



# Salt Lake County

## Network Cabling Global Specification

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**Information Technologies**

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Version 2.4**

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# I. GENERAL

## A. Purpose

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1. The purpose of this document is to provide a standard defining the structured communications cabling systems to be installed within, Salt Lake County 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 Salt Lake County, and shall be referred to as such, or as "Salt Lake County" or as "Information Technologies". Bidding low-voltage installers shall be referred to as "Contractor".
3. This specification defines quality standards and practices common to all Salt Lake County enterprise network cabling upgrades and Greenfield (new) projects.
4. In addition to this global cabling standard, individual projects will also have associated documentation such as Requests for Proposals (RFP), facility drawings, project schedules and requirements pertaining to that particular job. Such collateral will be referred to in this document as "Project-Specific Documentation", "Project Documentation", or simply "Construction Documents". Any conflict between this general specification and any project-specific documentation shall be brought to the attention of Salt Lake County and must be resolved in writing.
5. 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 Salt Lake County any design directions that may be improved. All such changes shall be approved in writing from Information Technologies.
6. Note that while many portions of this global specification are addressed to "The Contractor", these requirements apply equally to anyone doing the network cabling and infrastructure work within Salt Lake County, whether those persons are outside contractors or persons directly employed by Information Technologies.

## B. Scope of Work - Typical

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1. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn over the completed system fully warranted and operational for acceptance by Salt Lake County.
2. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:
  - a. Cabling Sub-system 1 – Horizontal Copper

- b. Cabling Sub-system 2 - Intrabuilding Fiber Backbone Cabling
  - c. Cabling Sub-system 3 – Interbuilding Fiber Backbone Cabling
  - d. Telecommunications Pathways
  - e. Communications Racks and Cable Managers
  - f. Communications Grounding Systems
  - g. Cabling Labeling and Administration
3. In addition to systems specifications, this document also addresses applicable codes and standards, contractor qualifications and requirements, system warranties and system testing and acceptance.
4. Products to be used in Salt Lake County telecommunications infrastructure projects are listed in “Appendix A” at the end of this document.

### **C. Applicable Regulatory References**

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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-E-2020 (March 2020) Generic Telecommunications Cabling for Customer Premises
  - f. ANSI/TIA-568.1-E-2020 (March 2020) Commercial Building Telecommunications Infrastructure Standard
  - g. ANSI/TIA-568.2-D (September 2018) Balance Twisted Pair Communications and Components Standards
  - h. ANSI/TIA-569-D (April 2015) Telecommunications Pathways and Spaces
  - i. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
  - j. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
  - k. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
  - l. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

- m. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
- n. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
- o. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
- p. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
- q. 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
- r. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
- s. 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
- t. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- u. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
- v. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
- w. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
- x. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
- y. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
- z. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
- aa. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
- bb. [TIA-TSB-155-A \(Reaffirmed 10-6-2014\) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T](#)
- cc. [TSB-184-A \(March 2017\) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling](#)
- dd. TIA TSB-184-A-1 (February 2019) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling- Addendum 1- use of 28 AWG cords - Addendum to TSB-184-A
- ee. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
- ff. [TSB-190 \(June 2011\) Guidelines on Shared Pathways and Shared Sheaths](#)
- gg. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
- hh. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
- ii. TIA-492AAAE (June 2016) Detail Specification for 50- $\mu$ m Core Diameter/125- $\mu$ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
- jj. TIA-492AAAB-A (November 2009) Detail specification for 50- $\mu$ m core diameter/125- $\mu$ m cladding diameter class 1a graded-index multimode optical fibers
- kk. 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

II. 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
- a. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
- b. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fibre cabling
- c. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centres
- 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 TR 24704 Information technology – Customer premises cabling for wireless access points
- k. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
- l. 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.

#### **D. Substitution Policy**

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1. This is a performance-based specification developed from the experience of the Salt Lake County IT Division 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.

## **E. Contractor Qualifications**

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### 1. General

**Contractor shall meet the following requirements: NO EXCEPTIONS. If you do not understand any aspect of these specifications, call Corey Hess– Managing Network Engineer over IT Infrastructure For clarification.**

- a. Contractor shall be a current Panduit ONE<sup>SM</sup> Partner, **SILVER** or above only, 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 must have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.
- c. Contractor shall have offices and service personnel based within a fifty-mile radius of Salt Lake County and be capable of same-day response to service calls.
- d. 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.
- e. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
- f. Contractor shall employ at least one BICSI certified Installer technician supervising and on the project full time.
- g. At least 30 percent of the technicians on the job must have a current Panduit Certified Copper Technicians certificate, or accepted substitute manufacturer, to install copper distribution systems.
- h. At least 30 percent of the technicians installing any Fiber Distribution Systems must have a current Panduit Certified Fiber Technicians certificate, or accepted substitute manufacturer certificate, to install fiber distribution systems
- i. The Telecommunications contractor must 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 Salt Lake County 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.
  - Participate in 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 Salt Lake County.
- j. Contractor Project manager must be manufacturer certified in the copper and fiber information transport systems to be installed.



k. Contractor shall have a BICSI certified RCDD on-site to supervise final testing.

## 2. References

- a. Communications Contractor shall provide with bid, a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year (twelve-month period).
- b. Communications Contractor shall provide copies of valid current certifications required in section E.1 of this document.

## 3. Termination of Services

- a. Salt Lake County reserves the right to terminate the Communication Contractor's services if at any time the Salt Lake County Engineer determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.
- b. Contractor's appearance and work ethics shall be of a professional manner; dress shall be commensurate with work being performed.
- c. Dress displaying lewd or controversial innuendos will strictly be prohibited.
- d. Conduct on Salt Lake County property will be professional in nature.
- e. Any person in the Contractor's employ working on a Salt Lake County project considered by Salt Lake County to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable to the Information Technologies, such person shall be removed from work on the Salt Lake County project.
- f. Upon termination, the Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.

## 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 30% fill according to manufacturer's fill charts based on projected cable densities when racking systems and cabling pathways are fully populated.
  - Pathways 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. 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.
- c. Contractor must 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 must consider this when placing bids.
- d. Contractor shall abide by the regulations set by local Salt Lake County Security Policy pertaining to access and conduct while on Salt Lake County property.
- e. Contractor shall obey all posted speed limits and parking regulations at the Salt Lake County facilities where the work is being performed.

- f. Test cables upon receipt at Project site.
  - Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 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 maintenance data.
  - Test each pair of UTP cable for open and short circuits.

#### Required Inspections

The contractor shall meet **before start of work** to go over the scope and all specs to clarify any concerns.

The contractor shall have a **mid-point inspection** of the project, so the County may go over the project to determine cable standards are being followed. No ceiling tiles shall be installed until inspections of cabling have passed.

The contractor shall have a **final inspection** County will provide a punch list if needed.

## **F. Warranty**

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### 1. General

- a. Contractor shall provide a 25 year Panduit Certification PLUS™ System Warranty on all copper and fiber permanent cabling links.
- b. It is understood the Certification PLUS™ Warranty is a system performance warranty guaranteeing for 25 years from acceptance that the installed system shall support all data link protocols for which that Category of copper cabling system or fiber OM/OS designation of fiber optic system is engineered to support according to current and future IEEE and TIA standards.
- c. The Certification PLUS™ System Warranty may be invoked only if the cabling channel links are comprised of continuous Panduit, General and Belden Cable components, including patch cords, equipment cords and fiber jumpers.
- d. Upon acceptance of Warranty, Panduit will mail a notification letter to the installer and a notification letter and warranty certificate to Salt Lake County.

### 2. Contractor Warranty Obligations

- a. Installation firm (Contractor) must be a current Panduit ONE<sup>SM</sup> Partner, SILVER or above, in good standing and shall include a copy of the company installation certification with the bid.
- b. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in Panduit Technician Certification Training, or approved equal, and according to all Standards cited in the Regulatory References section of this document.
- c. Contractor liaison (project supervisor) shall have a current, up-to-date Panduit Certified Technician (PCT) certificate in both copper and fiber. Copies of the copper and fiber certificates of the Panduit liaison shall be submitted with the bid.
- d. Fiber optic cabling system additions and upgrade 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

system.

- e. All intrabuilding new fiber optic installations shall utilize an appropriate construction of OM3/OM4 or OS1/OS2 fiber as specified herein.
- f. All UTP cable pulled and terminated shall be Category 6/6A cable and connectivity whether new or legacy systems.
- g. All UTP terminations within the Salt Lake County Greenfield (new) projects shall be terminated using the T568B pin-out (wire map). Legacy additions shall match the copper pin-out of the facility to which cabling is being added-to or upgraded.
- h. Contractor shall install all racking and support structures according to cited Standards in such fashion as to maintain both cited industry standards as well as manufacturer recommendations for uniform support, protection, and segregation of different cable types,
- i. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods as well as adhering to industry accepted practices of good workmanship.
- j. Contractor is responsible for understanding and submitting to Panduit all documents required prior to project start to apply for the Panduit Certification PLUS warranty. These include but are not limited to the project information form and SCS warranty agreement.
- k. Contractor is responsible for understanding and submitting to Panduit all documents required at project end. These include, but are not limited to: completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested.
- l. Test results shall be delivered in the tester native format (not Excel) and represent the full test report, summaries shall not be accepted. Contact your Panduit representative for a current list of approved testers, test leads and latest operating systems.
- m. The Communications Contractor will correct any problems and malfunctions that are warranty-related issues without additional charge to Salt Lake County for the entire warranty period.
- n. The warranty period shall commence following the final acceptance of the project by Salt Lake County and written confirmation of Warranty from Panduit.

<END OF SECTION>

## II. Installation and Maintenance Guidelines

### A. Maintenance of Patch Fields

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1. Any persons, whether with a Contractor or Salt Lake County, adding or moving copper or fiber optic patch (equipment) cords shall do so in a neat, workmanlike fashion in keeping with the original system cable management design concept and according to all industry best practices as outlined in cabling standards and applicable BICSI publications referenced in this document.
2. Persons performing such moves, adds or changes (MACs) shall further adhere to the following:
  - a. Use existing cabling management pathways and take care to place cable like with like, maintaining original segregation strategies for separating fiber and copper cables as well as any separation necessary between different types of copper cables.
  - b. Cables shall be dressed neatly within patch management pathways with care taken to maintain minimum bend radius of not less than 1 times the cord outer diameter for copper and not less than a 1" bend radius for fiber jumpers as per ANSI/TIA 568-C.0.
  - c. All patch cords used shall be of same Copper Category or Fiber OM/OS designation as the media used in the permanent cabling links.
  - d. Patching in all cases shall be done using factory terminated cords manufactured for that purpose. Hand terminated patch cords will not be accepted.
  - e. All patch cords or jumpers must be completely contained within supplied cable management paths. Cables draped across the front cabinets or racks will not be accepted and shall be remedied at Contractor's expense.
  - f. Any persons installing or moving fiber optic patch cords for any reason will clean the connector with lint-free wipes and 99% or higher isopropyl alcohol before replacing the connector in a patch or equipment port.
  - g. Any technicians, whether with Salt Lake County or Contractors performing moves, adds or changes within patch field will label additions to the system according to the labeling conventions in place at that facility.
  - h. Any persons with Salt Lake County or installing Contractor performing moves, adds or changes within patch field will record the move according to record system in place at that facility.

### B. Cable Pulling and Termination

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1. General
  - a. Contractor is responsible for installing systems according to all applicable codes and the standards cited in this document.
  - b. Contractor shall use grommets to protect the cable when passing through metal studs or any openings that can possibly cause damage to the cable. This includes grommets on ends of hard conduit where used.

- c. Do not deform the jacket of the cable. The jacket shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections.
- d. Install proper cable supports, spaced less than 5 feet apart, and within manufacturer's requirements for fill ratio and load ratings.
- e. Leave a pull string to the end of each conduit run. Replace pull string if it was used for a cable pull.
- f. Note service loops may not touch the drop-ceiling assembly. Any portion of the communications cabling making contact with ceiling structures must be remedied at the Contractor expense.
- g. Label every cable within 12 in. of the ends with self-laminating wire wrap cable appropriate to that cable size. Use a unique number for each cable segment as required by the project documentation and the labeling section of this document.
- h. Dress the cables neatly with hook and loop cable ties in telecommunications rooms. Contractor responsible for using plenum ties and appliances in air-return (plenum) spaces as required by the local AHJ (Authority Having Jurisdiction).
- i. Contractors installing cabling systems in Salt Lake County facilities shall install plenum rated cable in all instances. Non-plenum cable is not allowed and shall be removed at Contractor's expense.

## 2. Copper

- a. When making additions to legacy systems, Contractor shall match the cabling configuration (pinout) of the existing systems. Legacy systems at Salt Lake County are in most cases T568B.
- b. Within all new (Greenfield) installations within Salt Lake County facilities, contractor shall use copper pinout T568B.
- c. All four pair Category 6/6A cable runs shall be kept to a maximum permanent link length of 83 meters when using a total 10 meters of 28 awg "small diameter" patch cords.
- d. Copper links that are 90 meters in permanent link, shall not exceed 6 meters (total) of patch cords when using 28 awg "small diameter" patch cords.
- e. Use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.
- f. No pathway, including conduits shall have greater than a 35% fill per manufacturer fill charts. Contractor is responsible for bringing to the attention of Salt Lake County project manager any insufficiently sized conduit or cable pathways in project documentation.
- g. Keep Category 6/6A cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as required in cited TIA Standards.
- h. All copper horizontal cabling shall have slack service loops no less than 1 feet at the work area (equipment outlet) and not less than 2 feet in the ceiling with 10 feet of slack loop in the telecommunications room.
- i. Slack at the work area may be stored in the ceiling or in the wall space. Service loops in the telecommunications room may be wall mounted or contained in pathways or racking systems if done in a neat, workmanlike fashion.

- j. Service loops shall be stored in such fashion as to not violate bend radius, slack touching the drop ceiling is not allowed and must be remedied at Contractor expense.
- k. Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted.
- l. All UTP patching shall be accomplished using Category 6/6A rated modular patch panels as indicated elsewhere in this document.
- m. All removed copper cable is to be disposed of in a Salt Lake County recycling bin designated for "copper" or removed from the property to be disposed of by Contractor if this is the instructions in the project documentation.

### 3. Fiber

- a. When making additions to legacy systems, Contractor shall match the fiber type and fiber connectors used within that system.
- b. Within all new (Greenfield) fiber installations within Salt Lake County, contractor shall use Panduit field terminations or OptiCam LC connectors as specified in the fiber section of this document.
- c. When installing fiber cable, Contractor shall maintain a minimum bend radius, both under pulling load and static (installed), per requirements outlined within TIA standards, or manufacturer's recommendations, whichever is the most stringent.
- d. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements and accepted industry best practices.
- e. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.
- f. Contractor shall use fusion splices when terminating loose-tube fiber in legacy installations. New installations shall use indoor/outdoor tight-buffered fiber constructions.
- g. Contractor shall perform test setup and testing according to guidelines in the "Testing and Acceptance" section of this document.

<END OF SECTION>

## III. Cabling Systems and Associated Infrastructure

### A. Cabling Subsystem I – Horizontal Cabling System

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#### 1. Slack (Service Loops) in Horizontal UTP Cable

- a. Contractor shall use low-voltage mounting brackets (“box-eliminators”) for mounting low-voltage communications faceplates.
- b. Contractor shall provide a minimum slack or service loop at the equipment outlet (work area) on each terminated copper horizontal permanent link. All copper horizontal cabling shall have slack service loops no less than 1 feet at the work area (equipment outlet) and not less than 2 feet in the ceiling, with 10 feet in the telecommunications room.
- c. Where there is not sufficient space behind the faceplate, Contractor may pull work area slack into the ceiling space and properly store service loop with appropriately rated hook and loop cable ties. Cable slack shall in no instances touch the ceiling grid or associated drop ceiling components or fixtures.
- d. All WIFI access points shall have a 25 foot service loop installed in the ceiling at WAP location for relocation purposes.
- e. Contractor shall provide a minimum of 10 feet slack or service loop in the horizontal telecommunications room on each terminated copper horizontal permanent link, to be stored on the ladder rack using appropriate mounting rack shall be in a square pattern to allow for relocation of cable if needed. Or as specified in project drawings and bid documents.
- f. Contractor should consult project-specific documentation or the Salt Lake County project liaison for other mounting methods where wall mount is not an option.

#### 2. Metal Conduit

- a. Contractor shall size conduit large enough to accommodate at least 50% growth, i.e. conduit for 4 cables shall be sized to accommodate 6 cables, etc.

#### 3. Equipment Outlets (Faceplates)

- a. When adding horizontal cabling to existing facilities (Brownfield) within the Salt Lake County, Contractor shall match the existing cable plant in regard to color of existing raceway and faceplates.
- b. Vertical sloped series faceplates in new projects (Greenfield) shall be Mini-Com® Classic Series Sloped Vertical Faceplates with Label and Label Cover.
- c. Faceplates shall be form-molded plastic, single-gang, White in color and available in 1, 2, 3, 4 and 6-hole versions. Faceplates shall further have the following characteristics:
  - Accept Mini-Com ® Modules for STP and UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
  - Include label/label covers for easy port identification.

- Have available replacement label/label covers.
  - d. Contractor shall use blank inserts to reserve space on any unused positions (holes) in faceplates.
  - e. See appendix A for part numbers.
5. Copper Jacks – All Work Areas Category 6A
- a. Copper jacks shall be Mini-Com® TX6™ PLUS UTP Jack Modules.
  - b. Category 6 jacks at the work area shall be designated color per RFP.
  - c. Jacks used to populate angled modular panels shall be black or designated color per RFP.
  - d. Category 6 jacks shall further meet the following requirements:
    - Exceed ANSI/TIA-568.2-D Category 6 and ISO 11801 2nd Edition Class E standards
    - Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications
    - Be 100% tested to ensure NEXT and RL performance and be individually serialized for traceability.
    - Optional Color-coded, keyed jack modules mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed modular plugs accommodating more discrete networks.
    - Utilize patent-pending enhanced Giga-TX™ Technology for jack terminations which optimizes performance by maintaining cable pair geometry and eliminating conductor untwist.
    - Have contacts plated with 50 micro inches of gold for superior performance.
    - Rated for 2500 mating cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4
    - Require no punch down tool required; termination tool (EGJT) ensures conductors are fully terminated by utilizing a smooth forward motion without impact on critical internal components for maximum reliability.
    - Have available a high-volume “gun-style” optional termination tool (TGJT) that reduces termination time by 25% and is ideal for high volume installations.
    - Have guaranteed ability to be re-terminated a minimum of twenty times without measurable degradation of performance.
    - Employ a **GREEN** termination cap to designate Category 6 performance at a glance and provides positive strain relief; help control cable bend radius and securely retain terminated cable.
    - Have range to terminate 4-pair, 22 – 26 AWG, 100 ohms, solid or stranded twisted pair cable.
    - Utilize a universal termination cap is color-coded for T568A and T568B wiring schemes for flexibility across installations.
    - Accept 6 and 8-position modular plugs without damage to conductor pins.
    - Identified options that include optional labels and icons.
    - Be compatible with Mini-Com® Modular Patch Panels, Faceplates, and Surface Mount Boxes.



- Have available optional RJ45 blockout device that blocks out unauthorized access to jack modules and potentially harmful foreign objects, saving time and money associated with data security breaches, network downtime, repair, and hardware replacement
- Have an optional dust cap keeps out dust and debris while not in use.

a. See Appendix A at the end of this document for part numbers.

6. Copper Jacks/Field Terminable RJ45 - Wireless Access Points (WAPs) and Security Cameras  
Category 6A

- b. Category 6A jacks at the WAP and Camera areas shall be Panduit TX6A™ Category 6A UTP Field Term RJ45 Plug BLACK JACKS FOR Cameras
- c. Category 6A Panduit TX6A™ Category 6A UTP Field Term RJ45 Plug shall further meet the following requirements:
- Exceed ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA Channel performance requirements with up to two field term plugs in channel
  - Meets or exceeds proposed TIA Modular Plug Terminated Link requirements with up to two field term plugs in link
  - Available in unshielded straight or angled wire cap.
  - Available in shielded version with straight wire cap.
  - Unshielded version – compatible with 4-pair, 22-26 AWG solid or stranded shielded twisted pair cable with conductor insulation diameters of 0.060 in. maximum and overall cable O.D. 0.200 in. to 0.330 in.
  - Shielded version - compatible with 4-pair, 22–26 AWG solid or stranded shielded twisted pair cable with conductor insulation diameters of 0.039 in to 0.063 in (1.0mm to 1.6mm) and overall cable O.D. 0.230 in. to 0.354 in (5.8mm to 9.0mm)
  - Meets ANSI/TIA-1096-A (formerly FCC Part 68)
  - IEC compliance: IEC 60603-7, IEC 60529 (IP 20) and RoHS compliance
  - Supports IEEE 802.3af / 802.3at (PoE/PoE+) and proposed 802.3bt type 3 and type 4 (PoE++) applications. Supports Power over HDBaseT up to 100 watts.
  - UL rated - UL 1863 (Use as communications circuit accessory), UL 2043 (Suitable for use in air-handling spaces)
  - Rated to 2500 plug mating cycles
  - Unshielded version Operating temperature: -40°C to 75°C (-40°F to 167°F), Storage temperature: -40°C to 75°C (- 40°F to 167°F).
  - Shielded version Operating Temperature -40° C to 85° C (40 F to 185 F), Storage temperature: -40 C to 85 C (40 F to 185 F).
  - Backwards compatible for Category 6 and Category 5e applications.

- Proven electrical performance and quick installation speed from the same forward-motion termination technology used in Panduit's Mini-Com TG modular jacks
  - Ability to re-terminate up to 20 times with no additional parts, providing convenience and cost-savings in cases when plug must be re-terminated to cable
- d. Category 6A jacks used to populate angled modular panels shall be Mini-Com® TX6A™ PLUS UTP Jack Modules black.
- e. Category 6A jacks shall further meet the following requirements:
- Exceed ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards
  - Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications
  - Be 100% tested to ensure NEXT and RL performance and be individually serialized for traceability.
  - Color-coded, keyed jack modules mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed modular plugs accommodating more discrete networks.
  - Include MaTriX split foil tape to suppress the effects of alien crosstalk, allowing 10 Gb/s transmission even in high density 48-port, 1RU patch panels.
  - Utilize Giga-TX™ Technology for jack terminations which optimizes performance by maintaining cable pair geometry and eliminating conductor untwist.
  - Meets ANSI/TIA-1096-A contacts plated with 50 micro inches of gold for superior performance.
  - Rated for 2500 cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4
  - Have guaranteed ability to be re-terminated a minimum of twenty times without measurable degradation of performance.
  - Require no punch down tool; termination tool (EGJT) ensures conductors are fully terminated by utilizing a smooth forward motion without impact on critical internal components for maximum reliability.
  - Have available a high volume "gun-style" optional termination tool (TGJT) that reduces termination time by 25% and is ideal for high volume installations.
  - Employ a GREEN termination cap to designate Category 6A performance at a glance and provides positive strain relief; help control cable bend radius and securely retain terminated cable.
  - Have range to terminate 4-pair, 22 – 26 AWG, 100 ohms, solid or stranded twisted pair cable.
  - Utilize a universal termination cap is color-coded for T568A and T568B wiring schemes for flexibility across installations.
  - Accept 6 and 8-position modular plugs without damage to conductor pins.
  - Identified options that include optional labels and icons.
  - Be compatible with Mini-Com® Modular Patch Panels, Faceplates, and Surface Mount Boxes.
  - Have available optional RJ45 blockout device that blocks out unauthorized access to jack

modules and potentially harmful foreign objects, saving time and money associated with data security breaches, network downtime, repair, and hardware replacement

- Have an optional dust cap keeps out dust and debris while not in use.

f. See Appendix A at the end of this document for part numbers.

#### 7. All Work Areas and Wireless Access Points (WAPs) Category 6A Unshielded Twisted Pair Cable

- Inside 4 pair horizontal cable for Salt Lake County facilities shall be blue jacketed plenum “LP” rated TX6A™ 10Gig™ UTP Copper Cable with Advanced MaTriX Technology.
- A *minimum* of two (2) County approved Category 6A UTP cables shall be run from the telecommunication closets to each jack location. Additional cables called for in a particular Scope of Work may be more Category 6A cables or some combination of:
- In addition, performance Category 6A UTP Copper Cable must meet the following mechanical and performance criteria:
- UL Limited Power (LP) Certified which eliminates the need to consult the PoE ampacity table in the NEC 2017 code regarding maximum bundle sizes
- Meet TIA TSB-184-A/ IEEE P802.3bt “LP” rating for Limited Power cable requirements
- Exceeds requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA channel standards.
- Exceeds requirements of ANSI/TIA-568-C.2 and IEC 61156-5 Category 6A component standards.
- Meets requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
- Third party tested to comply with ANSI/TIA-568-C.2.
- Cable diameter: Plenum 0.23 in. (5.842 mm) nominal.
- Installation temperature range: 32°F to 122°F (0°C to 50°C).
- Operating temperature range: 14°F to 140°F (-10°C to 60°C).
- Include advanced MaTriX tape to suppress the effect of alien crosstalk allowing 10 Gb/s transmission, while minimizing cable diameter.
- Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap.
- See Appendix A at the end of this document for cable part numbers.

#### 8. Distributor I (Horizontal Patch Panels) – Angled mount standard density patch panels

- Salt Lake County copper patch panels in the horizontal patch fields shall be angled 1 RU or 2 RU Mini-Com® Modular Faceplate Patch Panels, as needed to accommodate UTP cable quantity.
- Modular patch panels shall be standard density of 48 ports per rack unit with front removable retaining plates so installing work may be done from the front of the rack in tight spaces.
- Contractor shall populate modular panels with green Panduit Category 6/6A jacks.
- Patch Panels shall further meet the following criteria:

- Have release snap feature on faceplate to allow front access to installed modules.
- Accept Mini-Com® Modules for UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
- Be available in label versions available for easy port identification, with replacement label/label covers available.
- Mount to standard EIA 19" racks or 23" racks with optional extender brackets.
- Be available in angled patch panels to facilitate proper bend radius control and minimize the need for horizontal cable managers.

j. For detailed part numbers see "Appendix A" at the end of this document.

#### 9. Work Areas - Small Diameter Category 6A Copper Patch Cords

- a. Copper patching of Category 6A links in Salt Lake County facilities shall use Panduit 28 awg "small diameter" patch cords.
- b. If other color patch cords are needed to designate particular applications, see Appendix A for instructions on changing patch cord colors.
- c. Small diameter patch cords shall have the following characteristics:
  - Cable diameter not more than 0.185 in. (4.7mm) nominal.
  - Category 6A/Class EA channel and component performance.
  - Exceeds all ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA electrical performance requirements for all frequencies from 1 to 500 MHz
  - FCC and ANSI compliance: Meets ANSI/TIA/EIA-1096-A; contacts plated with 50 micro inches of gold for superior performance.
  - IEC compliance: Meets IEC 60603-7
  - PoE compliance: Meets IEEE 802.3af and IEEE 802.3at for PoE applications in bundle sizes up to 48 cables.
  - Operating temperature: 14°F to 140°F (-10°C to 60°C).
  - Storage temperature: -40°F to 158°F (-40°C to 70°C).
  - Plug housing: UL94V-0 rated clear Polycarbonate.
  - Contacts: Gold plated phosphor bronze.
  - RoHS compliance: Compliant.
  - Flammability rating: CM/LSZH dual rated.
- d. Due to miniature size of patch cords, utilize increased attenuation de-rating value of 1.9. These supports 96 meter channels that include 90 meter permanent links, and 6 meters of patch cord. A channel using 10 meters total of patch cord would support a 93 meter channels.
- e. See Appendix A for part numbers.

#### 10. Wireless Access Points (WAPs) and Security Camera Patch Cords

- a. Not required when using the Panduit TX6A Field Terminable RJ45 Plug
- b. See Appendix A for part numbers.

#### 11. Surface Mount Raceway – Wall Mount

- a. On brownfield installations, Contractor shall match raceway to that already installed in the facility unless instructed otherwise in project-specific documentation.
- b. On Greenfield installations where environment (cinder block walls) or project documentation requires cable to be surface-mounted in the work area; horizontal cable shall be routed through International White (color), plastic "latching-duct raceway.
- c. Contractor is responsible to size raceway to accommodate not less than 40% fill upon installation, per manufacturer fill tables, providing room for at least 50% growth in additional cables: i.e. a work area requiring 4 cables, raceway shall be sized to hold 6, etc. LD10 will allow up to 8 CAT6 cables at a max OD of .240. If over this limit, replace surface raceway according to cable fill ratio.
- d. Contractor is responsible that raceway installation includes all associated fittings, drop ceiling fittings, couplers and 1" control-bend-radius fittings.
- e. Contractor shall not rely on the pressure sensitive adhesive foam to mount raceway, but rather use adhesive to hold raceway in place while screwing down the raceway to the structure beneath using anchors appropriate to the wall type at intervals not to exceed 2 ft. (24 inches).
- f. Standard raceway shall have the following features:
  - For routing data and low voltage cabling.
  - One-piece hinged design allows cables to be laid in.
  - Factory applied adhesive backing speeds installation.
  - FT4 rated.
  - Terminates using surface mount outlet box solutions or Panduit Mini-Com surface mount boxes
- g. Installations requiring raceway shall use the same faceplates used in flush-mount applications as specified in this document, mounted on Panduit "JB1" surface boxes. Salt Lake County shall not rely on adhesive-backing to hold surface boxes in place, but must use appropriate wall anchors for firm, permanent installation.
- h. T45/T70 Pan-Way® Fast-Snap™/Snap-On Technology - Pan-Way® Fast-Snap™ Surface Mount Boxes assemble without the use of screws or additional hardware and can accommodate both power and communication applications. Fast-Snap™ Boxes can accept any standard NEMA 70mm screw-on faceplate. Pan-Way® Snap-On Faceplates attach directly to Fast-Snap™ Boxes, any 70mm raceway, Cove, or Pan-Pole™ device without the use of screws or additional hardware
- i. Standard Surface Raceway shall have the following features:
  - allows multiple inline access points for space optimization and aesthetic installation
  - supports any NEMA standard screw-on faceplate with use of device bracket and can reduce to smaller profile raceway

- shall have a modular divider wall that allows channel configuration flexibility
- j. See Appendix A at the end of this document for part numbers.

## **B. Cabling Subsystems II - Intrabuilding Backbone Fiber**

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### 1. Singlemode Fiber Trunks for use within Buildings

- a. In additions to existing Salt Lake County fiber cable plant (brownfield projects), Contractor shall consult with Salt Lake County for fiber requirements.
- b. In new (Greenfield) Salt Lake County projects, backbone fiber running between telecom spaces within buildings shall be Panduit 12/24/48 strand OS2 singlemode, indoor tight buffered, plenum-rated, armored cable, with the following characteristics:
- Used in intrabuilding backbone, building backbone, and horizontal installations for riser (OFNR), plenum (OFNP), and general-purpose environments.
  - Available in 6, 12, and 24-fiber counts in a "single jacket" design, and in 36, 48, 72, 96 and 144-fiber counts in a "subunit" design.
  - Sheath markings provide positive identification, quality traceability, and length verification.
  - Cable design and flexible buffer tubes allow for quick breakout and ease of routing.
  - 900µm standards-based color-coded buffer coating protects fibers during handling and allows for easy identification and stripping.
- c. Contractor shall terminate tight buffered cable constructions with LC pigtailed and fusion splices as indicated elsewhere in this document.
- d. Contractor shall bond to ground armor from fiber backbones at both ends as indicated in the grounding section of this document; using armored cable grounding kits listed in the Appendix A grounding section.
- e. See Appendix A for part numbers.

## **C. Cabling Subsystems III - Interbuilding Backbone Fiber**

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### 1. Singlemode Fiber Trunks for Use Between Buildings

- a. In additions to existing Salt Lake County fiber cable plant (brownfield projects), Contractor shall consult with Salt Lake County for fiber requirements.
- b. In new (Greenfield) Salt Lake County projects, backbone fiber running between building telecom spaces shall be Panduit 12/24/48 strand OS1/OS2 singlemode, indoor/outdoor, loose-tube, armored cable, with the following characteristics:
- Allows installation using loose tube cable methods for aerial and duct applications.
  - Gel-free design with water swellable tape provides dry water blocking.
  - All-dielectric construction provides a non-metallic design that eliminates the need to bond or ground for aerial or duct applications, allowing easy access to cable for lower installation costs.
  - UV resistant cable sheathing protects the cable and meets or exceeds the performance requirements of Telcordia

GR-20, Issue 2 and ICEA 640 to withstand harsh outdoor environmental demands.

- Tested in accordance with relevant EIA-455 series FOTPs for fiber optic cables.
  - Complies with RUS 7 CFR 1755.900 requirements for fiber optic service entrance cables.
  - Available in 6, 12, 24, 36, 48, 72, 96 and 144-fiber counts as a “stranded loose tube” design.
  - Medium density polyethylene jacket provides low friction installation.
  - Sheath markings provide positive identification, quality traceability, and length verification.
  - 250µm buffer coating protects fibers during handling and allows for ease of stripping.
- c. Contractor shall bond to ground armor from fiber backbones at both ends as indicated in the grounding section of this document; using armored cable grounding kits listed in the Appendix A grounding section.
- d. Contractor shall terminate loose-tube cable constructions with LC pigtails and fusion splices as indicated elsewhere in this document.
- e. Plenum armored cable shall meet the following physical properties:

### physical properties - plenum

Fiber Count	Cable O.D. Inches (mm)	Installation Bend Radius Inches (cm)	Long-Term Bend Radius Inches (cm)	Cable Weight Lb./kft. (kg/km)
2	0.45 (11.4)	4.5 (11.5)	9.0 (22.9)	81 (120)
4	0.45 (11.4)	4.5 (11.5)	9.0 (22.9)	85 (127)
6	0.47 (11.9)	4.7 (12.0)	9.4 (23.9)	87 (130)
8	0.48 (12.1)	4.8 (12.2)	9.4 (23.9)	91 (135)
12	0.51 (13.0)	5.1 (13.0)	10.2 (25.9)	95 (142)
24	0.58 (14.7)	5.8 (14.8)	11.6 (29.5)	131 (195)
36	0.938 (23.8)	8.0 (20.4)	16.0 (40.7)	167 (248)
48	0.938 (23.8)	8.1 (20.6)	16.2 (41.2)	243 (363)
72	1.052 (26.7)	9.4 (23.9)	18.8 (47.8)	361 (537)
96	1.189 (30.2)	10.9 (27.7)	21.8 (55.4)	511 (760)

- f. Contractor shall bond to ground armor from fiber backbones at both ends as indicated in the grounding section of this document; using armored cable grounding kits listed in the Appendix A grounding section.
- g. See Appendix A for all fiber cable part numbers.

## **D. Fiber Connectivity**

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1. LC Fiber Connectors – Tight-Buffered Fiber
  - a. Tight-Buffered Fiber shall be terminated at the demarcation with fusion splices and LC fiber pigtails having

the following characteristics:

- Available in riser (OFNR) or plenum (OFNP) flame ratings
- Pass all TIA/EIA-568-B.3 performance requirements.
- LC connector housing and boot colors follow TIA/EIA-568-C.3 suggested color identification scheme.
- 100% factory inspected end face geometry in compliance with Telcordia GR-326-CORE, Issue 3.
- Typical insertion loss per connection: 0.25dB.
- UPC polished (55dB minimum return loss).
- Factory terminated and 100% tested for insertion loss and return loss.
- Insertion loss and return loss data recorded for every single mode pigtail.
- Lifetime traceability of test data to a Q.C. number on each patch cord.
- Highest quality flame retardant fiber optic cable with tight-buffered coating on each optical fiber

b. Fusion splices shall be contained in protective splice trays and tray brackets

c. See Appendix A for part numbers.

## 2. LC Fiber Connectors - Loose-tube cable and Fusion Splicing with LC Pigtails

a. Outdoor rated loose-tube fiber shall be terminated at the demarcation with fusion splices and LC fiber pigtails having the following characteristics:

- Available in riser (OFNR) or plenum (OFNP) flame ratings
- Pass all TIA/EIA-568-B.3 performance requirements.
- LC and SC connector housing and boot colors follow TIA/EIA-568-C.3 suggested color identification scheme.
- 100% factory inspected end face geometry in compliance with Telcordia GR-326-CORE, Issue 3.
- Typical insertion loss per connection: 0.25dB.
- UPC polished (55dB minimum return loss).
- Factory terminated and 100% tested for insertion loss and return loss.
- Insertion loss and return loss data recorded for every single mode pigtail.
- Lifetime traceability of test data to a Q.C. number on each patch cord.
- Highest quality flame retardant fiber optic cable with tight-buffered coating on each optical fiber

b. Fusion splices shall be contained in protective splice trays and tray brackets.

c. See Appendix A for pigtail and splice component part numbers.

## 3. Fiber Enclosures

a. Fiber cable terminations shall be contained in 1 RU, 2 RU or 4RU Panduit HD Flex rack mount fiber enclosures.



- b. Contractor shall select enclosure size as needed for the number of fibers projected to be in that telecommunication space when fully populated.
- c. Contractor shall fill any unused enclosure space with a blank cassette.
- d. Intra-building HD Flex fiber enclosures shall have the following attributes:
  - Have sliding trays that lock in two positions, fully out for installation or half out for maintenance
  - Have capacity (density) to contain 144 fiber strands, 72 duplex LC connections per 1 RU.
  - Have the ability to load cassettes into trays from the front or from the rear.
  - Include a split tray design that allows each side of the tray to move independently for redundant systems.
  - Have moveable cassette mounting rails for the ability to configure to either 6 duplex port or 12 duplex port (“doublewide”) cassettes.
  - Have MPO to LC cassettes with integrated (built-in) LC port shutters.
  - Have full line of cassettes and adapter panels (adapter cassettes) to accommodate 2, 8, 12 or 24 fiber connections between devices to accommodate all existing serial or parallel connections.
  - Include in the cassette line “dark fiber mitigation cassettes” that recover and use the dark centermost fibers in a 12 strand trunk for use in 8 strand parallel optics connections.
  - Have LC fusion splice cassettes that feature pre-installed 1 meter fiber pigtails and splice trays within the cassette
- e. See Appendix A for Part Numbers.

**E. Cabling Subsystem 3 – Interbuilding (Between Buildings) Fiber**

- 1. See Appendix A for Part Numbers
- 2. Installation Guideline
  - 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 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.

### 13. Interbuilding Fiber Cable Between Buildings

- a. In additions to existing [Client Name] fiber cable plant (brownfield projects), Contractor shall consult with [Client Name] for fiber requirements.
- b. In new (Greenfield) [Client Name] projects, backbone fiber running between telecom spaces between buildings shall be Panduit 12/24/48 strand OS2 singlemode, indoor/outdoor tight buffered, riser-rated, interlocking armored cable
- c. Backbone fiber cable between buildings shall have the following attributes:
  - Applications include intra-building backbones, building backbones, and horizontal installations for riser (OFCR), plenum (OFCP), and general or harsh environments.
  - Interlocking armored cable Compressive strength (crush) 440 PSI

- Gel-free design with water swellable tape provides dry water blocking
- UV-resistant outer jacket, coupled with dry water-blocking technology, address environmental concerns for outdoor use
- All singlemode cable is available in 6, 12, and 24-fiber counts as a “non-subunitized” design and in 36, 48, 72, and 96-fiber counts (144 for Riser) as a “sub-unitized” design
- Cable available in both riser rated and plenum rated version for deployment in any inside plant fire-code application
- Sheath markings provide positive identification, quality traceability, and length verification.
- Cable design and flexible buffer tubes allow for quick breakout and ease of routing.
- 900µm standards-based color-coded buffer coating protects fibers during handling and allows for easy identification and stripping.
- The fiber must comply with the ITU G657.A1 or G657.A2 fiber specification. This fiber shall be bend insensitive and have zero water peak
- Opti-Core® Fiber Optic Indoor/Outdoor Riser (OFCR) and Plenum (OFCP) Rated Cable with tight buffered fibers are tested in accordance with Telcordia GR-20, Issue 2, GR-409 and with relevant EIA/TIA-455 series FOTPs for fiber optic cable
- All Panduit Opti-Core® fiber cable is ROHS compliant
- Temperature range: Shipping/Storage: (Riser) -40 °F to +176 °F (-40 °C to +80 °C), (Plenum) -40 °F to +176 °F (-40 °C to +80 °C); Installation: (Riser) +14 °F to +140 °F (-10 °C to +60 °C) (Plenum) +32 °F to +140 °F (0 °C to +60 °C); Operation: (Riser) -40 °F to +176 °F (-40 °C to +80 °C) (Plenum) -40 °F to +176 °F (-40 °C to +80 °C)

#### 14. Fiber Connectors

- a. Interbuilding fiber connections shall be fusion spliced in an HD Flex Splice Cassette for singlemode fibers with pre-installed OS2 singlemode LC pigtails
- b. Interbuilding fiber splice cassettes shall have the following attributes:
  - Available with preloaded 12-fiber OS2 LC pigtail with 12 splice sleeves
  - Able to house splices and fiber slack within the cassette
  - 6-port duplex LC adapters in blue with zirconia sleeves
  - LC Duplex Adapters shall contain integral shutters to help prevent contamination
  - Meet TIA/EIA-568C.3 A.4.9 Durability: 500 mating cycles

#### 15. Fiber Enclosures (Distributor C)

- a. Fiber cable terminations shall be contained in 1 RU, 2 RU or 4 RU Panduit HD Flex rack mount fiber enclosures.
- b. Contractor shall select enclosure size as needed for the number of fibers projected to be in that telecommunication space when fully populated.

- c. Contractor shall fill any unused enclosure space with a blank cassette.
- d. Interbuilding HD Flex fiber enclosures shall have the following attributes:
  - Have sliding trays that lock in two positions, fully out for installation or half out for maintenance.
  - Have capacity (density) to contain 144 fiber strands, 72 duplex LC connections per 1 RU.
  - Have the ability to load cassettes into trays from the front or from the rear.
  - Include a split tray design that allows each side of the tray to move independently for redundant systems.
  - Have moveable cassette mounting rails for the ability to configure to either 6 duplex port or 12 duplex port (“doublewide”) cassettes.
  - Have MPO to LC cassettes with integrated (built-in) LC port shutters.
  - Have full line of cassettes and adapter panels (adapter cassettes) to accommodate 2, 8, 12 or 24 fiber connections between devices to accommodate all existing serial or parallel connections.
  - Include in the cassette line “dark fiber mitigation cassettes” that recover and use the dark centermost fibers in a 12 strand trunk for use in 8 strand parallel optics connections.
  - Have LC fusion splice cassettes that feature pre-installed 1 meter fiber pigtailed and splice trays within the cassette

16. Fiber Patch Cords (jumpers)

- a. Fiber patch cords (jumpers) for patching fiber links between buildings shall have the following attributes:
  - Push-Pull LC Duplex Fiber Optic Patch Cords shall feature the push-pull strain relief boot and duplex clip, to allow users easy accessibility in tight areas when deploying very high density LC patch fields.
  - Jumpers shall be available in OM3, OM4 and OS1/OS2 and be available in in riser (OFNR), plenum (OFNP), and low smoke zero halogen (LSZH) rated jacket materials

17.

- 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 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.

#### 18. Interbuilding Fiber Cable Between Buildings

- a. In additions to existing [Client Name] fiber cable plant (brownfield projects), Contractor shall consult with [Client Name] for fiber requirements.
- b. In new (Greenfield) [Client Name] projects, backbone fiber running between telecom spaces between buildings shall be Panduit 12/24/48 strand OS2 singlemode, indoor/outdoor tight buffered, riser-rated, interlocking armored cable
- c. Backbone fiber cable between buildings shall have the following attributes:
  - Applications include intra-building backbones, building backbones, and horizontal installations for riser (OFDR), plenum (OFDR), and general or harsh environments.
  - Interlocking armored cable Compressive strength (crush) 440 PSI

- Gel-free design with water swellable tape provides dry water blocking
- UV-resistant outer jacket, coupled with dry water-blocking technology, address environmental concerns for outdoor use
- All singlemode cable is available in 6, 12, and 24-fiber counts as a “non-subunitized” design and in 36, 48, 72, and 96-fiber counts (144 for Riser) as a “sub-unitized” design
- Cable available in both riser rated and plenum rated version for deployment in any inside plant fire-code application
- Sheath markings provide positive identification, quality traceability, and length verification.
- Cable design and flexible buffer tubes allow for quick breakout and ease of routing.
- 900µm standards-based color-coded buffer coating protects fibers during handling and allows for easy identification and stripping.
- The fiber must comply with the ITU G657.A1 or G657.A2 fiber specification. This fiber shall be bend insensitive and have zero water peak
- Opti-Core® Fiber Optic Indoor/Outdoor Riser (OFCR) and Plenum (OFCP) Rated Cable with tight buffered fibers are tested in accordance with Telcordia GR-20, Issue 2, GR-409 and with relevant EIA/TIA-455 series FOTPs for fiber optic cable
- All Panduit Opti-Core® fiber cable is ROHS compliant
- Temperature range: Shipping/Storage: (Riser) -40 °F to +176 °F (-40 °C to +80 °C), (Plenum) -40 °F to +176 °F (-40 °C to +80 °C); Installation: (Riser) +14 °F to +140 °F (-10 °C to +60 °C) (Plenum) +32 °F to +140 °F (0 °C to +60 °C); Operation: (Riser) -40 °F to +176 °F (-40 °C to +80 °C) (Plenum) -40 °F to +176 °F (-40 °C to +80 °C)

#### 19. Fiber Connectors

- a. Interbuilding fiber connections shall be fusion spliced in an HD Flex Splice Cassette for singlemode fibers with pre-installed OS2 singlemode LC pigtails
- b. Interbuilding fiber splice cassettes shall have the following attributes:
  - Available with preloaded 12-fiber OS2 LC pigtail with 12 splice sleeves
  - Able to house splices and fiber slack within the cassette
  - 6-port duplex LC adapters in blue with zirconia sleeves
  - LC Duplex Adapters shall contain integral shutters to help prevent contamination
  - Meet TIA/EIA-568C.3 A.4.9 Durability: 500 mating cycles

#### 20. Fiber Enclosures (Distributor C)

- a. Fiber cable terminations shall be contained in 1 RU, 2 RU or 4 RU Panduit HD Flex rack mount fiber enclosures.
- b. Contractor shall select enclosure size as needed for the number of fibers projected to be in that telecommunication space when fully populated.

- c. Contractor shall fill any unused enclosure space with a blank cassette.
- d. Interbuilding HD Flex fiber enclosures shall have the following attributes:
  - Have sliding trays that lock in two positions, fully out for installation or half out for maintenance.
  - Have capacity (density) to contain 144 fiber strands, 72 duplex LC connections per 1 RU.
  - Have the ability to load cassettes into trays from the front or from the rear.
  - Include a split tray design that allows each side of the tray to move independently for redundant systems.
  - Have moveable cassette mounting rails for the ability to configure to either 6 duplex port or 12 duplex port (“doublewide”) cassettes.
  - Have MPO to LC cassettes with integrated (built-in) LC port shutters.
  - Have full line of cassettes and adapter panels (adapter cassettes) to accommodate 2, 8, 12 or 24 fiber connections between devices to accommodate all existing serial or parallel connections.
  - Include in the cassette line “dark fiber mitigation cassettes” that recover and use the dark centermost fibers in a 12 strand trunk for use in 8 strand parallel optics connections.
  - Have LC fusion splice cassettes that feature pre-installed 1 meter fiber pigtailed and splice trays within the cassette

#### 21. Fiber Patch Cords (jumpers)

- a. Fiber patch cords (jumpers) for patching fiber links between buildings shall have the following attributes:
  - Push-Pull LC Duplex Fiber Optic Patch Cords shall feature the push-pull strain relief boot and duplex clip, to allow users easy accessibility in tight areas when deploying very high density LC patch fields.
  - Jumpers shall be available in OM3, OM4 and OS1/OS2 and be available in in riser (OFNR), plenum (OFNP), and low smoke zero halogen (LSZH) rated jacket materials
- a.

#### F.

- a. Installation Guidelines
- b.
- c. See Appendix A for Part Numbers
- d.

#### 2. Fiber Patch Cord (jumpers)

- a. Fiber patch fields within [Client Name] facilities shall utilize riser rated multimode “push/pull” fiber jumpers (fiber patch cords)
- b. Fiber patch cords (jumpers) for intrabuilding fiber shall have the following attributes:
  - Push-Pull LC Duplex Fiber Optic Patch Cords shall feature the push-pull strain relief boot and duplex clip, to allow users easy accessibility in tight areas when deploying very high density LC patch fields.
- a. Jumpers shall be available in OM3, OM4 and OS1/OS2 and be available in in riser (OFNR), plenum (OFNP), and low smoke zero halogen (LSZH) rated jacket materials.

- b. See "Appendix A" for part numbers.

## **G. Cable Pathways – Fiber & Copper**

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### 1. Cable Pathways

- a. Pathways shall be comprised of 24" Wyr-Grid to which is affixed separate 24"X4" FiberRunner® for segregation of fiber and copper cables. FiberRunner® shall be mounted above or to the side of the Wyr-Grid, as appropriate for that installation.

### 2. FiberRunner® fiber pathway

- a. Fiber routing system shall be a system of channel, fittings, covers, and brackets designed to segregate, route, and protect fiber optic cables. Available in 2x2, 4x4, 6x4, 12x4 and 24x4
- b. Channel and fittings shall be installed using pre-assembled couplers
- c. Fittings maintain a minimum 3" bend radius to protect against signal loss due to excessive cable bends
- d. QuikLock™ Couplers shall require no bolts to be tightened and no tools are required when installing the QuikLock™ Couplers; ready to use right from the package; speeds installation and reduces cost
- e. Available system colors shall be yellow, orange, and black
- f. Brackets shall be available for attaching system components to 1/2" threaded rod
- g. See Appendix A for part numbers

### 3. Overhead Metallic Copper Cable Pathway

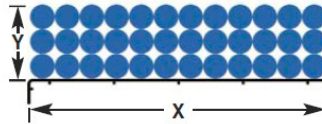
- a. Copper cable delivery over racking systems in telecommunications rooms shall be done with Wyr-Grid® overhead cable tray routing system.
- b. Any pathway offered must have the following properties:
  - Wyr-Grid® Pathways are provided in four widths: 12" (305mm), 18" (457mm), 24" (610mm), and 30" (762mm).
  - Wyr-Grid® System incorporates non-integral snap-on sidewalls which minimize specification requirements and are offered in three different heights: 2" (50mm), 4" (102mm), and 6" (152mm).
  - Wyr-Grid® Splice Connectors have an integral bonding screw that creates a mechanical-electrical bond between cable tray pathway sections.
  - Wyr-Grid® Waterfalls are offered in two different configurations that attach to all pathway sections: 12" (305mm), 18" (457mm), 24" (610mm), and 30" (762mm) to facilitate bend radius control and cable management.
  - Wyr-Grid® Support Brackets are offered in various widths to accommodate pathways: 12" (305mm), 18" (457mm), 24" (610mm), and 30" (762mm); have integral quick-clip retention; accommodate 1/2" or 12 mm threaded rods.
- c. All metallic cable trays must be grounded and all sections bonded in accordance with listing requirements



for the particular type of system and per TIA 607 including most recent revisions, TSB and addenda.

- d. Contractor is responsible sizing all pathways to represent no more than a 35% fill upon installation per manufacturer's fill chart below:

### Wire Fill for Wyr-Grid® Overhead Cable Tray Routing System



X (in.)	Y (in.)	Internal Area (in <sup>2</sup> )	Category 6A (SD) Diameter 6.1mm 0.240"	Category 6A Diameter 7.6mm 0.300"	Category 6 Diameter 6.1mm 0.240"	X (in.)	Y (in.)	Internal Area (in <sup>2</sup> )	Category 6A (SD) Diameter 6.1mm 0.240"	Category 6A Diameter 7.6mm 0.300"	Category 6 Diameter 6.1mm 0.240"
12.2	2	24.3	269	172	269	24.2	2	48.3	534	342	534
	4	48.7	538	344	538		4	96.7	1069	684	1069
	6	73.0	807	516	807		6	145.0	1603	1026	1603
18.2	2	36.3	401	257	401	30.2	2	60.3	666	427	666
	4	72.7	804	514	804		4	120.7	1334	854	1334
	6	109.0	1205	771	1205		6	181.0	2000	1280	2000

"Y" equates to the height of the Wyr-Grid® Optional Sidewalls. The internal area defines the allowable fill capacity based on the Wyr-Grid® Pathway width and optional sidewall height. The Wyr-Grid® Pathway cable fill is based on NEC allowable fill of 50%. The above cable diameters represent the nominal Panduit cable diameter per performance level.

- e. All cable trays and grounding conductors should be clearly marked in accordance with manufacturer's instructions, applicable codes, standards and regulations.
- f. Contractor shall take care to segregate and protect armored fiber from copper cabling in metallic pathway.
- g. Bundled copper and fiber backbones shall be dressed to maintain segregation of cable types throughout the pathway. Innerduct or separate fiber duct is not necessary due to armored construction on fiber backbone.
- h. See Appendix A for part numbers.

## 2. J-Hooks

- a. Bundles of 120 Category 6 cables or less may be required to be routed above ceilings using J-hooks. Check project documentation for clarification.
- b. J-hook systems used by Salt Lake County shall be Panduit "J-Pro" series.
- c. Contractor installing J-hook systems shall space them no more than 5 feet apart as per TIA 569-C standard.
- d. Contractor is responsible for proper sizing of J-hook systems based upon cable count and manufacturers recommendations for fill, with new J-hooks to have not more than 30% fill per manufacturer's fill charts based upon projected worst case future bundle size.
- e. If J-hooks are deemed too small by above criteria, Contractor shall bring this to the attention of Salt Lake County for resolution in writing. J-hook pathways that will not have sufficient capacity should be replaced in the design with the proper sized basket tray for future cable additions and flexibility.
- f. J-hook systems used by Salt Lake County shall have the following properties:

- Patented design provides complete horizontal and vertical 1" bend radius control that helps prevent degradation of cable performance.
- UL 2043 and CAN/ULC S102.2 listed and suitable for use in air handling spaces.
- Pre-riveted assemblies allow for attachment to walls, ceilings, beams, threaded rods, drop wires and underfloor supports to meet requirements of a variety of applications.
- Wide cable support base prevents pinch points that could cause damage to cables.
- Cable tie channel allows user to easily install 3/4" (19.1mm) Tak-Ty® Cable Ties to retain cable bundle.
- Durable non-metallic J Hook materials provide the ability to manage and support a large number of cables.
- Material: Black Nylon 6.6 J Hook with metal attachments.

g. See Appendix A for part numbers.

## H. Racks and Rack-mount Cable Managers

1. County approved racks and wire managers: all cabinets must have min 32-inch useable Depth

Panduit	WME3BL	42" H x 28.6" W x 9.5" D
Panduit	WME6BL	42" H x 28.6" W x 14.8" D
Panduit	WME9BL	42' H x 28.6" W x 20" D
Panduit	PR2VD10*	Front and back vertical cable manager, includes four PRSP7 slack spools. Dimensions: 83.9"H x 10.0"W x 16.4"D (2131mm x 254mm x 417mm)
Panduit	PR2VD08*	Front and back vertical cable manager, includes four PRSP7 slack spools. Dimensions: 83.9"H x 8.0"W x 16.4"D (2131mm x 203mm x 417mm)
Panduit	PR2VD06*	Front and back vertical cable manager, spools are not included. Dimensions: 84"H x 6"W x 16.4"D (2133.6mm x 152.4mm x 416.6mm)

d. All racks shall be outfitted with a vertical grounding busbar along one rail, with all equipment bonded to ground according to TIA 607-B Bonding and Grounding Standard. See Bonding and Grounding section of this document for details.

e. See Appendix A for part numbers.

2. Rack-mounted Cable Management – Vertical Managers

- a. Vertical cable managers shall be PatchRunner™ Vertical Cable Management System in size 6" wide.
- b. Contractor will use double sided (front and back) vertical managers on 2-post racks.
- c. Contractor shall choose vertical cable manager width according to manufacturer's fill tables to not represent more than a 35% fill at installation based on projected worst-case density when racks are fully populated.
- d. Part numbers are listed in Appendix A.

### 3. Rack-mounted Cable Management – Horizontal Managers

- a. Angle patch panels largely the need for horizontal cable managers, but there still may be instances requiring them. One example is in the network core where chassis switches are used.
- b. For these areas requiring horizontal cable managers, Contractor shall use double-sided NetRunner™ High Capacity Horizontal Cable Managers or PatchRunner™ series (for front access applications only) having the following features:
  - Innovative inset fingers slope inward toward back of managers offering unobstructed access to network cabling for easier moves, adds, and changes.
  - Large front finger openings easily accommodate Category 6A and 10 GbE cables, speeding installation and reducing maintenance costs.
  - Rear cable management finger spacing utilizes open D-rings for greater accessibility.
  - Can be used to create large capacity horizontal pathways for routing cable.
  - Patented front and rear dual hinged cover allows cable access without removing cover. (PatchRunner™ 2 series is front access only).
  - Curved surfaces maintain cable bend radius.
  - Pass-through holes allow for front to rear cabling.
  - Built in cable retainers hold cable in place for easy moves, adds, and changes.
  - Mount to 19" EIA racks and cabinets.
  - Covers, #12-24 and M6 mounting screws included.
- c. See Appendix A for part numbers.

## **I. Cable Accessories**

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### 1. Cable Ties

- a. Cable bundles on racks and in pathways shall be bundled with re-enterable hook and loop cable ties that come in continuous rolls. (We do not allow plastics Ties)
- b. Contractor is responsible for using plenum hook and loop ties in air-return spaces.
- c. See "Appendix A" for part numbers.

## 2. Physical Security Devices

- a. Some portions of Salt Lake County 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.
- c. See Appendix A for part numbers.

## **J. Communications Grounding Network**

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### 1. General

- a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA 607-B Standard.

### 2. Room Busbars

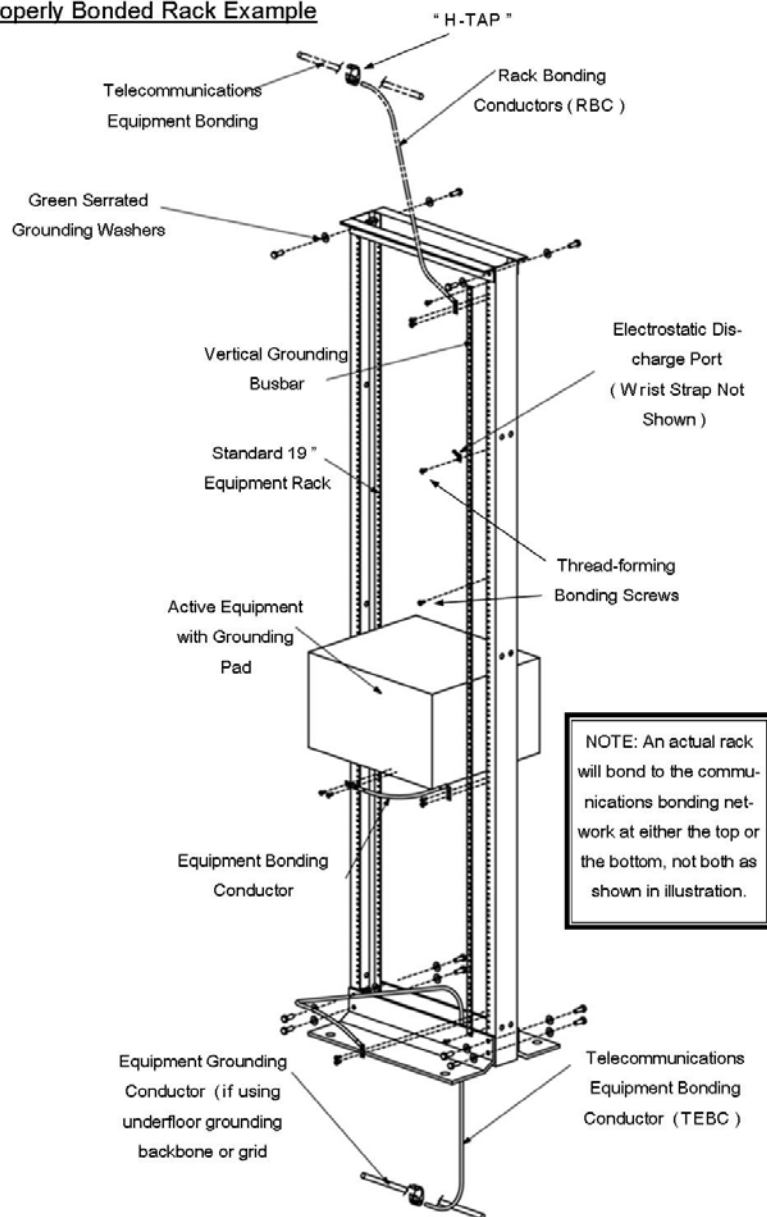
- a. All Telecommunications spaces and distributor rooms shall have installed an appropriately sized wall-mount busbar with BICSI hole spacing that bonds to the building bonding backbone.
- b. See Appendix A for appropriate room telecommunications grounding busbar.

### 3. Rack and Equipment Grounding

- a. 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-B standard.
- b. All newly installed racks and cabinets shall have installed a vertical busbar mounted along one equipment rail to serve as a clean, low-resistance bonding place for any equipment not equipped with a designated grounding pad.
- c. 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.
- d. 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.
- e. 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.
- f. 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.
- g. 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.

- h. 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.
- i. 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.
- j. Armored cables shall be properly bonded to the earthing system on both ends with a kit built to that purpose.
- k. For examples of rack grounding refer to the illustrations below:

**Properly Bonded Rack Example**



<END OF SECTION>

## IV. Network Labeling

### A. General Requirements

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1. Additions to brownfield (legacy) systems within Salt Lake County shall match the labeling convention in place at that location unless otherwise instructed by the project documentation.
2. All new installations shall be based on the guidelines on the ANSI/TIA 606-B standard, as well as, these general requirements listed below:
  - a. All newly installed cable and associated apparatus shall be labeled according to the guidelines in ANSI/TIA 606-B, or the most the most recent revision of this standard.
  - b. Labels shall be legible and placed in a position that ensures ease of visibility.
  - c. All newly installed cables shall be labeled within 12 inches at both ends using a permanent self-laminating cable labels built to that purpose, and designed to outlive the cable to which they attach.
  - d. All labels shall be machine printed, bold font and centered at the highest point that can fit all characters legibly.
  - e. Contractor shall, wherever possible pre-print labels using a laser jet printer.
  - f. A hand-held thermal transfer printer shall be used on site to print labels that were unanticipated, or that become damaged in application.
  - g. 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 requirements in standards cited herein.
  - h. Labeled cabling elements shall use designators (names) that identify their location within the cable system infrastructure.
  - i. Contractor shall record all labeling information on the as-built drawings, and all test documents shall reflect the appropriate labeling designators
  - j. Hand written labels will not be accepted and must be remedied at Contractors expense.
  - k. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
  - l. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.
  - m. All labels will be permanently affixed to all labeled elements, including, but not limited to, all installed cables, patch panels, racks, cabinets, and enclosures.
  - n. Conduit shall be marked indicating the identification of the cable within.
  - o. Information contained in the designator (element name) shall be crafted to contain location information to facilitate circuit tracing and trouble-shooting. The information necessary depends upon the size of the facilities being labeled.

### 3. How much information per label?

- a. It is not necessary to include every part of an identifier on a label. Information obvious to the user may be omitted.
  - For instance, when printing a rack label, it is not necessary to include the building number, telecom space number since the person knows in what building and room they are in.
  - Omitting unnecessary repetition where possible makes shorter, more realistic designators that will more easily fit on a label field.

## **B. Labeling Terms**

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1. Element – Element is the generic term for parts of a cabling system and associated infrastructure that must be labeled. For instance, Telecommunications Spaces are elements. Telecommunications Grounding Busbars are elements. Cabling Sub-system 1 (horizontal) are elements.
2. Component – An infrastructure component is an individual device in the cabling system or associated infrastructure that must be named and labeled with a unique identifier.
3. Identifier – An identifier is the name given to an element that is used on labels, in records and reports. Ideally an identifier should “encode” and incorporate information on the element location, and its relationship to other spaces and elements in the system. An identifier may also be referred to as the component’s name or “designator”.
4. Records – Records are collection of information about the system identifiers, how the system is laid out, and may contain other information like link test results.
5. Telecommunications Space – “Telecommunications Space” is the name for a room containing cabling patch systems. Often referred to in documentation as a “TS” (telecommunications space) or “TR” (telecommunications room).
6. Telecommunications Distributors – “Distributor” is a copper or fiber optic patching devices. These are usually patch panels in the case of copper. Optical patch fields usually have boxes or enclosures mounted behind the patch field to contain slack.
7. Equipment Outlets – The term “Equipment Outlet” (EO) is synonymous with Work Area Outlet and is usually a mounting appliance for connections, either faceplates or surface boxes.

## **C. Class of Facilities to be Administered**

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### 1. General

- a. The ANSI/TIA 606-B labeling standard divides facilities into four “Classes” of dependent upon size and complexity. This allows for the systematic listing of all components that must be labeled in each size, or “Class” of facility.
- b. Classes range from single floor, single telecom space installations, to multiple campuses located in different cities.



- c. Standards compliant labeling should ideally be able to scale as premises grow from smaller class facilities to larger class facilities, without having to rework the naming and labeling conventions originally put in place prior to growth.
- d. The description for each Class include the components to be labeled, identifiers, and records are listed below.

## 2. Class 1 Facilities

- a. Class 1 addresses the administration needs of a premise that is served by a single telecommunication space (TS) containing its telecommunications equipment.
- b. Required in Class 1 administration are identifiers for the TS, the telecommunications main grounding busbar (TMGB), and all elements of the horizontal links.
- c. For a copper, horizontal link, the elements to be labeled include:
  - The connecting hardware (e.g., patch panel port or the section of a punch down block terminating a four-pair horizontal cable, or fiber patch fields in the case of fiber-to-the-desk).
  - A four-pair horizontal cable, or fiber horizontal cable.
  - A telecommunications outlet/connector terminating a four-pair horizontal cable or fiber cable in the work area.
- d. If a consolidation point (CP) is present, the elements to be labeled include:
  - The segment of four-pair horizontal cable extending from the TS to the CP connecting hardware.
  - The CP connecting hardware or section of a punchdown block terminating a four-pair horizontal cable.
  - The segment of four-pair horizontal cable extending from the CP connecting hardware to the outlet/connector of a multi-user telecommunications outlet assembly (MUTOA) or to the work area outlet.
- e. If a MUTOA is present, the elements to be labeled include:
  - A telecommunications outlet/connector in the MUTOA.
- f. For an optical fiber, horizontal link, the elements include:
  - A pair of optical fiber terminations on a patch panel in the TS.
  - A pair of optical fibers in the fiber cable.
  - A pair of optical fiber terminations in the work area (equipment outlet).
  - A telecommunications outlet/connector terminating a pair of optical fibers in the work area.
- g. If a consolidation point (CP) is present, the elements to be labeled include:
  - The segment of optical fiber cable extending from the TS (telecommunications space) to the CP connecting hardware.
  - The CP connecting hardware or section terminating a pair of optical fibers.
  - The segment of optical fiber cable extending from the CP connecting hardware to the outlet/connector of a multi-user telecommunications outlet assembly (MUTOA) or to the work area outlet.

### 3. Class 2 Facilities

- a. Class 2 administration provides for telecommunications infrastructure administration needs of a single building or tenant that is served by a single or multiple TSs within a single building.
- b. Class 2 administration includes all elements of Class 1 administration, plus identifiers for:
  - Backbone cabling.
  - Multiple-element grounding and bonding systems.
  - Firestopping.

### 4. Class 3 Facilities

- a. Class 3 administration addresses the needs of a campus, including its buildings and outside plant elements.
- b. Class 3 administration includes all elements of Class 2 administration, plus:
  - Identifiers for buildings and interbuilding cabling.
  - Administration of pathways and spaces.
  - Outside plant elements.

### 5. Class 4 Facilities

- a. Class 4 administration addresses the needs of a multi-site system.
- b. Class 4 administration includes all elements of class 3 administration, plus:
  - An identifier for each site.
  - Identifiers for wide area network connections.

## **D. Telecommunications Spaces (Rooms)**

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### 1. General

- a. Contractor shall assign an identifier to each TS (telecommunication space) that is unique within the building.
- b. The TS identifier should follow the TIA 606 suggested format "F" where F represents the Floor number
- c. An example in the F (floor) format is shown below:

**4**

- d. In this example, 4 indicates the 4th floor in the building,

## **E. Identifiers for Racks and Cabinets**

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### 1. General

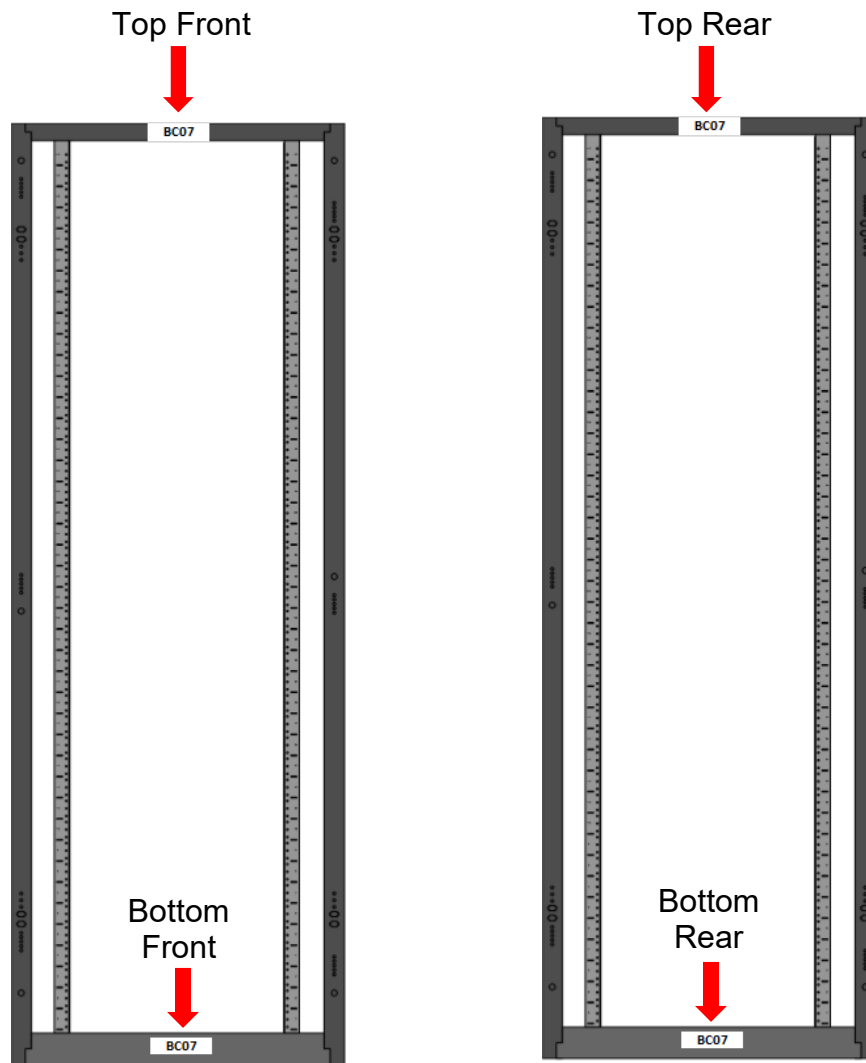
- a. Contractor shall use the following method for identifying racks and cabinets in Telecommunications Spaces:
  - The Floor/Rack Method
- b. Consult project documentation for which identification method do use on specific projects.
- b. The floor/rack location is based on which floor the room resides on.
- c. A typical Floor/rack label would have the following scheme:

**1 A**

- d. This identifier would define that the cabinet/rack is located on the first floor and rack A
- e. Cabinets and racks should have location labels applied to the top and bottom of both the front and rear to have a label easily visible from any position around the rack or cabinet.
- f. These labels should be visible whether or not doors are closed or opened on the cabinets.

### 4. Rack/Cabinet Label Position

- a. Contractor shall affix rack/cabinet labels depicting the unique identifier at both the top and bottom of the front and back of each rack/cabinet.
- b. Cabinet labels shall be visible whether cabinet doors are opened or closed.



Place labels at the top and bottom, both front and rear of racks/cabinets

#### F. Multi-strand Fiber Assemblies

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1. In modular fiber cassette “plug and play” systems, multi-fiber (MPO) trunk between cassettes shall have identifiers that list the ports associated with the strands at either end as shown in the example below:

**RF11-C:B ports 01-06/AE10-D:A ports 01-06**

2. This example is interpreted as LC duplex ports 1 through 6, in cassette B, in panel C in rack RF11, connecting to LC duplex ports 1 through 6, in cassette A in panel D in rack AE10.

3. In multi-stand fiber (MPO) assemblies between cassette enclosures, whichever port is closest to the system core (main crossconnect) shall be listed first in the identifier. If both are equidistant to the core, then the lowest alphanumeric identifier shall be listed first.

## G. Equipment Outlet Labels

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### 1. General

- a. Equipment outlets do not necessarily need a unique identifier for the work area appliance (faceplate or surface box), but may instead simply label the equipment outlet ports with the patch port to which it connects in the TS (telecommunications space).
- b. Identifying the EO port by its associated patch port makes sense since a link failure is nearly always first noticed by the end user at the EO, who can then guide the technician where to begin troubleshooting in the TS by simple reading off the number above the EO port.

### 2. EOs in Class 1 Facilities

- a. Identifying EO ports by the identifiers of the patch ports to which they connect make sense in smaller installations where it is generally known which TS serve which EOs. An example of this labeling strategy is shown below:



- b. Here the identifier in the upper left port indicates that it connects back to floor 1 patch panel A ports 1 through 4
- c. Identifying the EO port by its associated patch port makes sense since a link failure is nearly always first noticed by the end user at the EO, who can then guide the technician where to begin troubleshooting in the TS by simple reading off the number above the EO port.
- c. Consult County IS for exact EO identifications strategies on a specific project.
- d. Patch panels shall be labeled as followed  
Odd numbers on top starting with 1 left to right                    1 3 5 7  
Even numbers on bottom starting with 2 left to right                2 4 6 8  
Label according to floor and patch panel.

Example 1A24 1 represents floor, A represent top patch panel, 24 represents the port number.

Example 2B13 2 represents the second floor, B represents the 2-patch panel, 13 represent the port.

e.

## H. Other Systems to Be Labeled

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### 4. Pathways

- a. Cable Pathways are identified with information that defines routing of the cables contained in a pathway.
- b. This information is useful to determine which pathway connects between which telecom spaces.
- c. Locating the proper pathway is necessary to remove, add, or repair a cable in the infrastructure.
- d. A typical pathway label would have information in the following scheme:

**4B/4C**

- e. This identifier would be decoded to define that the pathway connects between telecommunications rooms B and C on floor 4.

### 5. Grounding Systems

- a. Labeling of the grounding and bonding system involves the identification of the main grounding busbar, grounding busbars, conductors connecting busbars, conductors connecting devices to busbars, and equalizing conductors.
- b. The typical scheme for the main grounding busbar would be:

**1-B301-TMGB**

- c. This identifier can be decoded to define that this is the main telecommunications grounding busbar located on floor 1 in space B301.
- d. The typical scheme for a grounding busbar would be:

**2-R201-TGB**

- e. This identifier can be decoded to define that this is the telecommunications grounding busbar on floor 2 in space R201.
- f. The typical scheme for the busbar connections would be:

**1-B301-TMGB/2-R201-TGB**

- g. This identifier can be decoded to define that this is the conductor that connects the main telecommunications grounding busbar located on floor 1 in space B301 to the telecommunications grounding busbar on floor 2 in space R201.

### 6. Firestopping

- a. Each firestopping location shall be labeled at each location where firestopping is installed, on each side

of the penetrated fire barrier, within 12 inches (300mm) of the firestopping material.



- b. A typical firestopping label would have information in the following scheme:

**1-FSL01(2)**

- c. This identifier would be decoded to define that this is firestopping location number 01 on the first floor and that the firestopping has a two-hour rating.

<END OF SECTION>

## V. Testing and Acceptance

### A. General

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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®™ System Warranty guidelines and best industry practice.
5. 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 Link Testing**

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1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA 1152 and ANSI/TIA 568-C.2 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 the more stringent.
3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime tester is left unused for more than two hours.
4. For warranty purposes, Contractor shall perform the appropriate Permanent Link test. Channel Link testing is rendered void by the movement of patch cords and can be run but not used for final acceptance criteria.

## **C. Fiber Testing**

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1. All installed fiber shall be tested for link-loss in accordance with ANSI/TIA-C.0 and shall be within limits specified within ANSI/TIA-C.3, or as spelled out in the project documentation.
2. For horizontal cabling system using multimode optical fiber, attenuation shall be measured in one direction at either 850 nanometer (nm) or 1300 nm using an LED light source and power meter.
3. 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.
4. Backbone single-mode fiber cabling shall be tested at the 1310 and 1550 wavelengths in both directions.
5. Test set-up and performance shall be conducted in accordance with ANSI/568-C.0 standard, Method B.
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 with a power



meter is required. The contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above.

7. The values for calculating loss shall be those defined in the ANSI/TIA 568-C.3 Standard. If the link loss requirements defined within the standard are in conflict with those referenced in the project documentation, Contractor shall immediately bring this to the attention of Information Technologies for resolution.

#### **D. System Documentation**

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1. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to Salt Lake County for approval. Documentation shall include the items detailed in the sub-sections below.
2. 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. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase.
3. Contractor shall submit with drawings a diagram of each telecommunications room with indicating which cabling drops will terminate in which rooms (classrooms). This is both to give an idea of contractor cable plant design, as well as to facilitate future troubleshooting.
4. At the request of the Information Technologies Engineer, the telecommunications contractor shall provide copies of the original test results in tester native format, not spreadsheet.
5. Information Technologies 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. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by Information Technologies, including a 100% re-test. This re-test shall be at no additional cost to the Salt Lake County.

#### **E. Test Results**

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1. Documentation shall be provided in electronic format within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year).
2. The results shall 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). Documentation shall also include test equipment name, manufacturer, model number, serial number, software version and last factory calibration date.

3. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation.
4. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
5. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form.
6. The media shall contain the electronic equivalent of the test results as defined by the specification along with the software necessary to view and evaluate the test reports.
7. 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.
8. 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.
9. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. Salt Lake County will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added.
10. These documents will be modified accordingly by the Telecommunications Contractor to denote as-built information as defined above and returned to the Salt Lake County.
11. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

<END OF SECTION>

## Appendix A – Materials List

Manufacturer	Part Number	Description
		<b>COPPER DISTRIBUTION</b>
Panduit	<b>PUP6AV04BU-G</b>	Category 6A, plenum (CMP), LP Rated, 4-pair, UTP copper cable
General	<b>7141849</b>	Gen <b>SPEED</b> ® 10 MTP™ Category 6A Cable, plenum rated – blue jacket
Belden Cable	<b>10GXS13 D151000</b>	Plenum rated blue jacket Cat 6A
Panduit	<b>CFPSL*WHY</b>	MiniCom Classic series single gang sloped vertical faceplate accepts two Mini-Com Modules, includes label and cover. Replace * with required ports.
Panduit	<b>CFPSL4WHY</b>	MiniCom Classic series single gang sloped vertical faceplate accepts two Mini-Com Modules, includes label and cover.
Panduit	<b>CFPSL6Why</b>	MiniCom Classic series single gang sloped vertical faceplate accepts two Mini-Com Modules, includes label and cover.
Panduit	<b>CFPL*WHY</b>	Classic Series, Single gang, vertical faceplate with labels, available in 1,2,3,4 and 6 ports accepts Mini-Com® Modules, replace “*” with required ports
Panduit	<b>CFPL4IWY</b>	Single gang, vertical faceplate accepts four Mini-Com® Modules
Panduit	<b>CFPL6IWY</b>	Single gang, vertical faceplate accepts six Mini-Com® Modules
Panduit	<b>CMB*-X</b>	Mini-Com blank module to blank out open spaces (holes) on faceplates and patch panels. “*” International White, “IW” with BL (Black) with EI (Electric Ivory), WH (White),
Panduit	<b>CBXJ2*-A</b>	Surface mount box accepts one or two Mini-Com® Modules; includes built-in removable blank to add a second module. Dimensions: 0.91"H x 1.77"W x 2.44"L (23.11mm x 44.96mm x 61.98mm). Knockout provides opening of 0.47"H x 0.36"W. “*” International White, “IW” with BL (Black) with EI (Electric Ivory), WH (White)
General Cable	<b>2131752E</b>	25 pair, plenum rated, Category 5E cable – gray. riser cable only
Panduit	<b>CPPA48FMWBLY</b>	48-port angled modular patch panel in black is supplied with rear-mounted faceplates
Panduit	<b>CJ6X88TGBL CJ6X88TGGR</b>	Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module. GREEN
Panduit	<b>CJLRCAPIW-X</b>	Category 6 45° angled left/right TG wire cap provides improved cable routing to jacks in confined spaces. For use with the TGSJT Termination Tool. 10 pk.
Panduit	<b>CJLRCAPBU-X</b>	Category 6A 45° angled left/right TG wire cap provides improved cable routing to jacks in confined spaces. For use with the TGSJT Termination Tool. 10 pk
Panduit	<b>FP6X88MTG</b>	The TX6A™ Category 6A UTP Field Term RJ45 Plug is a simple-to-attach plug for field termination of 4-pair unshielded twisted pair cable
Panduit	<b>FC-ICCP*MBU</b>	The Category 6A UTP FieldCord easily connects network devices, especially those with limited space for cords or RJ45 plugs, to network cabling. The FieldCord assembly combines a compact RJ45 plug, a 1.0 meter length of Category 6A UTP Plenum-rated 23AWG cable, and an in-line field-terminable connector for mating to 4-pair 100-ohm UTP twisted pair cabling. Blue cable color. Replace * with 0.5, 1, 3, For White color replace “B” with “WH”

Panduit	<b>UTP28X*BU</b>	Category 6A/Class EA, UTP, small diameter patch cords shall be constructed of 28 AWG, unshielded, twisted pair, solid copper (dual-rated CM/LSZH) cable with high performance modular plugs. For lengths 1 to 50 feet (increments of one foot), replace * with desired length in feet. For standard cable colors other than Off White, replace "BU" (Blue) with color code: BL (Black), RD (Red), YL (Yellow), GR (Green), OR (Orange), GY (Gray), PK (Pink), or VL (Violet). Cable diameter: 0.185 in. (4.7mm) nominal. No suffix designates Off White
		<b>FIBER DISTRIBUTION SYSTEMS</b>
Panduit	<b>FLEX1U04</b>	The HD Flex™ Fiber Enclosure is 1 RU and is configured with sliding front-access drawers to accept up to eighteen 4 port HD Flex™ cassettes or Fiber Adapter Panels for a maximum density of 144 fibers.
Panduit	<b>FLEX1U06</b>	The HD Flex™ Fiber Enclosure is 1 RU and is configured with sliding front-access drawers to accept up to twelve 6 port HD Flex™ cassettes or Fiber Adapter Panels for a maximum density of 144 fibers
Panduit	<b>FLEX4U04</b>	The HD Flex™ Fiber Enclosure is 4 RU and is configured with sliding front-access drawers to accept up to seventy-two 4 port HD Flex™ cassettes or Fiber Adapter Panels for a maximum density of 576 fibers.
Panduit	<b>FLEX4U06</b>	The HD Flex™ Fiber Enclosure is 4 RU and is configured to accept 6 port HD Flex™ cassettes. The modular design accepts up to 12 HD Flex Fiber Cassettes per RU or Fiber Adapter Panels for a maximum density of 144 fibers per RU.
Panduit	<b>FZ2ERQ1Q10NM***</b>	OM4 2 Fiber 1.6MM Jacket Patch Cord Riser LC Push-Pull to LC Push-Pull Optimized IL, *** At end of part number is for length in meters. Comes in 1 M increments up to 20 meters, then in lengths of 25 M, 30 M, and 35 M. Put the length in the following (3 digit) format: 001 for 1 M, 020 for 20 M, etc.
Panduit	<b>FSLP912</b>	12-fiber OS2 9/125µm singlemode plenum (OFNP) interlocking aluminum armored, indoor/outdoor cable with tight buffered fibers.
Panduit	<b>FSLP924</b>	24-fiber OS2 9/125µm singlemode plenum (OFNP) interlocking aluminum armored, indoor/outdoor cable with tight buffered fibers.
Panduit	<b>FSLP948</b>	48-fiber OS2 9/125µm singlemode plenum (OFNP) interlocking aluminum armored, indoor/outdoor cable with tight buffered fibers.
Panduit	<b>F9TBN1NNSZM001</b>	OS2 1 FIBER 900UM buffered LC to pigtail Std. IL, Set of 12 with buffered colors per TIA 568 – 1 meter
Panduit	<b>FHS9N-12-10P</b>	The HD Flex™ LC Splice Cassette is preloaded with 12 discrete OS2 standard IL pigtails and 12 splice sleeves. The cassette has a black cover and 6 blue duplex LC adapters with integral shutters to prevent contamination.
Panduit	<b>FHSZA-12-10R</b>	HD Flex™ LC Splice Cassette preloaded with 12-fiber ribbon OM4 pigtail and Ultra Low IL, 6-port duplex LC adapters in aqua with zirconia sleeves.
Panduit	<b>F92ERQNSNM***</b>	OS1/OS2 2-fiber, riser-rated, LC push-pull to LC push-pull, singlemode patch cord with custom push-pull strain relief boot and duplex clip, 1.6mm jacket, Std. IL. *** At end of part number is for length in meters. Comes in 1 M increments up to 20 meters, then in lengths of 20 M, 25 M, 30 M, and 35 M. Put length in the following (3 digit) format: 001 for 1 M, 020 for 20 M, etc.
Panduit	<b>FLCDSBUY</b>	Field Polish LC Duplex Pot & Polish Style OS2 Connector, Blue Housing with 1.6mm/2.0mm Blue Boot
		<b>RACKS AND CABLE MANAGERS</b>
Panduit	<b>R2P</b>	19" EIA 2-post rack, aluminum. Dimensions: 84.0"H x 20.3"W x 3.0"D (2134mm x 514mm x 76mm).
Panduit	<b>AR4P</b>	The Adjustable Depth 4-Post Rack supports equipment mounting depths from 23" to 42" in 0.5" increments to provide greater flexibility with a single part number. The front and rear structural posts of the rack are capable of mounting all Panduit™ Vertical Cable Managers and various accessories such as power distribution units, waterfalls and vertical tie-off brackets. Racks are available in black and white colors.
Panduit	<b>PR2VD**</b>	The PatchRunner™ 2 Vertical Cable Manager combines high-density capability and versatility, freeing up valuable floor space. The fully pre-assembled manager lowers

		overall costs. The dual-sided manager has a metal backbone with molded plastic fingers, and includes two full-length metal, dual-hinging, push-to-close doors. The manager is 45 RU, 6 inches wide, and is black. (relace * with 06,08, 10, 12)
Panduit	<b>NM1</b>	Horizontal Cable Manager High Capacity Front and Rear 1 Rack Unit. 1.7"H x 19.0"W x 13.1"D (44mm x 482mm x 332mm).
Panduit	<b>NM2</b>	Horizontal Cable Manager High Capacity Front and Rear 2 Rack Units. 3.5"H x 19.0"W x 13.1"D (88mm x 482mm x 332mm).
Panduit	<b>NMF3</b>	Horizontal Cable Manager High Capacity Front Only 3 Rack Units. 5.2"H x 19.0"W x 6.2"D (133mm x 482mm x 157mm). FOR MID-RACK INTERBAY ROUTING.
Panduit	<b>PR2HF2</b>	The PatchRunner™ 2 Horizontal Cable Manager organizes and protects copper and fiber network cabling in any standard EIA 19 inch (483mm) rack or cabinet. Large front finger openings easily accommodate Cat 6 and 6A cables, reducing installation time and maintenance costs. The manager matches depth for flush mount with PatchRunner™ 2 and PatchRunner™ 2 Enhanced Vertical Cable Managers. The single-sided manager is 2 RU and has a dual-hinged, magnetic front cover. The manager is black.
Panduit	<b>PR2HF3</b>	The PatchRunner™ 2 Horizontal Cable Manager organizes and protects copper and fiber network cabling in any standard EIA 19 inch (483mm) rack or cabinet. Large front finger openings easily accommodate Cat 6 and 6A cables, reducing installation time and maintenance costs. The manager matches depth for flush mount with PatchRunner™ 2 and PatchRunner™ 2 Enhanced Vertical Cable Managers. The single-sided manager is 3 RU and has a dual-hinged, magnetic front cover. The manager is black.
Panduit	<b>PR2HF4</b>	The PatchRunner™ 2 Horizontal Cable Manager organizes and protects copper and fiber network cabling in any standard EIA 19 inch (483mm) rack or cabinet. Large front finger openings easily accommodate Cat 6 and 6A cables, reducing installation time and maintenance costs. The manager matches depth for flush mount with PatchRunner™ 2 and PatchRunner™ 2 Enhanced Vertical Cable Managers. The single-sided manager is 4 RU and has a dual-hinged, magnetic front cover. The manager is black.
Panduit	<b>CMUT19</b>	2 RU upper trough with 1.3" bend radius mounts to the top of a standard 19" EIA rack. Dimensions: 3.5."H x 19.0"W x 4.5"D (89mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY.
Panduit	<b>CMLT19</b>	4 RU lower trough with 1.3" bend radius mounts to the bottom of a standard 19" EIA rack. Dimensions: 8.0"H x 19.0"W x 4.5"D (203mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY. LARGER OPTION THAN CMUT19 IF NEEDED.
Middle Atlantic	<b>CWR-18-32xx</b>	32D Wall mount Cabinet meshed door only
Great Lakes	<b>GL840E-2936</b>	72 H x 29W x 36 D meshed door only required for cat6A installs
Great Lakes	<b>GL24WDM/GL36WDM</b>	24"H x 24"W x 32.13"D,meshed door or 36"H x 24"W x 32.13"D, meshed
<b>CABLE PATHWAYS</b>		

Panduit	<b>FR4X4YL10</b>	Panduit 4 x 4 FiberRunner System
Panduit	<b>J-Pro J-Hook system</b>	Panduit J-Pro System. Plenum rated composite J-hooks with hardware available for various hardware applications. See <a href="http://www.panduit.com">www.panduit.com</a> for variations.
Panduit	<b>LD10IW10-A</b>	LD10 International White Plastic Raceway, see catalog or <a href="http://www.panduit.com">www.panduit.com</a> for fittings. For 8' sections order LD10IW18-A. For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).
Panduit	<b>JB1IW-A</b>	Single gang one-piece outlet box with adhesive backing. Box accepts Pan-Way ®Screw-On Faceplates or any NEMA standard single gang faceplate. For use with Pan-Way LD profile raceway. 5.09"L x 3.34"W x 1.75"H (129.4mm x 85.0mm x 44.4mm). Breakouts for 1/2", 3/4", or 1" diameter conduit. For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).

Panduit	<b>T702BIW8</b>	Pan-Way® Twin-70 Raceway Base, 8' sections, For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).
Panduit	<b>T70CIW8</b>	Pan-Way® Twin-70 Raceway Cover, 8' sections, For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).
Panduit	<b>T702****</b>	Pan-Way® Twin-70 Raceway Fittings and Accessories
Panduit	<b>T45BIW8-A</b>	Pan-Way® T-45 Raceway Base, 8' sections, For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).
Panduit	<b>T45CIW8</b>	Pan-Way® T-45 Raceway Cover, 8' sections, For standard colors other than IW (Off White), replace IW in part number with EI (Electrical Ivory) or WH (White).
Panduit	<b>T45***</b>	Pan-Way® T-45 Raceway Fittings and Accessories
Panduit	<b>WG12BL10</b>	12" wide x 10' long pathway section used to carry cables horizontally throughout the system. Snap-on sidewalls attach for job specific height requirements. Uses splice connector WGSPL1218BL to connect straight sections and intersection splice WGINTSPLBL to connect pathways at an intersection. For fittings and accessories see <a href="http://www.panduit.com">www.panduit.com</a> .
Panduit	<b>WG18BL10</b>	18" wide x 10' long pathway section used to carry cables horizontally throughout the system. Snap-on sidewalls attach for job specific height requirements. Uses splice connector WGSPL1218BL to connect straight sections and intersection splice WGINTSPLBL to connect pathways at an intersection. For fittings and accessories see <a href="http://www.panduit.com">www.panduit.com</a> .
Chatsworth	<b>10250-712</b>	12" Universal Cable Runway; 12"W x 1.5"H x 9.96'L; Black. For fittings and accessories see <a href="http://www.catalog.chatsworth.com">www.catalog.chatsworth.com</a>
Chatsworth	<b>10250-718</b>	18" Universal Cable Runway; 18"W x 1.5"H x 9.96'L; Black. For fittings and accessories see <a href="http://www.catalog.chatsworth.com">www.catalog.chatsworth.com</a>
<b>BONDING AND GROUNDING</b>		
Panduit	<b>ACG24K</b>	#6 AWG (16mm <sup>2</sup> ) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
Panduit	<b>LCC series</b>	Panduit two-hole compressing lugs for code conductors in BICSI hole spacing.
Panduit	<b>HTCT series</b>	Panduit HTAPs. Must be selected according AWG size of run and tap conductors.
Panduit	<b>CLRCVR series</b>	Panduit clear covers for HTAPs. Must be selected according to HTAP being covered.

Panduit	<b>RGS134-1Y</b>	Grounding strip (vertical busbar) for newly installed racks or cabinets with screw rails. 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
Panduit	<b>RGCBNJ660P22</b>	Jumper kit for bonding individual racks or cabinets into grounding backbone. #6 AWG (16mm <sup>2</sup> ) jumper; 60" (1.52m) length; 45° bent lug on grounding strip side; provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread forming screws and a copper compression HTAP* for connecting to a #6 to #2 awg sized bonding backbone.
Panduit	<b>GJ672UH</b>	Rack jumper (and cabinet) kits for smaller TR (5 bays or less) to bond individual rack or cabinet directly back to wall mounted busbar. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. This rack grounding jumper is 72" long. For other lengths replace the "72" in the part number. Available lengths are 72, 96, 120, 144, 168, 192, 216, 240, 264 and 288 inches.

Panduit	<b>RGESD2-1</b>	Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH WRIST STRAP RGESDWS.
Panduit	<b>RGESDWS</b>	Adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH ESD PORT RGESD2-1.
Panduit	<b>RGTBSG-C</b>	Green thread-forming bonding screws for use to mount equipment that does not have a built-in grounding pad (terminal).
Panduit	<b>RGEJ1024PHY</b>	24" long pre-terminated equipment grounding jumper #10 AWG (6mm <sup>2</sup> ) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).
Panduit	<b>RGEJ1036PFY</b>	36" long pre-terminated equipment grounding jumper#10 AWG (6mm <sup>2</sup> ) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).
Panduit	<b>GB2B0306TPI-1</b>	Wall mounted telecommunications busbar suitable for small telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 12" in size.
Panduit	<b>GB2B0514TPI-1</b>	Wall mounted telecommunications busbar suitable for med telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 24" in size.
Panduit	<b>GB4B0624TPI-1</b>	Wall mounted telecommunications busbar suitable for main grounding busbar in medium sized facility. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 4" x 20" in size.
Panduit	<b>LTYK</b>	Wall mounted busbar label kit. Label kit includes printed tag and one flame retardant cable tie.
		<b>NETWORK LABELING SOFTWARE – FOR INK JET/LASER PRINTER</b>
Panduit	<b>PROG-EM2GO</b>	Easy-Mark Labeling Software for PC, supplied on USB Flash Drive. For preprinting communications labels on laser/inkjet printer.
Panduit	<b>S100X150YAJ</b>	Self-laminating cable labels for Category 6 cable for use with Easy-Mark software and laser/ink jet printer.

Panduit	<b>C261X035Y1J</b>	Patch Panel labels for use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>C195X040Y1J</b>	Faceplate labels for single gang stainless or sloped plastic - use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>C288X040Y1J</b>	Faceplate labels for double gang stainless - use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>S100X650YAJ</b>	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with Easy-Mark software and ink jet printer.
Panduit	<b>S100X160YAJ and NWSLC-3Y</b>	Label and turn-tell sleeve for labeling fiber jumpers. For use with Easy-Mark software and ink jet printer.
Panduit	<b>C200X100FJJ</b>	1" high, white, vinyl tape labels for labeling grounding busbars, racks, cabinets and pathways. For use with laser/ink jet printer.
		<b>NETWORK LABELING – HANDHELD LABELER</b>

Panduit	<b>LS8EQ-KIT-ACS</b>	Panduit PanTher hand-held label printing system in kit. Includes LS8EQ printer with QWERTY keypad, one cassette of S100X150VAC self-laminating labels, six AA alkaline batteries, LS8E-ACS, LS8-CASE, LS8-PCKIT, LS8-IB, LS8-WS, quick reference card and operator's manual. USE FOR LABELS THAT MUST BE PRINTED ON THE JOB SITE.
Panduit	<b>S100X150VAC</b>	Self-laminating cable labels for Category 6 cable for use with PanTher LS8E hand-held printer.
Panduit	<b>C261X035Y1C</b>	Handheld printer labels for modular faceplate patch panels.
Panduit	<b>C195X040Y1C</b>	Faceplate labels for single gang stainless - use with PanTher handheld labeler.
Panduit	<b>C288X040Y1C</b>	Faceplate labels for double gang stainless - use with PanTher handheld labeler.
Panduit	<b>S100X650VAC</b>	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with handheld labeler.
Panduit	<b>S100X160VAC and NWSLC-3Y</b>	Label and turn-tell sleeve for labeling fiber jumpers. For use with hand-held labeler.
Panduit	<b>T100X000VPC-BK</b>	1" high, continuous black on white, vinyl tape labels for labeling racks, cabinets and pathways with PanTher LS8E handheld labeler.
		<b>Power Distribution Units</b>
Panduit	<b>G5 PDU Series</b>	<b>Contact Dallas Cook with SL County or Brad Orr with Ewing Foley</b>
		<b>PHYSICAL SECURITY LOCKING DEVICES</b>
Panduit	<b>PSL-DCJB-C</b>	Package of 100 RJ45 jack blockout devices and one removal tool. Color red.
Panduit	<b>PSL-USBA-L</b>	Package of 50 USB Type 'A' blockout devices and one removal tool. Color red.
Panduit	<b>PSL-USBB-L</b>	Package of 50 USB Type 'B' blockout devices and one removal tool. Color red.
Panduit	<b>PSL-DCPLX-BL-C</b>	Package of 100 RJ45 plug lock-in devices compatible with flush mount jacks, and one installation/removal tool. Color black.
Panduit	<b>PSL-DCPLRX-BL-C</b>	Package of 100 RJ45 plug lock-in devices compatible with recessed jacks, and one installation/removal tool. Color black.
		<b>CABLE TIES – HOOK AND LOOP</b>
Panduit	<b>TTS-35RX0</b>	.75" wide, continuous roll Hook and Loop Cable Ties, black. 35 ft. roll. Carton qty 10 rolls.

Panduit	<b>HLSP1.5S-X12</b>	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.
Panduit	<b>HLSP3S-X12</b>	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.



**Pricing and Availability:**

Salt Lake County has pre-negotiated global pricing with Panduit and Anixter and Graybar. Salt Lake County reserves the right to purchase material direct as needed. This global parts list for Salt Lake County is a North American based BOM, part numbers may change slightly based on regional codes and availability. For global pricing and availability please contact:

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