

New Waverly ISD Network Cabling Specifications



New Waverly ISD
HOME OF THE FIGHTING BULLDOGS

CAT6/6A NetKey/General Cable
Network Cabling Specifications

Specification Version History

Version #	Implemented	Revision	Approved	Approval	Reason
1	Neha Joshi				

Table of Contents

Section	Page #
I. General	4
A. Purpose of Document	4
B. Scope of Work – Typical	4
C. General Guidelines	5
D. Terminology from TIA 569	5
E. Applicable Regulatory References	8
F. New Waverly ISD Substitution Policy	9
G. Contractor Qualifications	9
H. Warranty	11
II. Subsystems and Components	12
A. Cabling Subsystem 1 – Horizontal Copper Cabling System	12
B. Cabling Subsystem 2 – Intrabuilding (Within Building) Fiber	19
C. Cabling Subsystem 3 – Interbuilding (Between Buildings) Fiber	23
D. Racks, Cabinets, and Cable Management	27
E. Communications Grounding Network	31
F. Cable Pathways	37
G. Network Infrastructure Labeling	40
H. Cabling Accessories	42
III. Testing and Acceptance	43
A. General	43
B. Copper Channel Testing	43
C. Fiber Testing	43
D. System Documentation	44
E. Inspection and Acceptance	45
F. Post Installation Maintenance Agreement	46
IV. Appendix A – Materials List	47

I. General

A. Purpose of Document

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

B. Scope of Work – Typical

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

3. The following cabling subsystems will be defined:
 - a. Cabling Subsystem 1 – Horizontal Copper Cabling
 - b. Cabling Subsystem 2 – Intrabuilding Fiber Backbone Cabling OM4
 - c. Cabling Subsystem 3 – Interbuilding Fiber Backbone Cabling OS2
 - d. Racks and Cable Management
 - e. Bonding and Grounding
 - f. Cable Pathways
 - g. Network Labeling
 - h. Cabling Accessories
4. In the event that requirements of the project documents cannot be met during design or installation, a written description of the need for variance will be submitted to the New Waverly ISD Project Manager for review by the Network Services Team.

C. General Guidelines

1. All voice telephony systems shall be VoIP unless otherwise specified in the project-specific documentation.
2. Any copper or fiber patch cords shall be factory terminated. Hand terminated patch cords will not be accepted.
3. All Greenfield (new) projects shall use [Cat6/CAT6A] cable.
4. On Brownfield (existing) installations, Contractor shall consult project documentation for guidance on the current Category of copper cable to be installed.
5. Any deviation from [Cat6/CAT6A] cabling shall be approved in writing by Panduit.
6. Wiring configuration on [Cat6/CAT6A] systems shall be T568B.
7. Any communications/IT consulting engineers retained by New Waverly ISD shall be at the sole discretion of Network Services.

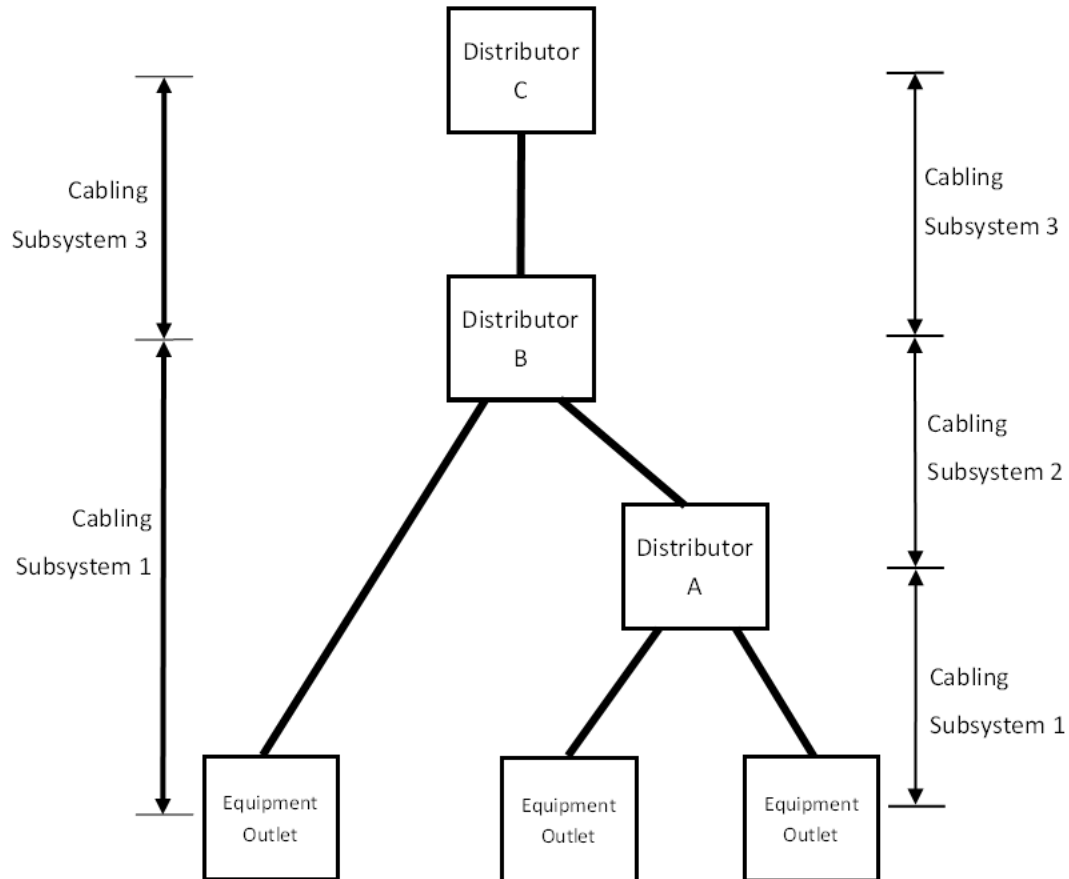
D. Terminology from TIA 569

1. New Terms for Telecommunications Spaces (Rooms)
 - a. This section reviews some of the current terminology for communications rooms and spaces as defined in TIA 569-D (April 2015).

- b. Awareness of these new terms is important for communicating accurately and for clearly understanding language used in specifications and other documents.
- c. This specification will use both new and old terms side-by-side for clarity.
- d. The table below shows some of the most important new terms and how they relate to traditional terminology:

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

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



E. Applicable Regulatory References

1. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes.
2. ANSI/TIA:
 - a. ANSI/TIA 568 series, most recent revisions, addenda and systems bulletins. All applicable
 - b. ANSI/TIA-569 Telecommunications Pathways and Spaces, most recent revision including all relevant addenda and systems bulletins
 - c. ANSI/TIA-606 Administration Standard for Telecommunications Infrastructure, most recent revision including all addenda and systems bulletins
 - d. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, most recent revision including all addenda and systems bulletins
 - e. ANSI/TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems, most recent revision including all addenda and systems bulletins
 - f. ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers, most recent revision including all addenda and systems bulletins
 - g. ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure Standard, most recent revision including all addenda and systems bulletins
 - h. ANSI/TIA-4966 Telecommunications Infrastructure Standard for Educational Facilities, most recent revision including all addenda and systems bulletins
 - i. TIA-TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points, most recent revision including all addenda and systems bulletins
3. BICSI – Building Industry Consultative Services International – Manuals
 - a. Telecommunications Distribution Methods Manual, most recent edition
 - b. Information Transport Systems Installation Methods Manual (ITSIMM), most recent edition
4. National Electric Codes – all applicable
5. OSHA Standards and Regulations – all applicable
6. Local Codes and Standards – all applicable
7. 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
8. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

F. New Waverly ISD Substitution Policy

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

G. Contractor Qualifications

1. General
 - a. Contractor shall be a current Panduit OneSM Partner (Registered Silver and above) that has completed the Structured Cabling Deployment training (Panduit Certified Installer). A copy of the corporate Panduit manufacturer certification shall be included with all quotes.
 - b. Contractor shall have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.
 - c. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
 - d. Contractor shall have all necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
 - e. At least 30 percent of the technicians installing low-voltage copper systems on the job shall have a current Panduit Certified Copper Technicians certificate.
 - f. At least 30 percent of the technicians installing any Fiber Distribution Systems shall have a current Panduit Certified Fiber Technicians certificate.
 - g. The Telecommunications contractor shall provide a Project Manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:
 - Initiate and coordinate tasks with the New Waverly ISD Project Manager and others as specified by the project schedule.
 - Provide day-to-day direction and-site supervision of Contractor personnel.
 - Ensure conformance with all contract and warranty provisions.
 - Acknowledge and remediate findings of New Waverly ISD 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 New Waverly ISD.
 - h. Contractor Project Manager on site shall have completed the Panduit Structured Cabling Deployment training and hold certificates for both copper and fiber.

2. References and Response Times

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

3. Termination of Services

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

4. Other Contractor Responsibilities

- a. Confirmation of Pathway and Cable Manager sizing:
 - Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.
 - Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.
- b. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.
- c. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.
- d. Projects are not considered finished and will not be paid by New Waverly ISD until all debris, dust, etc. has been cleaned and removed to the satisfaction of New Waverly ISD.
- e. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.
- f. Contractor shall abide by all New Waverly ISD Security Policies pertaining to access and conduct while on New Waverly ISD property.

- g. Contractor shall obey all posted speed limits and parking regulations at the New Waverly ISD facilities where the work is being performed.
- h. Contractor understands that illegally parked vehicles will be towed and Contractor is responsible for and will assume all costs associated with towing.

H. Warranty

1. Contractor shall provide a 25-year Panduit Certification PlusSM System Warranty on all copper and fiber links and/or channels.
2. Panduit[®] Certification PlusSM warranty shall meet the following criteria.
 - a. A 25-year guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
 - b. This warranty will cover all registered links and/or channels.
 - c. Contractor shall indicate in warranty documentation whether registered links are to be link or channel.
 - If links are covered, this warranty may be invoked only if the links are comprised entirely of Panduit components and cable.
 - If channels are covered, this warranty may be invoked only if entire channel links are comprised of continuous Panduit components and cable, including patch cords.
 - d. The communications Contractor will correct any problems and malfunctions that are warranty-related issues without charge for the entire warranty period.
 - e. If the Certification PlusSM warranty is needed by New Waverly ISD within the warranted period and the original installer is no longer in business, Panduit shall find a substitute Panduit ONESM certified contractor and assume costs to fulfill the obligations of the warranty.
 - f. Upon acceptance of the warranty paperwork and test results from the Contractor, Panduit will mail a notification letter to the installer and a notification letter with warranty certificate to New Waverly ISD.
 - g. The warranty period shall commence following the final acceptance of the project by New Waverly ISD and written confirmation of warranty from Panduit.

<END OF SECTION>

II. Subsystems and Components

A. Cabling Subsystem 1 – Horizontal Copper Cabling System

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

- n. When using miniature horizontal cable or small diameter patch cables, the channel length shall be derated per manufacturer's recommendations.
 - o. Contractor shall take care to never deform the cable by over cinching with cable ties. All cable ties shall be cinched firmly, but not so firmly that the tie cannot be rotated or moved on the bundle by hand.
 - p. Cable bundles in telecom spaces (rooms) shall be dressed using only hook and loop style cable ties. Plastic ties shall not be used in New Waverly ISD telecom rooms and shall be removed and replaced with hook and loop ties at Contractor expense.
 - q. Cable ties on all cable bundles shall be applied at random intervals to avoid harmonic effects.
 - r. All horizontal cabling installed shall include a cable slack loop of not less than 12 inches at the Equipment Outlet and not less than 36 inches in the horizontal telecom room.
 - s. Equipment outlet cable slack shall be stored in the box behind the faceplate if there is room to do so without violating the bend radius of the cable according to manufacturer's recommendations.
 - t. Contractor may affix 12 inch slack loop above ceiling using hook and loop cable ties if allowed in the project specific documentation or otherwise in writing from New Waverly ISD. Cable loops touching the drop ceiling shall not be accepted.
 - u. Service loops in the telecommunications room may be wall mounted or contained in pathways or racking systems if done according to manufacturer and industry best practices.
 - v. All terminations on new (Greenfield) New Waverly ISD projects shall be terminated using the T568B pin-out (wire map).
 - w. All terminations in existing New Waverly ISD facilities (Brownfield), shall match the pin-out and Category of the legacy cable plant, unless otherwise specified in the project documentation.
 - x. Contractor shall terminate twisted pairs so that the last twist is never more than ½ inch from the point of termination (insulation displacement clip). Maintaining the last twist closer than ½ inch is preferred.
 - y. Contractor shall maintain the cable jacket as close as possible to the connecting hardware. Twisted pair conductors deemed by New Waverly ISD to be unnecessarily exposed shall be re-terminated at Contractor's expense.
 - z. Contractor shall be responsible for using plenum cable, ties and appliances in any air-return (plenum) spaces as required by applicable codes, standards, and the local AHJ (Authority Having Jurisdiction).
3. Copper Horizontal Cable – All Work Areas – Data, Voice & Security Cameras – Category 6
- a. Inside 4 pair horizontal cable for New Waverly ISD facilities shall be white jacketed plenum "LP" rated TX6™ Category 6 UTP Copper Cable.
 - b. In addition, performance Category 6 UTP Copper Cable must meet the following mechanical and performance criteria:
 - c. UL Limited Power (LP) Certified which eliminates the need to consult the PoE ampacity table in the NEC 2017 code regarding maximum bundle sizes

- d. Meet TIA TSB-184-A/ IEEE P802.3bt “LP” rating for Limited Power cable requirements
 - e. Exceeds requirements of ANSI/TIA-568.2-D Category 6 and ISO 11801 2nd Edition Class E channel standards.
 - f. Exceeds requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6 component standards.
 - g. Meets requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
 - h. Third party tested to comply with ANSI/TIA-568-C.2.
 - i. Cable diameter: Riser 0.210 in. (5.3mm) nominal, Plenum 0.224 in. (5.7mm) nominal.
 - j. Installation temperature range: 32°F to 122°F (0°C to 50°C).
 - k. Operating temperature range: Riser & Plenum: -4°F to 167°F (-20°C to 75°C)
 - l. Characterized to 350 MHz, 100 MHz above the standard.
 - m. Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap
4. Copper Horizontal Cable – Wireless Access Points - Category 6A
- a. Copper cable shall be Panduit’s Vari-MaTriX Cable (Cat 6A, UTP horizontal cable). The inside 4 pair horizontal cable for New Waverly ISD facilities shall be blue jacketed plenum “LP” rated TX6A™ UTP Copper Cable with Vari-MaTriX Technology.
 - b. In addition, performance Category 6A UTP Copper Cable must meet the following mechanical and performance criteria:
 - Exceeds requirements of ANSI/TIA-568.2-D Category 6A and ISO 11801 Class EA channel standards in a 4-connector configuration up to 100 meters
 - Exceeds requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6A component standards
 - Third party tested to comply with ANSI/TIA-568-C.2
 - Meets requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications
 - UL Limited Power (LP) rated CMP-0.7A which eliminates the need to consult the PoE ampacity table in the NEC 2017 code regarding maximum bundle sizes
 - Nominal cable diameter must not exceed 0.250”
 - The nominal cable cross-sectional area must not exceed 0.05 in². Per the NEC 40% fill guidelines, the following minimum cable fill is required:
 - -- ¾” conduit = 4
 - -- 1” conduit = 7
 - -- 2” conduit = 27
 - -- 4” conduit = 119

- Installation temperature range: 32°F to 140°F (0°C to 60°C)
 - Operating temperature range: -4°F to 221°F (-20°C to 105°C)
 - Weight of cable not to exceed 32 lbs./1000 ft.
 - The UTP cable must include an electrically discontinuous metallic barrier (Vari-MaTriX) to suppress the effect of alien cross talk allowing 10 Gb/s transmission. The metallic barrier is not bonded/grounded. The continuity of the metallic barrier is to be partitioned along the cable's length into segments of varying length such that EMI immunity is uncompromised.
 - In order to minimize jobsite floor space and reduce shipping expenses, one full 44"x 44" pallet must consist of (36) 1000' reels
 - Descending length cable markings enable easy identification of remaining cable which reduces installation time and scrap
5. Equipment Outlet Copper Connectors (Jacks) – All Work Areas – Data, Voice & Security Cameras – Category 6
- a. Workstation modular jacks shall be Panduit Category 6 NetKey ® Jack Modules featuring 110-termination technology and have the following characteristics:
- The eight position modules shall meet the connector requirements of the ANSI/TIA Category 6 standard.
 - Termination shall be accomplished by use of a 110 termination.
 - The wiring scheme label shall be available with both T568A and T568B wiring schemes.
 - The modules shall terminate four pair 22 and 26 AWG 100 ohm solid unshielded twisted pair cable.
 - The modules shall be universal in design, including complying with the intermateability standard IEC 60603-7 for backward compatibility.
 - Category 6 modules shall have UL and CSA approval. The modules shall have ETL verified Category 6 performance and ISO Class E performance (as defined in ISO/IEC 11801) in both the basic and channel links.
 - They shall be universal in design, accepting six or eight pair modular plugs without damage to the outer module contacts.
 - The modules shall be able to be re-terminated a minimum of 10 times and be available in 11 standard colors for color-coding purposes.
 - The module shall snap into all NETKEY ® outlets and patch panels.
 - Consult project documentation for jack color coding in use for that installation.
6. Equipment Outlet Copper Connectors (Field Terminable Plugs) – Wireless Access Points – Category 6A
- a. Category 6A Panduit TX6A™ Category 6A UTP Field Term RJ45 Plug shall have the following attributes:

- 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 ANSI/TIA-568.2-D Modular Plug Terminated Link requirements with up to two field term plugs in link
- Compatible with 4-pair, 22–26 AWG solid or stranded unshielded twisted pair cable with conductor insulation diameters of 0.060 in. maximum and overall cable O.D. 0.200 in. to 0.330 in
- 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
- Rated to 2500 plug mating cycles
- Operating temperature: -10°C to 65°C (14°F to 149°F), Storage temperature: -40°C to 70°C (-40°F to 158°F)
- 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

7. Equipment Outlet Appliances – Faceplates

- a. When adding horizontal cabling to existing facilities (Brownfield) within New Waverly ISD, Contractor shall match the existing cable plant with the color of existing faceplates.
- b. Flush mount faceplates in new projects (Greenfield) shall be Panduit NetKey® faceplates with label fields in either electric ivory or international white as called for in the project documentation.
- c. NetKey® Faceplates shall be available in one, two, four and/or six-port vertical single gang configurations.
- d. Faceplates shall have the following attributes:
 - Faceplates with no labels shall include painted combination head screws.
 - The faceplates shall mount to standard boxes and adapters with screw-to-screw dimensions of 3.28" (83.3mm).
 - Faceplates shall be available with or without labels.
 - Dedicated sloped versions shall be available for improved bend radius control and decreased requirements in wall depth.
 - Each faceplate shall accept NetKey® modules that can be individually inserted and removed as required.

8. Equipment Outlet Appliances – Surface Mount Boxes (**Not required when using Panduit Field Terminable RJ45 Plugs**)
 - a. Wireless access points mounted on walls and in above ceilings utilize one Category 6A horizontal run (drop) terminated in NetKey® 1 hole surface mount boxes.
 - b. NetKey® Surface Mount Boxes shall have the following attributes:
 - Boxes shall be in electric ivory or international white as called for in project-specific documentation.
 - Able to accept all NetKey ® Modules
 - Include mounting screws and adhesive tape
 - Be compatible with Panduit® LD3, LD5, and LD10 Raceway.
9. Copper Horizontal Patch Panels (Distributor A)
 - a. New Waverly ISD copper patch panels in the horizontal patch fields shall be flat 1 RU or 2 RU NetKey® type with frames of molded polymer.
 - b. If made of molded polymer construction, the patch panels shall have the following attributes:
 - Patch panels shall be a molded modular design made of polymer material and mount to standard racks and cabinets
 - Patch panels shall be available in standard density 24 and 48-port configurations
 - Patch panels may include pre-numbered labels with writable surface on back
 - c. For instructions for which patch panel to use consult project-specific documentation
10. Copper Patch Cords – Work Area - Small Diameter Category 6 Patch Cords
 - a. Copper patching of Category 6 links in New Waverly ISD facilities shall use “Blue” 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. Due to miniature size of patch cords, utilize increased attenuation de-rating value of 1.9. These support 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.
 - d. Category 6 Small diameter patch cords shall have the following characteristics:
 - Cable diameter not more than 0.150 in. (3.8mm) nominal.
 - Category 6/Class E channel and component performance.
 - Exceeds all ANSI/TIA-568-C.2 Category 6 and ISO 11801 Class E Edition 2.1 electrical performance requirements for all frequencies from 1 to 250 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 c (UL) US listed: UL 1863, CSA standard C22.2.
- 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.

11. Copper Patch Cords – Telecom Room - Small Diameter Category 6A Copper Patch Cords

- a. Copper patching of Category 6A links in New Waverly ISD facilities shall use “Black” 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. Due to miniature size of patch cords, utilize increased attenuation de-rating value of 1.9. These support 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.
- d. Category 6A 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.

- Plug contact plated with 50 microinches of gold and rated to 2500 mating cycles
- RoHS compliance: Compliant.
- Flammability rating: CM/LSZH dual rated.

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

1. See Appendix A for Part Numbers
2. Installation Guidelines (Applies to all Fiber Trunks)
 - 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.

3. Intrabuilding Fiber Cable (Optical Multimode)

- a. In additions to existing New Waverly ISD fiber cable plant (brownfield projects), Contractor shall consult with New Waverly ISD for fiber requirements.
- b. In new (Greenfield) New Waverly ISD projects, backbone fiber running between telecom spaces within buildings shall be General Cable OM3 multimode 24 strand Gel Free Tight Buffer Distribution Interlock Armored Plenum Cable
- c. Contractor shall bond to ground interlocking 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. Intrabuilding fiber cable between telecoms rooms on different floors or on the same floor, within the same building, shall have the following attributes:
 - Used in intrabuilding backbone, building backbone, and horizontal installations for riser (OFCR), plenum (OFCP), and harsh environments
 - Interlocking aluminum armor eliminates the need for inner duct or conduit to provide a smaller crush resistant pathway for design flexibility and a lower installed cost
 - Available in 6, 12, 24, 36, 48, 72, 96 and 144-fiber counts
 - Multimode (OM4, OM3, OM2, and OM1) and singlemode (OS1/OS2) fiber available optimized) fiber available
 - Sheath markings provide positive identification, quality traceability, and length verification
 - 900µm standards-based color-coded buffer coating protects fibers during handling and allows for easy identification and stripping
 - Cable design and flexible buffer tubes allow for quick breakout and ease of routing

- 10Gig Fiber Optic Cable is designed to support network transmission speeds up to 10 Gb/s for link lengths up to 300 meters for OM3 and up to 550 meters for OM4 with an 850nm source per IEEE 802.3ae 10 GbE standard; backward compatible for use with all 50/125µm system requirements
- e. Contractor shall terminate tight-buffered cable constructions with Panduit Opticam LC fiber connectors

4. Fiber Connectors – LC Connectors

- a. All LC terminations shall be done with Panduit OptiCam LC connector having the following properties:
 - TIA/EIA-604 FOCIS-10 compatible connectors.
 - Exceed TIA/EIA-568-B.3 requirements.
 - Connector backbone and boot colors follow TIA/EIA-568-C.3 suggested color identification scheme.
 - Insertion loss: 0.3dB average (multimode and singlemode).
 - Return loss: >26dB (10Gig TM multimode), >20dB (multimode), >50dB (singlemode).
 - Spring-loaded “Senior” rear pivot latch LC connector.
 - Quick installation; provide field termination in less than half the time of field polish connectors.
 - Patented re-termination capability provides yield rates approaching 100%.
 - Factory pre-polished fiber endface eliminates time-consuming field polishing to reduce installation costs, labor, scrap and the number of tools required.
 - Cam activated fiber and buffer clamp mechanisms provide superior fiber and buffer retention – less sensitivity to fiber tensile loading.
 - OptiCam® Termination Tool simplifies tooling and termination, and virtually eliminates operator error by providing visual indication of proper termination after the cam step has been completed.
 - Cable retention boot assemblies consistently provide higher than industry standard cable retention.
 - Non-optical disconnect maintains data transmission under tensile loads for jacketed cable.

5. Fiber Enclosures (Distributor B)

- a. Fiber cable terminations shall be contained in 2 RU, or 4 RU Panduit FCE series 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 fiber adapter panel (FAP).
- d. FCE enclosures shall have the following properties:
 - Be able to hold QuickNet TM Fiber Optic Cassettes, Opticom ® Fiber Adapter Panels, or splice modules.

- Have a slide-out, tilt-down drawer to provide full front access to all fibers and cables.
 - Employ integral bend radius control and cable management appliances for fiber optic patch cords.
 - Have rear cable management for proper slacking/spooling of trunk cable break-outs and interconnect cables.
 - Have multiple trunk cable entry locations and include fiber optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for different installation configurations.
- e. FCE fiber enclosures shall be populated with fiber adapter panels containing either 6 LC multimode or singlemode duplex fiber adapters, or 12 LC multimode or singlemode duplex fiber adapters depending on the density needs of the telecom room.
- f. Consult project documentation to determine whether 6 or 12 LC multimode or singlemode duplex adapters are to be used on a given job.
- g. Contractor is responsible to blank out any enclosure spaces where adapter panels are not used.
- h. Fiber Adapter Panels shall have the following features:
- Loaded with TIA/EIA-604 FOCIS-10 compatible adapters.
 - Exceed TIA/EIA-568-B.3 requirements.
 - Adapter housing colors follow TIA/EIA-568-C.3 suggested color identification scheme.
 - Snap quickly into the front of all Opticom ® components
 - LC fiber adapter panels are Sr/Jr. to conserve enclosure space.
 - Accept FOCIS-10 compatible senior LC connectors at either end and FOCIS-10 junior LC connectors at the inside end for behind the wall applications.
 - Both ends accept FOCIS-10 compatible senior LC connectors.
 - Junior end also accepts FOCIS-10 compatible junior (fixed ferrule/springless) LC connectors.
 - Choice of phosphor bronze or zirconia ceramic split sleeves to fit specific network requirements; zirconia ceramic split sleeves are recommended for OM4/OM4 multimode and OS1/OS2 singlemode applications.
 - Every adapter is laser marked with Q.C. number to assure 100% traceability.
 - LC adapters are also available in QuickNet™ Fiber Optic Cassettes.

6. Fiber Patch Cords (jumpers)

- a. Fiber patch fields within New Waverly ISD facilities shall utilize riser rated multimode or singlemode “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.
- 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

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

1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.
 - b. Fiber optic cabling system additions and upgrades to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same channel unless specifically instructed to do so within the project specific documentation.
 - c. When installing fiber cable, Contractor shall maintain a minimum bend radius of 20 times the outer diameter of the cable when it is under load (being pulled).
 - d. Fiber service loops shall be stored to maintain a minimum bend radius of 10 times the outer diameter of the cable.
 - e. Optical fiber shall only be pulled using its internal strength member in conjunction with a properly rated multi-weave mesh grip and swivel pulling eye.
 - f. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered, fan-out or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.
 - g. Direct connection of terminated fiber backbone links to equipment is not allowed. All fiber connections shall go through a fiber enclosure interconnect and connect to active equipment via fiber jumpers.
 - h. Contractor shall perform fiber testing of all strands according to guidelines in the "Testing and Acceptance" section of this document.
 - i. Service loop (slack) in telecommunications rooms shall be at least 3 meters. Consult project documentation for length of service loops and storage method within a specific telecom room or space.
 - j. Slack shall be stored per manufacturer instructions inside the enclosure or stored outside the enclosure using appliances built for that purpose. Consult project documentation for details on storage of service loops.
 - k. Fiber pulls using multiple pull points shall use the "figure-8" technique any time excess cabling is piled on the floor as slack to supply the next pull-point.
 - l. Cable shall be rolled off the spinning cable reel, not pulled off of the end.

- m. During all fiber cable pulls Contractor shall have one person at each end of the pull to ensure proper cable pay out and pile up without damage to the fiber.
- n. Fiber backbone cables shall be installed separately from horizontal distribution cables. Under no circumstances may copper and fiber cables be pulled in common bundles.
- o. In pathways containing both fiber and copper cables, the fiber cable must either be of armored construction, or segregated in innerduct.
- p. Where cables are housed in sleeves or conduits, the backbone and horizontal cables shall be installed in separate conduits or the fiber segregated in separate innerduct within the conduits.
- q. Fiber shall be segregated within racks and patching systems unless instructed otherwise in the project documentation.
- r. Where possible fiber enclosures shall be mounted at the top of equipment racks and the fiber cable kept separate from copper cable.
- s. Contractor shall inspect fiber end faces with a fiber scope and clean the connectors (if needed) whenever plugging in a fiber connector.

3. Interbuilding Fiber Cable Between Buildings

- a. In additions to existing New Waverly ISD fiber cable plant (brownfield projects), Contractor shall consult with New Waverly ISD for fiber requirements.
- b. In new (Greenfield) New Waverly ISD projects, backbone fiber running between telecom spaces between buildings shall be Panduit 12 strand OS2 singlemode, indoor/outdoor tight buffered, plenum-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)

4. Fiber Connectors

- a. All LC terminations shall be done with Panduit OptiCam LC connector having the following properties:
 - TIA/EIA-604 FOCIS-10 compatible connectors.
 - Exceed TIA/EIA-568-B.3 requirements.
 - Connector backbone and boot colors follow TIA/EIA-568-C.3 suggested color identification scheme.
 - Insertion loss: 0.3dB average (multimode and singlemode).
 - Return loss: >26dB (10Gig TM multimode), >20dB (multimode), >50dB (singlemode).
 - Spring-loaded “Senior” rear pivot latch LC connector.
 - Quick installation; provide field termination in less than half the time of field polish connectors.
 - Patented re-termination capability provides yield rates approaching 100%.
 - Factory pre-polished fiber endface eliminates time-consuming field polishing to reduce installation costs, labor, scrap and the number of tools required.
 - Cam activated fiber and buffer clamp mechanisms provide superior fiber and buffer retention – less sensitivity to fiber tensile loading.
 - OptiCam® Termination Tool simplifies tooling and termination, and virtually eliminates operator error by providing visual indication of proper termination after the cam step has been completed.
 - Cable retention boot assemblies consistently provide higher than industry standard cable retention.
 - Non-optical disconnect maintains data transmission under tensile loads for jacketed cable.

5. Fiber Enclosures (Distributor C)

- a. Fiber cable terminations shall be contained in 2 RU, or 4 RU Panduit FCE series rack mount fiber enclosures, or (Enter Client Name) approved equal.
- 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 fiber adapter panel (FAP).
- d. FCE enclosures shall further have the following properties:
 - Be able to hold QuickNet™ Fiber Optic Cassettes, Opticom® Fiber Adapter Panels, or splice modules.
 - Have a slide-out, tilt-down drawer to provide full front access to all fibers and cables.
 - Employ integral bend radius control and cable management appliances for fiber optic patch cords.
 - Have rear cable management for proper slacking/spooling of trunk cable break-outs and interconnect cables.
 - Have multiple trunk cable entry locations and include fiber optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for different installation configurations.

6. Fiber Adapter Panels

- a. FCE fiber enclosures shall be populated with fiber adapter panels containing either 6 LC multimode or singlemode duplex fiber adapters, or 12 LC multimode or singlemode duplex fiber adapters depending on the density needs of the telecom room.
- b. Consult project documentation to determine whether 6 or 12 LC multimode or singlemode duplex adapters are to be used on a given job.
- c. Contractor is responsible to blank out any enclosure spaces where adapter panels are not used.
- d. Fiber adapter panels to populate enclosures on fiber links between buildings shall have the following attributes:
 - Loaded with TIA/EIA-604 FOCIS-10 compatible adapters.
 - Exceed TIA/EIA-568-B.3 requirements.
 - Adapter housing colors follow TIA/EIA-568-C.3 suggested color identification scheme.
 - Snap quickly into the front of all Opticom® components
 - LC fiber adapter panels are Sr/Jr. to conserve enclosure space.
 - Accept FOCIS-10 compatible senior LC connectors at either end and FOCIS-10 junior LC connectors at the inside end for behind the wall applications.
 - Both ends accept FOCIS-10 compatible senior LC connectors.
 - Junior end also accepts FOCIS-10 compatible junior (fixed ferrule/springless) LC connectors.

- Choice of phosphor bronze or zirconia ceramic split sleeves to fit specific network requirements; zirconia ceramic split sleeves are recommended for OM4/OM4 multimode and OS1/OS2 singlemode applications.
- Every adapter is laser marked with Q.C. number to assure 100% traceability.
- LC adapters are also available in QuickNet™ Fiber Optic Cassettes. Fiber Splice Trays and Tray Holders

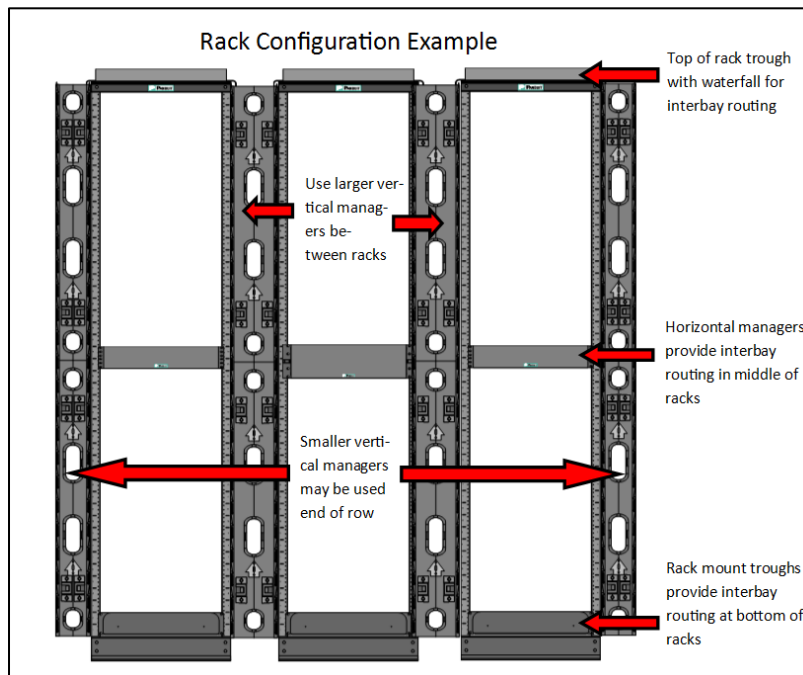
7. Fiber Patch Cords (jumpers)

- a. Fiber patch fields within New Waverly ISD facilities shall utilize riser rated multimode or singlemode “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.
 - 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

D. Racks, Cabinets, and Cable Management

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

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



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

- m. Empty horizontal spaces in cabinets in equipment rooms may be blanked with panels or blanking shades to facilitate hot/cold aisle cooling strategies. Consult project documentation for blanking requirements.
- n. Cable entrances in tops of cabinets shall be sealed using preinstalled brushes or using the appropriate sized Panduit cool boot seals.

3. Two-Post Communications Racks

- a. Two-post racks will be Panduit black-powdered coated aluminum
- b. Two-post communications racks shall have the following properties:
 - 19" EIA rack, aluminum.
 - Dimensions: 84.0"H x 20.3"W x 3.0"D (2134mm x 516mm x 76mm).
 - Rack units numbering up from bottom to allow quick and easy location of rack mount items
 - UL listed for 1,000 lbs. load rating.
 - Double-sided #12-24 EIA universal mounting hole spacing with 24 #12-24 mounting screws included.
 - Accepts all Panduit cable management and patch panel products in addition to any industry standard 19" components.
 - Includes paint piercing washers for assembly to assure electrical continuity between components as per TIA 607 Bonding and Grounding Standard

4. Four-Post Communication Racks

- a. Four-post racks will be Panduit black-powdered coated aluminum
- b. Four-post communications racks shall have the following properties:
 - Independent adjustable front and rear mounting rails can be adjusted while the rack is secured to the floor.
 - Printed rack space identification on all equipment rails allows for quick location of rack spaces, speeding installation of rack mount items (shipped numbers up per TIA-606B specifications; can be set to number down by flipping the rails).
 - Available in 30", 36" and 41" depths
 - Rack is UL listed for 2,500 lbs. load rating.
 - Rear rail construction provides a clear ventilation path for side ventilated switches.
 - Multiple mounting holes in top flanges for securing ladder rack.
 - Weld nut construction eliminates the need for a second wrench increasing speed and ease of assembly.

- Multiple mounting locations for vertical power strips on any of the four posts or on the adjustable mounting rails.
- PatchRunner™ and NetRunner™ Vertical Cable Managers mount directly to the 4 post rack at any of the four corners to provide a flexible end-to-end cable management solution.
- Paint piercing washers included to electrically bond rack for simplified grounding.

5. Rack-mounted Cable Management – Vertical Managers

- a. Contractor shall size vertical cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.
- b. Contractor shall use larger vertical cable managers between racks as described elsewhere in this section.
- c. Vertical cable managers shall be PatchRunner™ 2 (PR2V) Series Vertical Cable Management System
- d. Rack-mounted cable management – vertical managers shall have the following properties:
 - Shall consist of a metal backbone with cable management fingers that align with EIA rack spacing
 - Shall have integrated molded plastic door hinge pin receivers, which rest directly on the floor for added support.
 - Doors to have “push-to-close” functionality
 - Available in sizes 6” wide, 8” wide, 10” wide and 12” wide
 - Shall accept a metal, hinged, push-to-close door that can open to the right or left
 - Door support brackets shall be integrated into the manager with no assembly required
 - Doors ship with managers, simplifying ordering process with less packaging waste

6. Rack-mounted Cable Management – Horizontal Managers

- a. Contractor shall size horizontal cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.
- b. 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.
- c. Rack-mounted cable management – horizontal managers shall have the following properties:
 - 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.
 - 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.

- 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.

E. Communications Grounding Network

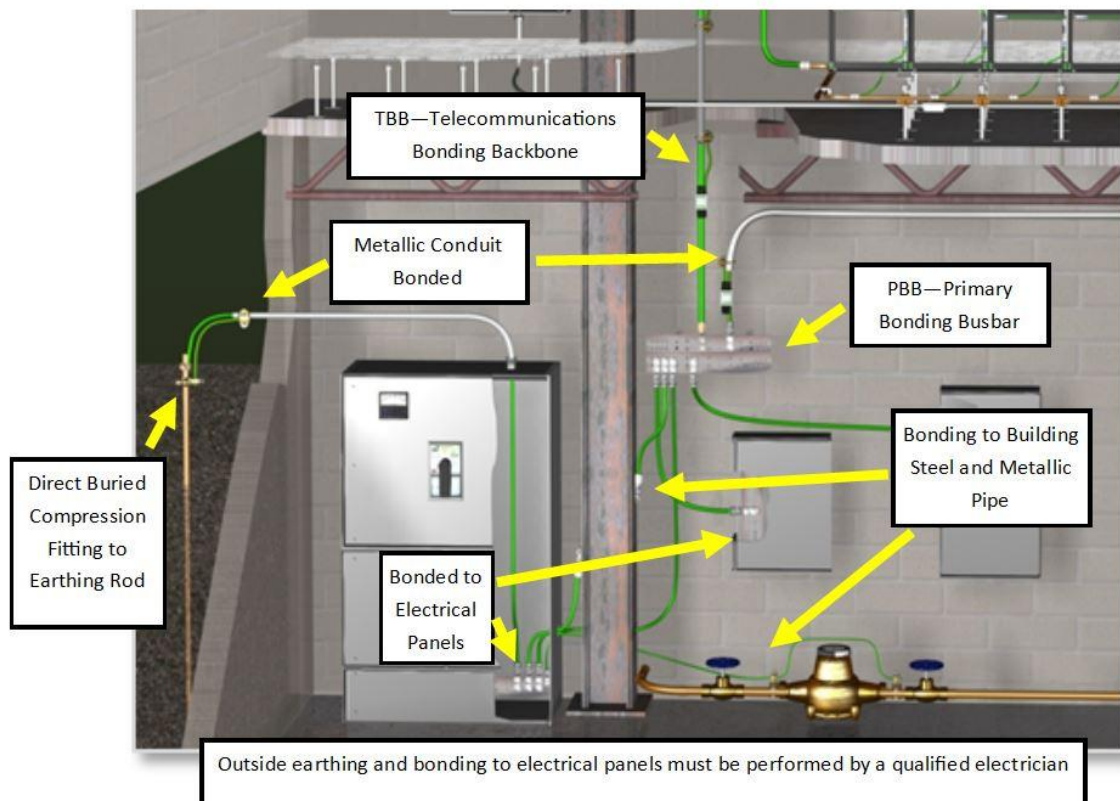
1. See Appendix A for Part Numbers
2. Installation Guidelines
 - a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA Standards.
 - b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays,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

4. Bonding to the Service Equipment (Power) Ground

- a. The bonding conductor for telecommunications shall bond the PBB (Primary Bonding Busbar) to the service equipment (power) ground and building steel.

5. Entrance Room

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

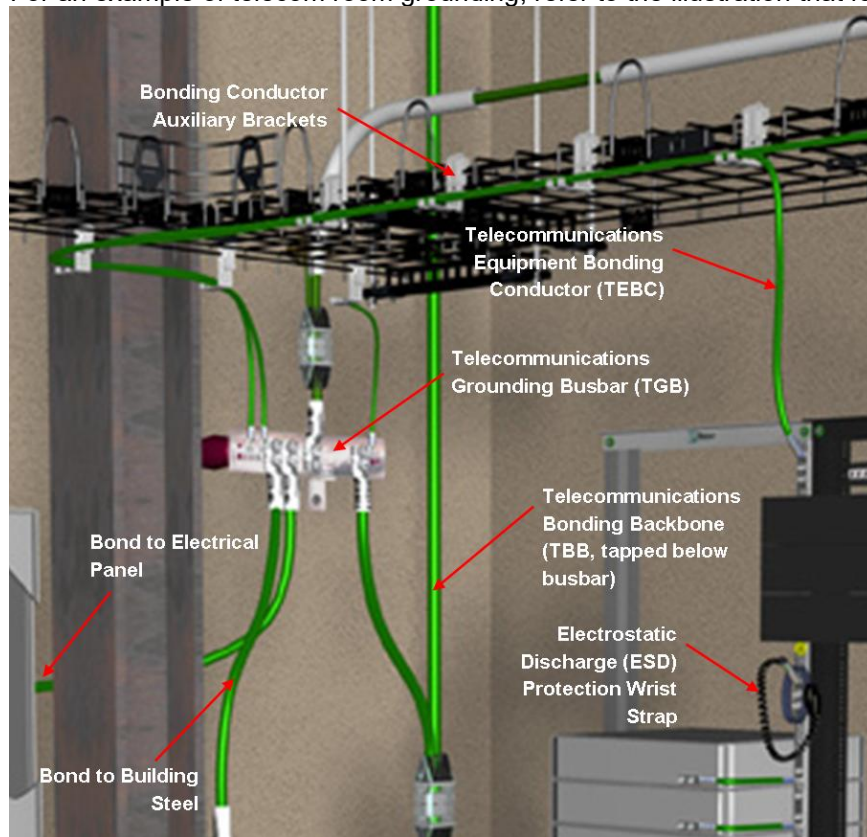


6. Distributor (Telecommunications) Rooms

- a. Within the telecommunications rooms and data centers all pathways and racks shall be grounded and bonded as indicated in the diagram below.
- b. Contractor is responsible for properly grounding all network equipment, racks and cabinets and bonding them to the wall mounted busbars as described in the TIA 607 series of standards.
- c. All newly installed racks and cabinets shall have installed a Panduit vertical strip mounted along one equipment rail to serve as a clean, low-resistance bonding place for equipment grounding jumpers used to bond equipment such as chassis switches, that come equipped with a designated grounding pad, back to the rack.

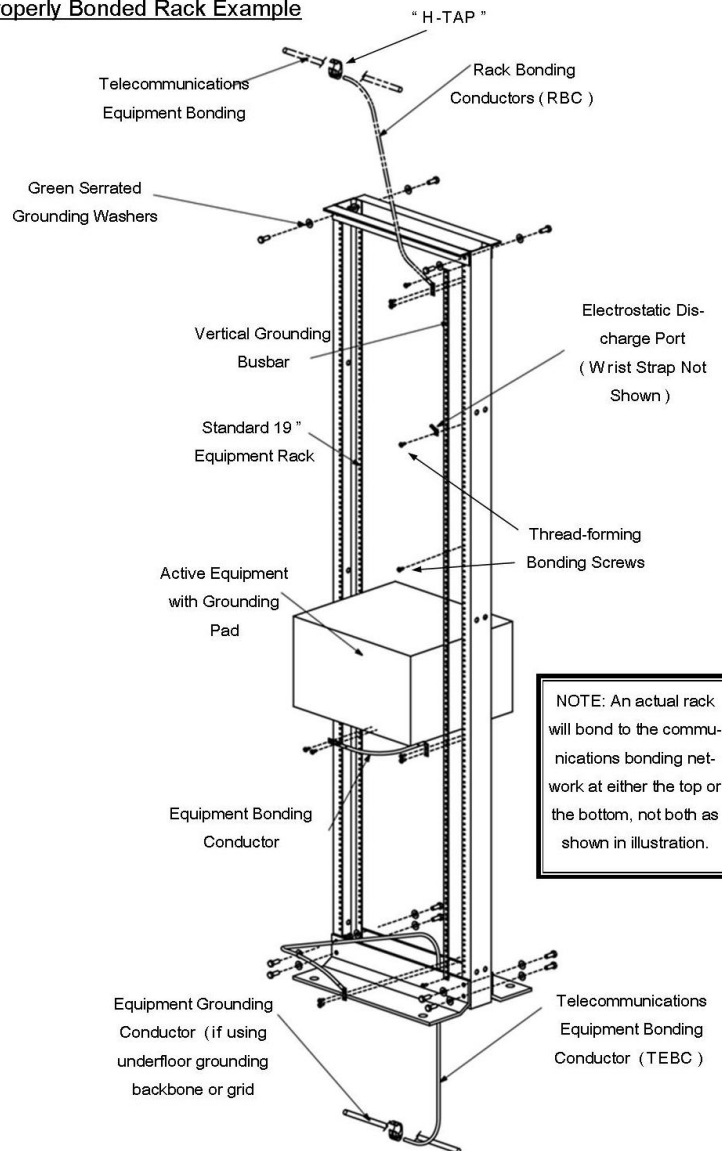
- d. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.
- e. Larger equipment (chassis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

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

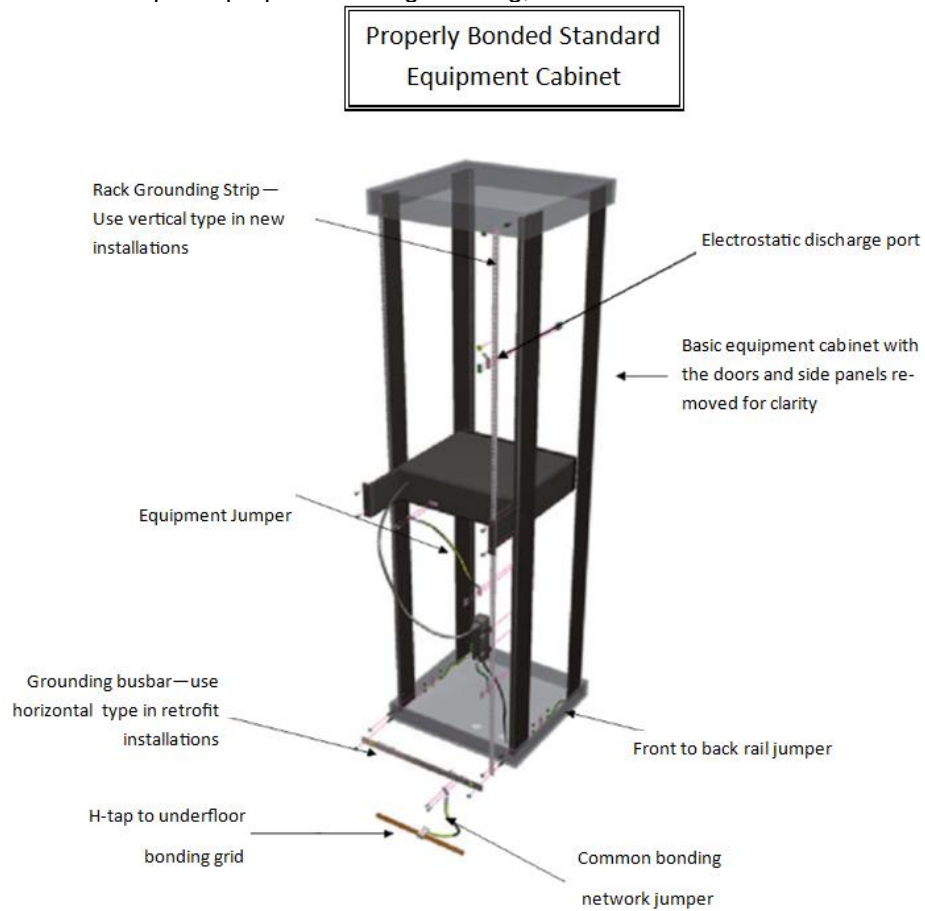


- m. For an example of proper rack grounding, see the illustration below:

Properly Bonded Rack Example



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

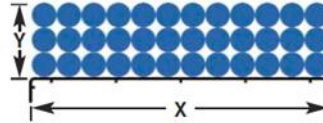


<END OF SECTION>

F. Cable Pathways

1. See Appendix A for Part Numbers
2. General Guidelines
 - a. Pathways shall be comprised of 12" Wyr-Grid to which is affixed separate 4"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.
3. Installation Guidelines
 - a. Installation of cable pathways shall be compliant with most recent versions of all applicable standards, national and local codes, as well as the local Authority Having Jurisdiction (AHJ).
 - b. Anywhere there is a conflict between standards, codes, installation specifications or project specific documentation contractor shall default to the most stringent.
 - c. If further clarification is needed, contractor shall submit a written request for clarification to New Waverly ISD. Response from New Waverly ISD shall be in writing.
4. Wyr-Grid
 - a. Copper cable delivery over racking systems in telecommunications rooms shall be done with Wyr-Grid® overhead cable tray routing system.
 - b. Metallic pathway shall have the following attributes:
 - 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 ²)	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 ²)	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.

5. FiberRunner

- a. Plastic Fiber Duct shall have the following attributes:
 - 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
 - Channel and fittings shall be installed using pre-assembled couplers
 - Fittings maintain a minimum 3" bend radius to protect against signal loss due to excessive cable bends
 - 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
 - Available system colors shall be yellow, orange, and black
 - Brackets shall be available for attaching system components to 1/2" or 5/8" threaded rod

6. J-Pro (J-Hooks)

- a. J-hook systems used by New Waverly ISD shall be Panduit "J-Pro" series.

- b. Bundles of Category 6/6A cables may be required to be routed above ceilings using J-hooks. Check project documentation for clarification.
- 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 50% 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 New Waverly ISD 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-Pro system shall have the following attributes:
 - 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.

7. Surface Mount Raceway

- a. On brownfield installations, Contractor shall match raceway to that is 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 Panduit LD10 International White (color), plastic "latching-duct raceway or Canyons approved equivalent.
- c. Areas requiring power and data be run through single raceway with partition, Contractor shall utilize Panduit LDP10 raceway, T-45 raceway or T-70 raceway system as needed to accommodate all cable with not more than a 35% fill according to manufacturer fill tables.
- d. Contractor is responsible to size raceway to accommodate not less than 35% fill upon installation, 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.

- e. Contractor is responsible that raceway installation includes all associated fittings, drop ceiling fittings, couplers and 1" control-bend-radius fittings where appropriate.
- f. 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).
- g. Surface mount raceway shall have the following attributes:
 - 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
- h. Installations requiring raceway shall use the same faceplates used in flush-mount applications as specified in this document, mounted on Panduit "JB1" surface boxes. Contractor shall not rely on adhesive-backing to hold surface boxes in place, but must use appropriate wall anchors for firm, permanent installation.
- i. Consult project-specific documentation or the New Waverly ISD project liaison if clarification on raceway type is needed.

<END OF SECTION>

G. Network Infrastructure Labeling

- 1. See Appendix A for Part Numbers
- 2. Installation Guidelines
 - a. Questions or comments regarding labeling strategies at New Waverly ISD may be sent to Brandon Clark at New Waverly ISD.
 - b. Contractor shall, wherever possible, pre-print labels using Panduit Easy-Mark software and desktop printer.
 - c. The Panduit PanTher (LS8E) hand-held thermal transfer printer shall be used onsite to print labels that were unanticipated, or that become damaged in application.
 - d. Labels shall be legible and placed in a position that insures ease of visibility.
 - e. All newly installed cables shall be labeled within 3 inches at both ends using a permanent self-laminating cable labels built to that purpose and designed to outlast the cable to which they attach.
 - f. Contractor is responsible for ordering the correct self-laminating cable labels appropriate to the cable outer diameter.

- g. Each end of the cable shall have the same label.
- h. The same identifier shall be contained in one line and repeated to be visible from all sides without having to rotate the cable to read it.
- i. All labels shall be machine printed, bold font and centered at the highest point that can fit all characters legibly. Hand written labels will not be accepted and shall be remedied at Contractor's expense.
- j. 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.
- k. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure.
- l. All test documents shall accurately reflect the labeling scheme.
- m. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
- n. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.
- o. All labels will be permanently affixed to installed cables, patch panels, racks, cabinets, and enclosures.
- p. Conduit shall be marked indicating the identification of the cable within.
- q. Consult project specific documentation for the labeling scheme for a particular project.

3. Communication and Systems Elements Requiring Labeling

- a. The following communications elements shall be labeled:
 - Equipment outlets – faceplates
 - Equipment outlets – surface boxes
 - Copper horizontal cable
 - Copper patch panels
 - Communications patch cords
 - Zone boxes (MUTOAs or consolidation points)
 - Equipment racks
 - Communications cabinets
 - Telecommunications rooms – (closets)
 - Fiber backbone cable
 - Fiber enclosures
 - Fiber optic patch cords (jumpers)

4. Other Systems Requiring Labeling

- a. The following systems shall be labeled:
 - Communications conduit and pathways
 - Firestopping locations
 - Grounding busbars
 - Grounding backbone
5. Labeling Records
 - a. Contractor shall provide a spreadsheet showing link records that list all labeled elements, including jack numbers, patch ports and telecom space identifiers.
 - b. All labeling information shall be recorded on the as-built drawings, and cross-reference sheets as described in project documentation.

H. Cabling Accessories

1. Refer to Appendix A for Part Numbers
2. Cable bundles on racks and in pathways shall be bundled with re-enterable hook and loop cable ties
3. Contractor is responsible for using plenum hook and loop ties in air-return spaces.
4. Plastic cable ties are not allowed
5. Physical Security Devices
 - a. Some portions of New Waverly ISD networks require additional physical security devices. These take three forms:
 - Devices that block-out copper and fiber ports in patch fields and faceplates that require a special tool for removal.
 - Devices that lock-in copper patch cords and require a special tool for removal of those patch cords.
 - Devices that temporarily or permanently block USB ports on laptops and computers.
 - b. Areas where such devices are required will be called out in the project documentation.

<END OF SECTION>

III. Testing and Acceptance

A. General

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

B. Copper Channel Testing

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

C. Fiber Testing

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

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

D. System Documentation

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

- d. It is mandatory that the test results from each phase be delivered in the tester native format. At the request of the New Waverly ISD project lead, the telecommunications contractor shall provide copies of the original test results.
- e. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

2. Documentation at Project Completion

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

E. Inspection and Acceptance

1. During Installation

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

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

2. Final Inspection

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

3. Live System Performance Verification

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

4. Final Acceptance

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

F. Post Installation Maintenance Agreement

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

<END OF SECTION>

IV. Appendix A – Materials List

Manufacturer	Part Number	Description
COPPER DISTRIBUTION		
Panduit	PUP6C04WH-ULP	Category 6 UTP LP rated cable, White - Plenum.
Panduit	PUP6AV04BU-G	Category 6A Vari-Matrix LP Rated Cable, Blue - Plenum
Panduit	NK6FWHY	NeKey 6-port, single gang, flush mount vertical faceplate with labels, White color.
Panduit	NK2FWHY	NetKey 2-port, single gang, flush mount faceplate with labels, White color.
Panduit	NK4FWHY	NetKey 4-port, single gang, flush mount vertical faceplate with labels, White color.
Panduit	NK688MBL	NetKey Cat 6 punchdown jack module – Black. *For standard colors replace color suffix (BL) with IW (Off White), EI (Electric Ivory), IG (International Gray), WH (White), BL (Black), BU (Blue), RD (Red), YL (Yellow), GR (Green), OR (Orange) or VL (Violet).
Panduit	NK6X88MBL	NetKey Cat 6 punchdown jack module – Black. *For standard colors replace color suffix (BL) with IW (Off White), EI (Electric Ivory), IG (International Gray), WH (White), BL (Black), BU (Blue), RD (Red), YL (Yellow), GR (Green), OR (Orange) or VL (Violet).
Panduit	NKBMWH-X	Blank keystone module. Reserves faceplate space for future use, White.
Panduit	NK2BXWH-A	Surface mount box accepts two NetKey® Modules, White color.
Panduit	NK6PP24P	NeKey All Molded Polymer Punchdown Patch Panel, Cat 6, Flat, 24 Port, 1 RU.
Panduit	NK6PP48P	NetKey All Molded Polymer Punchdown Patch Panel, Cat 6, Flat, 48 Port, 2 RU.
Panduit	NK6PPG24Y	NetKey Metal Punchdown Patch Panel, Cat 6, Flat, 24 Port, 1 RU.
Panduit	NK6PPG48Y	NetKey Metal Punchdown Patch Panel, Cat 6, Flat, 48 Port, 2 RU.
Panduit	NK6XPP24P	NeKey All Molded Polymer Punchdown Patch Panel, Cat 6A, Flat, 24 Port, 1 RU.
Panduit	NK6XPP48P	NetKey All Molded Polymer Punchdown Patch Panel, Cat 6A, Flat, 48 Port, 2 RU.
Panduit	NK6XPPG24Y	NetKey Metal Punchdown Patch Panel, Cat 6A, Flat, 24 Port, 1 RU.
Panduit	NK6XPPG24Y	NetKey Metal Punchdown Patch Panel, Cat 6A, Flat, 48 Port, 2 RU.
Panduit	FP6X88MTG	TX6A, Category 6A UTP Field Term RJ45 Plug is a simple-to-attach plug for field termination of 4-pair unshielded twisted pair cable, backward compatible for Category 5e/6 applications
Panduit	UTP28SP10BU	Copper Patch Cord, Category 6 Performance (SD), 28 AWG, Blue CM/LSZH UTP Cable, 10ft. *For lengths 1 to 50 feet (increments of one foot), and 55 to 150 feet (increments of five feet), change the length designation (10) in the part number to the desired length. ** For standard cable colors other than Blue (BU), add suffix IW (Off White), BL (Black), BU (Blue), RD (Red), YL (Yellow), GR (Green), OR (Orange), GY (Gray), PK (Pink), or VL (Violet).
Panduit	UTP28X10BU	Copper Patch Cord, Category 6A Performance (SD), 28 AWG, Blue CM/LSZH UTP Cable, 10ft. *For lengths 1 to 50 feet (increments of one foot), and 55 to 150 feet (increments of five feet), change the length designation (10) in the part number to the desired length. ** For standard cable colors other than Blue (BU), add suffix IW (Off White), BL (Black), BU (Blue), RD (Red), YL (Yellow), GR (Green), OR (Orange), GY (Gray), PK (Pink), or VL (Violet).

FIBER DISTRIBUTION SYSTEMS		
Panduit	FLCDMCXAQY	LC OptiCam® 10Gig™ 50/125µm Multimode Duplex Fiber Optic Connector for 900µm tight-buffered fiber installation.
Panduit	FLCDSCBUY	LC OptiCam® Singlemode Duplex Fiber Optic Connector for 900µm tight-buffered fiber installation.
Panduit	FOPRX24Y	24F OM3 Multimode Interlocking Armored tight buffered riser rated OFCR
Panduit	FSPR924Y	24F OS2 Singlemode Interlocking Armored tight buffered riser rated OFCR
Panduit	FCE2U	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to eight QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 3.48"H x 17.60"W x 16.30"D (88.4mm x 447.0mm x 414.0mm).
Panduit	FCE4U	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to twelve QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 6.98"H x 17.60"W x 16.30"D (177.0mm x 447.0mm x 414.0mm)
Panduit	FAP6WAQDLCZ	LC 10Gig™ OM3/OM4 FAP loaded with six LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with zirconia ceramic split sleeves
Panduit	FAP12WAQDLCZ	LC 10Gig™ OM3/OM4 FAP loaded with twelve LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with zirconia ceramic split sleeves.
Panduit	FAP6WBUDLCZ	LC FAP loaded with six LC duplex singlemode fiber optic adapters (Blue) with zirconia ceramic split sleeves.
Panduit	FAP12WBUDLCZ	LC FAP loaded with twelve LC duplex singlemode fiber optic adapters (Blue) with zirconia ceramic split sleeves.
Panduit	FAPB	Blank fiber adapter panel – reserves space for future use.
Panduit	FX2ERQ1Q1ONM001	2-fiber OM3 patch cord, LC push-pull to LC push-pull, 1.6mm jacket, riser (OFNR) rated, Optimized IL, 1m. 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	F92ERQ1Q1SNM001	2-fiber OS1/OS2 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.
RACKS, ZONE ENCLOSURES AND CABLE MANAGERS		
Panduit	R2P96	Standard 19" EIA Aluminum 52RU 2-Post rack with hardware kit and paint piercing bonding kit, numbered up
Panduit	R2P	Standard 19" EIA Aluminum 45RU 2-Post rack with hardware kit and paint piercing bonding kit, numbered up
Panduit	R4P96	4 post EIA rack with #12-24 threaded rails. Dimensions: 96.0"H x 23.25"W x 30.0"D.
Panduit	R4P	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 30.0"D
Panduit	R2PPRVWF	Waterfall Trough for 2 Post Rack.
Panduit	PR2VD06	PatchRunner™ 2 Vertical Cable Manager and Doors, Dual Sided, 45RU, 83.9 H x 6.0 W x 20.7 D
Panduit	WMPSE	19", 1RU Horizontal cable manager front/rear, 1.7"H x 19.0"W x 8.9"D (44mm x 483mm x 226mm).
Panduit	NM1	Horizontal Cable Manager High Capacity Front and Rear 1 Rack Unit. 1.7"H x 19.0"W x 13.1"D
Panduit	CMUT19	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	CMLT19	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.
CABLE PATHWAYS		
Panduit	WG12BL10	12" W, Wyr-Grid Pathway, 118.4in x 12.5in x 2.1in, Black powder coated
	FR4X4YL6	4 x 4 FiberRunner Channel
Panduit	J-Pro J-Hook system	Panduit J-Pro System. Plenum rated composite J-hooks with hardware available for various hardware applications. See www.panduit.com for variations.
Panduit	JB1IW-A	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.
BONDING AND GROUNDING		
Panduit	ACG24K	#6 AWG (16mm ²) 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	LCC series	Panduit two-hole compressing lugs for code conductors in BICSI hole spacing.
Panduit	HTCT series	Panduit HTAPs. Must be selected according AWG size of run and tap conductors.
Panduit	CLRCVR series	Panduit clear covers for HTAPs. Must be selected according to HTAP being covered.
Panduit	RGS134-1Y	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	RGCBNJ660P22	Jumper kit for bonding individual racks or cabinets into grounding backbone. #6 AWG (16mm ²) 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	GJ672UH	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	RGESD2-1	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	RGESDWS	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	RGTBSG-C	Green thread-forming bonding screws for use to mount equipment that does not have a built-in grounding pad (terminal).
Panduit	RGEJ1024PHY	24" long pre-terminated equipment grounding jumper #10 AWG (6mm ²) 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	RGEJ1036PFY	36" long pre-terminated equipment grounding jumper#10 AWG (6mm ²) 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	GB2B0306TPI-1	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	GB2B0514TPI-1	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	GB4B0624TPI-1	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	LTYK	Wall mounted busbar label kit. Label kit includes printed tag and one flame retardant cable tie.
NETWORK LABELING SOFTWARE – FOR INK JET/LASER PRINTER		
Panduit	PROG-EM2GO	Easy-Mark Labeling Software for PC, supplied on USB Flash Drive. For preprinting communications labels on laser/inkjet printer.
Panduit	S100X150YAJ	Self-laminating cable labels for Category 6 cable for use with Easy-Mark software and laser/ink jet printer.
Panduit	C261X035Y1J	Patch Panel labels for use with Easy-Mark software and laser/ink jet printer.
Panduit	C195X040Y1J	Faceplate labels for single gang stainless or sloped plastic - use with Easy-Mark software and laser/ink jet printer.
Panduit	C288X040Y1J	Faceplate labels for double gang stainless - use with Easy-Mark software and laser/ink jet printer.
Panduit	S100X650YAJ	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with Easy-Mark software and ink jet printer.
Panduit	S100X160YAJ and NWSLC-3Y	Label and turn-tell sleeve for labeling fiber jumpers. For use with Easy-Mark software and ink jet printer.
Panduit	C200X100FJJ	1" high, white, vinyl tape labels for labeling grounding busbars, racks, cabinets and pathways. For use with laser/ink jet printer.
NETWORK LABELING – HANDHELD LABELER		
Panduit	LS8EQ-KIT-ACS	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	S100X150VAC	Self-laminating cable labels for Category 6 cable for use with PanTher LS8E hand-held printer.
Panduit	C261X035Y1C	Handheld printer labels for modular faceplate patch panels.
Panduit	C195X040Y1C	Faceplate labels for single gang stainless - use with PanTher handheld labeler.
Panduit	C288X040Y1C	Faceplate labels for double gang stainless - use with PanTher handheld labeler.
Panduit	S100X650VAC	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with handheld labeler.
Panduit	S100X160VAC and NWSLC-3Y	Label and turn-tell sleeve for labeling fiber jumpers. For use with hand-held labeler.
Panduit	T100X000VPC-BK	1" high, continuous black on white, vinyl tape labels for labeling racks, cabinets and pathways with PanTher LS8E handheld labeler.

PHYSICAL SECURITY LOCKING DEVICES		
Panduit	PSL-DCJB-C	Package of 100 RJ45 jack blockout devices and one removal tool. Color red.
Panduit	PSL-USBA-L	Package of 50 USB Type 'A' blockout devices and one removal tool. Color red.
Panduit	PSL-USBB-L	Package of 50 USB Type 'B' blockout devices and one removal tool. Color red.
Panduit	PSL-DCPLX-BL-C	Package of 100 RJ45 plug lock-in devices compatible with flush mount jacks, and one installation/removal tool. Color black.
Panduit	PSL-DCPLRX-BL-C	Package of 100 RJ45 plug lock-in devices compatible with recessed jacks, and one installation/removal tool. Color black.
CABLE TIES – HOOK AND LOOP		
Panduit	TTS-35RX0	.75" wide, continuous roll Hook and Loop Cable Ties, black. 35 ft. roll. Carton qty 10 rolls.
Panduit	HLSP1.5S-X12	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.
Panduit	HLSP3S-X12	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.

<END OF APPENDIX A>

<END OF DOCUMENT>