SECTION 27 13 23

Communications fiber backbone cabling

Notes to the Specification Writer:

This Section has been written to cover most, but not all, project conditions that you will encounter. Depending on the project, you may need to add material, delete items, or modify what is currently written. Editing instructions are included throughout the document. (If this document is viewed or printed in color, these instructions appear in red italic text.)

Review this entire specification Section and edit it to meet the requirements of the specific project. Options or items where the specification writer’s input is needed are enclosed in <<karets>>.

Before publishing your final version of this specifications, remove all placeholders / instructions in red text.

1. GENERAL
	1. SUMMARY

### This Section includes:

#### The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings

#### The testing, documentation, and instructions for completing the Fiber Backbone Cabling System

#### Products supplied but not installed under this section, including loose equipment specified herein, which is to be turned over to the Owner at the completion of this project

### Examine the contract documents in their entirety (including drawings and specification sections in the other divisions) for requirements or work which may affect work under this section, regardless of whether such requirements or work are specifically indicated in this section.

### Contractor Shall Provide and Install

#### The Contractor shall furnish and install telecommunications passive equipment, including:

##### Fiber backbone cable

##### Splicing and terminations

##### Testing

##### Administration

#### Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

#### The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

### Errors or Omissions in Drawings or Documentation

#### If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.

#### Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.

### Related Sections:

#### Section 00 00 00 – Procurement and Contracting Requirements –

#### Section 01 00 00 – General Requirements

#### Section 26 05 26 – Grounding and Bonding for Electrical System

#### Section 27 05 00 – Common Work Results for Communications

#### Section 27 05 26 – Grounding and Bonding for Communication Systems

#### Section 27 05 53 – Identification for Communication Systems

#### Section 27 11 19 – Communications Termination Blocks and Patch Panels

#### Section 27 15 43 – Communications Faceplates and Connectors

#### Section 27 17 00 – Testing of Structured Cabling Systems

## Definitions

### ANSI – American Northern Standards Institute

### AWG – American Wire Gauge

### BICSI – Building Industry Consulting Service International

### BCT – Bonding Conductor for Telecommunications

### BD – Building Distributor – A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made

### CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for interconnection of cables extending from building pathways to the equipment outlet

### EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment

### EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space

### EIA – Electronics Industry Alliance

### ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.

### ESD – Electrostatic Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown

### ETL – Intertek Certification Services

### IEC – International Electrotechnical Commission

### IEEE – Institute of Electrical and Electronic Engineers

### IDC – Insulation displacement contact

### ISO – International Standards Organization

### HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers

### HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located, and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the Equipment Distribution Areas (EDAs)

### IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment

### MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling or equipment

### MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC)

### MM – Multi-Mode Fiber

### NECA – National Electrical Contractors Association

### NFPA – National Fire Protection Agency

### NRTL – Nationally Recognized Testing Laboratory

### TIA – Telecommunications Industry Association

### SM – SingleMode Fiber

### UL – Underwriters Laboratory

### Provide: Furnish, install, terminate, label, test and certify a complete operating cabling system.

### Contract Documents (CD): Design drawings, specifications, sketches and schedules provided by the Engineer as they directly relate to this scope of work and this project.

### Structured Cabling Systems (SCS) wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber cable installed and configured to provide computer data and voice connectivity.

### Point–of–Entry (POE): Unmarked Manholes/Vaults at property line

### NET–POP Rooms/MPOE (Main Point of Entry): The area where the outside plant media/carrier services appear in the facility. The NET–POP contains equipment used by owner or carrier to hand–off/transition cable from outside plant into inside plant type.

### Network Center/Main Distribution Frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid–connection point between the Core/Network and the TR/IDF/access zones for all connections.

### Telecommunications Room (TR)/Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access–layer switches and user network connections within each floor.

### Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS–232 controllers, Ethernet hubs, switches, routers, PBX, etc.

### Campus Backbone: cabling system consisting of media and termination hardware interconnecting POE, Net–Pop’s and Future onsite buildings.

### Building Backbone: cabling system consisting of media and termination hardware interconnecting MDFs to IDFs.

### Horizontal: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the TRs.

### Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

### Basket Cable Tray: A cable support and management system fabricated of continuous, rigid, welded steel wire mesh and available in many sizes with attachment hardware suiting multiple installation methods

### Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.

### Cabinet: free standing, floor–mounted or wall–mounted modular enclosure designed to house and protect rack–mounted electronic equipment and passive terminations.

### Channel: The end–to–end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.

### Cross–Connect: equipment used to terminate and tie together communications circuits.

### Cross–Connect Jumper: a cluster of twisted–pair conductors without connectors used to establish a circuit by linking two cross–connect termination points.

### Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.

### Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight–position/eight–contact modular jacks.

### Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

### LAN: Local area network.

### Link: Horizontal cabling link encompassing all components of the horizontal cabling (TO, patch panels, blocks, jumpers and patch cords that join them in the horizontal cross–connect). It is distinguished from a channel because it does not include the equipment cables/cords at the telecom spaces or work area.

### Media: twisted pair, and fiber optic cable or cables used to provide signal transmission paths.

### Mounting Frame: rectangular steel framework, which can be equipment rack or wall mounted to support wiring blocks, patch panels, and other communications equipment.

### Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter–building cables, conduits, manholes, hand–holes, and innerduct.

### UTP: Unshielded Twisted Pair.

### FO: Fiber Optic

### Passive Equipment: non–electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.

### Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross–connect.

### Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross–connect fields.

### Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, ceiling support wires, etc.

### Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.

### Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways and surface raceways; does not include cable tray.

### Racks: An open, freestanding, floor–mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.

### Riser Backbone: The Riser Backbone subsystem links the main cross connect (MDF) in the equipment room to the distribution rooms (TRs).

### Structured Cabling System (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

### Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.

### Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

### Work Area Subsystem: The connection between the telecommunications outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, adapters, and other transmission electronics.

### Wireless Access Point (WAP): Telecom outlet designated for use with wireless network devices. Such outlet shall be mounted above ceiling.

### Contractor – The successful bidder engaged to provide the work of this specification

## REFERENCES

### Most recent editions and addenda of the following documents:

### ANSI/TIA 568 series, most recent revisions, addenda and systems bulletins. All applicable

### ANSI/TIA–569 Telecommunications Pathways and Spaces, most recent revision including all relevant addenda and systems bulletins

### ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure, most recent revision including all addenda and systems bulletins

### ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, most recent revision including all addenda and systems bulletins

### ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems, most recent revision including all addenda and systems bulletins

### ANSI/TIA–942 Telecommunications Infrastructure Standard for Data Centers, most recent revision including all addenda and systems bulletins

### ANSI/TIA–1179 Healthcare Facility Telecommunications Infrastructure Standard, most recent revision including all addenda and systems bulletins

### ANSI/TIA–4966 Telecommunications Infrastructure Standard for Educational Facilities, most recent revision including all addenda and systems bulletins

### TIA–TSB–162 Telecommunications Cabling Guidelines for Wireless Access Points, most recent revision including all addenda and systems bulletins

### TIA-526 Series – Standard Test Procedures for Fiber Optic Systems

### TIA-942 – Telecommunications Infrastructure Standard for Data Centers

### Telecommunications Distribution Methods Manual, most recent edition

### Information Transport Systems Installation Methods Manual (ITSIMM), most recent edition

### National Electric Codes (NEC) – all applicable

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### NECA/FOA 301– Installing and Testing Fiber Optic Cables

### OSHA Standards and Regulations – all applicable

### Local Codes and Standards – all applicable

### UL444 – Standard for Safety of Communications Cable

### UL 1666 – Standard for Safety of Flame Propagation Height

### Local Authority Having Jurisdiction (AHJ)

### 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.

### Manufacturers’ Recommendations - Install all cabling and termination devices per the manufacturers’ recommended installation practices for the applications warranties.

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

## SYSTEM DESCRIPTION

### The Contractor will provide, install, and test a complete structured cabling system for the project’s voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components, as identified below.

### Fiber Backbone Cabling

#### Vertical and horizontal backbone cabling will consist of Multi-mode and Singlemode optical fiber cable installed from each TR to the ER.

### Backbone Cabling Termination

#### Provide fiber distribution enclosures at each end, sized for the number of fibers to be installed.

#### Terminate with field-installable connectors or with fusion splicing of factory cable assemblies and modular connector panels or splice cassettes.

### Typical Equipment Room (ER)

#### Open racks and/or enclosures with vertical and horizontal wire management.

#### Fiber Distribution Enclosures (FDEs).

#### Fire-resistant plywood installed on at least one (1) wall, at a height of 96 inches Above the Finished Floor (AFF) on which to install wall-mounted equipment.

#### A Grounding and bonding system connected to the building’s main grounding electrode system.

#### A cable runway system installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to the equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components.

### Typical Telecommunications Room (TR)

#### Open racks and/or enclosures with vertical and horizontal wire management.

#### Fiber Distribution Enclosures (FDEs).

#### Fire-resistant plywood installed on at least one (1) wall, at a height of 96 inches Above the Finished Floor (AFF) on which to install wall-mounted equipment.

#### A Grounding and bonding system connected to the building’s main grounding electrode system.

#### A cable runway system installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to the equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components.

### Pathways and Raceways

#### Pathways and raceways are the support system for the infrastructure. All pathways and raceways shall conform to the standards referenced in this Section.

#### All horizontal and backbone cable shall be properly supported every 48 to 60 inches. Infrastructure support systems include, but may not be limited to the following:

#### Properly supported cable trays and cable runway.

##### Properly supported conduits, inside or outside, above ground or underground.

##### Non-continuous cable supports, which shall be spaced no more than 60 inches apart.

##### Surface raceway systems that may consist of metallic or non-metallic raceways and boxes.

### Using a Combination of Cable Supports

#### The preferred method for providing pathways is to use a combination of cable tray and non-continuous cable supports.

#### Cable trays shall be used for main horizontal cable pathways on all levels from the ER and TR locations.

#### Cable trays shall be installed in the main corridors.

#### In areas of low cable density, use independently-supported non-continuous cable supports in lieu of the cable tray system.

####  All backbone cable shall also follow these cable tray pathways.

#### To allow for future maintenance and access, the primary cable routes shall be located over corridors.

#### To protect cable from damage and to provide a suitable aesthetic appearance, in areas where the cable may be exposed, such as in open ceiling rooms, conduit or surface raceway must be used instead of non-continuous cable supports.

## SUBMITTALS

### Engineer’s Review

#### The Engineer’s review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.

#### With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.

#### The Engineer’s review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

### General Component Data

#### For all products covered under this Section, the Contractor shall submit the following data for each component:

##### A Specification Section

##### The Manufacturer’s name.

##### The Manufacturer’s model and part number

### Fiber Cable

#### In addition to the general requirements above, the Contractor shall submit the following additional data:

##### Cable identification numbers.

##### Cable specifications including quantity of fibers, material, insulation, jacket, wavelength, attenuation, diameter, bend radius, core, cladding, coating, buffering, weight, and color.

### Splicing and Terminations

#### In addition to the general requirements above, the Contractor shall submit splicing and terminating tools, materials, and methods.

### Testing and Test Results

#### The equipment serial number.

#### A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable), the origin, and the destination of each cable tested.

#### Refer to Section 27 17 00.

## QUALITY ASSURANCE

### Standards for Materials and Equipment

#### The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.

### Installer Qualifications

#### Refer to Section 27 05 00.

## DELIVERY, STORAGE, AND HANDLING

### To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling.

### The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor’s expense.

#### Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.

#### Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.

#### If off-site storage of materials is necessary, this shall be at the Contractor’s expense.

## COORDINATION

### The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award

#### The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.

#### At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.

### Meeting Attendance and Schedule Adherence

#### The Contractor must attend all project-related meetings and adhere to schedule set by the Project Manager.

### Final Inspection

#### The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.

#### Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer. The final project documentation shall include, but may not be limited to:

##### As-Built Drawings, in an AutoCAD format, with legible outlet address and cable paths

##### Outlet location spreadsheets

##### Warranty paperwork

##### A copy of the Final Inspection and Acceptance Signoff Sheet

##### Photos of each ER and TR

## PROJECT CONDITIONS

### Project Environmental Requirements

#### Fiber Optic Cable Safety

##### The following warnings shall be posted on the job site:

1. WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.
2. CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.

##### Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals.

##### Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

#### Hazardous Materials Prohibition

##### The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

#### Existing Conditions

##### Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.

##### Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

### Record Drawings

#### Keep a complete set of all telecommunications drawings in the job site office for demonstration of the actual installation work specified in this Section.

#### Use this set of drawings for no other purpose.

#### Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil.

#### Upon completion of the project, submit the record set of drawings.

## USE OF THE SITE

### Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

### When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

### Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor’s Project Manager on and when to work in these areas.

### Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:

#### The Contractor shall replace all ceiling tiles that they have removed.

#### The Contractor shall place all furniture and equipment that they have moved back into its original location.

#### The Contractor shall return any equipment that they have disconnected to working order.

#### The Contractor’s Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.

#### It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

## CONTINUITY OF SERVICES

### Take no action that will interfere with or interrupt existing building services, unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time.

### The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the Contractor shall give three (3) days advance notice.

### Should building services be inadvertently interrupted:

#### The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.

#### The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

## WARRANTY

### Refer to Section 27 05 00.

# PRODUCTS

## GENERAL

### Refer to Section 27 05 00 for General Requirements

### All materials and products shall be:

#### Appropriate for the intended use.

#### Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA) or the American National Standards Institute (ANSI).

#### Permitted by the Authority Having Jurisdiction (AHJ).

### All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.

### Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

### Cable lubricants specifically designed for installing communications cable may be used as needed to reduce pulling tension when pulling cable into conduit.

### Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

### All components will be approved by the Engineer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:

#### Be in compliance with the Construction Documents.

#### Have fit and finish compatible with the existing surrounding structure.

#### Be unobtrusive.

#### Provide the required functionality.

### All work area termination hardware, including mounting boxes, faceplates, and outlets, shall match the existing wall surface color as closely as possible.

### All copper and fiber products shall be from a single manufacturer so that a single performance warranty covers all applications on vertical and horizontal links.

### Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.

### Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.

## SUBSTITUTION POLICY

### Refer to Section 27 05 00 for General Requirements

## OPTICAL FIBER CABLES

### Optical Fiber Strands

#### All optical fibers shall:

##### Be usable and shall meet required specifications.

##### Be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

##### Consist of a doped silica core surrounded by a concentric glass.

##### Be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2).

##### Be coated with a dual layer acrylate protective coating that is in physical contact with the cladding surface.

##### Have a maximum attenuation value for each cabled fiber at 23˚C ± 5˚C on the original shipping reel.

### Graded Index (50/125 µm OM3)

#### The multimode fiber utilized in the OM3 optical fiber cable shall meet TIA-492AAAC-A, “Detail Specification for 850-nm Laser-Optimized, 50µm Core Diameter/ 125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.” The fibers shall have:

##### A core diameter of 50.0 ± 2.5 µm.

##### Core non-circularity of no more than 5%.

##### A cladding diameter of 125.0 ± 1.0 µm.

##### Cladding non-circularity of no more than 1.0%.

##### A core-to-cladding concentricity of no more than 1.0 µm.

##### A coating diameter of 250 µm, plus optional 900 µm buffer.

##### A refractive index core (graded index).

##### A numerical aperture of 0.200 ± 0.015.

##### Maximum attenuation of 2.3 dB/km at 850 nm, 0.6 dB/km at 1300 nm, and 1.0 dB/km at 1301-1380 nm.

##### IEEE 802.3ae performance that supports laser-based 10 Gigabit Ethernet (GbE) operation in the 10GBASE-SR/SW (850 nm) and 10GBASE-LX4 (1310 nm) at 300 m and 10GBASE-LRM (1310 nm) at 220 meters.

##### A minimum LED bandwidth of 500/500 MHz•km at 850/1300 nm.

##### Attenuation uniformity with no point discontinuities greater than 0.08 dB at either 850 nm or 1300 nm.

##### Water peak attenuation with a coefficient at 1380 nm that does not exceed the coefficient at 1300 nm by more than 3.0 dB/km.

##### Macrobend attenuation due to 100 turns of fiber around a 75 mm ± 2 mm diameter mandrel that does not exceed 0.05 dB at 850 nm or 1300 nm.

### Graded Index (50/125 µm OM4)

#### The multi-mode fiber utilized in the OM4 optical fiber cable shall meet TIA 492AAAD "Detail specification for OM4 850-nm laser-optimized, 50-µm core diameter/125 µm cladding diameter class 1a graded-index multimode optical fibers." The fibers shall have:

##### A core diameter of 50.0 µm ± 2.5 µm.

##### Core non-circularity of no more than 5%.

##### A cladding diameter of 125.0 µm ± 1.0 µm.

##### Cladding non-circularity of no more than 1.0%.

##### Core-to-cladding concentricity of no more than 1.0 µm.

##### A coating diameter of 250 µm, plus optional 900 µm buffer.

##### A refractive index core (graded index).

##### A numerical aperture of 0.200 ± 0.015.

##### Maximum attenuation of 2.3 dB/km at 850 nm and 0.6 dB/km at 1300 nm.

##### IEEE 802.3ae performance that supports laser-based 10 Gigabit Ethernet (10GbE) operation in the 10GBASE-SR/SW (850 nm) to a maximum distance of 550 meters and 10GBASE-LX/LX4 (1300 nm) to a maximum distance of 300 meters.

##### A minimum LED bandwidth of 500/500 MHz•km at 850/1300 nm.

##### Attenuation uniformity with no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.

##### Water peak attenuation with a coefficient at 1380 nm that does not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km.

##### Macrobend attenuation due to 100 turns of fiber around a 75 mm ± 2 mm diameter mandrel that does not exceed 0.5 dB at 850 nm or 1300 nm.

### Singlemode (8.5/125 µm)

#### Single-mode fibers shall meet TIA 492CAAB, “Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak,” and ITU recommendation TG.652, “Characteristics of Single-Mode Optical Fiber Cable.” The fibers shall have:

##### A core/cladding diameter (characterized) of 8.2 µm/125.0 µm ± 0.7 µm.

##### Core-to-cladding concentricity of no more than 0.5 µm.

##### Cladding non-circularity of no more than 1.0%.

##### A coating diameter of 250 µm, plus optional 900 µm buffer.

##### Attenuation of 0.34 dB/km at 1310 nm and 0.22 dB/km at 1550 nm.

##### Attenuation uniformity with no point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm.

##### Water peak attenuation at 1383 nm ± 3 nm that is no more than 0.31 dB/km.

##### A cabled cutoff wavelength: (∂ccf) that is no more than 1260 nm.

##### IEEE 802.3ae performance that supports laser-based Gigabit Ethernet (GbE) operation in the 10GBASE-LR (1300 nm) operating window at 10,000 m.

##### A mode field diameter of 9.20 µm ± 0.40 µm at 1310 nm and 10.4 µm ± 0.8 µm at 1550 nm.

##### Macrobend attenuation due to 100 turns of fiber around a 50 mm ± 2 mm diameter mandrel that does not exceed 0.05 dB at 1310 nm and 1550 nm.

##### A zero dispersion wavelength (∂o) of 1301.5 nm that is not more than ∂o at 1321.5 nm or less.

##### A zero dispersion slope (So) of no more than 0.086 ps/(nm•km).

##### Maximum dispersion of no more than 3.2 ps/(nm•km) from 1285 nm through 1330 nm and less than 18 ps/(nm•km) at 1550 nm.

##### A fiber curl with a curvature radius of no less than 4.0 m.

### Fiber Optic Cable Fire Ratings

#### Only <<insert OFNP or OFCP as appropriate>> listed optical fiber backbone cable is acceptable for use on this project.

### Fiber Optic Cable Termination

#### Where cables are installed, the 900 µm buffer, 250 µm coated fibers or ribbonized fibers contained in these cables may be terminated either by:

##### Fusion splicing of factory-polished splice-on connectors or factory-terminated cable assemblies (“pigtails”).

##### Cam-style mechanical splice connectors using a tool that provides calculated insertion loss at the point of termination

##### Individual fibers secured in a protective covering, such as an aramid-reinforced tube with connectors mated to the resulting assembly

### Fiber Optic Cable Features

#### The size and configuration of fiber optic cables shall be as shown on the Drawings.

#### The buffered fibers shall be grouped in subunits of 6 or 12 fibers.

##### Subunits shall be stranded around a dielectric central member.

##### Layered aramid yarns shall serve as the tensile strength member of the subunit.

##### To facilitate jacket removal, a ripcord may be applied between the aramid yarns and the subunit jacket.

##### For physical and environmental protection, the subunit jacket shall be extruded over the aramid yarns.

##### The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections have a consistent, uniform thickness and be smooth, as is consistent with the best commercial practice

##### The subunits shall be stranded around a dielectric central member, a ripcord shall be inserted beneath the outer jacket to facilitate jacket removal, an outer jacket shall be extruded around the subunits.

#### An overall helically wound interlocking metallic armor shall be provided, to surround the outer cable jacket, to which a listed outer jacket shall be applied. <<Include when appropriate for the project.>>

#### The individual fibers shall be color-coded for identification and shall meet these requirements:

##### The optical fiber color coding shall be in accordance with EIA/TIA 598, “Optical Fiber Cable Color-Coding.”

##### The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers.

##### Color-coded buffered fibers shall not adhere to one another.

#### The overall jacket for graded index cables as specified herein shall be aqua for distribution cables, or black for indoor-outdoor rated cables.

#### The overall jacket for single-mode cables as specified herein shall be yellow for distribution cables, or black for indoor-outdoor rated cables.

### <<ClientName>> approved Manufacturer:

#### Panduit

### <<ClientName>> approved Fiber Optic Cables - The table below lists part numbers. The part numbers and sizes listed are a small subset of the number available. For additional information, contact Panduit customer service or refer to the current parts catalog.

|  |  |
| --- | --- |
| **Part Number** | **Description** |
| **Indoor Distribution Cable** |
| FODPZ12Y | 50um OM4 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| FODPZ24Y | 50um OM4 24 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| FSDP912Y | 9um OS2 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| FSDP924Y | 9um OS2 24 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| FODPW12Y | 50um OM5 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| FODPW24Y | 50um OM5 24 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers |
| **Indoor Distribution Cable with Interlocking Armor** |
| FOPPZ12Y | 50um OM4 12 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| FOPPZ24Y | 50um OM4 24 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| FSPP912Y | 9um OS2 12 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| FSPP924Y | 9um OS2 24 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| FOPPW12Y | 50um OM5 12 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| FOPPW24Y | 50um OM4 24 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers |
| **Indoor Distribution Cable with 12-Fiber Ribbons** |
| FFDPBF048F | OS2 48 Fiber Indoor Distribution Cable, Plenum (OFNP), Flat Ribbon |
| FFDPBF096F | OS2 96 Fiber Indoor Distribution Cable, Plenum (OFNP), Flat Ribbon |
| FFDPZF048F | OM4 48 Fiber Indoor Distribution Cable, Plenum (OFNP), Flat Ribbon |
| FFDPZF096F | OM4 96 Fiber Indoor Distribution Cable, Plenum (OFNP), Flat Ribbon |
| **Indoor-Outdoor Loose Tube Cable** |
| FOCPZ12Y | 50um OM4 12 Fiber Indoor-Outdoor Central Tube Cable, Plenum (OFNP), 250um Fibers |
| FONPZ24Y | 50um OM4 24 Fiber Indoor-Outdoor Stranded Tube Cable, Plenum (OFNP), 250um Fibers |
| FSCP912Y | 9um OS2 12 Fiber Indoor-Outdoor Central Tube Cable, Plenum (OFNP), 250um Fibers |
| FSNP924Y | 9um OS2 24 Fiber Indoor-Outdoor Stranded Tube Cable, Plenum (OFNP), 250um Fibers |
| **Armored Outside Plant Cable** |
| FSWN912 | 9um OS2 12 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers |
| FSWN924 | 9um OS2 24 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers |
| FSWN948 | 9um OS2 48 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers |
| **Dielectric Double Jacketed DDJ Cable** |
| FOJDZ12 | 50um OM4 12 Fibers, Indoor/Outdoor DDJ cable, Riser (ONFR-LS) LSZH |
| FOJDZ24 | 50um OM4 24 Fibers, Indoor/Outdoor DDJ cable, Riser (ONFR-LS) LSZH |
| FSJD912 | 9um OS2 12 Fibers, Indoor/Outdoor DDJ cable, Riser (ONFR-LS) LSZH |
| FSJD924 | 9um OS2 24 Fibers, Indoor/Outdoor DDJ cable, Riser (ONFR-LS) LSZH |

## OPTICAL FIBER CONNECTORS

### Refer to Section 27 15 43 Communications Faceplates and Connectors

## Optical Fiber Cassettes

### Refer to Section 27 16 13.01 Communications Custom Cable Assemblies Fiber

## OPTICAL FIBER DISTRIBUTION ENCLOSURES and connector panels

### Refer to Section 27 11 19 Communications Terminations Blocks and Patch Panels

# EXECUTION

## GENERAL

### Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer.

### The Contractor shall input the cabling data into the cable management software.

### Install all cables in accordance with project Drawings.

### Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.

### Furnish any special installation equipment or tools required to properly complete the installation.

### Do not roll or store cable reels without an appropriate underlay.

### Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

### Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations.

### Plug conduits where cabling has been installed in the main equipment room, backbone and other cable entrance locations with re-enterable duct seal of flame-retardant putty.

### Provide bushings on all conduit ends.

### All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics, meet ANSI/TIA 568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.

### All techniques and fixtures used in the installation must minimize complexity must allow for easy maintenance of, and ready access to, all components for test measurements.

### No self-tapping screws shall be used.

### All parts shall be made of corrosion-resistant material, such as plastic, anodized aluminum, or brass.

### All materials used in the installation shall be resistant to fungus growth and moisture deterioration.

### To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.

### All empty innerduct or conduit shall include a non-corrosive pull-rope.

### All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

## OPTICAL FIBER CABLE

### Install the optical fiber backbone in a continuous length from the FDE in the MC to an FDE within each TR.

### Throughout its length, run the backbone cable in appropriate, listed raceway.

### Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a “figure 8” loop at the rear of the FDE.

### Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.

### On each end, remove all outer jacket and strength member materials to expose the individual fiber strands or ribbons for a length of 0.5 m (18 inches).

### On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE.

### Route individual strands in the rear of the FDE in a neat and orderly fashion and place them so as not to create undue stress or micro bending of the strands.

## CABLE BUNDLING MATERIALS

### Secure all cable bundles with proper bundling or securing materials so as to ensure that the cable runs are securely held in place both vertically and horizontally.

### Do not tighten bundling materials or securing devices so tightly that they deform the inherent cable geometry or construction.

### Do not use cable ties or hook-and-loop tape to secure cable runs to other building systems such as electrical conduit, Electric Metallic Tube (EMT), sprinkler pipes, ceiling suspension members.

### In environmental air-handling spaces, only use appropriately-listed materials.

## SYSTEM ADMINISTRATION

### Uniquely identify all components of the installed system by location, function, unit, and sub-unit.

### Identify each location with a unique alphanumeric identifier.

### Assign a unique alphanumeric identifier for each equipment enclosure in the building.

### Identify each adapter module in each distribution or interconnect enclosure with an alphanumeric identifier.

### Identify all conduits, trays, and pathways with a unique alphanumeric identifier.

### Identify optical fiber cables by a textual label that indicates its type, strand count, point of origin, and termination.

### Supply a Cable Identification Matrix

### Supply all records in compliance with ANSI/TIA 606.

## IDENTIFICATION

### Before installing or terminating cable, confirm all specific labeling requirements with the Owner or the Owner’s Engineer.

### Mark each backbone cable at each endpoint and at all intermediate pull and access points and junction boxes with a label that indicates the origination and destination identifiers, the sheath identifier, and the strand or pair range.

### Fiber Distribution Enclosures (FDEs)

#### Mark each FDE with an adhesive label that indicates the range of circuits installed within it.

#### Label each port with the origination and destination grid identifier and the individual strand ID.

#### At each end of each cable, within 75 mm (3 inches) of the end of the sheath, place a self-laminating label that surrounds the outermost jacket and bears the appropriate cable identifier.

#### On each equipment enclosure, affix self-adhesive labels, bearing the enclosure’s identifier in block characters, at the top center of the front and rear doors or faces.

#### In all enclosures, place a label directly adjacent to the shortest side of each adapter that bears that adapter’s identifier. Rotate the characters on the labels to maintain a left to right, top to bottom orientation.

### Refer to Section 27 05 53

## FIELD QUALITY CONTROL

### General Testing

#### Refer to Section 27 17 00 for complete testing specifications.

END OF SECTION 27 13 2 3