 479.783.2480

Fax: 479.783.4844

E-mail: breck@childersarchitect.com

www.childersarchitect.com

Division	Section Title	Pages
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PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 27 - COMMUNICATIONS

27 0000.1 NETWORK CABLING SPECIFICATIONS

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Cherokee Nation Network Cabling Specifications

January 17, 2020



Cherokee Nation Representative
Network Engineer

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Specification Version History

Version #	Implemented	Revision	Approved	Approval	Reason
1	Brett Swett	Draft: May 24, 2019			
2	Brett Swett	Draft: Nov. 21, 2019			Incorporated sections of CNIS Construction Standards and Requirements into document.
3	Brett Swett	Dec. 16, 2019			Updated per Cherokee Nation meeting on December 13, 2019.
4	Brett Swett	January 17, 2020			Updated fiber enclosure part numbers



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I. General

A. Purpose of Document

1. This document is to provide a standard defining the structured communications cabling systems to be installed within Cherokee Nation facilities. It is geared toward leveraging our legacy cabling infrastructure while upgrading to more recent technologies in new installations. The goal is to accomplish this in the most economic and systematic fashion possible, and in a manner compliant with the latest codes, cabling standards, and industry best practices.
2. Within this document, the facilities owner is Cherokee Nation, and shall be referred to as such, or as Cherokee Nation. Bidding low-voltage installers shall be referred to as "Installer" or "Contractor".
3. It is the responsibility of the installing Contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of Cherokee Nation any design directions that may be improved. All such changes shall be approved in writing from Cherokee Nation.
4. This specification defines quality standards and practices common to all Cherokee Nation network cabling upgrades and Greenfield (new) projects. The system offered and quoted, shall incorporate all features and facilities listed in this specification.
5. In addition to this cabling standard, individual projects will also have associated documentation such as Requests for Proposals (RFP), facility drawings, and project schedules pertaining to that particular job. Such collateral will be referred to in this document as "Project-specific Documentation", "Project Documentation", or simply "Construction Documents". Many of the requirements described herein may be detailed or expanded upon by such project-specific documents.
6. Any conflict between this general specification and any project-specific documentation shall be brought to the attention of Cherokee Nation and will be resolved by Cherokee Nation in writing.
7. Note that while many portions of this specification are addressed to "The Contractor", these requirements apply equally to architects, engineers, project managers, planning, or anyone doing network cabling and infrastructure work within Cherokee Nation facilities, whether those persons are outside contractors or persons directly employed by Cherokee Nation.

B. Scope of Work – Typical

1. Contractor shall be solely responsible for all parts, labor, testing, documentation, and all other processes and physical apparatus necessary to turn over the completed cabling system and associated infrastructure fully warranted and operational for acceptance by Cherokee Nation.
2. This specification includes structured cabling for the production Ethernet network, but may address other systems that have converged onto Ethernet-style cabling. These associated systems may include VoIP, Building Automation Systems (BAS), Building Access Control, Security Cameras and Audio-Visual Systems.



3. The following cabling subsystems will be defined:
 - a. Cabling Subsystem 1 – Horizontal Copper Cabling
 - b. Cabling Subsystem 2 – Intrabuilding Fiber Backbone Cabling OM4
 - c. Cabling Subsystem 3 – Interbuilding Fiber Backbone Cabling OM4
 - d. Racks and Cable Management
 - e. Bonding and Grounding
 - f. Cable Pathways
 - g. Network Labeling
 - h. Cabling Accessories
 - i. Cabling Subsystem 1 – Horizontal Copper Cabling
 - j. Cabling Subsystem 2 – Intrabuilding Fiber Backbone Cabling OM4
 - k. Cabling Subsystem 3 – Interbuilding Fiber Backbone Cabling OM4
 - l. Racks and Cable Management
 - m. Bonding and Grounding
 - n. Cable Pathways
 - o. Network Labeling
 - p. Cabling Accessories
4. As part of the submittals process samples will need to be provided as listed.
 - a. Samples of cable and components shall be provided to the Owner, its Consultants and Construction Manager for evaluation prior to Installation.

Submit samples of each type of cable:
 - (i) Three (3) 24" long samples of each type of cable, copper (6e & 6A) and fiber (SM & MM). For the copper, the sample cannot be from the same box/reel. Must 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 should start at the lowest footage mark.
5. In the event that requirements of the project documents cannot be met during design or installation, a written description of the need for variance will be submitted to the Cherokee Nation Project Manager for review by the Cherokee Nation Team.



C. General Guidelines

1. All voice telephony systems shall be VoIP unless otherwise specified in the project-specific documentation.
2. Any copper or fiber patch cords shall be factory terminated. Hand terminated patch cords will not be accepted.
3. All Greenfield (new and remodeling) projects shall use Cat 6A cable.
4. On Brownfield (existing, moves, adds, and changes) installations, Contractor shall consult project documentation for guidance on the current Category of copper cable to be installed.
5. Any deviation from Cat 6A cabling shall be approved in writing by Cherokee Nation Representative.
6. Wiring configuration on Cat 6A systems shall be T568B.
7. Any communications/IT consulting engineers retained by Cherokee Nation shall be at the sole discretion of Cherokee Nation.

D. Terminology from TIA 569

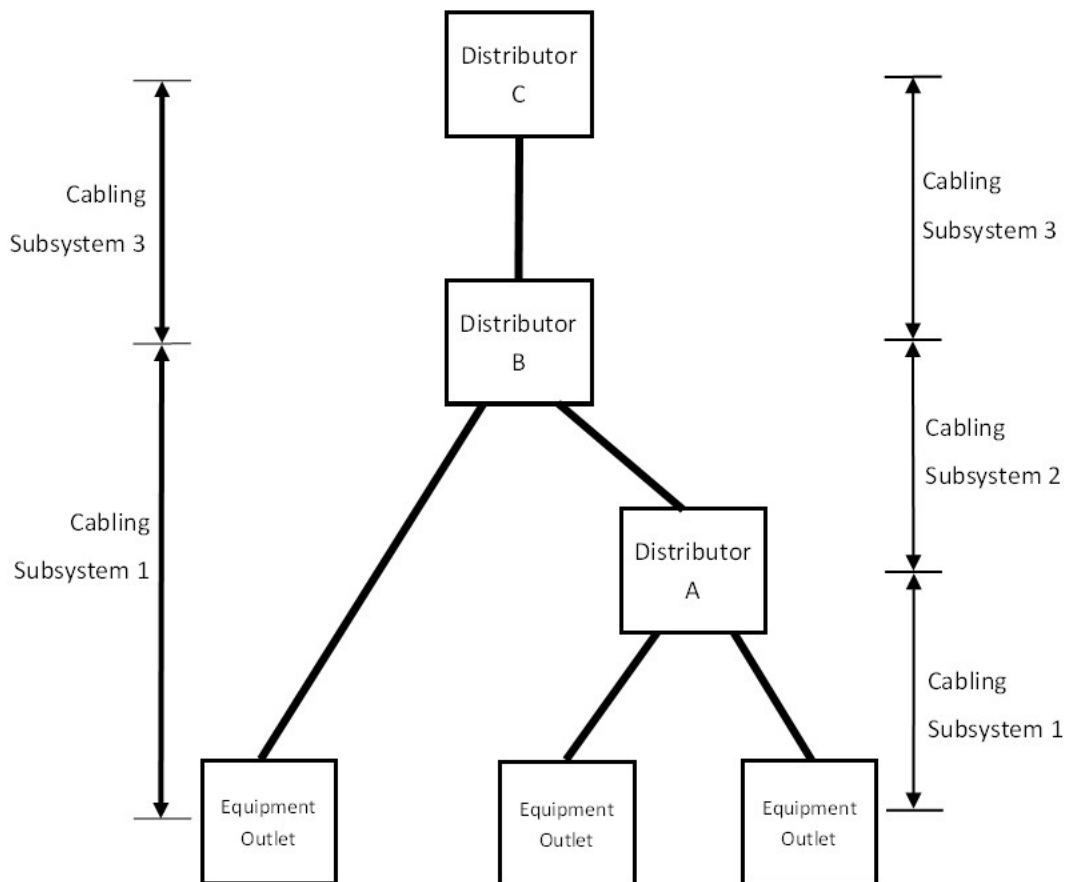
1. New Terms for Telecommunications Spaces (Rooms)
 - a. This section reviews some of the current terminology for communications rooms and spaces as defined in TIA 569-D (April 2015).
 - b. Awareness of these new terms is important for communicating accurately and for clearly understanding language used in specifications and other documents.
 - c. This specification will use both new and old terms side-by-side for clarity.
 - d. The table below shows some of the most important new terms and how they relate to traditional terminology:

Old Term(s)	New Term
Entrance Facility.	Entrance Room
Telecommunications Room, Equipment Room.	Distributor Room
Telecommunications Room, Equipment Room.	Telecommunications Space
Cross-connect, Patching System, Optical Enclosure.	Distributor
Horizontal Cross-connect. Usually copper patch panels in enterprise installations.	Distributor A
Intermediate Cross-connect, Intermediate Distribution Frame. Usually multimode optical enclosure in enterprise installations. Can apply to intra and interbuilding fiber cabling subsystems.	Distributor B



Old Term(s)	New Term
Main Cross-connect, Main Distribution Frame. Usually singlemode optical enclosure in enterprise installations. Can apply to intra and interbuilding fiber cabling subsystems.	Distributor C
Faceplate, Surface Box, Work Area Appliance.	Equipment Outlet
Work Area.	Equipment Outlet Location
Horizontal Cabling. Extends from Equipment Outlet to Distributor A, B, or C depending on size of cable plant. Usually balanced twisted pair cable in enterprise installations.	Cabling Subsystem 1
Extends from Distributor A to Distributor B or C, depending on size of cable plant. Usually 50-micron intra-building backbone fiber cable in enterprise installations. But may be singlemode fiber.	Cabling Subsystem 2
Connects Distributor A to Distributor B. In enterprise installations, this is usually singlemode fiber between buildings.	Cabling Subsystem 3

Example of a logical cabling topology with the new terminology see illustration below:





E. Applicable Regulatory References

1. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
2. ANSI/TIA:
 - a. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - b. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 - c. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 - d. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - e. ANSI/TIA-568.0-D (September 2015) Generic Telecommunications Cabling for Customer Premises (supersedes TIA-568-C.0 and TIA-568-C-1)
 - f. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)
 - g. ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - h. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
 - i. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
 - j. ANSI/TIA-569-D (April 2017) Telecommunications Pathways and Spaces
 - k. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
 - l. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 - m. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
 - n. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - o. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 - p. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - q. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
 - r. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises



- s. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
- t. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
- u. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
- v. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- w. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
- x. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
- y. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
- z. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
- aa. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
- bb. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
- cc. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
- dd. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
- ee. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
- ff. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
- gg. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
- hh. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
- ii. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
- jj. TIA-492AAAE (June 2016) Detail Specification for 50- μ m Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
- kk. TIA-492AAAB-A (November 2009) Detail specification for 50- μ m core diameter/125- μ m cladding diameter class 1a graded-index multimode optical fibers
- ll. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis



mm. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

3. ISO/IEC

- a. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
- b. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
- c. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
- d. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
- e. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
- f. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
- g. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration
- h. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
- i. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
- j. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling
- k. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
- l. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
- m. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment

4. BICSI – Building Industry Consultative Services International – Published Standards

- a. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
- b. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
- c. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
- d. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
- e. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices



- f. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
 - g. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - h. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
5. BICSI – Building Industry Consultative Services International – Manuals
- a. Telecommunications Distribution Methods Manual, 13th Edition
 - b. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 - c. Outside Plant Design Reference Manual, 5th Edition
 - d. BICSI's ICT Terminology Handbook, Version 1.0
 - e. Telecommunications Project Management Manual (TPMM), 1st edition
 - f. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 - g. BICSI's Special ICT Design Considerations, Version 1.0
 - h. Essentials of Bonding and Grounding, Version 1.0
6. National Electric Codes
- a. National Electrical Safety Code (NESC) (IEEE C2-2012)
 - b. NFPA 70-2016, National Electrical Code® (NEC®)
 - c. ANSI/IEEE C2-207, National Electrical Safety Code®
 - d. National Electrical Code (NEC) (NFPA 70)
 - e. NFPA 72 National Fire Alarm and Signaling Code
7. ASHRAE
- a. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings
8. OSHA Standards and Regulations – all applicable
9. Local Codes and Standards – all applicable
10. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
11. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.



12. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

F. Cherokee Nation Substitution Policy

1. This is a performance-based specification developed from the experience of the Cherokee Nation in providing exceptional solutions for all our facilities and departments. As such, substitution of specified products or systems is not allowed.
2. Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

G. Contractor Qualifications

1. General
 - a. Contractor shall be a current Panduit OneSM Gold Partner that has completed the Structured Cabling Deployment training (Panduit Certified Installer). A copy of the corporate Panduit manufacturer certification shall be included with all quotes.
 - b. Contractor shall have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.
 - c. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
 - d. Contractor shall have all necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
 - e. Contractor and all subcontractors will have the following personnel on site during install:
 - i. Supervisor for every 4 Panduit Certified Copper and Fiber Technicians (PCT) (1) If the supervisor is a PCT, the supervisor can also have up to a maximum of 4 non-certified PCT's.
 - ii. 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.
 1. Primary supervisor has no limit to subcontractor supervisor to manage.
 2. Primary supervisor will then have an assistant supervisor who will supervise as follows:
 - a. If the assistant supervisor is a PCT, the supervisor can also have up to a maximum of 4 noncertified PCT's. d At least 30 percent of the technicians installing low-voltage copper systems on the job shall have a current Panduit Certified Copper Technicians certificate.



- f. The Telecommunications contractor shall provide a Project Manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:
 - Initiate and coordinate tasks with the Cherokee Nation Project Manager and others as specified by the project schedule.
 - Provide day-to-day direction and-site supervision of Contractor personnel.
 - Ensure conformance with all contract and warranty provisions.
 - Acknowledge and remediate findings of Cherokee Nation weekly site project meetings.
 - This individual will remain Project Manager for the duration of the project. The contractor may change Project Manager only with the written approval of Cherokee Nation.
- g. Contractor Project Manager on site shall have completed the Panduit Structured Cabling Deployment training and hold certificates for both copper and fiber.
- h. The Contractor must allow Owner, its Consultants, Construction Manager, CNIT, their agents and the manufacturer's agent to observe and evaluate workmanship and can have problems corrected or work halted until corrected.

2. References and Response Times

- a. Communication Contractor shall provide with bid, a list of four (4) reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year (twelve-month period).

3. Termination of Services

- a. Cherokee Nation reserves the right to terminate the Communication Contractor's services if at any time it is determined the Communication Contractor is not fulfilling their responsibilities as defined within this document and all associated project documentation.
- b. Upon termination, the Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.
- c. Contractor's appearance and work ethic shall be of a professional manner. Dress shall be appropriate to the work being performed.
- d. Conduct on Cherokee Nation property will be professional in nature.
- e. Any person in the Contractor's employ working on a Cherokee Nation project considered by Cherokee Nation to be incompetent, disorderly, or for any other reason unsatisfactory or undesirable to Cherokee Nation, such person shall be removed from the Cherokee Nation project.

4. Other Contractor Responsibilities

- a. Confirmation of Pathway and Cable Manager sizing:



- Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.
 - Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.
- b. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.
 - c. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.
 - d. Projects are not considered finished and will not be paid by Cherokee Nation until all debris, dust, etc. has been cleaned and removed to the satisfaction of Cherokee Nation.
 - e. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.
 - f. Contractor shall abide by all Cherokee Nation Security Policies pertaining to access and conduct while on Cherokee Nation property.
 - g. Contractor shall obey all posted speed limits and parking regulations at the Cherokee Nation facilities where the work is being performed.
 - h. Contractor understands that illegally parked vehicles will be towed and Contractor is responsible for and will assume all costs associated with towing.

H. Warranty

1. Contractor shall provide a 25-year Panduit Certification PlusSM System Warranty on all copper and fiber links and/or channels.
2. Panduit[®] Certification PlusSM warranty shall meet the following criteria.
 - a. A 25-year guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
 - b. This warranty will cover all registered links and/or channels.
 - c. Contractor shall indicate in warranty documentation whether registered links are to be link or channel.
 - If links are covered, this warranty may be invoked only if the links are comprised entirely of Panduit components and cable.
 - If channels are covered, this warranty may be invoked only if entire channel links are comprised of continuous Panduit components and cable, including patch cords.
 - d. The communications Contractor will correct any problems and malfunctions that are warranty-related issues without charge for the entire warranty period.



- e. If the Certification PlusSM warranty is needed by Cherokee Nation within the warranted period and the original installer is no longer in business, Panduit shall find a substitute Panduit ONESM certified contractor and assume costs to fulfill the obligations of the warranty.
- f. Upon acceptance of the warranty paperwork and test results from the Contractor, Panduit will mail a notification letter to the installer and a notification letter with warranty certificate to Cherokee Nation.
- g. The warranty period shall commence following the final acceptance of the project by Cherokee Nation and written confirmation of warranty from Panduit.

<END OF SECTION>



II. Subsystems and Components

A. Cabling Subsystem 1 – Horizontal Copper Cabling System

1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Installation of horizontal cabling shall be compliant with most recent versions of all applicable standards, national and local codes, as well as the local Authority Having Jurisdiction (AHJ).
 - b. The cabling system and support hardware shall be installed so as not to obscure any valves, fire alarm conduit, boxes, or other control, security or life safety devices.
 - c. Contractor shall use the same Category of performance for both cable and connecting hardware through the entire horizontal channel.
 - d. Anywhere there is a conflict between standards, codes, installation specifications or project specific documentation contractor shall default to the most stringent.
 - e. If clarification is needed, contractor shall submit a written request for clarification to Cherokee Nation. Response from Cherokee Nation shall be in writing.
 - f. All cable pulled and terminated shall be Cat 6A unless specified otherwise in the project documentation.
 - g. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods required by cited standards, as well as manufacturer's recommendations and industry accepted best practices.
 - h. Contractor shall use low to moderate force when pulling cable. Maximum tensile load may not exceed 25 lbs. maximum pulling force per 4-pair cable.
 - i. Bundles of cable shall be pulled using pulling socks to distribute the tensile force over all cables in the bundle.
 - j. Contractor shall take care not to knot, snag or otherwise deform the cable while pulling. The jacket on installed cable shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections. Damaged or deformed cable shall be removed and replaced at no cost to Cherokee Nation.
 - k. Bend radius on 4-pair cable shall never be below 4 times the cable outer diameter, or manufacturer's requirements, whichever is most stringent.
 - l. Cables shall not be attached to lighting support wires nor touch the drop-ceiling assembly. Any portion of the communications cabling making contact with ceiling structures shall be remedied at Contractor expense.
 - m. Cables shall be kept as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as practical and in shall in no cases pass closer than recommended in cited TIA standards.



- n. When using miniature horizontal cable or small diameter patch cables, the channel length shall be derated per manufacturer's recommendations.
- o. Contractor shall take care to never deform the cable by over cinching with cable ties. All cable ties shall be cinched firmly, but not so firmly that the tie cannot be rotated or moved on the bundle by hand.
- p. Cable bundles in telecom spaces (rooms) shall be dressed using only hook and loop style cable ties. Plastic ties shall not be used in Cherokee Nation telecom rooms and shall be removed and replaced with hook and loop ties at Contractor expense.
- q. Cable ties shall not be used.
- r. All horizontal cabling installed shall include a cable slack loop of not less than 12 inches at the Equipment Outlet and not less than 36 inches in the horizontal telecom room.
- s. Equipment outlet cable slack shall be stored in the box behind the faceplate if there is room to do so without violating the bend radius of the cable according to manufacturer's recommendations.
- t. Contractor may affix 12-inch slack loop above ceiling using hook and loop cable ties if allowed in the project specific documentation or otherwise in writing from Cherokee Nation (See Appendix C). Cable loops touching the drop ceiling shall not be accepted.
- u. Service loops in the telecommunications room may be wall mounted or contained in pathways or racking systems if done according to manufacturer and industry best practices.
- v. All terminations on new (Greenfield) Cherokee Nation projects shall be terminated using the T568B pin-out (wire map).
- w. All terminations in existing Cherokee Nation facilities (Brownfield), shall match the pin-out and Category of the legacy cable plant, unless otherwise specified in the project documentation.
- x. Contractor shall terminate twisted pairs so that the last twist is never more than ½ inch from the point of termination (insulation displacement clip). Maintaining the last twist closer than ½ inch is preferred.
- y. Contractor shall maintain the cable jacket as close as possible to the connecting hardware. Twisted pair conductors deemed by Cherokee Nation to be unnecessarily exposed shall be re-terminated at Contractor's expense.
- z. Contractor shall be responsible for using plenum cable, ties and appliances in any air-return (plenum) spaces as required by applicable codes, standards, and the local AHJ (Authority Having Jurisdiction).

3. Copper Horizontal Cable

- a. Copper cable shall have the following attributes:
 - All horizontal cable except where noted shall be Panduit® TX6A™ 10Gig™ UTP Copper Cabling Systems with Vari-MaTriX Technology.
 - Network / Data = Blue
 - Security = White
 - TV = White
 - Paging = Orange



- All wireless application cables shall be Panduit TX6A 10Gig U/FTP Copper Cable.

- Wireless / WAPs = Blue

4. Equipment Outlet Copper Connectors (Jacks)

- a. Copper Connectors shall have the following attributes:

- Copper RJ45 jacks except where noted shall be Panduit Mini-Com® TX6A™ 10Gig UTP Jack Modules.
 - Network / Data = Blue
 - Security = Yellow
 - TV = White
- Copper RJ45 plugs shall be Panduit TX6A™ Category 6A UTP Field Term RJ45 Plugs.
- Copper RJ45 jacks used in wireless applications shall be Panduit Mini-Com® TX6A™ 10Gig Shielded Jack Modules.
 - Wireless / WAPs = Green
- Copper RJ45 plugs used in wireless applications shall be Panduit TX6A™ Category 6A STP Field Term RJ45 Plugs.

5. Equipment Outlet Appliances – Faceplates

- a. Faceplates shall have the following attributes:

- Faceplates shall be Panduit faceplates that accept 2, 4, or 6 Mini-Com modules and include a label and label cover.
- All empty ports shall be populated with Mini-Com blanks.

6. Equipment Outlet Appliances – Surface Mount Boxes

- a. Surface Mount Boxes shall have the following attributes:

- Surface Mount Boxes shall be Panduit surface mount boxes that accept 2, 4, or 6 Mini-Com modules and include a label and label cover.
- All empty ports shall be populated with Mini-Com blanks.

7. Copper Horizontal Patch Panels (Distributor A)

- a. Patch panels shall have the following attributes:

- All patch panels shall be Panduit Mini-Com® Modular Patch Panels
- Patch Panels may be flat or angled based on the application.

8. Copper Patch Cords – Work Area



- a. Copper patch cords shall have the following attributes:
 - All patch cords except where noted shall be Panduit TX6A™ Category 6A UTP Patch Cords.
 - All patch cord colors shall follow the color code listed below:
 - Network / Data = Blue
 - Security = Yellow
 - TV = White
 - Paging = Orange
 - All patch cords in wireless applications shall be Panduit TX6A™ Category 6A Shielded Patch Cords.
 - Wireless / WAPs = Green

9. Copper Patch Cords – Telecom Room

- a. Copper patch cords shall have the following attributes:
 - All patch cords shall be Panduit TX6A-28™ Category 6A Performance 28 AWG UTP Patch Cords.
 - All patch cord colors shall follow the color code listed below:
 - Network / Data = Blue
 - Security = Yellow
 - TV = White
 - Paging = Orange
 - All patch cords in wireless applications shall be Panduit TX6A-28™ Category 6A Performance 28 AWG Shielded Patch Cords.
 - Wireless / WAPs = Green

10. Zone Cabling

- a. Wireless Access Points shall have the following attributes:
 - Copper RJ45 jacks shall be Panduit Mini-Com® TX6A™ 10Gig Shielded Jack Modules.
 - Copper RJ45 plugs shall be Panduit TX6A™ Category 6A Shielded Field Term RJ45 Plugs.
- b. Security Cameras shall have the following attributes:
 - Copper RJ45 jacks shall be Panduit Mini-Com® TX6A™ 10Gig UTP Jack Modules with MaTriX Technology.
 - Copper RJ45 plugs shall be Panduit TX6A™ Category 6A UTP Field Term RJ45 Plugs.

11. Special Applications

- a. Field Term Plugs shall have the following attributes:



- Copper RJ45 plugs shall be Panduit TX6A™ Category 6A UTP Field Term RJ45 Plugs.
- Copper RJ45 plugs shall be Panduit TX6A™ Category 6A STP Field Term RJ45 Plugs.

12. Other Work Area Connectors

- Other work area connectors shall have the following attributes:
 - Copper RJ45 jacks shall be Panduit Mini-Com® TX6A™ 10Gig UTP Jack Modules with MaTriX Technology.
 - Copper RJ45 plugs shall be Panduit TX6A™ Category 6A UTP Field Term RJ45 Plugs.

B. Cabling Subsystem 2 – Intrabuilding (Within Building) Fiber

- See Appendix A for Part Numbers
- Installation Guidelines (Applies to all Fiber Trunks)
 - Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.
 - Fiber optic cabling system additions and upgrades to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same channel unless specifically instructed to do so within the project specific documentation.
 - When installing fiber cable, Contractor shall maintain a minimum bend radius of 20 times the outer diameter of the cable when it is under load (being pulled).
 - Fiber service loops shall be stored to maintain a minimum bend radius of 10 times the outer diameter of the cable.
 - Optical fiber shall only be pulled using its internal strength member in conjunction with a properly rated multi-weave mesh grip and swivel pulling eye.
 - All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered, fan-out or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.
 - Direct connection of terminated fiber backbone links to equipment is not allowed. All fiber connections shall go through a fiber enclosure interconnect and connect to active equipment via fiber jumpers.
 - Contractor shall perform fiber testing of all strands according to guidelines in the "Testing and Acceptance" section of this document.
 - Service loop (slack) in telecommunications rooms shall be at least 3 meters. Consult project documentation for length of service loops and storage method within a specific telecom room or space.
 - Slack shall be stored per manufacturer instructions inside the enclosure or stored outside the enclosure using appliances built for that purpose. Consult project documentation for details on storage of service loops.



- k. Fiber pulls using multiple pull points shall use the “figure-8” technique any time excess cabling is piled on the floor as slack to supply the next pull-point.
- l. Cable shall be rolled off the spinning cable reel, not pulled off the end.
- m. During all fiber cable pulls Contractor shall have one person at each end of the pull to ensure proper cable pay out and pile up without damage to the fiber.
- n. Fiber backbone cables shall be installed separately from horizontal distribution cables. Under no circumstances may copper and fiber cables be pulled in common bundles.
- o. In pathways containing both fiber and copper cables, the fiber cable must either be of armored construction, or segregated in innerduct.
- p. Where cables are housed in sleeves or conduits, the backbone and horizontal cables shall be installed in separate conduits or the fiber segregated in separate innerduct within the conduits.
- q. Fiber shall be segregated within racks and patching systems unless instructed otherwise in the project documentation.
- r. Where possible fiber enclosures shall be mounted at the top of equipment racks and the fiber cable kept separate from copper cable.
- s. Contractor shall inspect fiber end faces with a fiber scope and clean the connectors (if needed) whenever plugging in a fiber connector.

3. Fiber Between Telecom Rooms on the Same Floor

- a. Backbone fiber cable between telecoms rooms on the same floor within building shall have the following attributes:
 - All backbone fiber shall be Panduit Opti-Core® OM4 50um Multimode Fiber Optic Distribution Cable unless length exceeds maximum reach for OM4 fiber; then substitute with Panduit OS2 9um Singlemode Fiber Optic Cable.
 - Backbone fiber may be of varying fiber counts, flame rating and cable construction based on application and location.

4. Fiber Between Telecom Rooms on Different Floors

- a. Backbone fiber cable between telecoms rooms on different floors within building shall have the following attributes:
 - All backbone fiber shall be Panduit Opti-Core® OM4 50um Multimode Fiber Optic Distribution Cable or Panduit OS2 9um Singlemode Fiber Optic Cable.
 - Backbone fiber may be of varying fiber counts, flame rating and cable construction based on application and location.

5. Intrabuilding Fiber Cable (Optical Multimode)



- a. Intrabuilding fiber cable between telecoms rooms on different floors within building shall have the following attributes:
 - All Intrabuilding shall be Panduit Opti-Core® OM4 50um Fiber Optic Distribution Cable.
 - Intrabuilding fiber may be of varying fiber counts, flame rating and cable construction based on application and location.

6. Fiber Connectors

- a. Intrabuilding fiber connectors shall have the following attributes:
 - All multimode fiber connectors shall be pre-polished LC OptiCam® OM3/OM4 50/125µm MM simplex connectors, aqua color.
 - All singlemode fiber connectors shall be pre-polished LC OptiCam® OS2 9µm SM simplex connectors, blue color.

7. Fiber Enclosures (Distributor B)

- a. Intrabuilding fiber enclosures shall have the following attributes:
 - All fiber enclosure shall be Panduit Opticom® Rack Mount FCE Series of Fiber Enclosures.
 - The specific size of enclosure shall be determined by the number of fiber adapters panels (FAP) needed. The FCE Series supports up to 4, 8, or 12 FAPs in enclosures that are 1, 2, or 4 rack units.
- b. Fiber Adapter Panels shall have the following attributes:
 - All fiber adapter panels shall be Panduit® Opticom® Fiber Adapter Panels. The fiber type and port density can vary based on the number of fibers needed.
- c. Fiber Splice Trays and Tray Holders shall have the following attributes:
 - If fiber splices are used, then Panduit Opticom® fiber splice trays and holders shall be used as per specific Panduit Fiber Enclosure.

8. Fiber Patch Cords (jumpers)

- a. Fiber patch cords (jumpers) for intrabuilding fiber shall have the following attributes:
 - All fiber patch cords (jumpers) shall be Panduit OM4, LC push pull to LC push pull patch cords, 16mm jacket, and riser (OFNR) rated. Length may vary based on application.

9. Fiber Pig Tails

- a. Fiber pig tails used in intrabuilding fiber shall have the following attributes:
 - All fiber pigtails shall be Panduit OM4, 900m buffered, LC to pigtail, Aqua color or Panduit OS2, 900m buffered, LC to pigtail, Blue color.



C. Cabling Subsystem 3 – Interbuilding (Between Buildings) Fiber

1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.
 - b. Fiber optic cabling system additions and upgrades to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same channel unless specifically instructed to do so within the project specific documentation.
 - c. When installing fiber cable, Contractor shall maintain a minimum bend radius of 20 times the outer diameter of the cable when it is under load (being pulled).
 - d. Fiber service loops shall be stored to maintain a minimum bend radius of 10 times the outer diameter of the cable.
 - e. Optical fiber shall only be pulled using its internal strength member in conjunction with a properly rated multi-weave mesh grip and swivel pulling eye.
 - f. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered, fan-out or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.
 - g. Direct connection of terminated fiber backbone links to equipment is not allowed. All fiber connections shall go through a fiber enclosure interconnect and connect to active equipment via fiber jumpers.
 - h. Contractor shall perform fiber testing of all strands according to guidelines in the "Testing and Acceptance" section of this document.
 - i. Service loop (slack) in telecommunications rooms shall be at least 3 meters. Consult project documentation for length of service loops and storage method within a specific telecom room or space.
 - j. Slack shall be stored per manufacturer instructions inside the enclosure or stored outside the enclosure using appliances built for that purpose. Consult project documentation for details on storage of service loops.
 - k. Fiber pulls using multiple pull points shall use the "figure-8" technique any time excess cabling is piled on the floor as slack to supply the next pull-point.
 - l. Cable shall be rolled off the spinning cable reel, not pulled off of the end.
 - m. During all fiber cable pulls Contractor shall have one person at each end of the pull to ensure proper cable pay out and pile up without damage to the fiber.
 - n. Fiber backbone cables shall be installed separately from horizontal distribution cables. Under no circumstances may copper and fiber cables be pulled in common bundles.
 - o. In pathways containing both fiber and copper cables, the fiber cable must either be of armored construction, or segregated in innerduct.



- p. Where cables are housed in sleeves or conduits, the backbone and horizontal cables shall be installed in separate conduits or the fiber segregated in separate innerduct within the conduits.
- q. Fiber shall be segregated within racks and patching systems unless instructed otherwise in the project documentation.
- r. Where possible fiber enclosures shall be mounted at the top of equipment racks and the fiber cable kept separate from copper cable.
- s. Contractor shall inspect fiber end faces with a fiber scope and clean the connectors (if needed) whenever plugging in a fiber connector.

3. Fiber Cable Between Buildings

- a. Backbone fiber cable between buildings shall have the following attributes:
 - All backbone fiber shall be Panduit Opti-Core® OM4 50um Multimode Fiber Optic Distribution Cable or Panduit OS2 9um Singlemode Fiber Optic Cable.
 - Backbone fiber may be of varying fiber counts, flame rating and cable construction based on application and location.

4. Fiber Connectors

- a. Fiber connections between buildings shall have the following attributes:
 - All multimode fiber connectors shall be pre-polished LC OptiCam® OM3/OM4 50/125µm MM simplex connectors, aqua color.
 - All singlemode fiber connectors shall be pre-polished LC OptiCam® OS2 9µm SM simplex connectors, blue color.

5. Fiber Enclosures (Distributor C)

- a. Fiber enclosures for fiber links between buildings shall have the following attributes:
 - All fiber enclosure shall be Panduit Opticom® Rack Mount FCE Series of Fiber Enclosures.
 - The specific size of enclosure shall be determined by the number of fiber adapters panels (FAP) needed. The FCE Series supports up to 4, 8, or 12 FAPs in enclosures that are 1, 2, or 4 rack units.

6. Fiber Adapter Panels

- a. Fiber adapter panels to populate enclosures on fiber links between buildings shall have the following attributes:
 - All fiber adapter panels shall be Panduit® Opticom® Fiber Adapter Panels. The fiber type and port density can vary based on the number of fibers needed.

7. Fiber Splice Trays and Tray Holders



- a. Fiber splice trays and tray holders used in enclosures for fiber links between buildings shall have the following attributes:
 - If fiber splices are used, then Panduit Opticom® fiber splice trays and holders shall be used as per specific Panduit Fiber Enclosure.
8. Fiber Patch Cords (jumpers)
 - a. Fiber patch cords (jumpers) for patching fiber links between buildings shall have the following attributes:

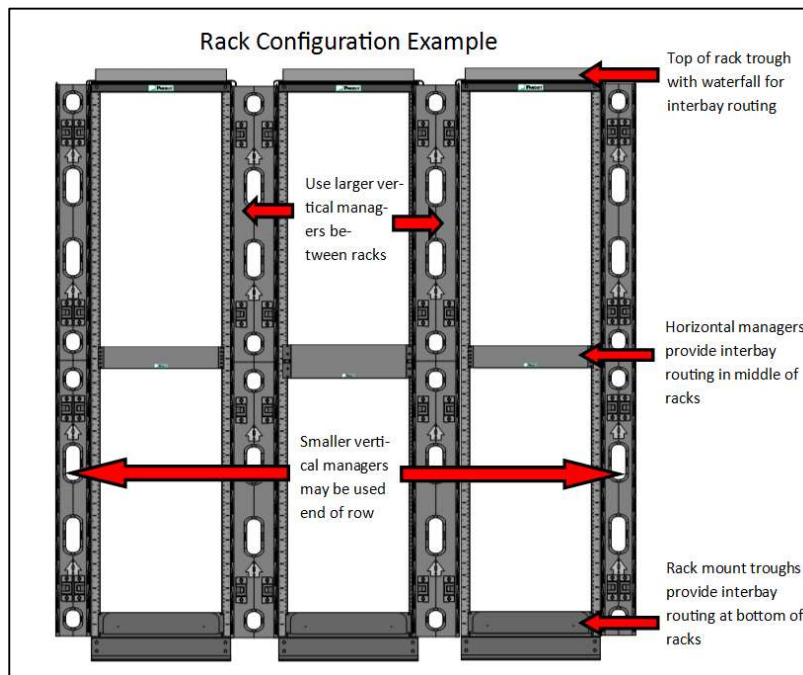
All fiber patch cords (jumpers) shall be Panduit OM4, LC push pull to LC push pull patch cords, 16mm jacket, and riser (OFNR) rated. Length may vary based on application.
9. Fiber Pig Tails
 - a. Fiber pig tails used for splicing fiber links between buildings shall have the following attributes:
 - All fiber pigtails shall be Panduit OM4, 900m buffered, LC to pigtail, Aqua color or Panduit OS2, 900m buffered, LC to pigtail, Blue color.

D. Racks, Cabinets, and Cable Management

1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Racks shall be securely attached to the concrete floor using appropriate mounting hardware.
 - b. All racks shall be grounded to the telecommunications ground bus bar in accordance with cited standards the bonding and grounding section of this document.
 - c. Rack mount screws (#12-24) not used for installing fiber panels and other hardware shall be bagged and left with the rack upon completion of the installation
 - d. In telecommunications rooms with multi-bay rack rows, Contractor is responsible to include in design interbay routing pathways at the top, middle, and bottom of each rack to provide efficient and neat patch routing between any two points within rack rows.



- e. See the 2-post rack configuration example below for general guidelines for pathways between ganged racks:



- f. For bottom-of-rack interbay routing where cable quantities exceed capacity of interbay troughs, Contractor should substitute 4RU troughs.
- g. All racks shall be outfitted with a vertical grounding busbar along one rail, with all equipment bonded to ground according to the Bonding and Grounding Standards cited in this document. See Bonding and Grounding section of this document for details.
- h. Cabinets should be positioned to create aisle widths able to accommodate the movement and installation of the largest equipment anticipated.
- i. Minimum aisle width is 3 feet clearance in the front of the cabinet and not less than 2 feet of clearance in the rear. Consult project documentation for clearance requirements on a specific job.
- j. Cabinets shall be secured to the building structures according to the manufacturer's instructions and in compliance with applicable codes, standards, and the requirements of the local AHJ. Please also refer to project-specific documentation as appropriate.
- k. Racks and cabinets shall be individually electrically bonded to the communications earthing system according to the manufacturer's instructions and in compliance all applicable standards, codes and the requirements of the local AHJ.
- l. All cabinets shall be clearly identified at both the top and bottom of the in both the front and back of each cabinet with a large label (not less than 1" in height). Labels must be visible with the cabinet doors open or closed.



- m. Empty horizontal spaces in cabinets in equipment rooms may be blanked with panels or blanking shades to facilitate hot/cold aisle cooling strategies. Consult project documentation for blanking requirements.
 - n. Cable entrances in tops of cabinets shall be sealed using preinstalled brushes or using the appropriate sized Panduit cool boot seals.
3. Two-Post Communications Racks
 - a. Two-post communications racks shall have the following properties:
 - All two-post communication racks shall be Panduit Two-post Racks.
4. Four-Post Communication Racks
 - a. Four-post communications racks shall have the following properties:
 - All four-post communication racks shall be Panduit Adjustable Four-post Racks.
5. Rack-mounted Cable Management – Vertical Managers
 - a. Contractor shall size vertical cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.
 - b. Contractor shall use larger vertical cable managers between racks as described elsewhere in this section.
 - c. Rack-mounted cable management – vertical managers shall have the following properties:
 - Vertical cable managers shall be Panduit PatchRunner® 2 Vertical Cable Managers.
6. Rack-mounted Cable Management – Horizontal Managers
 - a. Contractor shall size horizontal cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.
 - b. Rack-mounted cable management – horizontal managers shall have the following properties:
 - Rack-mount cable management shall be Panduit® NetManager® High Capacity Horizontal Cable Managers.
7. Switch Cabinets
 - a. Switch cabinets shall have the following attributes:
 - Switch cabinets shall be Panduit Net-Access™ N-Type Cabinets.
8. Server Cabinets
 - a. Server cabinets shall have the following attributes:



- Server cabinets shall be Panduit Net-Access™ S-Type Cabinets.

E. Communications Grounding Network

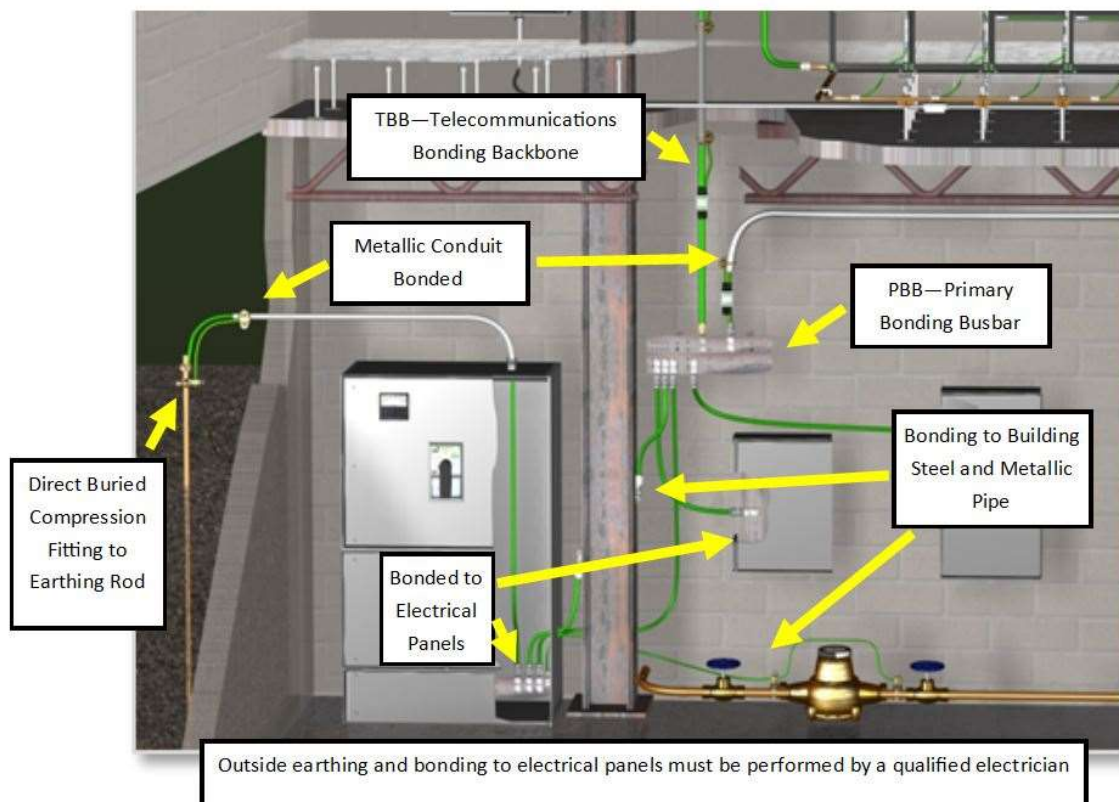
1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA Standards.
 - b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the entrance facility or distributor (telecom) rooms shall be grounded to the respective PBB (Primary Bonding Busbar otherwise known as TMGB – Telecommunications Main Grounding Busbar) or SBB (Secondary Bonding Busbar otherwise known as TGB – Telecommunication Grounding Busbar) using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
 - c. Metallic panels attached to the rack or cabinet shall be bonded to the rack or cabinet using a green thread forming screw.
 - d. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack-mount equipment.
 - e. All jacketed wires used for telecommunications grounding purposes should be identified with green or green with yellow stripe insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape.
 - f. All cables and busbars shall be identified and labeled in accordance with the labeling standards cited in the Regulatory References section of this specification.
 - g. The TBB (Telecommunications Bonding Backbone) shall adhere to the recommendations of the ANSI/TIA grounding and bonding standards cited in the Regulatory References section of this document and shall be installed in accordance with cited standards and best industry practices.
 - h. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.
3. Room Busbars
 - a. All Telecommunications spaces and distributor rooms shall have installed an appropriately sized wall-mount busbar with BICSI hole spacing that bonds to the building bonding backbone.
 - b. Telecommunications spaces and distributor room busbars shall have the following properties:
 - Busbars and connecting hardware shall be a Panduit Grounding and Bonding Solution.
4. Bonding to the Service Equipment (Power) Ground



- a. The bonding conductor for telecommunications shall bond the PBB (Primary Bonding Busbar) to the service equipment (power) ground and building steel.
- b. Bonding conductors for telecommunications shall have the following properties:
 - Bonding jumpers and connecting hardware shall be a Panduit Grounding and Bonding Solution.

5. Entrance Room

- a. The following figure illustrates the grounding in an Entrance Room.



- b. Entrance room bonding shall have the following properties:
 - TBB, PBB and connecting hardware shall be a Panduit Grounding and Bonding Solution.

6. Distributor (Telecommunications) Rooms

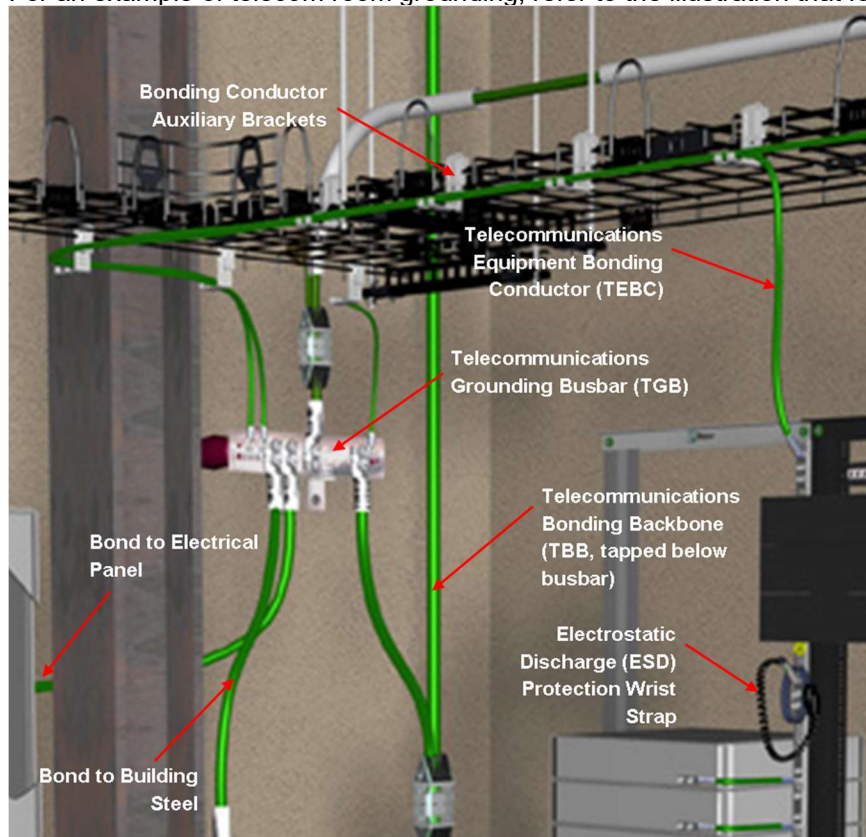
- a. Within the telecommunications rooms and data centers all pathways and racks shall be grounded and bonded as indicated in the diagram below.
- b. Contractor is responsible for properly grounding all network equipment, racks and cabinets and bonding them to the wall mounted busbars as described in the TIA 607 series of standards.



- c. All newly installed racks and cabinets shall have installed a Panduit vertical strip mounted along one equipment rail to serve as a clean, low-resistance bonding place for equipment grounding jumpers used to bond equipment such as chassis switches, that come equipped with a designated grounding pad, back to the rack.
- d. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.
- e. Larger equipment (chassis switches) with a designated grounding terminal shall be bonded to the vertical busbar with an EBC (equipment bonding conductor) kit built to that purpose.
- f. Contractor shall take care to clean (wire brush, Scotch Brite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.
- g. All bonding lugs on racks and busbars shall be of two-hole irreversible compression type. Mechanical lugs and single-hole lugs will not be accepted and shall be removed and replaced at Contractor's expense.
- h. Every rack or cabinet shall have an individual bonding conductor into the grounding network, serially connecting (daisy-chaining) of racks is expressly forbidden and will not be accepted.
- i. Rack Bonding Conductors (RBC) may tap into an overhead or underfloor aisle ground, or may run to the wall-mounted grounding busbar in smaller Telecommunications rooms containing 5 racks or less.
- j. A minimum of every other rack or cabinet shall be outfitted with a properly installed and bonded ESD (electro-static discharge) port along with a wrist strap and lead to be used by any technicians servicing network equipment. On four post racks and cabinets these ESC ports and straps shall be provided on front and back to be accessible and able to reach any active equipment needing servicing.
- k. Armored cables shall be properly bonded to the earthing system on both ends with a kit built to that purpose.



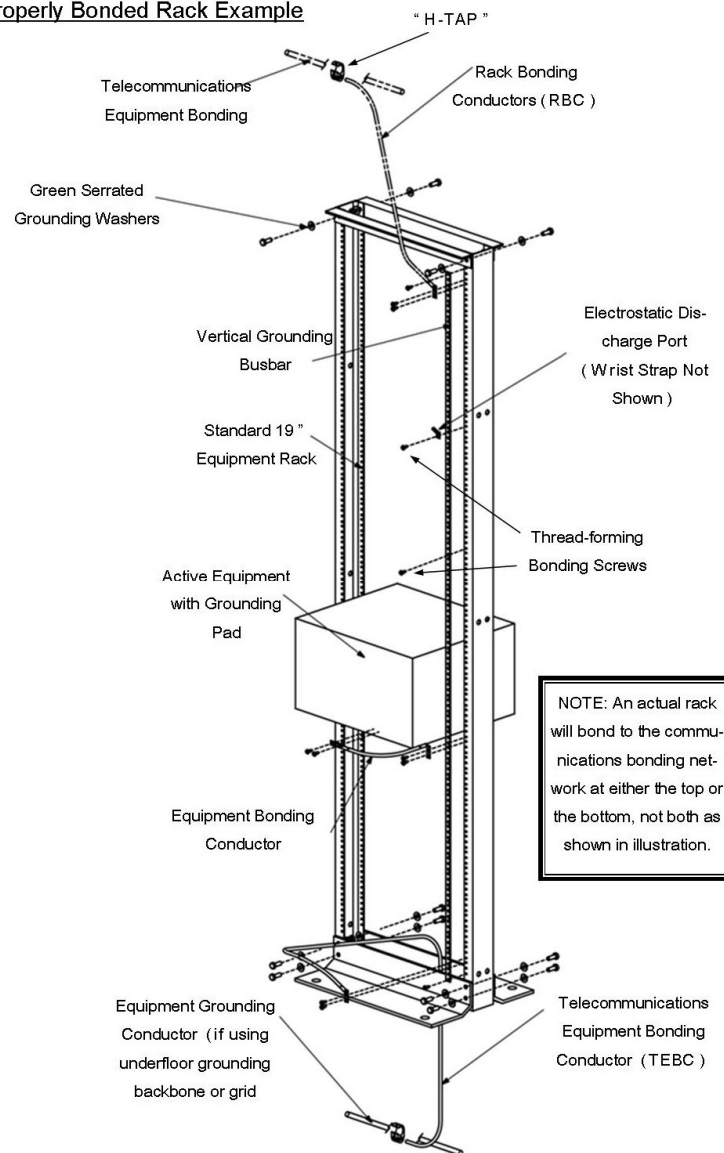
- I. For an example of telecom room grounding, refer to the illustration that follows:





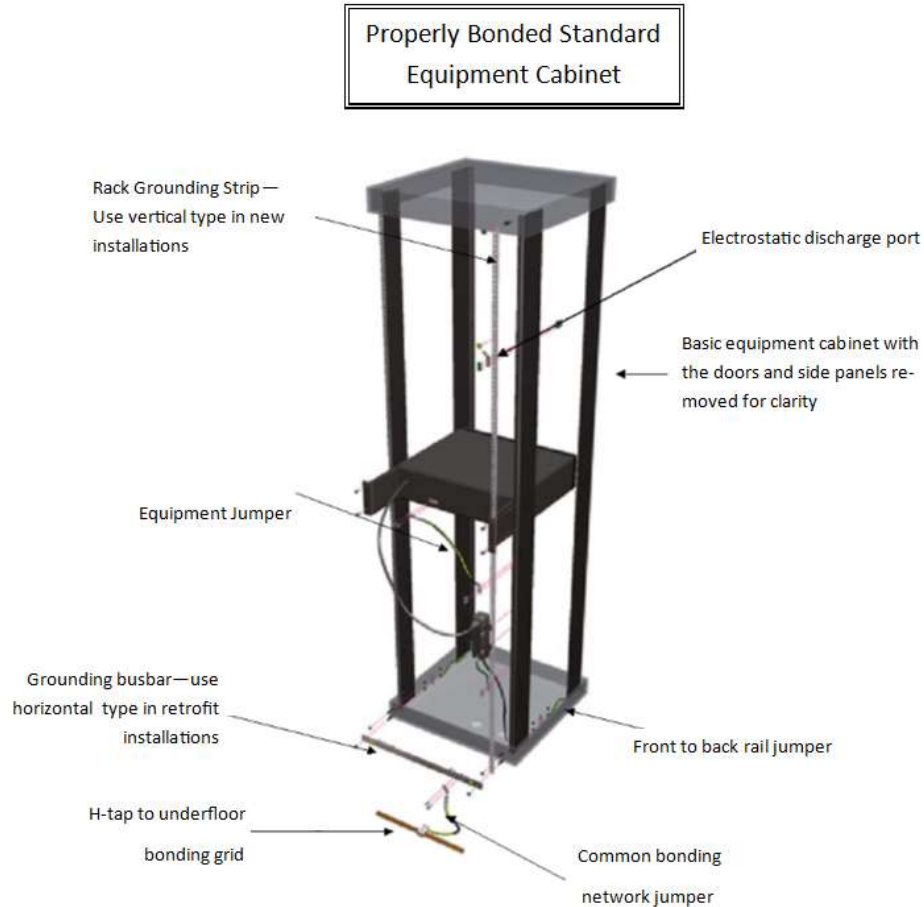
- m. For an example of proper rack grounding, see the illustration below:

Properly Bonded Rack Example





- n. For an example of proper cabinet grounding, see the illustration below:



7. Backbone Bonding Conductor (General Cable)

- a. Backbone bonding conductors (General Cable) for telecommunications shall have the following properties:
- Backbone bonding conductors and connecting hardware shall be a Panduit Grounding and Bonding Solution.

8. Rack/Cabinet Grounding Hardware – RBC (Rack Bonding Conductor)

- a. Rack bonding conductors for telecommunications shall have the following properties:
- Rack and Cabinet bonding components and connecting hardware shall be a Panduit Grounding and Bonding Solution.

9. Rack/Cabinet Grounding Hardware – Clear Covers for H-taps (Optional)

- a. Rack bonding clear covers for H-taps shall have the following properties:



- Rack and Cabinet grounding hardware shall use Panduit clear H-taps and all connecting hardware shall be a Panduit Grounding and Bonding Solution.

10. Rack/Cabinet Grounding Hardware – Electrostatic Discharge Kit

- a. Rack electrostatic discharge kits shall have the following properties:
 - Racks and cabinets shall use a Panduit Electrostatic Discharge kit

11. Rack/Cabinet Grounding Hardware – ESD Wrist Strap for ESD Kit

- a. ESD wrist strap for ESD kit shall have the following properties:
 - Wrist strap shall be a Panduit ESD wrist strap.

12. Rack/Cabinet Grounding Hardware – Green Bonding Screws

- a. Green bonding screws shall have the following properties:
 - Bonding screws shall be Panduit green bonding screws.

13. Rack/Cabinet Grounding Hardware – Green Bonding Cage Nuts

- a. Green bonding cage nuts shall have the following properties:
 - In cage nut applications all cage nuts need to be Panduit green bonding cage nuts.

14. Rack/Cabinet Grounding Hardware – Thread Forming Screws

- a. Thread forming screws shall have the following properties:
 - Thread forming screws shall be Panduit thread forming screws.

15. Rack/Cabinet Grounding Hardware – Paint Piercing Grounding Washer Kit

- a. Paint piercing grounding washer kit shall have the following properties:
 - Grounding washers shall be Panduit paint piercing grounding washers.

16. Grounding Busbars – Primary Bonding Busbar (PBB)

- a. Primary bonding busbar shall have the following properties:
 - PBB shall be a Panduit Primary Bonding Busbar.

17. Grounding Busbars – Secondary Bonding Busbar (SBB)

- a. Secondary bonding busbar shall have the following properties:
 - SBB shall be a Panduit Secondary Bonding Busbar.



18. Grounding Busbars – Rack Bonding Busbar (RBB)

- a. Rack bonding busbar shall have the following properties:
 - RBB shall be a Panduit Rack Bonding Busbar.

19. Grounding Busbars – Rack Bonding Busbar (RBB) for 19" Horizontal (Retrofit)

- a. Rack bonding busbar for 19" horizontal (retrofits) shall have the following properties:
 - Horizontal RBB shall be a Panduit 19" Horizontal Rack Bonding Busbar.

20. Grounding Busbars – Rack Bonding Busbar (RBB) – Vertical Busbar Strip (Threaded Rails)

- a. Rack bonding busbar for vertical busbar strip (threaded rails) shall have the following properties:
 - Vertical busbar shall be a Panduit busbar strip for threaded rails.

21. Grounding Busbars – Rack Bonding Busbar (RBB) – Vertical Busbar Strip (Cage Nut Rails)

- a. Rack bonding busbar for vertical busbar strip (cage nut rails) shall have the following properties:
 - Vertical busbar shall be a Panduit busbar strip for cage nut rails.

22. Other Bonding Hardware – Access Floor Grounding Clamps

- a. Access floor grounding clamps shall have the following properties:
 - Access floor shall be bonded with Panduit Access Floor grounding clamps and hardware.

23. Other Bonding Hardware – Armored Fiber Grounding Kit

- a. Armored fiber grounding kit shall have the following properties:
 - Armored fiber shall be properly bonded with a Panduit armored fiber ground kit.

24. Other Bonding Hardware – Enclosure Grounding Kit

- a. Enclosure grounding kit shall have the following properties:
 - All enclosures shall be properly grounded/bonded with a Panduit ground kit designed for the specific enclosure.
 - If no specific ground kit is available for the enclosure, then enclosure needs to be grounded/bonded with Panduit grounding hardware and components wherever possible.

F. Cable Pathways

1. See Appendix A for Part Numbers



2. Installation Guidelines

- a. Installation of cable pathways shall be compliant with most recent versions of all applicable standards, national and local codes, as well as the local Authority Having Jurisdiction (AHJ).
- b. Anywhere there is a conflict between standards, codes, installation specifications or project specific documentation contractor shall default to the most stringent.
- c. If further clarification is needed, contractor shall submit a written request for clarification to Cherokee Nation. Response from Cherokee Nation shall be in writing.

3. Cable Pathway

- a. Metallic pathway shall be per application as follows:
 - All metallic basket pathway shall be Cablofil Basket Tray except in the Equipment Room or Telecommunication Room (MDF/IDF).
 - Equipment Room or Telecommunication Room (MDF/IDF) shall use metallic ladder rack pathway shall be Chatsworth Universal Cable Runway.

4. FiberRunner

- a. Plastic Fiber Duct shall have the following attributes:
 - All fiber cable routing duct shall be Panduit Fiber Runner and accessories.

5. J-Hooks

- a. J-Hook system shall have the following attributes:
 - All J-Hook systems shall be components from Panduit J-Pro Cable Support System

6. J-Pro

- a. J-Pro system shall have the following attributes:
 - All J-Hook systems shall be components from Panduit J-Pro Cable Support System

7. Above Floor Raceway

- a. Above floor raceway shall have the following attributes:
 - All above floor raceway shall be Panduit raceway and accessories.
 - All above floor raceway shall be ADA compliant.

8. Surface Mount Raceway

- a. Surface mount raceway shall have the following attributes:



- All surface raceway shall be Panduit raceway and accessories.

G. Network Infrastructure Labeling

1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Questions or comments regarding labeling strategies at Cherokee Nation may be sent to Cherokee Nation Representative at Cherokee Nation.
 - b. All newly installed cable and associated apparatus shall be labeled according to the guidelines in ANSI/TIA 606-C or the most recent version of the standard.
 - c. All newly installed cables shall be labeled within 3 inches at both ends using permanent self-laminating cable labels built to that purpose and designed to outlast the cable to which they attach.
 - d. The end of each cable shall have the same label.
 - e. Labels shall be legible and placed in a position that insures ease of visibility.
 - f. Contractor shall, wherever possible, pre-print labels using Panduit Easy-Mark software and desktop printer.
 - g. The Panduit PanTher (LS8E) hand-held thermal transfer printer shall be used onsite to print labels that were unanticipated, or that become damaged in application.
 - h. Contractor is responsible for ordering the correct self-laminating cable labels appropriate to the cable outer diameter.
 - i. The same identifier shall be contained in one line and repeated to be visible from all sides without having to rotate the cable to read it.
 - j. All labels shall be machine printed, bold font and centered at the highest point that can fit all characters legibly. Hand written labels will not be accepted and shall be remedied at Contractor's expense.
 - k. This labeling strategy shall, at a minimum, clearly identify all components of the system: racks, cables, panels and outlets, grounding, pathways and spaces like telecommunications rooms per the requirements in the cited standards.
 - l. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure.
 - m. All test documents shall accurately reflect the labeling scheme.
 - n. Outlet, patch panel, and wiring block labels shall be installed on, or in, the space provided on the device.
 - o. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.
 - p. All labels will be permanently affixed to installed cables, patch panels, racks, cabinets, and enclosures.



- q. Conduit shall be marked indicating the identification of the cable within.
- r. Consult project specific documentation for the labeling scheme for a particular project.

3. Communication and Systems Elements Requiring Labeling

a. The following communications elements shall be labeled:

- Equipment outlets – faceplates
- Equipment outlets – surface boxes
- Copper horizontal cable
- Copper patch panels
- Communications patch cords
- Zone boxes (MUTOAs or consolidation points)
- Equipment racks
- Communications cabinets
- Telecommunications rooms – (closets)
- Fiber backbone cable
- Fiber enclosures
- Fiber optic patch cords (jumpers)

4. Other Systems Requiring Labeling

a. The following systems shall be labeled:

- Communications conduit and pathways
- Firestopping locations
- Grounding busbars
- Grounding backbone

5. Labeling Records

- a. Contractor shall provide a spreadsheet showing link records that list all labeled elements, including jack numbers, patch ports and telecom space identifiers.
- b. All labeling information shall be recorded on the as-built drawings, and cross-reference sheets as described in project documentation.

H. Cabling Accessories



1. Refer to Appendix A for Part Numbers
2. Hook and Loop Ties for cable bundling.
 - a. Hook and loop ties shall have the following attributes:
 - All cable bundling shall use Panduit Tak-Ty® hook & loop cable ties or Panduit Tak-Tape® hook & loop cable ties.
3. Physical Security Devices
 - a. Some portions of Cherokee Nation networks require additional physical security devices. These take three forms:
 - Devices that block-out copper and fiber ports in patch fields and faceplates that require a special tool for removal.
 - Devices that lock-in copper patch cords and require a special tool for removal of those patch cords.
 - Devices that temporarily or permanently block USB ports on laptops and computers.
 - b. Areas where such devices are required will be called out in the project documentation.

<END OF SECTION>



III. Testing and Acceptance

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.
2. All copper pairs or optical fibers of each installed cable shall be tested and verified prior to system acceptance.
3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors or fibers in all cables installed.
4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the Panduit warranty guidelines, and industry best practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.
2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is more stringent.
3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime the tester unit shuts down due to inactivity.
4. Resetting references shall also be done whenever test results become sporadic or the tester demonstrates a consistent deterioration of test measurement performance.
5. Testing of any links that include field-terminated plugs shall follow the procedure outlined in Panduit document #PN614, available from the Panduit representative, or downloadable from www.panduit.com.

C. Fiber Testing

1. All installed fiber shall be tested for link-loss in accordance with ANSI/TIA standards cited in this document.
2. For horizontal cabling system using multimode optical fiber, attenuation should be measured in at least one direction, according to customer requirements, at either 850 nm (nanometer) or 1300 nm using an appropriate light source and power meter.
3. Fiber testing must be performed using reference grade test leads. Test results from tests using test leads that are not reference grade will not be accepted and must be retested at the Contractor's expense.



4. Backbone multimode fiber cabling should be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.
5. Test set-up and performance shall be conducted in accordance the Method B (One Jumper Method).
6. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. Only basic link loss testing (OLTS) is required, not OTDR testing. OTDR testing is optional as a secondary test method but, by itself, is not a valid means by which links or channels can be certified.
7. The contractor can optionally install Panduit patch cords to complete the circuit and then test the entire channel, though Panduit currently issues only a link warranty, not a channel warranty. The test method shall be the same used for the test described above.
8. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
9. Qualification of the reference cords shall be completed after each reference and the insertion loss of the reference connectors shall be saved and presented as part of the testing documentation.
10. Panduit highly recommends utilizing the practice of individual end face inspection, cleaning if necessary then re-inspection before connecting any fiber end faces together in a link. This complete process should be performed BEFORE any OLTS testing takes place. For further process clarification, refer to Panduit Visual Inspection and Cleaning Best Practices #FS061.
11. Contractor shall further inspect, clean and re-inspect the Reference Lead connector end faces anytime testing shows inconsistent results. If this does not correct accuracy, contractor shall re-certify (test) the reference leads and replace them if necessary.

D. System Documentation

1. Documentation During Installation Phases
 - a. Cherokee Nation will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information and returned to Cherokee Nation.
 - b. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.
 - c. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.



- d. It is mandatory that the test results from each phase be delivered in the tester native format. At the request of the Cherokee Nation project lead, the telecommunications contractor shall provide copies of the original test results.
 - e. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.
2. Documentation at Project Completion
 - a. A final, complete set of all documentation shall be provided in electronic format within three weeks after the completion of the project.
 - b. The testing results shall also be provided to Panduit in raw data format (native tester format), along with all associated warranty paperwork for evaluation and issuance of warranty.
 - c. All documentation shall be clearly marked with the words "Project Test Documentation" plus the project name, and the date of completion.
 - d. The test documentation shall detail the test methods used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
 - e. The test results shall further include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s).
 - f. The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document.
 3. Unless the manufacturer specifies a more frequent calibration cycle, an annual factory calibration is mandatory on all test equipment used for the installation.
 4. The project lead from Cherokee Nation may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above.
 5. If retest findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Project Lead, including a 100% re-test. This re-test shall be at no additional cost to Cherokee Nation.

E. Inspection and Acceptance

1. During Installation
 - a. The Cherokee Nation Project Lead will make periodic inspection of the project in progress.
 - b. One inspection will be performed at the conclusion of cable pulling, prior to closing of the drop ceiling, to inspect the method of cable routing and support, and the firestopping of penetrations.



- c. A second inspection will be performed at completion of cable termination to validate that cables were dressed and terminated in accordance with ANSI/TIA recommendations for jacket removal and pair untwist, compliance with Manufacturer's minimum bend radius, and that cable ends are dressed neatly and orderly.

2. Final Inspection

- a. Upon completion of the project, the Cherokee Nation Project Lead will perform a final inspection of the installed cabling system with the Contractor's project foreman.
- b. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the technical performance and aesthetic expectations of the Cherokee Nation.

3. Live System Performance Verification

- a. During the three-week period between final inspection and delivery of the test and as-built documentation, Cherokee Nation will activate and validate operation of the cabling system.

4. Final Acceptance

- a. Final acceptance is possible after completion of the installation, in-progress and final inspections, receipt of the test results, receipt of the as-built documentation, and receipt of the manufacturer's system performance warranty and successful performance of the system for a three-week period.
- b. Acceptance of the installed system by Cherokee Nation must be in writing to be valid

F. Post Installation Maintenance Agreement

1. The Contractor shall furnish an hourly rate with the proposal submittal which shall be valid for a period of one year from the date of acceptance.
2. This rate will be used when cabling support is required to do moves, adds, and changes (MACs) to the system.
3. MACs shall not void the Contractor's nor Manufacturer's warranty.

<END OF SECTION>



IV. Appendix A – Materials List

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
	PUP6AV04BU-G	Panduit	Vari-Matrix Cable, Cat 6A, Plenum, Blue color
	PUP6AV04WH-G	Panduit	Vari-Matrix Cable, Cat 6A, Plenum, White color
	PUP6AV04OR-G	Panduit	Vari-Matrix Cable, Cat 6A, Plenum, Orange color
	PUR6AV04BU-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Blue color
	PUR6AV04WH-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, White color
	PUR6AV04OR-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Orange color
	CJ6X88TGBU	Panduit	Cat 6A RJ45 jack, blue color
	CJ6X88TGOR	Panduit	Cat 6A RJ45 jack, orange color
	CJ6X88TGIW	Panduit	Cat 6A RJ45 jack, off white color
	CJ6X88TGYL	Panduit	Cat 6A RJ45 jack, yellow color
	CJ6X88TGBU-24	Panduit	Cat 6A RJ45 jack, blue color, 24 pack
	CJ6X88TGOR-24	Panduit	Cat 6A RJ45 jack, orange color, 24 pack
	CJ6X88TGIW-24	Panduit	Cat 6A RJ45 jack, off white color, 24 pack
	CJ6X88TGYL-24	Panduit	Cat 6A RJ45 jack, yellow color, 24 pack
	FP6X88MTG	Panduit	Cat 6A RJ45 plug, TG field terminable
	UTP6A7BU	Panduit	Cat 6A UTP patch cord, 7 ft, Blue color
	UTP28X10BU	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Blue color
	UTP6A7WH	Panduit	Cat 6A UTP patch cord, 7 ft, Off White color
	UTP28X10WH	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Off White
	UTP6A7YL	Panduit	Cat 6A UTP patch cord, 7 ft, Yellow color
	UTP6A20YL	Panduit	Cat 6A UTP patch cord, 20 ft, Yellow color
	UTP28X10YL	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Yellow
	UTP28X10OR	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Orange
Cat 6A Shielded	CSJ6X88TGGR	Panduit	STP Cat 6A RJ45 jack, Green color
	FPS6X88MTG	Panduit	STP Cat 6A RJ45 plug, TG field terminable
	PUFP6X04BU-UG	Panduit	Shielded U/FTP Cable, Cat 6A, Plenum, Blue color
	PUFR6X04BU-UG	Panduit	Shielded U/FTP Cable, Cat 6A, Riser, Blue color



Product Category	Part Number	Manufacturer	Part Description
	STP28X3MGR	Panduit	Cat 6A 28 AWG STP Patch Cord, 3 m, Green
	STP6X20GR	Panduit	Cat 6A STP Patch Cord, 20 ft, Green color
Outside Plant	PFO6X04BL-CEG	Panduit	Shielded F/UTP Cable, Cat 6A, OSP, Black color
	8136100	General	Shielded F/UTP Cable, Cat 6A, OSP, Black color
Multi-Pair Cables	2131505	General	25-pair Cable, Cat 3, Plenum
	2131757	General	50-pair Cable, Cat 3, Plenum
	2131758	General	100-pair Cable, Cat 3, Plenum
	2133269E	General	25-pair Cable, Cat 5e, Riser
	2131752E	General	25-pair Cable, Cat 5e, Plenum
	7525785.99	General	25-pair Cable, Cat 3, OSP
	7525793.99	General	50-pair Cable, Cat 3, OSP
	7525819.99	General	100-pair Cable, Cat 3, OSP
	VP24382TV25Y	Panduit	Voice Patch Panel
	CFPL2IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 2 Mini-Com modules, off white color
	CFPL3IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 3 Mini-Com modules, off white color
	CFPL4IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 4 Mini-Com modules, off white color
	CFP1IW	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 1 Mini-Com modules, off white color
	CMBIW-X	Panduit	Mini-Com blank module
	CBIW	Panduit	Single gang faceplate frame accepts two 1/2 size module inserts or three 1/3 size module inserts.
	CHS2IW-X	Panduit	Two module space, 1/2 size, sloped insert accepts two Mini-Com modules
	CHB2IW-X	Panduit	1/2 Blank Insert
	KWPY	Panduit	Stainless steel phone plate
	Vendor specific	Panduit	Mini-Com Snap -On Modular furniture faceplates
	CBXQ2IW-A	Panduit	Surface Mount Box with label, accepts up to 2 Mini-Com modules, Off White color
	CBXQ4IW-A	Panduit	Surface Mount Box with label, accepts up to 4 Mini-Com modules, Off White Color



Product Category	Part Number	Manufacturer	Part Description
	CBXQ6IW-A	Panduit	Surface Mount Box with label, accepts up to 6 Mini-Com modules, Off White Color
	CPPL24WBL Y	Panduit	Mini-Com Patch Panel, Flat, 1 RU, 24 ports
	CPPL48WBL Y	Panduit	Mini-Com Patch Panel, Flat, 2 RU, 48 ports
	CPPLA24WBL Y	Panduit	Mini-Com Patch Panel, Angled, 1 RU, 24 ports
	CPPLA48WBL Y	Panduit	Mini-Com Patch Panel, Angled, 2 RU, 48 ports
	SRB19DSBL	Panduit	19" Deep Strain Relief Bar
For switch mapping	CPP48FMVNSWBL Y	Panduit	48-Port, 2 RU Patch Panel with Vertical Numbering
For switch mapping	UTP28SP8INBU	Panduit	Category 6A Performance, 28AWG, UTP Patch Cord, CM/LSZH, Blue, 8in
Fiber Cabling Products			
	FOPRX24Y	Panduit	50um OM3 24 Fiber Indoor Armored Cable, Riser (OFCR), 900um Buffered Fibers
	FODPZ**Y	Panduit	Fiber Distribution Cable, OM4, Plenum, **=fibers
	FOPPZ24Y	Panduit	Fiber Interlocking Armor Cable, OM4, P, **=fibers
	FSDP9**Y	Panduit	Fiber Distribution Cable, OS2, Plenum, **=fibers
	FSP9**Y	Panduit	Fiber Interlocking Armor Cable, OS2, P, **=fibers
	FLCSMCXAQY	Panduit	LC OptiCam® OM3/OM4 50/125µm MM simplex connector, aqua
	FLCSSCBUY	Panduit	LC OptiCam® SM, 9um, simplex connector, blue
	FAP6WAQDLC FAP12WAQDLC	Panduit	Opticom® OM3/4 LC Fiber adapter panels, 6 & 12 ports
	FAP6WBUDLCZ FAP12WBUDLCZ	Panduit	Opticom® OS2 LC Fiber adapter panels, 6 & 12 ports
	FZ2ERQ1Q1SNM***	Panduit	OM4, LC push pull to LC push pull patch cord, 16mm jacket, riser (OFNR) rated, Standard IL; ***=length in meters
	FZ1BN1NNNSNM***	Panduit	OM4, LC to pigtail, ***=length in meters
	F91BN1NNNSNM***	Panduit	OS2, LC to pigtail, ***=length in meters
	FCE1U, FCE2U, FCE4U	Panduit	Opticom® Rack Mount Fiber Enclosure, 1,2, or 4 RU; Holds up to 4/8/12 FAPs
	FOSMH1U, FOSMH2U, FOSMH4U	Panduit	Opticom® Splice tray holder for Rack Mount Fiber Enclosure, 1,2, or 4 RUs



Product Category	Part Number	Manufacturer	Part Description
Racks, Cabinets, and Cable Management			
	R2PS	Panduit	2-Post Steel Rack
	R4PS	Panduit	4-Post Steel Rack
	PR2VD06 (Dual-sided) PR2VFD06 (Front only)	Panduit	PatchRunner 2 Vertical Cable Manager. 6" wide, 7 ft, Black with door(s)
	PR2VD08 (Dual-sided) PR2VFD08 (Front only)	Panduit	PatchRunner 2 Vertical Cable Manager. 8" wide, 7 ft, Black with door(s)
	PR2VD10 (Dual-sided) PR2VFD10 (Front only)	Panduit	PatchRunner 2 Vertical Cable Manager. 10" wide, 7 ft, Black with door(s)
	PR2VD12 (Dual-sided) PR2VFD12 (Front only)	Panduit	PatchRunner 2 Vertical Cable Manager. 12" wide, 7 ft, Black with door(s)
	PR2VEP	Panduit	PatchRunner 2 End Panel
	NM1 (Dual-sided) NMF1 (Front only)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 1RU, Black
	NM2 (Dual-sided) NMF2 (Front only)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 2RU, Black
	S6222BF	Panduit	Net-Access S-Type 600mm x 1200mm, 42 RU cabinet, vertical cable management, side panels, casters, black color
	S7222BF	Panduit	Net-Access S-Type 700mm x 1200mm, 42 RU cabinet, vertical cable management, side panels, casters, black color
	S8222BF	Panduit	Net-Access S-Type 800mm x 1200mm, 42 RU cabinet, vertical cable management, side panels, casters, black color
Bonding and Grounding			
	RBRB19U	Panduit	Grounding busbar for threaded rails
	RGRB19CN	Panduit	Grounding busbar for cage nut mounting rails
	GB2B0312TPI-1	Panduit	Telecommunications ground bar
	RGCBNJ660P22	Panduit	Rack bonding conductor (CBN jumper)
	GB4N0007TPI-1	Panduit	Grounding Busbar, 1/4" x 4" x 12"
	GPQC**-1/0	Panduit	Access Floor Grounding Clamps; ** = size
	RGESD2-1	Panduit	Electrostatic Discharge port kit for #12-24 tapped holes



Product Category	Part Number	Manufacturer	Part Description
	RGESD2B-1	Panduit	Electrostatic Discharge port kit for cage nut mounting rails
	REGESDWS	Panduit	Electrostatic Discharge protection wrist strap
	RGTBSG-C	Panduit	Green thread-forming bonding screw, #12-24 x 1/2", 100 pack
	CNBK	Panduit	Green bonding cage nut, #12-24 bonding cage nuts, 50 pack
	ACG24K	Panduit	Armored Fiber Bonding Kit
Fire Barriers			
	CP-653-2"-BA	Hilti	2" Speed Sleeve
	CP-653-4"-BA	Hilti	4" Speed Sleeve
	CFS-MS	Hilti	1" Matalic Sleeve
	CP 618	Hilti	Fire Putty Stick
	FS-ONE	Hilti	Fire Caulk Tube
	CFS-D	Hilti	Fire Putty Disc
	CFS-BL	Hilti	Firestop Block
J-Hooks			
	JP75 Series	Panduit	J-Pro Cable Support System, .75"
	JP131 Series	Panduit	J-Pro Cable Support System, 1.3"
	JP2 Series	Panduit	J-Pro Cable Support System, 2"
	JP4 Series	Panduit	J-Pro Cable Support System, 4"
Above Floor Raceway			
	AFR4BCBL6	Panduit	Above Floor Raceway – 6 Foot Base and Cover, Black color
	AFR4CCBL	Panduit	Above Floor Raceway, Coupler Fitting, Black color
	AFR4TRT70BL	Panduit	Above Floor Raceway, Transition to T70 Fitting. Black color
	AFR4RABL	Panduit	Above Floor Raceway, Right Angle Fitting, Black color
	AFR4ECBL	Panduit	Above Floor Raceway, End Cap Fitting, Black color
	AFR4JB2SBL	Panduit	Above Floor Raceway, Junction Box, Black color



Product Category	Part Number	Manufacturer	Part Description
Other Cabling Accessories			
	HLS-15R0	Panduit	Tak-Ty® hook & loop strip roll, 15' length, .75 width, nylon loop, polyethylene hook, black.
	HLS-75R0	Panduit	Tak-Ty® hook & loop strip roll, 75' length, .75 width, nylon loop, polyethylene hook, black.
	TTR-35RX0	Panduit	Tak-Tape® Hook and Loop 35' Rolls, 10 Roll-pack, black.
	PSL-DCJB-C	Panduit	RJ45 Jack Block out Device, 100 block-outs (red) and 5 removal tools (black), polycarbonate.
	PSL-DCPL-C	Panduit	RJ45 Plug Lock-In Device, 100 devices (red) and 5 installation/removal tool (black), polycarbonate.
	PSL-USBA	Panduit	USB type A block-out device, 5 devices (red) and 1 removal tool (black), polycarbonate.
Ladder Rack Pathway			
	10250-724	Chatsworth	Universal cable runway, Black – 24-Inch-Wide Reference
	11301-702	Chatsworth	Butt Splice Kit, 2" Stringer, Black Reference
	10724-724	Chatsworth	Cable runway radius bend – 24inch Wide Reference
	11309-701	Chatsworth	Foot kit, cable runway Reference
	11421-724	Chatsworth	Wall angle support kit, cable runway – 24inch Wide Reference
	31470-712	Chatsworth	Cable runway standoff support kit Reference
	10506-702	Chatsworth	Cable runway elevation kit Reference
	11302-701	Chatsworth	Junction-splice kit Reference
	10723-724	Chatsworth	Cable runway radius bend Reference
	11959-724	Chatsworth	Corner Bracket 24-inch Radius, Reference
	11746-724	Chatsworth	Triangular Supports Bracket, steel Reference
	11310-003	Chatsworth	Threaded Ceiling Kit, Cable Runway
	11421-712	Chatsworth	Wall Angle Support Kit, Cable Runway



Product Category	Part Number	Manufacturer	Part Description
	10250-712	Chatsworth	Universal Cable Runway – 12 inch wide
	10723-712	Chatsworth	Cable Runway Radius Bend 90-Degree Outside Bend – 12 inch Wide
	10724-712	Chatsworth	Cable Runway Radius Bend 90-Degree Inside Bend – 12 inch Wide
	11301-702	Chatsworth	Butt-Splice Kit
	11298-701	Chatsworth	Heavy Duty Junction-Splice Kit
	10642-001	Chatsworth	Protective End Caps for Runway
	10622-010	Chatsworth	Standard Busbar 4"Wx1/4"Hx10"L
	40164-001	Chatsworth	#6AWG Ground Strap
	10250-718	Chatsworth	Universal Cable Runway
	10723-718	Chatsworth	Cable Runway Radius Bend 90 degree Outside Bend
	10724-718	Chatsworth	Cable Runway Radius Bend 90 degree Inside Bend
	11421-718	Chatsworth	Wall Angle Support Kit, Cable Runway
	11304-000	Chatsworth	Chatsworth J-bolt Kit
	11301-001	Chatsworth	Butt-Splice Kit
	10506-706	Chatsworth	Cable Runway Elevation Kit 6"
	11201-701	Chatsworth	Cable Runway Radius Drop Stringer
	12100-718	Chatsworth	Cable Runway Radius Drop Cross Member



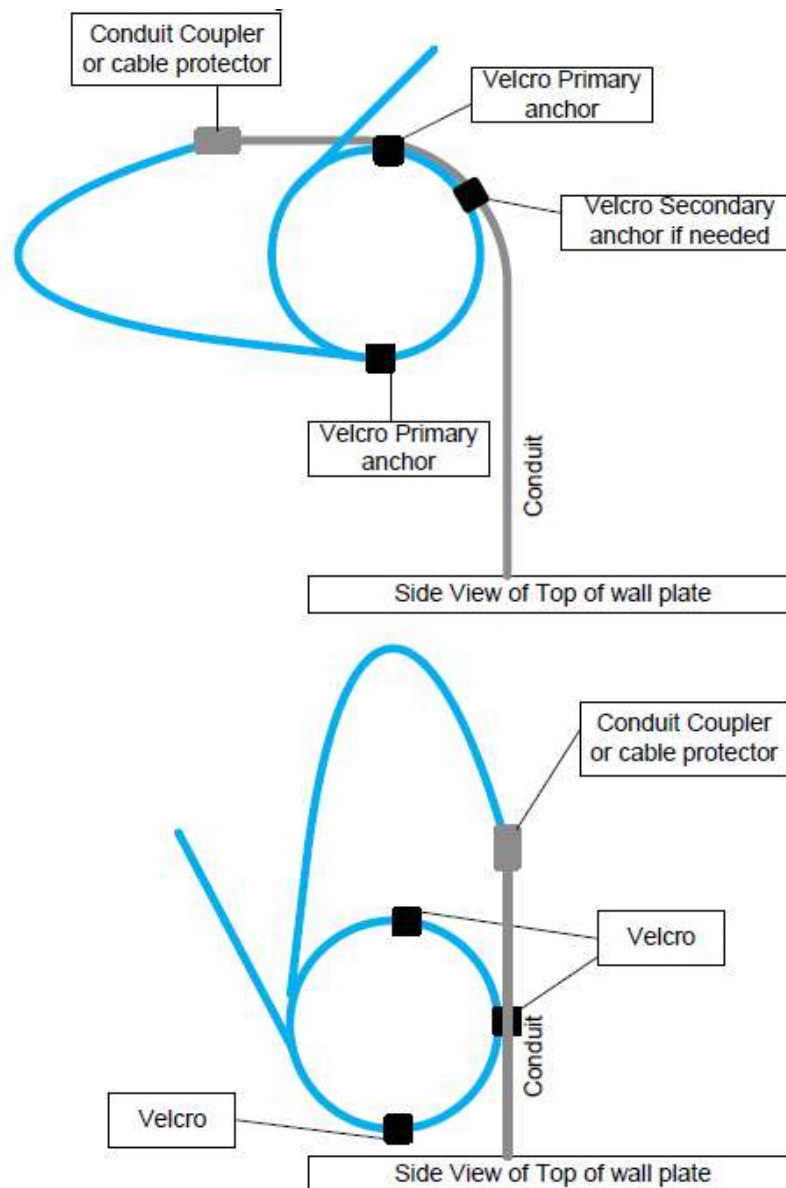
Basket Tray Pathway	CF 54/300	Cablofil	2" side, 12" wide, 10' stick
	CF 54/450	Cablofil	2" side, 18" wide, 10' stick
	CF 54/600	Cablofil	2" side, 24" wide, 10' stick
	CF 105/300	Cablofil	4" side, 12" wide, 10' stick
	CF 105/450	Cablofil	4" side, 18" wide, 10' stick
	CF 105/600	Cablofil	4" side, 24" wide, 10' stick
	FAS PCH	Cablofil	Center Hanger
	FAS P	Cablofil	Trapeze
	AS	Cablofil	Trapeze Clips
	FASL	Cablofil	L Bracket
	CRP	Cablofil	Universal Wall Bracket
	ED 275	Cablofil	Universal Splice Bar
	SWK	Cablofil	1/4 Hardware Bolts
	EZT 90 KIT	Cablofil	Hardware for 90's

<END OF APPENDIX A>

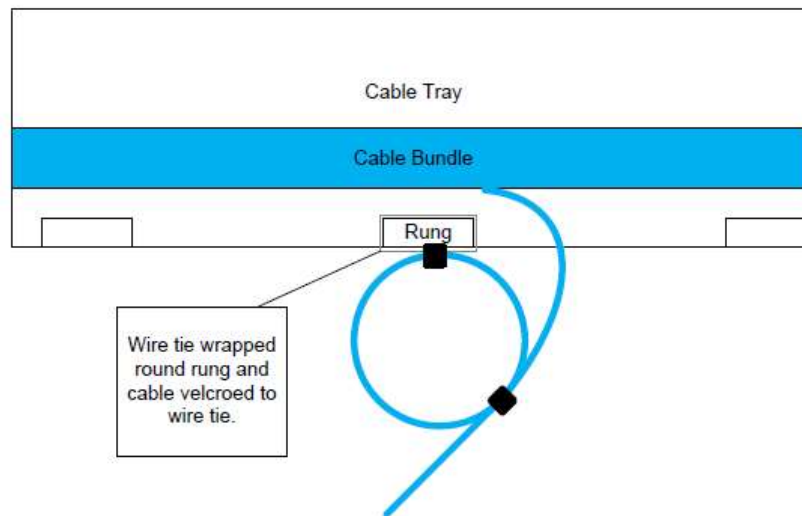


Appendix B – Cable Slack Installation

When cable is installed there will 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 will be anchored to the drop's 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:



(cont'd.)



<END OF APPENDIX B>

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