

**27 02 00 General Requirements (Structured Cabling Systems and Pathways and Spaces systems for all Voice and Data systems)**

**27 02 01 Summary**

- A. The Scope of Work covered by this document is to furnish and install the complete end to end Structured Cabling Systems and Pathways and Spaces systems for Spectrum Health. This work will provide for the structured cabling system (SCS) for all Voice and Data systems. Work on this project will commence after the award of the bid to a successful bidder.
- B. Telecommunications system shall include the following systems:
  - 1. Structured Cabling System (SCS) For Telecommunications Systems
  - 2. Pathways for Telecommunications Systems
  - 3. Grounding and Bonding System (GBS) For Telecommunications Systems
  - 4. Firestopping for Telecommunications Systems

**Additional Requirements**

- A. **Integration:** Responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and suppliers shall rest with Contractor named in construction contract issued by Owner's Representative. Work covered by this division of specifications shall be coordinated with related work indicated on drawings or specified elsewhere under project specifications. Work related to telecommunications system shall be performed under direct supervision of telecommunications system installer in a manner approved by product manufacturer.
- B. **Coordination of work:** Contractor shall be responsible for coordination of work among project specification divisions and contractor/subcontractors involved in this project. This coordination of Work Includes following instructions provided the Construction Manager or General Contractor if project is managed by such. See section 27 02 10 for additional information.
- C. **General compliance requirements:** Provide a complete and operable system in compliance with project drawings, specifications, referenced standards, applicable building codes, and Authority Having Jurisdiction (AHJ) requirements. Scope of this contract includes planning, design, materials, equipment, labor, configuration, programming, testing, startup and commissioning services, and documentation costs for complete and operable system that meets all requirements indicated on drawings or contained in specifications. Comply with all contract documents, specifications, drawings, manufacturer's instructions, and Owner and AHJ requirements. In case of conflict among applicable documents or standards, contractor shall notify owner's representative in writing of apparent conflict, and then comply with most stringent requirements unless otherwise directed in writing from owner's representative. Work Includes all items required for complete system whether or not identified in specification or drawings.
- D. Information about general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.
- E. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.
- F. Work related to telecommunications system shall be installed by an SCS manufacturers authorized or certified trained installer and supervised an SCS manufacturers authorized or certified SCS Engineer. Owner reserves the right to review and approves any personnel assigned to this project in a supervisory or managerial role.
- G. SCS contractor shall have had at least 10 years of comparable experience with telecommunications projects. As part of the proposal, SCS installer shall submit at least three (3) comparable Project reference descriptions with reference contacts. Comparable projects shall equal or exceed size and complexity of work on drawings.

- H. **Complete and usable work:** Refer to and comply with requirements in section 27 02 67 outlined below.

#### 27 02 10 Related Documents and Drawings

- A. **General:** The project drawings and general conditions of Contract shall apply to this section.
- B. **Coordination:** Coordinate with work specified in other sections and divisions of specifications.
- C. **Reference:** Codes and standards as referenced in Section 27 02 20 may define additional specifications or requirements not specifically called out within this division. However, contractor shall adhere to most stringent requirements as defined herein, or as defined by reference within section 27 02 20.
- D. Architectural and Engineering specifications may have additional conditions or requirements that affect the work defined by this division of specifications. Contractor shall be responsible for the coordination of all conditions and other trade requirements that may impact schedule, scope of work, work progress, or other factors that may affect the overall ability for contractor to execute the requirements of this division of specifications.

#### 27 02 20 Codes and Standards

- A. **General:** All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation and workmanship shall comply with the latest editions of the requirements of the Authority Having Jurisdiction (AHJ), National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the Contractor shall satisfy the most stringent requirements.
- B. Other sections of this document contain References to Codes and Standards that are applicable to the section.

#### 27 02 20.20 Codes

- A. Insulated Cable Engineers Association (ICEA)
  - ANSI/ICEA S-80-576-2002, Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems, 2002.
  - ANSI/ICEA S-84-608-2002, Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, 2002.
  - ANSI/ICEA S-90-661-2002, Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems, 2002.
  - ICEA S-102-700-2004, ICEA Standard for Category 6 Individually Unshielded Twisted-Pair Indoor Cables for Use in LAN Communication Wiring Systems Technical Requirements, 2004

B. National Fire Protection Association (NFPA)

NFPA 70, National Electrical Code® (NEC®), 2008

NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, 2004

NFPA 72, National Fire Alarm Code®, 2007

NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment, 2009

NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities, 2009

NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009

NFPA 101, Life Safety Code®, 2006

NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006

NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, 2007

NFPA 780, Standard for the Installation of Lightning Protection Systems, 2004

NFPA 5000™, Building Construction and Safety Code, 2006

**27 02 20.40 Reference Standards**

A. Telecommunications Industry Association (TIA)

ANSI X3T9.5, Requirements for UTP at 100 Mbps

TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning, 2001

TIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)

TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7

T-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, 2009

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 2009

TIA-568-C.2, Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components, 2008

TIA-568-C.3, Optical Fiber Cabling Components Standard, 2008

TIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2004

TIA-569-B-1, Commercial Building Standard for Telecommunications Pathways and Space – Addendum 1 – Temperature and Humidity Requirements for Telecommunications Spaces, 2009

ANSI/TIA-598-C, Optical Fiber Cable Color Coding, 2005

ANSI/TIA-604.2-A, FOCIS 2—Fiber Optic Connector Intermateability Standard, 2003

TIA-606, Administration Standard for Commercial Telecommunications Infrastructures, 2008

ANSI J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002

ANSI/TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard, 2005

ANSI/TIA-854, A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001

TIA-862, Building Automation Systems Cabling for Commercial Buildings, 2002

TIA-942, Telecommunications Infrastructure Standard for Data Centers, 2005

ANSI/NECA/BICSI 568-2006, Standard for Installing Telecommunications Systems, 2006

Category TSB-155, Guidelines for the Assessment and Mitigation of Installed 6 Cabling to Support 10GBASE-T, 2007

B. Other Reference Materials

ANSI/NECA/GICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling

BICSI Outside Plant Design Reference Manual (COOSP), current edition.

BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition

BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition

BICSI Network Design Reference Manual (NDRM), current edition

BICSI Telecommunications Distribution Methods Manual (TDMM), current edition

BICSI Wireless Design Reference Manual (WDRM), current edition

Institute of Electrical and Electronic Engineers (IEEE)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories (UL) Cable Certification and Follow Up Program

## 27 02 25 Abbreviations, Acronyms and Definitions

### 27 02 25.20 Abbreviations and Acronyms

ACD	Automatic Call Distribution
AFF	Above Finished Floor
AWG	American Wire Gauge
BICSI	Building Industry Consulting Services International
CAT5	Category 5 Copper Cable
CAT5e	Category 5e Copper Cable
CAT6	Category 6 Copper Cable
CAT6A	Category 6A Copper Cable
CDDI	Copper Distributed Data Interface
CMP	Communications Multipurpose Plenum: cable rating
CMR	Communications Multipurpose Riser: cable rating
EIA	Electronic Industries Association
ELFEXT	Equal-Level Far-End Crosstalk
FEXT	Far End Crosstalk
Gbps	Gigabits per second
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Intermediate Distribution Frame - Termination frames, relay racks, and cable management
IEEE	The Institute of Electrical and Electronics Engineers
IM	Information Management
ISDN	Integrated Services Digital Network
LAN	Local Area Network
Mbps	Megabits per second
MDF	Main Distribution Frame, consisting of carrier entrance rooms and head-end
MMF	Multi-mode fiber optics, 50 or 62.5 micron laser optimized core
MUTOA	Multi-User Telecommunications Outlet Assembly
NEXT	Near End Cross Talk
NRTL	Nationally Recognized Testing Laboratories
OSHA	Occupational Safety and Health Act
PBX-	Private Branch Exchange: telephone switch

PDS	Premises Distribution Systems (See SCS.)
PoE	Power over Ethernet (IEEE 802.3af)
POP	Point of Presence
PSACR	Power Sum Attenuation-to-Crosstalk Ratio
PSAFEXT	Power Sum Alien Far-End Crosstalk
PSAELFEXT	Power Sum Alien Equal Level Far-End Crosstalk
PSANEXT	Power Sum Alien Near-End Crosstalk
PSELFEXT	Power Sum Equal Level Far-End Crosstalk
PSNEXT	Power Sum Near-End Crosstalk
SCC	Security Command Center
SCS	Structured Cabling System, or Structure Connectivity System; a complete cabling system
SFF	Small Form Factor
SMF	Single-mode fiber optics, 8.3 micron core
TC	Telecommunications Closet
TE	Telecommunications Enclosure
TEF	Telecommunications Entrance Facility
TIA	Telecommunications Industry Association
TR	Telecommunications Room
TO	Telecommunications Outlet
TWC	Time Warner Cable - Owner
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VoIP	Voice over Internet Protocol
WAO	Work Area Outlet
WAN	Wide Area Network

#### 27 02 25.40 Definitions

**Access Floor** - A floor system that has removable floor panels.

**Building Backbone Cabling** – Cabling used to connect Floor Distributors (FD) or other local collection points to the Building Distributor (BD). Building backbone cabling typically carries aggregate traffic and, as such, impacts multiple network devices and users. Building backbone cabling may include either fiber optic or copper cabling or both.

**Building Distributor (BD)** – Termination point from which all building backbone cabling emanates and interconnection point for the network backbone. Commonly

referred to as BDF in Americas, Main Comms Room in EMEA and Communication Room, IT Lab or IT Room in AsiaPac. Referred to as BD in international and European industry standards and Intermediate Cross-connect (IC) in American industry standards. There is one BD for each building and it feeds all FD's in the same building. The BD should be located so that all FD's served are within 300 cable meters (984 cable feet). All BD's are linked to the

**Campus Backbone Cabling** – Cabling used to connect Building Distributors (BD) or other key network segments to the Campus Distributor (CD). With rare exceptions, campus backbone cabling carries aggregate traffic and typically impacts entire buildings worth of network devices and users and, as such, link redundancy with diverse routing is highly recommended. Campus backbone cabling almost exclusively consists of fiber optic cabling. Copper cabling may be used in short-distance (< 90m) applications. In such cases, lightning protection will usually be required by code.

**Campus Distributor (CD)** – Termination point from which all campus backbone cabling emanates and highest-level interconnection point for the network backbone. Commonly referred to as NOC in Americas and Main Comms Room in EMEA. Referred to as CD in international and European industry standards and Main Cross-connect (MC) in American industry standards. On smaller campuses, there is one CD for the campus. On larger campuses there might be several CD's with each CD serving several buildings. Besides linking to each of the BD's it serves, the CD is also the network interconnection point for data center links and links to service providers.

**Category 3 (Cat 3)** – A category of transmission performance, defined in EIA standards, that specifies electrical properties up to 10 MHz. Cat 3 is the minimum performance grade permissible and is used typically for analog voice distribution.

**Category 5e (Cat 5e) / Class D** – A category/class of transmission performance that specifies electrical properties up to 155.5 MHz. Capable of supporting copper-based, four-pair Gigabit Ethernet (IEEE 802.3ab 1000BASE-T) applications. Category 5e is defined in TIA/EIA 568B.2 standard. Class D is defined in the ISO 11801 standard.

**Category 6 (Cat 6) / Class E** – A category/class of transmission performance that specifies electrical properties up to 250 MHz. Refer to the TIA/EIA 568B family of standards for more information on Category 6 and ISO/IEC 11801 for more information on Class E requirements. Also refer to CENELEC EN50173.

**Category 6A (Cat 6) / Class EA** – A category/class of transmission performance that specifies electrical properties up to 500 MHz and capable of supporting data applications operating at 10Gbps. Refer to the TIA/EIA 568B family of standards for more information on Category 6 and ISO/IEC 11801 for more information on Class EA requirements.

**Certification** – The testing and documentation of the transmission performance (e.g., Category 5e / Class D) of a permanent link or channel, based on sweep frequency (where applicable) testing of numerous parameters with results

compared to a range of acceptable values. This project requires 100% certification (with documentation) of all permanent link cabling at the time of installation. Channel certification is optional and is the responsibility of the group using the channel.

**Channel** – The entire physical pathway between active equipment ports, inclusive of all patch cords, patch panels, jacks and cabling segments.

**Class C** – A category of transmission performance, defined in ISO and EN standards, that specifies electrical properties up to 16 MHz (equivalent to EIA

**Conduit** - A raceway of circular cross-section.

**Entrance Facility (EF)** – Termination point of service provider cables that have entered the building and location of service demarcation point (MPOE) and interconnection point to the network. Commonly referred to as Telco Room in Americas, POP Room in EMEA and Building Entrance in AsiaPac. Referred to as Building Entrance Facility in international and European industry standards and Entrance Facility (EF) in American industry standards. The EF is linked to the CD, where present, or to the BD.

**Floor Distributor (FD)** – Termination point for horizontal cabling and interconnection point for network access. Commonly referred to as IDF in Americas and AsiaPac and as Sub Comms Room in EMEA. Referred to as Floor Distributor (FD) in international and European industry standards and Horizontal Cross-connect (HC) - FD quantities and locations are determined by building size and geometry so that all points served are within 90 cable meters (295 cable feet) of an FD. The FD feeds all Telecommunications Outlets (TO's) in its service zone. All FD's in a building are linked to the building's Building Distributor (BD) via backbone cabling.

**Horizontal Cabling** – Cabling used to connect individual work area outlets to local Floor Distributors (FD) or other collection points. Unlike backbone cabling, horizontal cabling does not typically carry aggregate traffic and, as such, impacts only single network devices or users. In buildings, horizontal cabling almost exclusively consists of copper cabling. Fiber optic cabling may be used where situations dictate but, unlike horizontal copper cabling, horizontal fiber optic cabling is not installed in advance as default building facilities. At this writing, horizontal copper cabling in many networks is capable of supporting Gigabit (1Gb/s) Ethernet applications as well as other applications of similar bandwidth.

**Permanent Link** – A stationary cabling segment, consisting of the permanently installed cable and the permanently affixed jack at both ends (typically at the outlet faceplate and closet patch panel, or on a patch panel on both ends). The concept is based on the assumption that, while patch cords might be disconnected or moved over time, the permanent cable and jacks will not be disturbed and the electrical characteristics of the permanent link will remain unaltered.

**Plenum** -A space within the building designed for the movement of environmental air; i.e., a space above a suspended ceiling or below an access floor.

**Raceway** - Any channel designed for holding wires or cables; i.e. conduit, electrical metal tubing, busways, wireways, ventilated flexible cableway.

**Spine** – also called a backbone, the main communications cables in an IDF.

## 27 02 30

### Project Drawings

- A. **General Drawing Specifications:** Detail and elevation drawings shall be D size (24" x 36") with a minimum scale of 1/4" = 1'0" or larger. ER, TR and other enlarged detail floor plan drawings shall be D size (24" x 36") with a minimum scale of 1/4" = 1'0" or larger. Building composite floor plan drawings shall be D size (24" x 36") with a minimum scale of 1/8" = 1' 0".
- B. **Building composite floor plans:** Provide building floor plans showing outlet locations and jack configuration, types of jacks, run distance for each jack cable, and cable routing/locations. Identify TO's that, according to location and available pathway systems, require cable length greater than allowed by standards. Recommend alternatives for Owners Representative's consideration.
- C. **Telecommunications space plans/elevations:** Include enlarged floor plans of TRs indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunications spaces showing racks, termination blocks, and cable paths.
- D. **Logical Drawings:** Provide logical riser or schematic drawings for all systems. Include schematic symbol key.

## 27 02 50

### Substitutions

- A. **Substitution requests:** Substitution requests will be considered only if submitted to Owner's Representative not less than 7 working days prior to project bid date. Acceptance or rejection of proposed substitution is at Owner's Representatives sole discretion. No exceptions. Requests for substitutions shall be considered *not approved* unless approval is issued in writing by Owner's Representative.
- B. **Rejection:** For equipment, cabling, wiring, materials, and all other products indicated or specified as *no substitutions* or *no alternates*, Owner does not expect nor desire requests for substitutions and alternate products other than those specified. Owner reserves right for Owner's Representative to reject proposed substitution requests and submissions of alternates without review or justification.

## 27 02 63

### Pre-Installation Meeting

- A. **General:** After award, convene a pre-installation meeting at least 14 calendar days prior to commencing SCS and related work. The meeting must be scheduled at least 14 days in advance. Require attendance of parties directly affecting work of this section, including other trades and utilities if necessary.

Review conditions of operations, procedures and coordination with related work.

B. **Agenda:** Comply with following agenda specifications:

1. Tour, inspect, and discuss building conditions relating to telecommunications system cabling and equipment, coordination with Telephone Utility Company, Owner's telecommunications system requirements, and coordination with existing conditions and other work in contract.
2. Review exact location of each item within building construction, casework, and fixtures, and their requirements.
3. Review required submittals, both completed and yet to be completed.
4. Review drawings and specifications.
5. Review proposed equipment, cabling, and related work.
6. Review and finalize construction schedule related to telecommunications system and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
7. Review required inspections and testing.
8. Review cable routing and support provisions.

**27 02 65**      **Warranty**

**27 02 65.10**    **Contractors Warranty**

- A. **General requirements:** Comply with additional requirements in contract general requirements and extended warranties required in other specification sections. Refer to all other 27xxx sections for specific additional warranty requirements that exceed or are in addition to those of this section.
- B. **Contractor warranty:** Provide all services, materials and equipment necessary for successful operation of entire telecommunications system and SCS system for a period of one year after system acceptance. Scope of warranty includes all equipment, devices, wiring, accessories, software, hardware, installation, programming, and configuration required to maintain a complete and operable system. Provide manufacturer's published recommended preventative maintenance procedures during warranty period. This shall apply to all items except those specifically excluded, or items wherein a longer period of service and warranty is specified or indicated. All warranties shall be effective for one year, minimum, from date Certificate of Final Acceptance is issued. Use of systems provided under this section for temporary services and facilities shall not constitute final acceptance of work nor beneficial use by Owner and shall not institute warranty period. The warranty shall cover repair or replacement of defective materials, equipment, workmanship, and installation that may be incurred during this period. Warranty work is to be done promptly and to Owner's satisfaction. In addition, warranty shall cover correction of damage caused in making necessary repairs and replacements under warranty. Additional warranty responsibilities are:

1. Obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's designated name. Replace material and equipment that require excessive service during guarantee period as determined by Owner.
  2. Provide 2-business day service beginning on date of Substantial Completion and lasting until termination of warranty period. Service shall be at no cost to Owner. Service can be provided by installing contractor or by a separate service organization. Choice of service organization shall be subject to Owner's approval. Submit name and a phone number that will be answered on a 24-hour basis each day of week, for duration of service.
  3. Submit copies of equipment and material warranties to Owner before final acceptance.
  4. At end of warranty period, transfer manufacturers' equipment and material warranties still in force to Owner.
  5. If warranty work problems cannot be corrected immediately to Owner's satisfaction, advise Owner in writing, describing efforts to correct situation, and provide analysis of cause for problem. If necessary to resolve problem, provide at no cost services of manufacturer's engineering and technical staff at site in a timely manner to analyze warranty issues, and develop recommendations for correction, for review and approval by Owner.
- C. **Owner's rights:** This section shall not be interpreted to limit Owner's rights under applicable codes and under this Contract.
- D. **Pathways Material and Installation warranty:** Provide all services, materials and equipment necessary to warrant the installation and performance of all pathway materials for a period of one year after beneficial use. Scope of warranty includes all equipment, devices, installation and other work required to maintain a complete and operable system. Provide manufacturers published recommended preventative maintenance procedures during warranty period.
- E. **Grounding and Bonding Material and Installation warranty:** Provide all services, materials and equipment necessary for successful operation of GBS for a period of one year after beneficial use. Scope of warranty includes all equipment, devices, installation and other work required to maintain a complete and operable system. Provide manufacturers published recommended preventative maintenance procedures during warranty period.
- F. **Firestopping Material and Installation warranty:** Provide all services, materials and equipment necessary to warrant the performance of all Firestopping material for a period of one year after beneficial use, or longer if required by the local AHJ. Scope of warranty includes all equipment, devices, installation and other work required to maintain a complete and operable system. Provide manufacturers published recommended preventative maintenance procedures during warranty period.

#### 27 02 65.20 SCS Manufacturers Extended Warranty

- A. SCS Systems will be covered by a two-part certification program provided by a single manufacturer and that manufacturer's certified vendor. Manufacturer

shall administer a follow on program through the Vendor to provide support and service to the purchaser. The first part is an assurance program, which provides that the certified system will support the applications for which it is designed, during the 20-year warranty of the certified system.

- B. The second portion of the certification is a 20-year warranty provided by the manufacturer and the vendor on all products within the system (cords, telecommunications outlet/connectors, cables, cross-connects, patch panels, etc.).
- C. In the event that the certified system ceases to support the certified application(s), whether at the time of cutover, during normal use or when upgrading, the manufacturer and vendor shall commit to promptly implement corrective action.
- D. Documentation proving the cabling system's compliance to the End-to-End Link Performance recommendations, as listed in ANSITIA/EIA-568-B shall be provided by the Vendor prior to the structured cabling system being installed.
- E. The cabling system must conform to the current issue of industry standard ANSI/TIA/EIA-568. All performance requirements of this document must be followed. As well, workmanship and installation methods used shall be equal to or better than that found in the BICSI (Building Industry Consulting Service International) ITSIM manual.
- F. Purchaser demands strict adherence to the performance specifications listed in ANSI/TIA/EIA-568-B series standards.
- G. Manufacturer shall maintain ISO Quality Control registration for the facilities that manufacturer the product used in this cabling system.

27 02 67

#### Completeness of Work

- A. **Complete and usable work:** The contractor is responsible for providing complete and usable work according to contract documents. All materials and equipment shall be provided with all accessories and additional work required for field conditions, as well as additional work and accessories required for complete, usable, and fully functional construction and systems, even if not explicitly specified or indicated. Telecommunications system in this Contract shall be provided as complete and operable systems in full compliance with requirements on drawings and specification requirements. Drawings are diagrammatic and specifications are performance-based, and Contractor shall provide all work required to comply with drawings and specifications, even if not explicitly indicated or specified. Contractor shall be responsible for coordinating installation of electrical systems with all field conditions and work of other trades. Minimum clearances and work required for compliance with NFPA 70, *National Electrical Code*<sup>®</sup> (*NEC*<sup>®</sup>), and manufacturer's instructions shall be provided. Comply with additional requirements indicated for access and clearances. Contractor shall verify all field conditions and dimensions that affect selection and provision of materials and equipment, and shall provide any disassembly, reassembly, relocation, demolition, cutting and patching required

to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment. Contractor shall protect from damage resulting from Contractor's operations existing facility, equipment, and wiring. Extra charges for completion and contract time extension will not be allowed because of field conditions or additional work required for complete and usable construction and systems. Comply with additional requirements indicated for access and clearances.

- B. **Drawings and specifications form complementary requirements;** provide work specified and not shown, and work shown and not specified as though explicitly required by both. Except where explicitly modified by a specific notation to contrary, it shall be understood that indication or description of any item, in drawings or specifications or both, carries with it instruction to furnish and install item, provided complete.
- C. **Terms:** As used in this specification, *provide* means *furnish* and *install*. *Furnish* means "to purchase and deliver to project site complete with every necessary appurtenance and support," and *install* means "to unload at delivery point at site and perform every operation necessary to establish secure mounting and correct operation at proper location in project."
- D. **Authority approvals:** Give notices, file plans, obtain permits and licenses, pay fees, and obtain necessary approvals from authorities that have jurisdiction as required to perform work according to all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
- E. **Supplementary items:** Provide supplementary or miscellaneous items, appurtenances, devices and materials necessary for a sound, secure and complete installation. Examine project drawings and other Sections of specifications for requirements that affect work of this section. Completely coordinate work of this section with work of other Sections and provide a complete and fully functional installation. Refer to all other drawings and other specifications sections that indicate types of construction in which work shall be installed and work of other sections with which work of this section must be coordinated
- F. **Quantities:** Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

## 27 02 70

### Project Conditions

- A. **Field verification:** Carefully verify location, use and status of all material, equipment, and utilities that are specified, indicated, or deemed necessary for removal. Verify that all materials, equipment, and utilities to be removed are completely inactive and will not be required or in use after completion of project. Replace with equivalent any material, equipment and utilities that were removed by Contractor that are required to be left in place.
- B. **Existing utilities:** As applicable, do not interrupt utilities serving facilities occupied by Owner or others unless permitted under following conditions and

then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify owner in writing at least 14 days in advance of proposed utility interruptions. Do not proceed with utility interruptions without Owner's written permission.
2. Equipment installation:
  - a. Determine suitable path for moving unit substation into place; consider Project conditions.
  - b. Verify clearance requirements and locate equipment to meet installation tolerances.
  - c. Revise locations and elevations from those indicated to those required to suit Project.

#### 27 02 73 Delivery Storage and Handling

- A. **General:** Contractor shall be responsible for the deliveries, storing and handling of all materials relative to the SCS systems, including materials supplied by others that are part of the SCS installation contract. Material shall be stored and protected according to manufacturer's instructions. Contractor shall be responsible for the security of all material during installation. For all material provided by contractor, or delivered to contractor on site, contractor assumes full responsibility and liability for any material shortages, damage or loss due to storage and handling methods.

#### 27 02 75 Permits and Inspections

- A. **General:** All telecommunications systems shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over the telecommunications systems and the Project.
- B. Contractor shall obtain and pay for all licenses, permits, and inspection fees required by local agencies and/or other agencies having jurisdiction.
- C. Contractor agrees to furnish any additional labor or material required to comply with all local and other agencies having jurisdiction at no additional cost.
- D. Contractor shall obtain certificates of inspection and approval from all authorities having jurisdiction, and forward copies of same to Owner's Representative prior to request for Project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing/demonstrations.
- E. All required permits and inspection certificates shall be made available at the completion of the telecommunications system installation and commissioning.
- F. Any portion of the telecommunications work which is not subject to the requirements of an electric code published by a specific AHJ shall be governed by the National Electrical Code and other applicable sections of the *National Fire Code*, as published by the National Fire Protection Association (NFPA).

- G. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

27 02 77

#### Examination

- A. **General:** Prior to submitting a proposal, Contractor shall examine site, review Project drawings and specifications, and determine exact extent of work required. Contractor shall include in their proposals all materials, labor, and equipment required to complete required work indicated. Work that is necessary to obtain complete and usable Project as specified herein shall be included in Contractor's proposal, even if not indicated or specified.
- B. **Bidders' questions:** Should bidders have questions as to intent of drawings and specifications, quality of materials to be used, and work to be performed, questions shall be submitted in writing to Owner's Representative in manner dictated by Owner's Representative. All answers and clarifications to drawings and specifications will be issued in writing.
- C. Extra payment will not be allowed for claims for due to unfamiliarity with work to be performed by other trades, existing conditions at job site, local or state laws and codes, and alterations due to field conditions.

27 02 79

#### Additional Costs

- A. **General:** Project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing/demonstrations shall be conducted after verification of system operation and completeness by Contractor.
- B. **Inspections and testing:** For Project acceptance inspections, final completion inspections, substantial completion inspections, and/or testing/demonstrations that require more than one site visit by Owner's Representative or Architect/Engineer to verify Project compliance for same material or equipment, Owner reserves right to obtain compensation from Contractor to defray cost of additional site visits that result from Project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions. Owner's Representative will notify Contractor of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits. Payment of additional site visit costs by Contractor is required within 30 days of invoicing. Owner reserves right to deduct additional costs defined herein that are indicated on past due invoices from Project amount due Contractor.
- C. **Exclusions:** Contractor shall not be eligible for extensions of Project schedule or additional charges resulting from additional site visits that result from Project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

**END of SECTION**

## 27 04 00 Execution

### 27 04 01 General Requirements

- A. General: Sequence, coordinate, and integrate various elements of telecommunications system, materials, and equipment. Comply with following requirements as a minimum.
- C. Coordinate systems, equipment, and materials installation with other building components.
- D. Verify all dimensions by field measurements.
- E. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
- F. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- G. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Give particular attention to large equipment requiring positioning prior to closing in building.
- H. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.
- I. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- J. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by Contract Documents, recognizing that portions of Work are shown only in diagrammatic form. In case of conflict among individual system requirements, request direction in writing from Owner's Representative.
- K. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.
- L. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- M. Provide access panel or doors where units are concealed behind finished surfaces.
- N. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

- O. Comply with all requirements and work indicated on drawings.
- P. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of Owner and according to code requirements.
- Q. Install equipment and cabling/wiring so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel or roof curbs as appropriate.
- R. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall and ceiling mounting of equipment as required.
- S. Provide steel supports and hardware for proper installation of hangers, anchors, guides, and other support hardware.
- T. Obtain and analyze catalog data, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.
- U. Structural steel and hardware shall conform to ASTM standard specifications. Use of steel and hardware shall conform to requirements of AISC Code of Practice: Section Five.
- V. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

## 27 04 10

### Equipment Installation

- A. General: Install equipment according to manufacturer's written instructions. Install equipment level and plumb. Install wiring and cabling between equipment and all related devices.
- B. Mounting: If neither the Owner's Instructions nor the individual section call out the required hardware mounting, use the following.
  1. For equipment at walls, bolt units to wall or mount on structural steel channel strut bolted to wall.
  2. For equipment not at walls, provide freestanding racks fabricated of structural steel members and slotted structural steel channel strut.
  3. Use feet consisting of 0.25 inch thick steel plates, 6 square inch, bolted to floor.
  4. Use feet for welded attachment of vertical posts not over 3 feet on center.
  5. Connect posts with horizontal U channel steel strut and bolt control equipment to channels.
- C. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

- D. Connections: Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A and UL 486B.

#### **27 04 30**

#### **Cutting and Patching**

- A. General: Perform cutting and patching according to contract general requirements. In addition, following requirements apply:
  - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new Work.
  - 2. Remove and replace defective Work.
  - 3. Remove and replace Work not conforming to requirements of Contract Documents.
  - 4. Remove samples of installed Work as specified for testing.
  - 5. Install equipment and materials in existing structures.
- B. Demolition and removal: Cut, remove, and legally dispose of selected equipment, components, and materials as indicated, including but not limited to removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new Work. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
- C. Protection of work: Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed. During cutting and patching operations, protect adjacent installations. Patch finished surfaces and building components using new materials specified for original installation and experienced Installers.

#### **27 04 33**

#### **Penetrations and Sleeves**

- A. General: Coordinate work with other sections. SCS Installation Contractor shall be responsible for the provision of cabling sleeves and conduits unless specifically provided by the Electrical Contractor. SCS Installation Contractor shall coordinate with Electrical Contractor to determine exact requirements.
- B. When required, set sleeves in form work before concrete is poured. Provide core drilling as necessary if walls are poured or otherwise constructed without sleeves and wall penetration is required. Do not penetrate structural members. Provide sleeves and packing materials at all penetrations of foundations, walls, slabs (except on-grade), partitions, and floors. Sleeves shall meet requirements of pertinent specifications. Lay out penetration and sleeve openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.

- C. Sleeve fill: Sleeves that penetrate outside walls, basement slabs, footings, and beams shall be waterproof.
  - 1. Fill slots, sleeves and other openings in floors or walls if not used.
  - 2. Fill spaces in openings after installation of conduit or cable.
  - 3. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes.
  - 4. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes. See section 27 05 32 - Firestopping for Telecommunications Systems.
  - 5. Sleeves through floors shall be watertight and shall extend 2 inches above floor surface.
  - 6. Where raceways passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.
- D. Conduit sleeves:
  - 1. Annular space between conduit and sleeve shall be at least 1/4 inch.
  - 2. Sleeves shall not be provided for slabs-on-grade unless specified or indicated otherwise.
  - 3. For sleeves through rated fire walls and smoke partitions, comply with requirements for firestopping. See section 27 05 32 - Firestopping for Telecommunications Systems.
- E. Supports: Do not support piping risers or conduit on sleeves.
- F. Future use: Identify unused sleeves and slots for future installation.

## 27 04 36

### Core Drilling

- A. General: Core drilling shall be avoided where possible. Where core drilling is unavoidable, locate all required openings prior to coring.
- B. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
- C. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.
- D. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc. Protect all areas from damage.

## 27 04 39

### Cleaning

- A. Contractor is responsible for cleanup of debris on a daily basis. Cost of cleanup is the responsibility of the Contractor.
- B. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition. Perform cleaning and washing

required to provide acceptable appearance and operation of equipment to satisfaction of Owner's Representative.

- C. After completion of Project, clean exterior surface of all equipment, including concrete residue, dirt, and paint residue. Final cleaning shall be performed prior to Project acceptance by Owner's Representative.

#### **27 04 50 Access and Access Panels**

- A. General: Provide access to materials and equipment that require inspection, replacement, repair or service. Provide access panels and/or doors as required to allow service of all equipment components. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling. Ceilings consisting of lay-in or removable splined tiles do not require access panels. Locations of equipment requiring access shall be noted on record drawings. Access panels shall have same fire rating classification as surface penetrated.
- B. Coordination: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to Owner.
- C. Construction: Panels shall be at least 12 inches by 12 inches, and located to provide optimum access to equipment for maintenance and servicing. Verify access panel locations and construction with Owner's Representative.

#### **27 04 60 Startup and Operational Testing**

- A. General: Owner maintains right to have access to entire project site to prepare facility for occupancy and operation. Completion of startup and field testing shall be accomplished as a prerequisite for substantial completion. Operate and maintain systems and equipment until final acceptance by Owner. All guarantees and warranties shall not begin until final acceptance of systems and equipment by Owner. Acceptance requires, at a minimum, complete systems startup and testing.

#### **27 04 70 Special Responsibilities and Information**

- A. Coordination of information: Cooperate and coordinate with work of other sections in executing work of this section. Perform work such that progress of entire project, including work of other sections, shall not be interfered with or delayed. Provide information as requested on items furnished under this section, which shall be installed under other sections. Obtain detailed installation information from manufacturers of equipment provided under this section.
- B. Information gathering: Obtain final rough-in dimensions or other information as needed for complete installation of items furnished under other sections or by Owner. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other sections. Give full information so that openings required by work of this section may be coordinated with other work and other openings and may be provided for in

advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at no expense to Owner.

- C. Housekeeping pads: Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor mounted equipment
- D. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.
- E. Use of premises: Use of premises shall be restricted as directed by Owner's Representative and as required below:
  - 1. **Cleaning and rubbish removal:** Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Owner's Representative.
  - 2. **Rubbish Removal:** Provide for the removal from the site of all spoils, debris, boxes, packaging, crates, and trash generated from the work.
  - 3. **Storage:** Store materials maintaining an orderly, clean appearance. If stored on site in open or unprotected areas, all equipment and material shall be kept off ground by means of pallets or racks, and covered with tarpaulins.
- F. Protection of fireproofing:
  - 1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, if possible, prior to start of spray fire proofing work.
  - 2. Conduits and other items that would interfere with proper application of fireproofing shall be installed after completion of spray fire proofing work.
  - 3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this section shall be performed by installer of fireproofing and paid for by section responsible for damage and shall not constitute grounds for an extra to Owner.
- G. Temporary utilities: Refer to contract general requirements regarding requirements.
- H. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

## 27 04 80

### Division of Work

- A. General: Division of work responsibility matrix at the end of this section is for Contractor's reference to clarify roles of various manufacturers, installers, subcontractors, and trades involved in telecommunications system Project.

- B. Contractor holding contract with Owner is responsible for coordinating work of all subcontractors to provide a complete and usable Project complying with contract provisions of Project documents.
- C. Failure to coordinate work by subcontractors and suppliers will not be considered justification for additional compensation or extension of schedule.

Spec. section	System	Division of work responsibility chart				Remarks
		Gen	Elec	Mec	Telecom	
25 xx xx	Building Automation System (BAS)	1	C	C	C	BAS low voltage cabling by Division 15 uses telcom cable tray.
21 xx xx	Fire Detection And Alarm System (FDAS)	1	C	C	C	Completely separate cabling system and raceways by Division 16
26 xx xx	Electrical wiring (line voltage)	1	2,W	C	C	Completely separate cabling system and raceways by Division 16
26 xx xx	Poke-through fittings and floor boxes	1	2, E	C	C	Telcom to provide data jacks and A-V connectors
26 xx xx	Cable tray	1	2, E	C	C	Comply with Section 27 05 28
26 xx xx	Electrical raceways	1	2, E	C	C	Comply with Section 27 05 28
27 02 00	General requirements for telecommunications system	2	C	C	1	
27 10 00	Structured Cabling System (SCS) for telecommunications systems		C	C	1, E, W	
27 05 28	Pathways for telecommunications systems	1	2, P	C	1	
27 05 26	Grounding and Bonding System (GBS) for telecommunications systems	1	2, G	C	1	
27 05 32	Firestopping for telecommunications systems		2, FP	C	1, FC	

1 = primary contractual responsibility  
 2 = secondary responsibility  
 3 = tertiary responsibility  
 C = coordination of work responsibility  
 E = provision of specified equipment and devices  
 W = provision of specified system wiring/cabling  
 P = provision of specified system pathways/conduits  
 S = provision of specified system spaces  
 FP = provision of specified firestopping for pathways  
 FC = provision of specified firestopping for cabling

**END of SECTION**

**27 05 00 Common Work Results for Communications**

**27 05 26 Grounding and Bonding for Communications Systems**

**1. GENERAL**

**1.1. Work Includes**

Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

**1.2. Scope of Work**

- A. This section includes the minimum requirements for the equipment and cable installations in communications equipment rooms (Telecommunications Closets).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
  - 1. Grounding Electrode System
  - 2. Busbars
  - 3. Bonding accessories

**1.3. Quality Assurance**

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current revision of the following:
  - ANSI/TIA – 568 Commercial Building Telecommunications Cabling Standard
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code

#### 1.4. Submittals

A. Provide product data for the following:

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

## 2. PRODUCTS

### 2.1. Grounding Electrode System

A. Grounding Electrode System

1. When required the Grounding Electrode System shall meet the following
  - a. Active grounding system constantly replenishing moisture into the soil
  - b. Provide low resistance to ground
  - c. Provide season to season stability
  - d. Be maintenance-free for 30 years
  - e. Contain no hazardous materials or chemicals
2. Approved Manufacturers:

### 2.2. Wall-mount Busbars

A. Telecommunications Main Grounding Busbar (TMGB)

1. Telecommunications Main Grounding Busbar (TMGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
2. The busbar shall be 4" (100 mm) high and 20" (510 mm) long and shall have 30 attachment points (two rows of 15 each) for two-hole grounding lugs.
3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 27 lugs with 5/8" (15.8 mm) hole centers and 3 lugs with 1" (25.4 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" (100 mm) standoff from the wall.
5. The busbar shall be UL Listed as grounding and bonding equipment.

B. Telecommunications Grounding Busbar (TGB)

1. Telecommunications Grounding Busbar (TGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
2. The busbar shall be 2" (50 mm) high and 12" (300 mm) long and shall have 9 attachment points (one row) for two-hole grounding lugs.
3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 6 lugs with 5/8" (15.8 mm) hole centers and 3 lugs with 1" (25.4 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" (100 mm) standoff from the wall.
5. The busbar shall be UL Listed as grounding and bonding equipment.

### 2.3. Bonding Accessories

- A. Two Mounting Hole Ground Terminal Block
  - 1. Ground terminal block shall be made of electroplated tin aluminum extrusion.
  - 2. Ground terminal block shall accept conductors ranging from #14 AWG through 2/0.
  - 3. The conductors shall be held in place by two stainless steel set screws.
  - 4. Ground terminal block shall have two 1/4" (6.4 mm) holes spaced on 5/8" (15.8 mm) centers to allow secure two-bolt attachment to the rack or cabinet.
  - 5. Ground terminal block shall be UL Listed as a wire connector.
- B. Compression Lugs
  - 1. Compression lugs shall be manufactured from electroplated tinned copper.
  - 2. Compression lugs shall have two holes spaced on 5/8" (15.8 mm) or 1" (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.
  - 3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0, as stated below.
  - 4. Compression lugs shall be UL Listed as wire connectors.
- C. Antioxidant Joint Compound
  - 1. Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.
- D. C-Type, Compression Taps
  - 1. Compression taps shall be manufactured from copper alloy.
  - 2. Compression taps shall be C-shaped connectors that wrap around two conductors forming an irreversible splice around the conductors; installation requires a hydraulic crimping tool
  - 3. Compression taps shall be sized to fit specific size conductors, sizes #2 AWG to 4/0, as stated below.
  - 4. Compression taps shall be UL Listed.
- E. Pedestal Clamp With Grounding Connector
  - 1. Pedestal clamp shall be made from electroplated tinned copper or bronze. Installation hardware will be stainless steel.
  - 2. Pedestal clamps shall be sized to fit a specific size conductor, size #6 and/or 2/0, as stated below.
  - 3. Pedestal clamp installation hardware shall be sized to attach to round and/or square raised access floor pedestals that are 1-1/8" to 1-3/4" in diameter, as stated below.
  - 4. Pedestal clamp shall provide straight (in-line) or cross (intersection) support for up to two conductors.
  - 5. Pedestal clamp shall be UL Listed as grounding and bonding equipment.
- F. Pipe Clamp With Grounding Connector

1. Pipe clamp shall be made from electroplated tinned bronze. Installation hardware will be stainless steel.
  2. Pipe clamp shall be sized to fit up to two conductors ranging in size from #6 to 250 MCM; conductors must be the same size.
  3. Pipe clamp installation hardware shall be sized to attach to pipes, sizes 1" to 6" (.75" to 6.63" in diameter), as stated below.
  4. Pipe clamp shall be UL Listed as grounding and bonding equipment.
- G. Equipment Ground Jumper Kit
1. Kit includes one 24"L insulated ground jumper with a straight two hole compression lug on one end and an L-shaped two hole compression lug on the other end, two plated installation screws, an abrasive pad and a .5 ounce tube of antioxidant joint compound.
  2. Ground conductor is an insulated green/yellow stripe #6 AWG wire
  3. Lugs are made from electroplated tinned copper and have two mounting holes spaces .5" to .625" apart that accept 1/4" screws.
  4. Jumper will be made with UL Listed components

### 3. EXECUTION

#### 3.1. Installation

- A. Outdoor grounding and bonding connections.
1. All outdoor grounding and bonding (earthing) connections shall be accomplished using exothermic welding.
- B. Wall-Mount Busbars
1. Attach busbars to the wall with appropriate hardware according to the manufacturer's installation instructions.
  2. Conductor connections to the TMGB or TGB shall be made with two-hole bolt-on compression lugs sized to fit the busbar and the conductors.
  3. Each lug shall be attached with stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
  4. The wall-mount busbar shall be bonded to ground as part of the overall Telecommunications Bonding and Grounding System.
- C. Rack-Mount Busbars and Ground Bars
1. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar or ground bar to the rack or cabinet. The rack-mount busbar or ground bar provides multiple bonding points on the rack for rack and rack-mount equipment.
  2. Attach rack-mount busbars and ground bars to racks or cabinets according to the manufacturer's installation instructions.
  3. Bond the rack-mount busbar or ground bar to the room's TMGB or TGB with appropriately sized hardware and conductor.

#### D. Ground Terminal Block

1. Every rack and cabinet shall be bonded to the TMGB or TGB.
2. Minimum bonding connection to racks and cabinets shall be made with a rack-mount two-hole ground terminal block sized to fit the conductor and rack and installed according to manufacturer recommendations.
3. Remove paint between rack/cabinet and terminal block, clean surface and use antioxidant between the rack and the terminal block to help prevent corrosion at the bond.

#### E. Pedestal Clamp

1. At minimum, bond every sixth raised access floor pedestal with a minimum #6 AWG conductor to the TMGB or TGB using a pedestal clamp sized to fit the pedestal and the conductor and installed according to the manufacturer's recommendations.
2. If pedestal clamps are used to construct a signal reference grid, bond the signal reference grid to the TMGB or TGB and bond each rack and/or cabinet to the signal reference grid using a compression tap or similar non-reversible bonding component sized to fit both conductors.
3. Remove paint between the pedestal and pedestal clamp, clean surface and use antioxidant between the pedestal and the clamp to help prevent corrosion at the bond.
4. Remove insulation from conductors where wires attach to the pedestal clamp.

#### F. Pipe Clamp

1. Bond metal pipes located inside the data center computer room with a minimum #6 AWG conductor to the TMGB or TGB using a pipe clamp sized to fit the pipe and the conductor and installed according to the manufacturer's recommendations.
2. Remove paint between the pipe and pipe clamp, clean surface and use antioxidant between the pipe and the clamp to help prevent corrosion at the bond.
3. Remove insulation from conductors where wires attach to the pipe clamp.

#### G. Equipment Ground Jumper Kit

1. Bond equipment to a vertical rack-mount busbar or groundbar using ground jumper according to the manufacturer's recommendations.
2. Clean the surface and use antioxidant between the compression lugs on the jumper and the rack-mount busbar or groundbar to help prevent corrosion at the bond.

**END of SECTION**

## 1. GENERAL

### 1.1. Scope of Work

- A. Install empty raceway system, including underfloor and overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system, as indicated for distribution of Telecommunications wiring which includes cables for Data, Voice, Video, Audio, Security and future signal requirements.
- A. The location at which all new telecommunications wiring will terminate is called a Telecom Outlet (TO). There are several styles of outlets:
  - 1. New construction
  - 2. Existing construction typical
  - 3. Existing construction variations
  - 4. Telephone (Voice) only
  - 5. Data only
- B. Furnish and install split channel raceway and outlet boxes as specified in the Drawings and as specified herein.
- C. Furnish and install conduit stubs in walls and floors for cable routes.

### 1.2. References

ASI/NFPA 70/250 - National Electric Code – Ground and Bonding  
ANSI/NFPA 70/318 – National Electric Code – Cable Trays  
CANSI/NFPA 70/645 – National Electric Code – Information Technology Equipment  
ANSI/NFPA 70/770 – National Electric Code – Optical Fiber Cables and Raceways  
ASTM A 510 - Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel  
ASTM B 633 - Specifications for Electrodepositing Coatings of Zinc on Iron and Steel, Sections SC2 and SC3  
ASTM A653 - Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process  
ASTM A123 - Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel  
ANSI/TIA - 568-B Commercial Building Telecommunications Cabling Standard.  
ANSI/TIA - 569-A Commercial Building Standard for Telecommunications Pathways and Spaces  
ASTM – A276-06 Standard Specification for Stainless Steel Bars and Shapes  
ASTM A580/A580M-06 Standard Specification for Stainless Steel Wire  
NEMA VE 2-2006 Cable Tray Installation Guidelines  
NEMA VE-1/CSA C22.2 No 126 1-02 Metal Cable Tray Systems  
UL and cUL E209183  
ANSI C80.1 Rigid Steel Conduit - Zinc Coated  
ANSI C80.4 Fittings for Rigid Metal Conduit

BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition  
BICSI Information Transport Systems Installation Methods Manual (ITSIM),  
current edition  
BICSI Network Design Reference Manual (NDRM), current edition  
BICSI Telecommunications Distribution Methods Manual (TDMM), current  
edition  
BICSI Wireless Design Reference Manual (WDRM), current edition

### 1.3. Quality Assurance:

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.
- D. Material and work specified herein shall comply with the applicable requirements of the current revision of the following:
  - ANSI/TIA – 568 Commercial Building Telecommunications Cabling Standard
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual
  - NFPA 70B, “Recommended Practice for Electrical Equipment Maintenance” pertaining to cable tray systems.

### 1.4. Submittals

- A. Product Data: For features, ratings, and performance of each component specified.
- B. Submit manufacturer’s instructions for storage, handling, protection, examination, preparation, operation, and installation of products. Include application conditions or limitations of use stipulated by any product testing agency. Submit for the following:

1. Wall Boxes
  2. Raceway
  3. Conduit
  4. Conduit Bushings
- C. Shop Drawings:
1. Component List: List manufacturer, part number, and quantity of each component.
  2. Include dimensioned plan and elevation views of equipment rooms, labeling each individual component. Show raceway assemblies, method of field assembly, workspace requirements, and access for cable connections.

#### 1.5. Delivery Storage And Handling:

- A. Delivery: Deliver materials to site in manufacturer's original un-opened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.

## 2. PRODUCTS

### 2.1. Telecom Outlets (TO)

- A. New construction TO consists of one (1) 4-11/16" square by 2-1/8" deep flush mounted box. Each outlet box shall have a EMT conduit stubbed above the drop ceiling or extended into the hallway cabletray. Conduits size is as follows:
  1. For Outlets with 3 or less cables, use a 1.25" EMT conduit
  2. For Outlets with 3-6 cables, use a 1.25" EMT conduit
  3. For all other sizes, calculate fill ratio at 40% for proper sized conduit
- B. Existing surface-mounted construction TO typically consists of surface-mounted raceway including base, cover, end fitting, entrance end fitting, and (2) 1" EMT conduits stubbed out top of entrance end fitting to above ceiling or out to nearest hallway distribution system. Size of the raceway is site dependent based on number of conductors to be installed.
- C. The intent of the installation of the TOs which consist of the raceway is as follows:
  1. Where ceilings are accessible, the raceway and entrance end fitting shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
  2. Where ceilings are partially accessible, or if the Drawings and/or Specifications indicate installation of access panels, the raceway shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.

3. Where ceilings are inaccessible or no ceilings exist, the raceway shall extend up as close to the ceiling as practical to allow installation of conduits as high as possible to the nearest hallway distribution system.

## 2.2. Horizontal Distribution Systems

- A. Conduit System (Renovations only, where conduit exists)
  1. Provide conduits secured to wall above corridor ceilings as shown on the Drawings or as specified herein for installation of telecommunications cables. Any exposed conduit
  2. Corridor conduits shall be 4" EMT, furnished in 10 foot lengths wherever possible, with no sharp edges, reamed as necessary, evenly supported at two locations per 10 foot section spacing. Conduits shall be sized and quantified to account for handling cables in all TO conduits at 40% fill back to the TR and/or ER rooms. Verify size prior to installation. Bushings and/or connectors on ends of EMT are required.
  3. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation. When this condition exists, mount conduits side-by-side supported with 3/8" rod attached to building structure utilizing unistrut channel to form a trapeze. Double nut the top and bottom at the unistrut. Utilize conduit clamp to secure conduits to unistrut.
  4. Provide measured pull line in each conduit rated at 1200 lbs. minimum. Increments must be in 12" steps.
  5. Grounding of conduits is not required per NEC #250-33, Exception No. 2. shall be painted except conduit above suspended ceilings or in mechanical, electrical or telecommunication rooms. Color to match that of surface installed upon or as directed by Owner's Representative. Coordinate with other trades prior to painting.
  6. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire rated construction to be verified with AHJ. See Section 27 05 32 for more firestopping information.
- B. Corridor Cable Tray System
  1. Complete wall mounted or suspended aluminum cable tray system and necessary accessories shall be provided as shown on plans. Install entire cable tray system in accordance with manufacturer's minimum installation practices and all local governing codes.
  2. Coordinate installation of cable tray with other trades to allow a minimum of 12" above, 12" in front, and 12" below of clearance from piping, conduits, ductwork, etc. Allowance must be provided for access to the tray with reasonable room to work. Obstructions to the tray must be minimized and cannot block more than 6 feet of the tray at any point in the run.
  3. Submittal drawings, in the form of 8 1/2"x 11" catalog cut sheets, shall be provided for the following items: cable tray, fittings, accessories and load data.

4. Cable tray shall not be loaded beyond 60% of manufacturer's recommended load capacity.
5. Install wall mounted cable tray on both sides of hallway as shown on drawings and where applicable.
6. Where a new cable tray distribution system encounters a wall, install sufficient 4" EMT sleeves through the wall so cabling does not exceed 20% fill.
7. Where cable tray is exposed below ceiling, install the appropriate solid bottom inserts to conceal cables.
8. Install cable tray dropouts where large quantities of cables exit the distribution system.
9. Cable tray must be sized to facilitate sufficient growth capacity for migration cable plant to coexist in same tray as existing cable plant, wherever possible.
10. Manufacturer of cable tray in corridors and telecom rooms shall be:

C. Telecommunication Room Cable Tray System

1. TR cable tray shall completely wrap all walls within the room. Cable tray shall extend over all equipment frames.
2. Cable tray shall be a minimum width of 2" high x 12" wide. Cable tray may be sized upwards if fill ratio requirements need to be met based on cable quantities.
3. Manufacturer of tubular ladder type cable tray in telecommunication rooms shall be CommScope.
4. Cable tray shall be 12 inch cable runway.
5. Rectangular steel tubing cross members welded at 12-inch intervals. Finish in black enamel. CommScope, Part Number CR-SLR-10L-12W or equivalent.
  - a. 12-inch Wall Angle Assembly Kit – CommScope Part Number CR6-12WRSK or equivalent.
  - b. 3-inch Channel Rack-To-Runway Mounting Plate - CommScope Part Number CRR2RRMK or equivalent.
  - c. End Closing Tube - CommScope Part Number CRPECK or equivalent.
  - d. Corner Clamp - CommScope Part Number CRTJSK or equivalent (2 required per End Closing Tube to complete assembly).
- D. All open pathway/trays shall be installed a minimum of six (6) inches away from any light fixture or other source of EMI (Electromagnetic Interference).
- E. All pathways shall be grounded per NEC Article 250.
- F. Provide external grounding strap at expansion joints, sleeves and crossover and at other locations where pathway/tray continuity is interrupted.
- G. Support all pathways from building construction. Do not support pathways from ductwork, piping, or equipment hangers.
- H. Install cable tray level and straight unless noted on the construction drawings

### 2.3. Station Conduits

Station conduit is defined as conduit that originates at the TO and rises within the walls or is exposed from a raceway and extends up into the drop ceiling or over to the hallway distribution system.

- A. Provide station conduits from TOs to above the drop ceiling or extend over to the hallway distribution systems consisting of 1" EMT minimum or appropriate size as shown on the Drawings or as specified herein for installation of telecommunications cables.
- B. Provide an insulating press fit bushing on all telecommunications conduits including interconnecting nipples and stub to distribution system. To prevent conflicts with other cables or conduits to cable tray, the conduit shall be stubbed not less than 6" above or below conduit/cable tray center line. Where space permits, every effort shall be made to bend station conduits down such that the flow of installed cables promotes the minimum length back to the TR and the least amount of bends in the cables. Bushings must be rated to be used in an environmental air handling space (Plenum).
- C. Manufacturer of insulating bushing on all telecommunication conduits shall be:
- D. Provide measured pull line in 12" increments in each empty conduit to hallway distribution system.
- E. Indelibly mark station conduit at hallway distribution end with Room # that conduit serves.
- F. The use of 90 degree electrical pulling elbows is prohibited.
- G. Do not include more than two 90 degree bends between pulling points when installing station conduit runs. If the path of the station conduits requires more than 180 degrees of total bends, installation of an appropriate sized junction box is required. See section 2.4 for junction box requirements.
- H. Place an appropriate sized junction box in each individual station conduit run that exceeds 100 feet in length.
- I. The use of a third bend in a conduit is only acceptable if:
  - 1. The total conduit run is reduced by 15%.
  - 2. The conduit size is increased to the next trade size.
  - 3. One of the bends is located within 12" of the cable feed end.

### 2.4. Junction Box Requirements For Station Conduits

- A. If the station conduit route exceeds the 180 degree of total bends limitation, an appropriate sized junction box is required within a straight section of the conduit run.
- B. Each station conduit run requires a separate junction box. The sharing of a junction box by multiple conduits is prohibited.

- C. A junction box shall not be used in place of a bend. All junction boxes in station conduit paths shall be installed within a straight section of the conduit run.

## 2.5. Service Entrance Conduits

- A. Minimum of (4) 4" IMC conduits shall be installed from the nearest utility tunnel on outside of the building as shown on the Drawings. Terminate entrance conduits entering ER rooms from below grade to extend 4" above finished floor. Location of entrance conduits shall be within 12" of room corners.
- B. Terminate entrance conduits entering ER rooms from above ceiling height to extend 4" below finished ceiling or 12" above cable tray.
- C. Terminate entrance conduits entering an ER rooms from below ceiling height to extend 4" into the room.
- D. Entrance conduits shall be continuous into the building and to the ER. Securely fasten all entrance conduits to the building to withstand any cable placing operation. Do not include more than two 90 degree bends between pulling points when installing entrance conduits.
- E. On exterior wall penetrations, seal both sides of the wall around outside of conduit with hydraulic cement to prevent water from entering the building. Seal the inside of the conduit on both sides with conduit plugs, water plugs, or duct sealer to prevent water, vapors, or gases from entering the building.

## 2.6. Pathway Requirements for Entrance Conduits

- A. If the entrance conduits exceeds the 180 degree of total bends limitation, an appropriate sized junction box, manhole, or handhole is required.
- B. As-built drawings of entrance conduit path required to be submitted to Owner's Representative before covered with soil.

## 2.7. Riser Conduits

Riser conduits shall only be used when noted on the Construction Documents for special applications only. Riser conduits are not required as a general rule for the riser system. However, when required:

- A. Minimum of (2) 4" conduits shall be installed between the ER room and each TR room as shown on the Drawings.
- B. Conduits entering ER and TR rooms shall be reamed or bushed and terminated not more than 4" from entrance wall and within 12" of room corners.
- C. Conduits entering ER and TR rooms from below floor shall be terminated not more than 4" above finished floor.
- D. Conduits for riser cables shall be continuous and separate from all other conduit or enclosed raceway systems. Do not include more than two 90 degree bends between pulling points when installing riser conduits. Where junction boxes are required, locate in accessible areas, such as above suspended ceilings in hallways.

- E. Conduits shall not be less than 4" trade size and be equipped with a measured pull line at 12" increments rated at a minimum 1200 pound test.
- F. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire-rated construction to be verified with AHJ. See Section 27 05 32 for more firestopping information.
- G. Provide an insulating press fit bushing on all telecommunications riser conduits. Bushings must be rated to be used in an environmental air handling space (Plenum).
  - 1. Manufacturer of insulating bushing on all telecommunication conduits shall be Arlington or equal.
- H. Riser conduits shall not be used for the distribution of horizontal cables.

## 2.8. Firestopping

- A. In all buildings, floor/ceiling assemblies, stairs, and elevator penetrations must be sealed with a 2-hour fire stop assembly at a minimum, unless otherwise noted.
- B. Contact Owner's Representative to identify walls which are fire-rated construction. Walls must be sealed with a 2-hour fire stop assembly at a minimum.
- C. Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of Moves, Adds, and Changes.
- D. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM.
- E. See Section 27 05 32 - Firestopping for Telecommunications Systems

## 3. EXECUTION

### 3.1. General Requirements

- A. The intention of the telecommunications conduits is to provide a route between ER and TR rooms, routes from the TRs throughout building floors to hallways, and routes from hallway distribution systems into rooms to individual TOs for telecommunications cabling.
- B. Installation of new pathways shall not interfere with existing pathways in such a way that installation of new cables within the existing pathway is made more difficult.

### 3.2. Examination

- A. Examine areas to receive cable management system. Notify the Owner's Representative of conditions that would adversely affect the installation or subsequent utilization of the system.
- B. Do not proceed with installation until unsatisfactory conditions are corrected.

### 3.3. Installation

- A. Install in accordance with recognized industry practices, to ensure that the equipment complies with requirements of the NEC, and applicable portions of NFPA 70B and NECA "Standards of Installation" pertaining to general electrical installation practice.
- B. Coordinate installation with other trades.
- C. Field verification is required before installation.
- D. Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.

**END OF SECTION**

## 1. GENERAL

### 1.1. Work Includes

The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports as described in this specification.

### 1.2. Scope of Work

This Section includes the minimum requirements for the support structures for the Communications Systems for the project as outlined in the Bid Document.

- A. Non-continuous cable supports (2.3A)
- B. Adjustable non-continuous cable support sling (2.3B)
- C. Multi-tiered non-continuous cable support assemblies (2.3C)
- D. Non-continuous cable support assemblies from tee bar (2.3D)
- E. Non-continuous cable support assemblies from drop wire/ceiling (2.3E)
- F. Non-continuous cable support assemblies from beam, flange (2.3F)
- G. Non-continuous cable support assemblies from C & Z Purlin (2.3G)
- H. Non-continuous cable support assemblies from wall, concrete, or joist (2.3H)
- I. Non-continuous cable support assemblies from threaded rod (2.3I)
- J. Raised floor non-continuous cable support assemblies (2.3J)
- K. Cantilever-Mounted Option for non-continuous cable supports (2.3K)
- L. Installation accessories for non-continuous cable supports (2.3L)

### 1.3. Submittals

- A. Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to; materials, finishes, approvals, load ratings, and dimensional information.

### 1.4. Quality Assurance

- A. Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
- B. Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
- C. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

### 1.5. Coordination

Coordinate installation of hangers, supports and cables with other trades.

## 2. PRODUCTS

### 2.1. Acceptable Manufacturers

- A. Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by:

### 2.2. References

- ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled
- ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
- A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
- ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
- ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
- ASTM B117 Standard Method of Salt Spray (Fog) Testing
- ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
- UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
- ANSI/ TIA-568 Commercial Building Telecommunications Cabling Standard, current revision level.
- ANSI/ TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
- NFPA 70 National Electrical Code®

### 2.3. Non-continuous Cable Support Systems

- A. Non-continuous cable supports

1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
  2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
  3. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
  4. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
  5. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
  6. Non-continuous cable supports shall be as manufactured by:
- B. Adjustable non-continuous cable support sling
1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5e and higher cable, or optical fiber cable; cULus Listed.
  2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
  3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
  4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
  5. Acceptable products:
- C. Multi-tiered non-continuous cable support assemblies
1. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
  2. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
  3. The multi-tiered support bracket shall consist of:
- D. Non-continuous cable support assemblies from tee bar
1. Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
  2. Acceptable products:
- E. Non-continuous cable support assemblies from drop wire/ceiling
1. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

- 2. Acceptable products:
- F. Non-continuous cable support assemblies from beam, flange
  - 1. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
  - 2. Acceptable products:
- G. Non-continuous cable support assemblies from C & Z Purlin
  - 1. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
  - 2. Acceptable products:
- H. Non-continuous cable support assemblies from wall, concrete, or joist
  - 1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
  - 2. Acceptable products:
- I. Non-continuous cable support assemblies from threaded rod
  - 1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
  - 2. The multi-tiered support bracket shall have a static load limit of 300 lbs.
  - 3. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
  - 4. Acceptable products:
- J. Raised floor non-continuous cable support assemblies
  - 1. Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
  - 2. Acceptable products:
- K. Cantilever-Mounted cable supports
  - 1. U-hook shall be able to be assembled to a wide variety of wall mount brackets.
  - 2. Spacing of individual U-hooks as needed, max of 4' to 5' apart.
  - 3. U-hooks may have the optional attachment of a cable roller for ease in pulling cables.
  - 4. Acceptable products:
- L. Installation accessories for non-continuous cable supports
  - 1. Cable Pulley
    - a. Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
    - b. The pin and roller assembly must be removed after cables are installed.
    - c. Acceptable products:
  - 2. Cable Protector

- a. The protective steel tube shall fit over threaded rod and be at least 4" in length.
- b. The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
- c. Acceptable products:

#### 2.4. Finishes

- A. ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel  
ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel  
ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products  
ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- B. Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

### 3. EXECUTION

#### 3.1. Installation

- A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- B. Do not exceed load ratings specified by manufacturer.
- C. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- D. Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.
- E. Locate pathways per Telecommunications Drawings.

**END of SECTION**

## 1. GENERAL

### 1.1. Scope

- A. This SECTION describes the requirements for furnishing and installing firestopping for fire-rated construction. This includes all openings in fire-rated floors, walls and other rated elements of construction, both blank (empty ) and those accommodating items such as cables, conduits, pipes, ducts, etc.
- B. Fireblocking for Concrete Floor or Wall Sleeved Cables.
- C. Fireblocking for Gypsum Wall Sleeved Cables.
- D. Fireblocking for Concrete Block Wall Sleeved Cables.

### 1.2. Related Documents:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 7 Specification Sections, apply to this Section.
- B. Cable fill calculations must be included to show the maximum cable fill ratio for each FireStopping System and cable type.

### 1.3. References:

UL 1479 - Fire Tests of Through-Penetration Firestops  
ASTM E-814 - Fire Tests of Through-Penetration Fire Stops  
ASTM E-119 - Fire Tests of Building Construction and Materials  
ANSI/NFPA 70 – National Electrical Code (NEC)  
TIA 569 – Commercial Building Standard for Telecommunications Pathways & Spaces  
ICBO – Uniform Building Code  
BOCA – Basic/National Building Code  
SSBCCI – Standard Building Code  
NFPA 101 - Life Safety Code  
UL Fire Resistance Directory – Penetration Firestops System (XHE2) and Fill, Void or Cavity Materials.

### 1.4. Submittals

- A. Submit manufacturer's product literature and installation procedures for each type of Firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance and limitation criteria and test data. Submit cured samples of firestop materials.
- B. Shop drawings: Show typical installation details for the methods of installation. Indicate which firestop materials will be used where and when applications requirements to meet Specific jobsite conditions.

- C. Product Data: Shall be clearly marked to indicate all technical information which specifies full compliance with requirements of this section and Contract Documents, including the following:
  - 1. Copy of UL illustration of each proposed system indicating manufacturer's approved modifications.
  - 2. Each condition requiring penetration seals in proposed UL systems materials, anchorage, methods of installation and actual adjacent construction.
- D. Applicator's Qualification Statement: Shall include a list of projects indicating required experience.

### 1.5. Quality Assurance

- A. Firestopping systems (materials and design) shall conform to both Flame (F) ratings and Time (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
- B. The work of this section shall be performed by a company which specializes in stalling UL Classified penetration seals required for this Project, with a minimum of five years of documented successful experience and shall be performed by skilled Workmen thoroughly experience in the necessary crafts.
- C. Deliver material in the manufacturer's original, unopened containers or packages with the manufacturer's name, product identification, lot number, UL label, and mixing and installation instructions as applicable.
- D. Store materials in the original, unopened containers or packages, and under conditions recommended by the manufacturer.
- E. All firestop materials shall be installed prior to expiration of shelf life.

### 1.6. Coordination

- A. Coordinate layout and installation of Firestopping System with other trades.
- B. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
- C. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store devices and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

## 2. PRODUCTS

### 2.1. Acceptable Manufacturers:

- A. Materials and products required for work of this section shall not contain asbestos or polychlorinated biphenyls (PCB).
- B. Manufacturer and Firestopping System must be approved by the local AHJ before purchase or installation.

## 2.2. General

Provide and install firestopping materials to meet applicable codes and installation requirements for each firestopping application. Products using caulking, putties, wrap strips, mortars, composite boards and/or mechanical devices shall be used as appropriate for the specific condition.

## 2.3. Caulking

When caulking is used, provide and install flexible caulking materials. Cured firestop materials 1/8 thick shall be able to flex around a 1" mandrel without breaking.

## 2.4. Firestop

Do not use any firestop products which re-emulsify, leach active intumescent ingredients or dissolve when placed in water after curing. Product must withstand the passage of cold smoke, either as inherent property of the system or by the use of a separate product included as part of the UL system or device, and designed to perform this function.

## 2.5. Penetration Seals

### A. General:

1. Penetration seals (firestopping material) shall be asbestos-free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ASTM E814 and UL 1479.
2. Materials shall meet and be acceptable for use by all three model building codes, Basic/National Building Code, Building Code and Standard Building Code, per National Evaluation Service, Inc. report # NER-243.
3. Materials shall meet requirements of NFPA 101 and NFPA 70.
4. Materials shall be suitable for the firestopping of penetrations made by steel, glass, plastic and insulated pipe, conduit, bus duct, noninsulated pipe and ductwork.
5. On insulated pipe, fire-rating classification must not require removal of insulation.
6. The rating of penetration seals shall not be less than the rating of the time-rated floor or wall assembly.
7. Systems shown below are examples and other equal systems may be approved or required by the AHJ.

### B. 2-hour Rated Concrete Floor:

1. Penetrants: Multiple pipes.
2. Firestop as manufactured by:
3. UL System: No. 93.

### C. 2-hour Rated Concrete Floor:

1. Penetrants: Maximum 30" dia. Metal pipe/conduit.
2. Firestop as manufactured by:
3. UL System: No.319

### D. 1-2 –Hour Rated Gypsum Board Wall:

1. Penetrant: Metal pipe/conduit.
  2. Firestop as manufactured by:
  3. UL System: No. 147
- E. 2-Hour Rated Gypsum Board Wall:
1. Penetrant: Metal pipe/conduit.
  2. Firestop as manufactured by:
  3. UL System: No. 147.
- F. 3-Hour Rated Concrete Wall:
1. Penetrant: Metal duct, maximum 2' square and maximum dimension of 30".
  2. Firestop as manufactured by:
  3. UL System: No. 105.
- G. Walls Below Grace:
1. Penetrants: Pipe sleeves.
  2. Seal: Thunderline "Link Seal" casing seal.

### 3. EXECUTION

#### 3.1. Inspection

Examine the areas and condition where Firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the Architect.

#### 3.2. Conditions Requiring Firestopping

- A. General – Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.
- B. At any point where a fire rated wall is penetrated with cable or conduit.
- C. Penetrations
  1. Penetrations include conduit, cable wire, pipe, duct or other elements which pass through one or both outer surfaces of a fire rated floor, wall or partition.
  2. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop any annular space between the sleeve and wall opening.
- D. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction as specified herein.

#### 3.3. 3.3 Installation

- A. General

1. Installation of Firestops shall be performed by a applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
  2. Apply Firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
  3. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of Firestop.
- B. Field Quality Control
1. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
  2. Follow safety procedures recommended in the Material Safety Data Sheets.
  3. Finish surfaces of firestopping which is to remain exposed in the completed work to a uniform and level condition.
  4. All areas of work must be accessible until inspection by the applicable Code Authorities.
  5. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.
- C. Calculate the maximum cable fill ratio for each FireStopping System and cable type. Do not exceed the maximum fill ratio.
- D. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.

### 3.4. Warranty

- A. A. Comply with General Conditions, and include but not be limited to:
1. Repairs and replacement of penetration seals which fail in joint adhesion, cohesion, abrasion, resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability, or appear to deteriorate in any other manner not clearly specified in submitted manufacturer's data as an inherent quality of the material for exposure indicated.

### 3.5. Cleaning

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

**END OF SECTION**

## 1. GENERAL

### 1.1. Outlets

- A. Each data outlet in a wall or floor shall be served by a 1 ¼ in. conduit and a double-gang deep device box with a single-gang mud ring.
- B. Wall mounted telephones shall be served by one 21 mm (0.75 in.) conduit and a single-gang deep device box with a single-gang mud ring. The outlet box shall be mounted at a center height of 1220 mm (48 in.) above the finished floor, unless otherwise specified on the drawing, and shall have a clearance of 305 mm (12 in.) of wall surface on all sides.
- C. All outlet conduits shall be stubbed into accessible ceiling space.
- D. All outlet conduits shall have burrs and any other abrasive elements removed and an insulating bushing shall be installed on both ends.
- E. No section of conduit shall be longer than 30 m (100 ft.) between pull points.
- F. No more than 180 degrees of conduit bends shall be permitted between pull points.
- G. The minimum inside radius for any bend of an outlet conduit shall be six times the inside diameter of that conduit.

### 1.2. Conduits

- A. Electric metallic tubing: Comply with UL 797. Tubing shall have hot dipped galvanized exterior, enamel-coated interior.
- B. Flexible conduit shall not be used in lieu of conduit bends and offsets.
- C. PVC conduit: Comply with UL 651, listed for use with 90 degrees C conductors operating at 90 degrees C.
- D. 1 ¼" conduit for cable pathway

### 1.3. Standards Compliance

- A. General standards: Comply with current revision of TIA 569 as amended

### 1.4. Submittals

Provide product data for the following:

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

### 1.5. Coordination

- A. Coordinate installation of labels with other trades.
- B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store materials in original cartons and in a clean

dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

## 2. PRODUCTS

### 2.1. Approved Products

- A. Dry location device boxes: Manufacturer shall be:  
Equivalent products by other manufacturers may be used where approved in writing by Owner's Representative.
- B. Wet location boxes: Manufacturer shall be:  
Equivalent products by other manufacturers may be used where approved in writing by Owner's Representative.

## 3. EXECUTION

### 3.1. Installation

- A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- C. Install conduits using techniques, practices, and methods that are consistent with Category 6 or higher requirements and that supports Category 6 or higher performance of completed and linked signal paths, end to end.
- D. Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support based on 1 ¼" pathway.

**END of SECTION**

## 1. GENERAL

### 1.1. Scope

- A. Continuous, rigid, welded steel or stainless steel wire mesh cable management system.
- B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

### 1.2. Related Documents:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.3. Summary

#### References:

- IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
- NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
- ANSI/NFPA 70 – National Electrical Code (NEC)
- TIA 569– Commercial Building Standard for Telecommunications Pathways & Spaces
- ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

### 1.4. Submittals

- A. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.
- C. Design Calculations: Verify loading capacities for supports.
- D. Field verification of all dimensions, routing, etc., is directed.
- E. Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.
- F. Submit manufacturer’s certification indicating ISO 9001 quality certified.
- G. Submit training procedure for certifying cable tray installers.

## 1.5. Quality Assurance

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- H. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
  - The Terms "Classified" pertaining to cable trays (rather than "Listed") and "Labeled": As defined in NFPA 70, Article 100, including painted trays.
  - Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- I. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.
- J. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.
- K. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide cCSAus Certificate and labels.
- L. Provide documentation of the following certifications:
  - ISO 9001 quality certification.
  - American Bureau of Shipping (ABS) Product Design Assessment certification.
  - Det Norske Veritas (DNV) certification.
  - E 90 Fire Testing certification.
  - VDE certification.
- M. Provide ETL test documentation showing cable compression/deformation testing.

## 1.6. Coordination

- A. Coordinate layout and installation of cable tray with other trades.
- N. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
- O. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

## 2. PRODUCTS

### 2.1. Manufacturers

Subject to compliance with requirements, provide products by the following:

### 2.2. Materials and Finishes:

- A. Cable Tray Materials:

Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

P. Cable Tray Finishes:

Finish for Carbon Steel Wire after welding and bending of mesh;

1. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
2. Powder-Coated Trays – UL classified Black powder-coated surface treatment over Electrodeposited Zinc Plating (or plain steel) using ASA 61 black polyester coating.

Q. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.

R. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.

Mesh: 2 x 4 inches (50 x 100 mm).

Straight Section Lengths: 118 inches (3,000 mm).

Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray Strength; and to allow tray to remain lightweight.

Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.

Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.

S. CF Series Cable Tray Size:

1. Depth: Cable tray depth will be 4 inches
2. Width: Cable tray width will be 6, 12, 18, or 24 inches as shown on Telecommunications Drawings:
3. Length: Cable tray section length will be 118 inches (3000mm) unless otherwise shown on drawings.
4. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 20% spare capacity recommended to accommodate future cabling changes or additions.
5. Load Span Criteria:
6. Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.

### 2.3. Cable Tray Supports & Accessories

- A. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports will include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation

time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.

1. FAS System support methods to mount from ceiling and wall structures with 1/4", 3/8" or 1/2" threaded rod, if applicable
  2. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable:
    - a. UL Classified EDRN Fast Splice: No hardware required
    - b. UL Classified SWK Splice Washer Kit: Swaged set for splicing, turns, bends, tees
    - c. UL Classified ED Universal Splice Bar: Cut & bend to fit any configuration
    - d. Preclick Splice: Bolted connection optional
    - e. UL Classified EDT Splice Plate: Bolted connection
    - f. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN 1/4" Nut & Bolt
    - g. UL Classified CE 40 Square Splice Washer: Use with EZ BN 1/4" to splice trays on bends, adjustable tees
    - h. FASLock Splice: For sweeps and bends with tray 12" (300mm) and wider.
    - i. UL Classified EZ T 90 kit: For Tees and 90s
    - j. UL Classified RADT90 kit: For 5-1/2" radius Tees and 90s
- T. Accessories: As required to protect, support, and install a cable tray system. Select from the following accessories, if applicable:
1. Cable Routing Accessories:
- U. Support Accessories:

#### 2.4. Equipment Grounding Conductor Function & Grounding

- A. UL Classified cable trays (including painted tray) may act as Equipment Grounding Conductors.
- B. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended.
- C. Ground cable trays at end of continuous run.
- D. Test cable tray system per NFPA70B, Chapter 18 to verify grounding less than 1 ohm.
- E. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp.

### 3. EXECUTION

#### 3.1. Examination:

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.2. Installation

- A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
  - 1. Cut cable tray wires in accordance with manufacturer's instructions.
  - 2. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
  - 3. Remove burrs and sharp edges from cable trays.
- C. Vendor Certified Installers

**END of SECTION**

## Underground Ducts and Raceways for Communications Systems

A. Outdoor telecommunications pathways connect building, pedestals, maintenance holes, handholds, and towers. These pathways consist of underground, direct-buried or aerial. Underground or direct-buried are generally preferred over aerial because of aesthetics and security. Generally, underground duct banks are preferred over direct-buried because of security, ease of future cable installation and maintenance.

### B. Conduit Types

Examples of conduit types include:

- EB-20 – For encasement in concrete;
- EB-35 – For encasement in concrete;
- DB-60 – For direct burial or encasement in concrete;
- DB-100 – For direct burial or encasement in concrete;
- DB-120 – For direct burial or encasement in concrete;
- Rigid Nonmetallic Conduit Schedule 40 – For direct burial or encasement in concrete;
- Rigid Nonmetallic Conduit Schedule 80 – For direct burial or encasement in concrete;
- Multiple Plastic Duct (MPD) – For direct burial or installation in conduit;
- Rigid Metallic Conduit – For direct burial or encasement in concrete;
- Intermediate Metallic Conduit – For direct burial or encasement in concrete;
- Fiberglass Duct – For direct burial or encasement in concrete;
- Innerduct Polyethylene (PE) – For direct burial or installation in conduit;
- Innerduct Polyvinyl Chloride (PVC) – For direct burial or installation in conduit

### C. Installation

1. The length of conduit between pulling points shall not exceed 600 ft (183m).
2. Manufactured bends should be used whenever possible. No section of conduit shall contain more than two 90-degree bends, or equivalent between pull points.
3. Conduits should be installed such that a slope exists to allow drainage and prevent the accumulation of water.
4. When conduits connect maintenance holes, a slope of .125 in per foot (10 mm per meter) should exist from the middle of the span to each maintenance hole.
5. Conduits must be buried at a minimum depth of 18 in. (45.7 cm).

**END of SECTION**

## 1. GENERAL

### 1.1. Work Includes

Work covered by this Section shall consist of furnishing labor, equipment and materials necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.

### 1.2. Scope of Work

This Section includes the minimum requirements for the Identification and labeling of the Communications Systems for the project as outlined in the Bid Document.

### 1.3. Summary

- A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces. All facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.
- B. The owner maintains a campus wide labeling scheme for voice and data outlets and patch panels.
- C. Industry Labeling Standards and Conventions shall be used unless otherwise stated in the bid documents or by the Owner's Representative.
- D. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.
- E. Installer shall maintain accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.
- F. Installer shall provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.

#### 1.4. Quality Assurance

- A. All labels shall be installed in a neat and workmanlike manner. All methods of labeling that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Labels shall be of the quality and manufacture indicated. The labels and labeling equipment specified are based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data labeling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA/EIA - 606-A Administration Standards.
  - ANSI/TIA - 569 Pathway and Spaces
  - ANSI/TIA - 568 Telecommunications Cabling Standard
  - BICSI Telecommunications Distribution Methods Manual
  - UL 969 - UL Standard for Safety for Marking and Labeling Systems

#### 1.5. Submittals

Provide product data for the following:

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.6. Coordination

- A. Coordinate installation of labels with other trades.
- B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store materials in original cartons and in a clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

## 2. PRODUCTS

### 2.1. Manufacturers

### 2.2. Labels

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

- C. Where insert type labels are used provide clear plastic cover over label.
- D. Outside plant labels shall be totally waterproof even when submerged.
- E. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
- F. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
- G. Work Area Copper, Fiber, and Coax Riser Cable Labels
- H. Patch Panel Labels

### 3. EXECUTION

#### 3.1. Identification & Labeling

- A. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
- B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
- C. All labels shall be printed or generated by a mechanical device.

#### 3.2. Telecommunication Identifiers

- A. Refer to the University of Houston Information Technology Telecommunications Infrastructure Standards Manual for labeling practices.
- B. Outside Plant cabling shall be clearly marked using permanent means. Outside plant shall use the following system of numbering and labeling:
  - 1. Fiber Optic:
    - a. Identify: far-end building name, building number, fiber-type and strand-count
    - b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible and long cable length in tunnel at 200 foot intervals.
    - c. Label at termination panels at both ends.
  - 2. Copper:
    - a. Identify: far-end building name, building number and strand-count
    - b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible and long cable length in tunnel at 200 foot intervals.
- C. Riser cabling shall be clearly marked using permanent means. Riser cabling shall use the following system of numbering and labeling:
  - 1. Fiber Optic:
    - a. Identify: far-end EF / ER / TR, fiber-type and strand-count .

- b. When small facilities are fed from a primary location and treated as an ER, riser shall be labeled similar to Outside Plant Fiber Optic.
- 2. Copper:
  - a. Identify: far-end EF / ER / TR and pair-count
  - b. Termination points shall be labeled as to actual pair at every fifth (5th) pair-point.

### 3.3. Labeling Procedures

- A. To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.
- B. Visibility and durability:
  - 1. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
  - 2. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
  - 3. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
  - 4. Outside plant labels shall be totally waterproof, even when submerged.
  - 5. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
  - 6. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.
- C. Mechanical generation
  - 1. All labels shall be printed or generated by a mechanical device.
  - 2. Hand written labels are NOT acceptable.

**END of SECTION**

## 1. General Requirements

- A. All work will be done in a neat and workman like manner.
- B. All solutions will be specified by approved HILTI Firestop Guide for Specifiers.
- C. Label with the appropriate HILTI label listing the catalog number, date of penetration, **and initials of the Technician completing the work.**
- D. Photograph each penetration and label.
- E. Provide cd/dvd containing all photos of location penetrations.
- F. For work requests and change orders, ensure that permits are filed with facilities to ensure audit is available.
- G. If the request is related to a change order, please include the work order number on the photo label.



## Structured Cabling

### 1. General Requirements

- A. Transmission performance of structured cabling varies with length, connecting hardware, cords and total number of connections. The installer must take care to properly install the cabling components. To ensure that the installed structured cabling solution meets or exceeds the required performance it must be 'tested' or 'certified'.
- B. The requirements for each category of cabling (Cat5e, Cat6, or Cat6A) and optical fiber optics links are located in the ANSI/TIA-568 series standards.
- C. Test equipment must meet the requirements set forth in the ANSI/TIA-568 series Standard for Field Test Equipment. All Copper testers shall be Level III. All fiber testers shall meet the requirements in ANSI/TIA-568.
- D. Field Power Meters shall meet the following:
  - Accuracy  $\pm 0.2$  dB
  - Resolution 0.01 dB
  - Precision  $\pm 0.15$  dB
- E. The Field light source shall meet the following:
  - Accuracy  $\pm 0.01$  dB
  - Wavelength  $850 \pm 30$  nm
  - $1300 \pm 50$  nm
  - $1310 \pm 30$  nm
  - $1550 \pm 30$  nm
- F. The calibration on all test equipment shall be current.
- G. The software in all test equipment shall be current.

### 2. Products

The following manufacturer's testers are approved.

- A. FLUKE
  - 1. DTX1800
  - 2. OptiFiber OTDR
  - 3. DTX-CLT CertiFiber Optical Loss Test Set
- B. Ideal
  - 4. LanTEK II
  - 5. LANTEK 6/6A/7G
  - 6. FIBERTEK
- C. Or other test equipment approved by the Owner

## **27 10 20 Systems Testing and Documentation**

### **27 10 20.01 General Requirements**

- A. Provide installation testing of equipment where required by manufacturer's installation instructions.
- B. Provide complete end to end testing for all copper and fiber optic systems/channels based on latest applicable standards. Document all testing and submit with final as-built submittal package.
- C. For all controls and operating equipment, submit equipment/systems to at least three complete operational sequences, in which all equipment operations are tested, observed, and verified.
- D. Prior to substantial completion and project acceptance inspection, submit test reports to indicated scope of startup and operational tests, with results of testing for each specified operation.

### **27 10 20.10 Copper Cabling System Testing**

- A. General: Copper cabling shall be tested and certified after installation as follows and as required for cable manufacturer's warranty. Twisted-pair copper cable channels shall be tested for continuity as specified below, presence of ac/dc voltage, and performance. All cabling shall be tested for conformance to horizontal cable specifications as outlined herein, and shall be tested according to test set manufacturer's instructions utilizing latest firmware and software. Testing shall include all of electrical parameters as specified under Product. All cables and termination hardware shall be 100 percent tested by installation contractor for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified useable by Contractor prior to system acceptance. All cables shall be tested according to contract documents, manufacturer's warranty provisions, and best industry practices. If any of these are in conflict, Contractor shall comply with most stringent requirements. All defects in cabling system installation shall be repaired or replaced in order to ensure 100 percent useable conductors in all cables installed, at no additional cost to Owner.
- B. Continuity: Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by test unit according to manufacturers' recommended procedures, and referenced to appropriate cable identification number and circuit or pair number. Any faults in wiring shall be corrected and cable re-tested prior to final acceptance.
- C. Length: Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to maximum distances set forth in TIA/EIA-568-C standards and all other applicable standards specified in Appendix 1: Codes, Standards, and Informative References. Cable lengths shall be recorded,

referencing cable identification number and circuit or pair number. For multi-pair cables, shortest pair length shall be recorded as length for cable.

- D. Factory testing: Every reel of cable shall be tested by cable manufacturer for all characteristics specified for cable type in this section. This testing shall be performed using a sweep test method and include frequencies specified for cable. A test report shall be available electronically, at no additional cost, for a minimum of five (5) years from the date of manufacture. The test report shall include the reel number, the date of the test, the Lot number, and test results for Return Loss (RL), Insertion Loss (Attenuation), Pair-to-Pair NEXT, and Power Sum NEXT Pair-to-Pair ELFEXT and Power Sum ELFEXT. The test report shall show the “Worst Case Margin” for the listed transmission characteristics.
- E. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from TIA/EIA-568-C standards and all other applicable standards specified in Appendix 1: Codes, Standards, and Informative References, and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
- F. Test reports: Test reports for all factory testing and field test reports for copper cabling installation shall be submitted to the Owner’s Representative and manufacturer prior to commissioning voice and data system and final contract payment. Refer to Submittals in this Section.

#### **27 10 20.20 Optical Fiber Cable Testing**

- A. General: Optical fiber cabling shall be tested and certified after installation as described below and as required for cable manufacturer’s warranty. Fiber testing shall be performed on all fibers in completed end to end system. Testing shall consist of a bi-directional end to end test in accordance with applicable standards in 27 02 20.20, or a bi-directional end to end test performed by EIA/TIA-455-53A and all other applicable standards in 27 02 20.20. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode type glass and 1310 and 1550 nanometers for single-mode type glass. These tests shall also include continuity checking of each fiber. For spans greater than 90 meters, each tested span must test to a value less than or equal to value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be less than or equal to 2.0 decibels. The insertion loss for each mated optical fiber connector pair shall not exceed 0.40 decibels.
- B. Pre-installation testing: Test all optical fiber cable for all fibers prior to installation of cable.
- C. Performance testing: Where links are combined to complete a circuit between devices, Contractor shall test each link from end to end to ensure performance of system. Only a basic link test is required. Contractor can optionally install patch cords to complete circuit and then test entire channel. The test method shall be same used for test described above. The values for calculating loss shall

be those defined in applicable TIA/EIA standards in Appendix 1: Codes, Standards, and Informative References.

- D. Attenuation testing: Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. The light source shall be left in place after calibration and power meter moved to far end to take measurements.
- E. Loss budget: All fiber cabling shall be tested at both wavelengths 850 nm and 1310 nm for multimode and 1300 nm and 1550 nm for single mode.
  - 1. The link attenuation shall be calculated using:
    - a) The CommScope Fiber Performance Calculator for CommScope installations
    - b) The following calculation for other installations:  
Link Attenuation Allowance (dB) + Cable Attenuation (dB) + Connector loss (dB) = Splice Insertion Loss (dB)  
Where:  
Cable attenuation (dB) = Cable attenuation (dB/km) X Length (km)  
Connector loss (dB) = Number of Connector pairs X Allowable connector loss (dB)  
Splice Insertion Loss (dB) = Number of Splices X Allowable Splice loss (dB)
- F. Link loss: A mated connector to connector interface shall be considered a single connector. Loss numbers for installed link shall be calculated by taking sum of bi-directional measurements and dividing that sum by two. All links not meeting requirements of standard shall be brought into compliance by Contractor, at no additional cost to Owner.
- G. Documentation: Following final documentation shall be submitted to the owner's representative prior to commissioning data system and final contract payment according to Submittals in this section.
- H. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from all applicable standards specified in 27 02 20.20 and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
- I. End to End Loss Data: final documentation shall be submitted to the owner's representative.
- J. As Installed/ As Built Diagrams: Final documentation shall be submitted to the owner's representative.

## 27 10 20.30 Test Documentation

### K. Electronic Format – if required

1. Certification Test Reports shall be submitted in electronic format using the appropriate software supplied by the test equipment manufacturer. The data format should be that of the test report software (i.e. \*.flw files for Fluke). The contractor shall provide any necessary software to view and evaluate the test data.
2. The following list is provided as a reference:

<u>Tester</u>	<u>Test Report Software</u>
Fluke	LinkWare™
Ideal	LanTek® Reporter
3. One electronic copy of the Test Reports shall be provided.

### L. Paper Format – if required

1. Provide test documentation in 3-ring binders within 2 weeks after completion of project testing. Binders shall be clearly marked on outside front cover and spine with words Test Results, project name, and date of completion (month and year). Major heading tabs, Horizontal and Backbone, shall divide binder. Each major heading shall be further sectioned by test type. Within horizontal and backbone sections, divide by tabs scanner test results by category, optical fiber attenuation test results, and continuity test results. Present test data within each section in sequence listed in administration records.
2. Provide test equipment by name, manufacturer, model number and last calibration date at the end of document. Unless manufacturer specifies more frequent calibration cycle, annual calibration cycle shall be required on all test equipment used for this installation.
3. Test document shall detail test method used and specific settings of equipment during test. Scanner tests shall be printed on 8 1/2 by 11 inches. Hand written test results (attenuation results and continuity results) shall be documented on a suitable test form.
4. When repairs and re-tests are performed, note problem found and corrective action taken, and collocate in binder both failed and passed test data.

**END OF SECTION**

1.1 Summary

This section includes the minimum installation requirements for equipment and cabling infrastructure in Telecommunication rooms.

Telecommunications Room (TR) Requirements, Size Requirements

Size requirements are based on distributing telecommunications service to one individual work area per 10 m<sup>2</sup> (100 ft<sup>2</sup>) of usable floor space. Minimum tenant TR sizes are shown in Table 1.1

Table 1.1 Size requirements

<u>If the Serving Area Is...</u>	<u>Then the Interior Dimensions of the Room Must Be at least...</u>
5,000 sf or less (500 m <sup>2</sup> )	10'-0"x8'-0" (3.0mx2.4m)(See note below)
5,000sf – 8,000sf (500m <sup>2</sup> -800m <sup>2</sup> )	10'-0"x9'-0" (3.0mx2.7m)
8,000sf – 10,000sf (800m <sup>2</sup> – 1000m <sup>2</sup> )	10'-0"x11'-0" (3.0mx3.4m)

NOTES: ANSI/TIA/EIA-569-B recommends a minimum TR size of 10'-0"x7'-0" (3.0 m x 2.1). The size of 10'-0"x8'-0" (3.0 m x 2.4 m) is specified here to allow a center rack configuration.

Common TRs serving up to 20,000 ft<sup>2</sup> (2,000 m<sup>2</sup>) should be 80 sf(6 m<sup>2</sup>). When the area served exceeds20,000sf (2000 m<sup>2</sup>), consider providing more than one common TR.

Minimum composition requirements and installation methods for the following:

1. Floor Mounted Racks
2. Wall Mounted Racks
3. Cable management Hardware
4. Cable tray
5. Back Boards
6. Grounding Bars
7. Patch Panels
8. Fiber Patch Panels
9. Power strips
10. Rack Mounted Shelves
11. UPS Backup Power

## 1.2 TIA-1179 Standards

### 1.Design according to TIA-569-B

1. Plan for 100% growth
2. Minimum two diverse paths between MDF and IDF

## 1.3 Quality Assurance

A. All Telecommunications Room equipment shall be installed in a neat and workmanlike manner. All construction that is not specifically described or indicated in this document shall be subject to the control and approval of the Telecommunications Department.

B. Materials specified here in shall comply with the requirements of:

- i. ANSI/TIA/EIA - 568-B Commercial Building Telecommunications Cabling Standard\
- ii. ANSI/TIA/EIA - 569-A Commercial Building Standard for
- iii. Telecommunications Pathway and Spaces
- iv. EIA/TIA-606-A Administration Standard for the
- v. Telecommunications Infrastructure of Commercial Buildings
- vi. EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications
- vii. NEMA - 250
- viii. Federal Communications Commission 47 CFR 68.
- ix. BICSI Telecommunications Distribution Design Manual (10th edition)
- x. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
- xi. BICSI Telecommunications Cabling Installation Manual (2nd edition)
- xii. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial
- xiii. Building Telecommunications Cabling
- xiv. ADA - Americans with Disabilities Act
- xv. NFPA 70 - 2002, including:
  1. NEC - Article 770
  2. NEC - Article 800
  3. Underwriters Laboratory

## 1.2 Related Work

- A. Section 27 05 26 – Grounding and Bonding for Communications.
- B. Section 27 05 28.33- Conduit and back boxes for communications systems.
- C. Section 27 05 28.34

## 1.3 Submittals

- A. All specifications for grounding and bonding hardware used for the project must be given to the Owner's designated staff prior to the installation of the components.
- B. Written confirmation by either drawings or document which outlines the construction of each Telecom room in the project.

## 2.1 Products

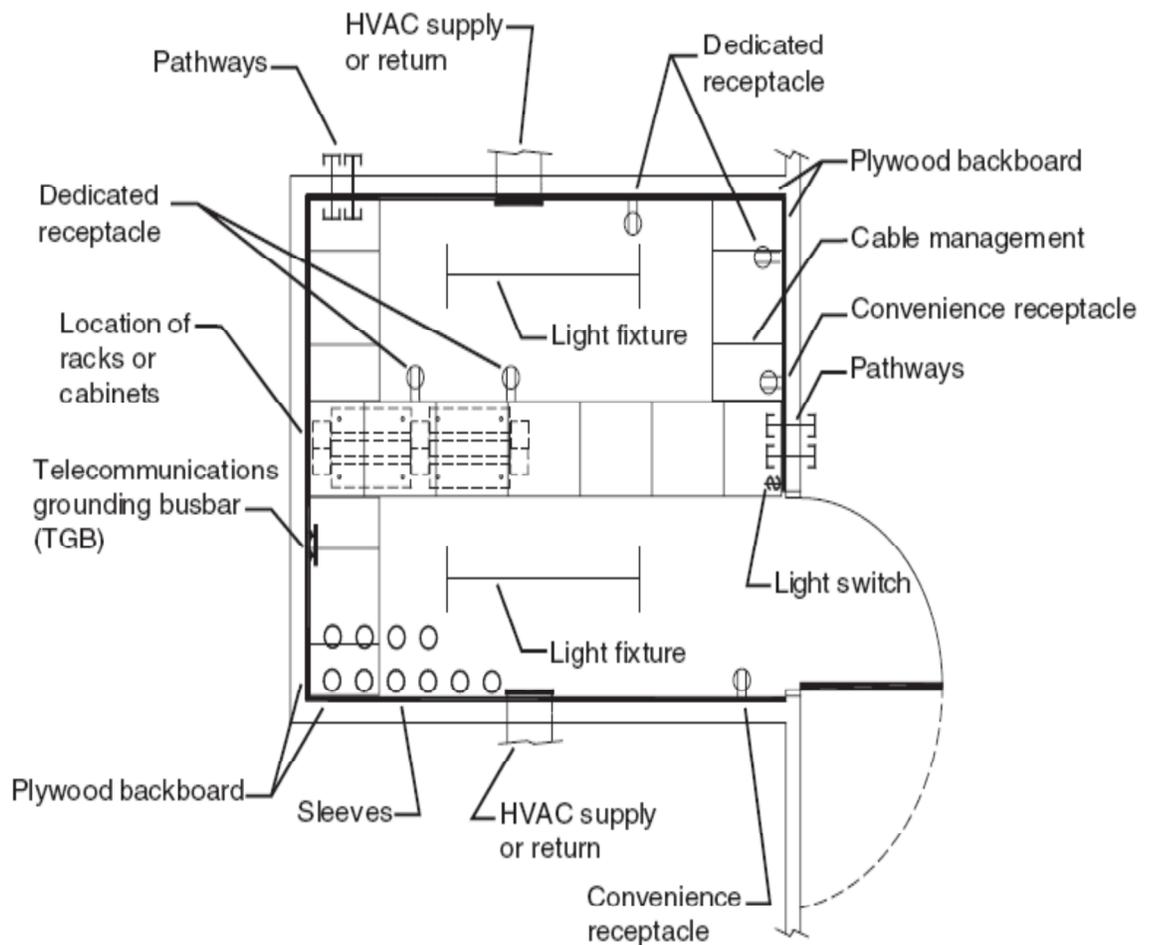
### 3.1 Room Requirements

#### Execution

- A. No ceiling obstructions impeding the installation of the telecommunications systems, such as cable tray, conduits, sleeves or other raceways.
- B. Any wall mounted boards shall be void free plywood with a minimum thickness of  $\frac{3}{4}$  in. The plywood will be mounted with the grade A side exposed and painted with two coats of fire retardant paint.
- C. One wall minimum will be identified to be covered with plywood from floor to ceiling or minimum of 8 ft. in height.
- D. A minimum of two quad 110V 20 amp dedicated circuits will be placed in the room on walls opposite from the doorway. An additional quad outlet will be mounted at the top of the relay rack that will mount the network equipment. If generator backup is available, these outlets would be serviced from the generator. Power requirements will vary per project needs, IS staff will work with electricians to validate requirements during the project.
- E. Environmental control will maintain positive pressure in the room. More stringent requirements may apply based on equipment needs and BTU output.
- F. Tile or smooth surface is required to minimize the collection of dust.
- G. The room should not be located adjacent to washrooms, custodial closets or mechanical rooms where it is subject to water or steam infiltration. A floor drain is required if there is risk of water entering the facility.

- H. Doorways should not be less than 36" in width to allow for equipment to be installed or removed without issues.
- I. Any door to the room shall have direct access to the hallway. If the room is larger than 10'X10' the door may open inwards, otherwise the door will open outward.
- J. If sprinklers are required in the telecommunications space, wire cages should be installed to prevent the sprinklers from being accidentally activated.
- K. Fire sprinkler heads should have a higher heat rating than other areas of the building, and a smoke detector will be required as well.
- L. Designed in accordance with TIA-569B
  - a. Larger than office oriented commercial Building
  - b. Minimum 12m<sup>2</sup> or Larger

*Common telecommunications room example 1*



HVAC = Heating, ventilating, and air conditioning

## 1. GENERAL

### 1.1. Work Includes

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

### 1.2. Scope of Work

- A. This section includes the minimum requirements for the equipment and cable installations in communications equipment rooms (Telecommunications Closets).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
  - Communication Racks and Rack Cable Management

### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - EIA-310-E, Cabinets, Racks, Panels, and Associated Equipment (most recent version)
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

#### 1.4. Submittals

- A. Provide product data for the following:
- B. Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

## 2. PRODUCTS

### 2.1. General

#### A. RACKS

- 1. Racks shall be manufactured from aluminum and/or steel extrusion.
- 2. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with nut and bolt hardware. The base angles will be pre-punched for attachment to the floor.
- 3. Equipment mounting channels will be punched on the front and rear flange with the EIA-310 Universal Mounting hole pattern.
  - a. Aluminum Racks will be threaded with 12-24 roll-formed threads and will include 40 each combination pan head, pilot point mounting screws.
  - b. Steel Racks will have 3/8" square holes and will include 40 each #12-24 x 1/2" mounting screws and 40 each #12-24 cage nuts.

The rack will include assembly and equipment-mounting hardware.

The rack will be rated:

- a. Two Post Racks: 1,000 lb. (453.6 kg) of equipment
- b. Four Post Racks: 2,000 lb. (907.2 kg) of equipment
- 4. The rack will be UL Listed
- 5. When assembled with top and bottom angles, equipment-mounting channels will be spaced to allow attachment of 19" EIA rack-mount equipment.

#### B. RACK CABLE MANAGEMENT

- 1. Vertical cable management shall have doors that are lightweight, sturdy, and be available in different sizes to allow flexibility in design.
- 2. The cable management system shall have a C-Channel bracket that allows for easy access to the cable trough.
- 3. The vertical cable management system shall allow tool-less installation of Cable Spool.
- 4. Doors shall come standard with on all cable management and be available in both single and double sided configurations.
- 5. The door shall have dual hinge design that can be opened to the right or left.
- 6. The door latching mechanism shall have an easy closing feature.
- 7. The door shall have one point removal and installation process for door.
- 8. Horizontal wire managers will be integrated into the patch panel design for ease of use and configuration of rack space.

## 2.2. Free Standing Two Post Aluminum Racks

- A. 45U - 7ft (2134 mm) H x 3in (76 mm) Channel x 19in (482.6 mm) Equipment Rack
1. Rack is to provide 45 rack-mount spaces in a "7 foot rack" for equipment. Each mounting space will be marked and numbered on the mounting channel.
  2. For the "7 foot rack" the assembled rack will measure 84" (2133.6 mm) high, 20.4" (518 mm) wide and 15" (381 mm) deep. The sides (webs) of the equipment-mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.
  3. Finish shall epoxy-polyester hybrid powder coat in the color as specified below.
  4. Approved Manufacturer:  
Chatsworth-CPI  
CommScope  
RK3-45A (MID [760082479](#)), Black
- B. 52U - 8ft (2438 mm) H x 3in (76 mm) Channel x 19in (482.6 mm) Equipment Rack
1. Rack is to provide 52 rack-mount spaces in an "8 foot rack" for equipment. Each mounting space will be marked and numbered on the mounting channel.
  2. For the "8 foot rack" the assembled rack will measure 96" (2438 mm) high, 20.4" (518 mm) wide and 15" (381 mm) deep. The sides (webs) of the equipment-mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.
  3. Finish shall be epoxy-polyester hybrid powder coat in the color as specified below.
  4. Approved Manufacturer:  
Chatsworth-CPI  
CommScope or End to End solution equivalent

[RK3-52A \(MID 760082487\)](#), Black

## 2.3. Vertical Cable Management For Racks

- A. The vertical cable management kits are installed on the side of a 19-inch or 23-inch (483 or 584 mm) wide industry standard rack.
- B. The door(s) shall be designed to provide a concealed vertical space for organizing patch cables.
- C. Cable spools shall be used to organize longer patch cable lengths.
- D. Cable managers are to be matched to the cable rack. Cable managers are available in 6 inch (152 mm), 8 inch (203 mm), 10 inch (254 mm), and 12 inch

(305 mm) widths and in 7 foot (2.1 m), 8 foot (2.4 m), and 9 foot (2.7 m) heights.

E. Approved Manufacturer:

Chatsworth-CPI

CommScope

VCM-SS-84-12B ([760089458](#)) 12" Single Side, Vertical Cable Management, Black Door

VCM-DS-84-6B ([760089375](#)) 12" Double Side, Vertical Cable Management, Black Door

VCM-SS-84-6B ([760089425](#)) 6" Single Side, Vertical Cable Management, Black Door

VCM-DS-84-6B ([760089342](#)) 6" Double Side, Vertical Cable Management, Black Door

### 3. EXECUTION

#### 3.1. Installation

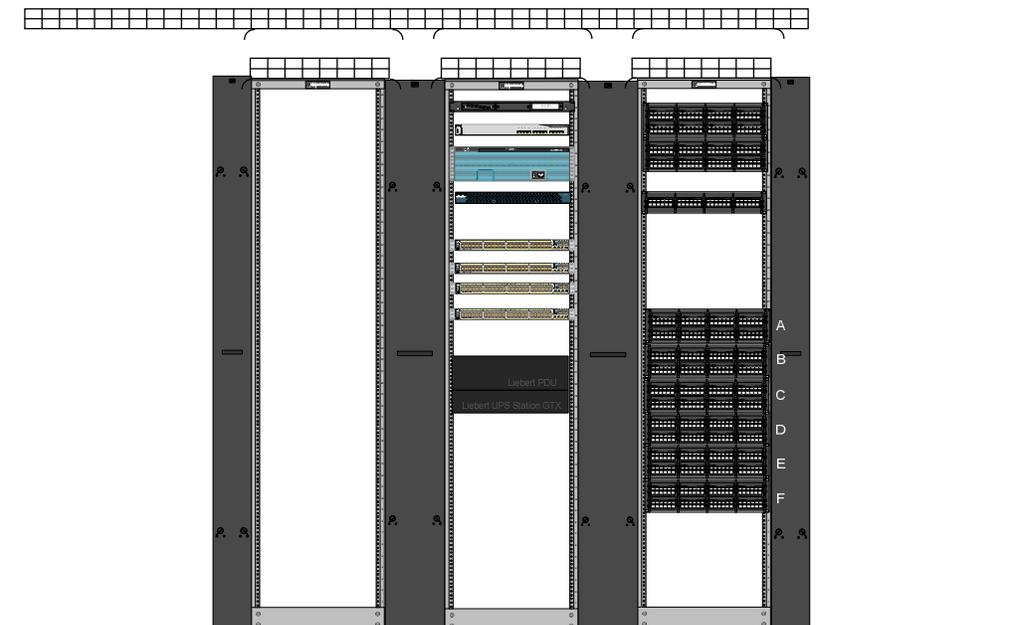
A. Racks and Cable Management

1. Assemble racks and cable management according to manufacturer's instructions. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching the rack to the floor.
2. All racks must be attached to the floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through the raised floor tile and be secured in the structural floor below.
3. Racks shall be grounded to the TGB using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).
4. In seismic areas, the rack should have additional bracing as required by building codes and the recommendations of a licensed structural engineer.
5. Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.
6. The equipment load should be evenly distributed and uniform on the rack. Place large and heavy equipment towards the bottom of the rack. Secure all equipment to the rack with equipment mounting screws.
7. 7" free standing racks shall be placed in the room to allow the maximum growth for the space.
8. Racks will be placed with a 6" wire manager between the frame and the wall.
9. The first rack closest to the wall will allow for a designated voice riser cable to be terminated on patch panels at the top of the rack. Allow enough rack space for an additional 50 pair feed to be available in the future.
10. Begin copper station termination below expansion space.
11. Install 12" wire manager between two racks.

12. Second rack will maintain fiber optic riser at the top and equipment only.
13. A third rack will be placed after another 12" vertical wire manager and have a 6" vertical wire manager on the end if this is the last rack. (see diagram below)
14. Wire basket will be supported from the top of the rack assembly.
15. Water falls will be installed to properly support patch cords that transition from the vertical channel to the horizontal channel to prevent cords from being pinched against the basket tray.



Spectrum Health Site Name			
EXP-MDF	Floor	MDF Rack Design	Date Approval Pending



**END of SECTION**

## 1. GENERAL

### 1.1. Work Includes

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

### 1.2. Scope of Work

- A. This section includes the minimum requirements for Horizontal and Backbone cable terminations installed in communications equipment rooms (Telecommunications Rooms, Equipment Rooms, or “Telecommunications Closets”).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
  - a) Patch Panels

### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - ISO/IEC 11801 - Generic cabling for customer premises
  - CENELEC EN-50173 - Generic cabling systems
  - BICSI – Telecommunications Distribution Methods Manual

#### 1.4. Submittals

A. Provide product data for the following:

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

## 2. PRODUCTS

### 2.1. Patch Panels

A. Category 5e/Class D Patch Panels

1. General specifications: Patch panel shall be constructed of high strength steel with black powder finish and designed for wall or 19-inch rack mounting.
2. Panels shall be available in 24-port and 48-port configurations, with height of 1 Rack Unit (RU) of 44.5 millimeters (1.75 inches) for each group of 24 ports.
3. Removable rear mounted cable management bar and front and rear identification labels.
4. Panel shall support 1 Gb network line speeds.
5. Panel shall be Category 5 and 3 backward compatible.
6. Panel shall comply with the standards for Category 5e/Class D patch panels listed in the TIA/EIA-568 Series Standards and ISO/IEC 11801.
7. Panel shall support IEEE 802.3 1000BASE-T plus other legacy LANs and applications.
8. Approved Manufacturer: Systimax Patchmax Patch panels

B. Category 6/Class E Patch Panels

1. General specifications: Patch panel shall be constructed of high strength steel with satin chrome finish and designed for wall or 19-inch rack mounting.
2. Panels shall be available in 24-port and 48-port configurations, with height of 1 Rack Unit (RU) of 44.5 millimeters (1.75 inches) for each group of 24 ports.
3. Removable rear mounted cable management bar and front and rear identification labels.
4. Patch panels shall support 5 meter cables in 3 and 4 connector channels, 3 meter cables in 2 connector channels and cross connect cords down to 1 meter.
5. Comply with the standards for Category 6/Class E patch panels listed in the TIA/EIA-568 Series Standards and ISO/IEC 11801.
9. Approved Manufacturer: Systimax Patchmax Patch panels

C. Fiber Optic Shelf Panels

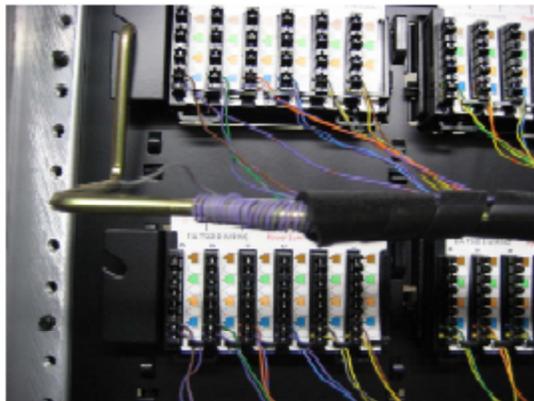
1. General specifications: Shelves shall be constructed of high strength steel with black powder finish and designed for wall or 19-inch rack mounting.
2. Shelves shall be available in multi U configurations, with height of 1 Rack Unit (RU) 44.5 mm (1.75 in), to 4 RU 177.8 mm (7 in).

3. Removable rear mounted cable management bar, door or cover and front and rear identification labels.
4. Comply with the standards for patch panels listed in the TIA/EIA-568 Series Standards and ISO/IEC 11801.
5. Fiber Shelf Panels shall accept ST, SC or LC modular adapter panels.

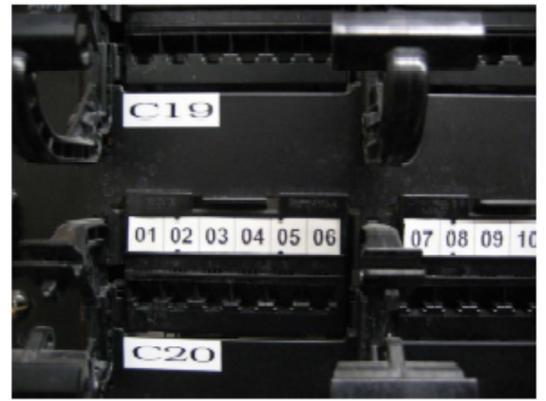
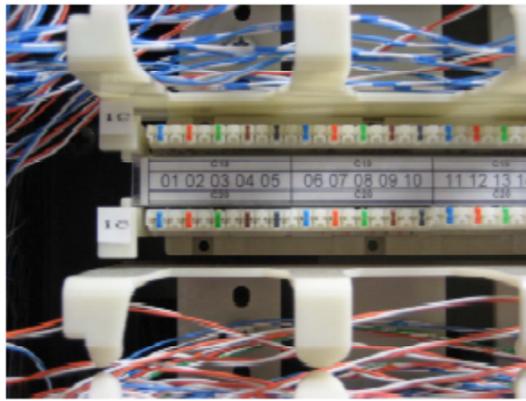
### 3. EXECUTION

#### 3.1. Installation

- A. All Patch Panels shall be installed in the racks installed in the telecommunications space.
- B. Each patch panel shall be attached to the rack using the four (4) rack screws supplied with the panel
- C. All Patch Panels shall be installed level and plum within the racks.
- D. Patch Panels shall be installed per the elevation drawings for the Telecommunications space.
- E. Voice Risers will be terminated on 110 punch open frames in the MDF rooms and labeled according to the closet it feeds. Voice risers will be terminated on 110 punch 48 port patch panels in the IDF closets.
- F. The 25<sup>th</sup> pair on each patch panel will be reserved for special circuits such as T1's to be punched down on the 24<sup>th</sup> port of each row.



- G. Each 24 port row will be independently labeled to the riser binder that is attached.
- H. The labeling on each patch panel will match the same riser binder that is terminated on the open 110 frame in the MDF.



**END of SECTION**

## 1. GENERAL

### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of work called for in the contract documents.

### 1.2. Scope of Work

- A. This section includes the minimum requirements for the equipment and cable installations in telecommunications rooms.
- B. Included in this section are the minimum composition requirements and installation methods for the following:

Ladder Rack/Tray

### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the owner or the owner representative.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:

ANSI/TIA – 568 Series

TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces

ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

NFPA 70 – National Electric Code

BICSI – Telecommunications Distribution Methods Manual

NEMA – VE-1 – Metal Cable Tray Systems

NEMA – VE-2 – Metal Cable Tray Installation Guidelines

## 1.4. Submittals

Provide product data for the following:  
Manufacturers data/cut sheets, product drawing/specifications and installation instructions for all products (submit with bid).

## 2. PRODUCTS

### 2.1. Ladder Rack/Tray, Supports, And Accessories

#### A. Ladder Rack / Tray

1. Ladder rack/tray shall be manufactured from tubular steel. Stringers (sides) will be made from 3/8" wide by 1-1/2" high tubular steel with .065" wall thickness. Cross members (rungs) will be made from 1" wide by 1/2" high tubular steel with .065" wall thickness.
2. Ladder rack/tray cross members will be welded in between stringers on 9" centers. There will be 8" of open space in between each cross member.
3. Design Make:

CommScope example part numbers

[CR-SLR-10L12W \(760085647\)](#) 10ft long, 12" wide, Black

[CR-SLR-10L18W \(760085654\)](#) 10ft long, 18" wide, Black

[CR-SLR-10L24W \(760085662\)](#) 10ft long, 24" wide, Black

#### B. Horizontal 90° Turns (Cable Runway E-Bend)

1. Horizontal 90° turns shall be manufactured from 3/8" wide by 1-1/2" high tubular steel with .065" wall thickness.
2. Stringers (sides) will be formed in a 90° arc. Cross members will be welded in between stringers on approximate 23° increments so that there are 5 cross members per turn. The welded assembly will have an inside radius that will create a smooth horizontal 90° turn.
3. Design Make:

CommScope example part numbers

[CR90FCB-12W \(760085530\)](#) 12 inch (305 mm) W

[CR90FCB-18W \(760085548\)](#) 18 inch (457 mm) W

[CR90FCB-24W \(760085555\)](#) 24 inch (610 mm) W

#### C. Ladder Rack/Tray Splices

1. Splice kits will provide a method of mechanically connecting ladder rack/tray sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.
2. Design Make:

CommScope example part numbers

[CRBSK \(760083899\)](#) Butt Splice Kit

[CRTJSK \(760084046\)](#) Junction Splice Kit

#### D. Ladder Rack/Tray Accessories

1. Cable straps used for attaching cable bundles to the ladder rack/tray cross members must be reusable with a hook and loop-style closure, at least ¾" wide, and sized for cable bundles that are 2", 3" or 4" in diameter.
2. Cable retaining posts used to keep cable from falling off of the side of the ladder rack/tray shall be manufactured from 1" by ½" tubular steel with .065" wall thickness. Cable retaining posts will be 8" high and will attach to the side stringer of the ladder rack/tray with included hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.
3. End caps used to cover the ends of ladder rack/tray will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8" wide by 1-1/2" high side stringers and will be sold in pairs.
4. Radius drops or "waterfalls" used to maintain the bend Radius of the cables as they exit or enter the ladder rack/tray will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3". Radius drops will attach to either the side stringer or the cross member of the ladder rack/tray using a clevis pin. Radius drops will include 1-1/2" high cable spools that attach to the top of the radius drop to guide cables.
5. Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack/tray will be made from 1/8" x 1" steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack/tray. The bracket will hang below the ladder rack/tray a minimum of 4". The bracket support surface will be 4" long. The bracket will be zinc plated with a gold chem. finish.
6. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below. Hardware will be zinc plated with a gold chem. finish.
7. Design Make:

CommScope example part numbers

CRRP-8H ([760083980](#)) Cable retaining posts

CRPECK ([760084012](#)) Ladder rack end caps

CRDK-12W ([760083956](#)) Radius Drops

### 3. EXECUTION

#### 3.1. Installation

- E. Provide all components of the ladder rack/tray system (ladder rack/tray, turns, splices, supports, and accessories) from a single manufacturer.
- F. Ladder rack/tray shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.
- G. Ladder rack/tray shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).

- H. Ladder rack/tray splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.
- I. Ladder rack/tray shall be supported every 5' or less in accordance with TIA-569. Ladder rack/tray shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support ladder rack/tray within 2' on both sides of every change in elevation. Support ladder rack/tray every 2' when attached vertically to a wall.
- J. When the pathway is overhead, ladder rack/tray shall be installed with a minimum clearance of 12" above the ladder rack/tray. Leave a minimum of 12" in between ladder rack/tray and ceiling/building truss structure. Leave a minimum of 3" in between ladder rack/tray and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack/tray shall be installed with a minimum clearance of 12" in between each tier of ladder rack/tray. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the ladder rack/tray.
- K. All threaded rod used in support of overhead cable trays shall have cable guard protectors installed over the exposed threaded rod in the area of the tray. The exposed end of the threaded rod hangers shall be cut flush with the mounting brackets, filed, and painted to match site conditions. Install rubber finishing caps on any exposed metal end rail or potential sharp point.
- L. When installed under a raised floor, ladder rack/tray shall be installed with a minimum 3" clearance between the top of the ladder rack/tray and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3" clearance between ladder racks/trays wherever ladder racks/trays cross.
- M. Within each telecommunications room, ladder rack/tray should be bonded together, electrically continuous, and bonded to the TGB, unless otherwise noted in the specifications and contract documents. Ladder rack/tray and turns shall be bonded across each splice with a bonding kit. Ladder rack/tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack/tray and a minimum #6 grounding wire or as recommended by the AHJ. Remove paint from the ladder rack/tray where bonding/ground lugs contact the ladder rack/tray so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack/tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack/tray sections and turns and through the bond to the TGB.
- N. The quantity of cables within the ladder rack/tray will not exceed a whole number value equal to 50% of the interior area of the ladder rack/tray divided by the cross-sectional area of the cable. The interior area of ladder rack/tray will be considered to be the width of the ladder rack/tray multiplied by a height of 2", unless cable retaining posts are added to the ladder rack/tray. The

interior area of ladder rack/tray equipped with cable retaining posts will be considered to be the width of the ladder rack/tray multiplied by a height of 6". Actual cable fill for ladder rack/tray that is not equipped with cable retaining posts will not exceed 2" in height. Actual cable fill for ladder rack/tray equipped with cable retaining posts will not exceed 6" in height.

- O. The combined weight of cables within the ladder rack/tray will not exceed the stated load capacity of the ladder rack/tray as stated in the manufacturer's product specifications or load/design tables.
- P. Cables (cable bundles) will be secured to the cross members of ladder rack/tray with  $\frac{3}{4}$ " wide reusable straps. Straps are not required when ladder rack/tray is equipped with cable retaining posts.
- Q. Use a radius drop to guide cables wherever cable exits overhead ladder rack/tray to access a rack, cabinet or wall-mounted rack, and cabinet or termination field. Provide a support other conductors that should be physically separated from cables within the ladder rack/tray as defined by local code or the authority having jurisdiction (AHJ).
- R. Whenever possible, maintain a 2' separation between ladder rack/tray used for communications cables and pathways for other utilities or building services.
- S. The installer will provide touch-up paint color-matched to the finish on the ladder rack/tray and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack/tray system.

**END of SECTION**

**27 13 00 Communications Backbone Cabling**

**27 13 13 Communication Copper Backbone Cabling**

**1. GENERAL**

**1.1. Work Includes**

Provide all labor, materials, and equipment for the complete installation of all voice backbone applications called for in the Contract Documents. Provide sufficient pair count to support 100% expansion at the outlet locations.

**1.2. Scope of Work**

- A. This section includes the minimum requirements for Inter and Intra Building Copper Backbone Cables.
- B. Included in this section are the minimum composition requirements and installation methods for the following:
  - Intra-Building Backbone (Inside buildings (ISP))
  - Inter-Building Backbone (Between buildings (OSP))

**1.3. Quality Assurance**

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

## 1.4. Submittals

Cable Manufacturer's data, including part numbers, cut sheets and detailed descriptions, for all proposed equipment

The Contractor shall submit installation plan indicating:

1. Equipment and personnel
2. Materials and staging area
3. Start and completion dates
4. Locations, including floor, room and building

The Contractor shall submit a copper cable pulling plan for all multi-pair copper cables with a pair count of 25 pairs or greater, that includes, but is not limited to, the following:

1. Each cable run and route.
2. Date and duration of the pull.
3. Pulling methodology and equipment setups.
4. Pulling tension calculations for each pull in the run.
5. Safety issues and precautions to be taken.

Product data for all termination and test equipment to be used by Contractor to perform work.

1. Equipment shall be calibrated with traceability to National Institute of Standards and Technology (NIST) requirements.
2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

## 2. PRODUCTS

### 2.1. Intra-Building Copper Backbone for Analog/Voice only

- A. All cable shall be listed for use per the National Electrical Code (NFPA-70).
- B. Cable shall meet one of the following, per bid document:
  1. UL-listed CMR cable: Solid copper conductors with high-density polyolefin insulation and overall low smoke PVC jacket to achieve riser (i.e., non-plenum) rating by UL standards
  2. UL-listed CMP cable: Solid copper conductors with FEP insulation and overall low smoke PVC jacket to achieve plenum rating by UL standards
  3. LSZH cable: Solid copper conductors with non-halogen HDPE insulation and low smoke, zero halogen, compound jacket to achieve LSZH rating by:
    - IEC 60754—Part 2.
    - IEC 61034—Part 2.
    - IEC 60332—Part 1.
    - Def Stan 713.
- C. Cable shall meet the requirement of ANSI/TIA/EIA-568 series Standards for Category 3 performance.
- D. Approved Manufacturer:

1. CommScope, Inc.

1010 025 ([106824329](#)) 25 Pair Riser Rated  
1010 050 ([106824378](#)) 50 Pair Riser Rated  
1010 100 ([106824469](#)) 100 Pair Riser Rated  
2010 025 ([107765992](#)) 25 pair Plenum Rated  
2010 050 ([107766040](#)) 50 pair Plenum Rated  
2010 100 ([107766057](#)) 100 pair Plenum Rated  
3010 025 ([760010900](#)) 25 pair LZSH Rated  
3010 100 ([760010918](#)) 100 pair LZSH Rated

2.2. Inter-Building Copper Backbone for Analog/Voice only

- A. All cable shall be manufactured and constructed for use in the Outside Plant Environment.
- B. Cable shall meet the requirement of ANSI/TIA/EIA-568 series Standards for Category 3 performance
- C. Approved Manufacturer:

1. CommScope, Inc.

Outdoor Multi-Pair Data Cable, 25 pair ([999903004](#))  
Outdoor Multi-Pair Data Cable, 50 pair ([999903005](#))  
Outdoor Multi-Pair Data Cable, 100 pair ([999903006](#))  
Outdoor Multi-Pair Data Cable, 200 pair ([999903010](#))

2.3. Building entrance protection

Building entrance protection for copper cabling shall be installed utilizing a two (2) foot fuse link between outside plant cable plant splice and the protector module with IDC-type input and output terminals, 100 pair-pair capacity and female mounting base, equipped with 230 volt solid state protector modules. Sufficient protector modules shall be provided to completely populate all building entrance terminals.

2.4. Voice backbone cables

Voice backbone cables shall have a minimum 10-foot service loop when terminated in the ER and TR, and at any splice points in telecommunications manholes.

2.5. Protector Panels

2.6. Copper Termination Hardware

- D. Main Cross Connect (MC) and Entrance Facility (EF)

1. Approved Manufacturer:

### 3. EXECUTION

#### 3.1. Installation

##### A. General - Inter And Intra Building Copper Backbone Cable

1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
2. Provide all necessary products for installation of Copper Backbone cablings to include cable attachments, etc.
3. Backbone cable shall be installed following industry standard practices.
4. All Outside Plant Backbone cable shall terminate on Primary protection (per the NEC) upon entering the building.
5. All installations shall comply with:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

##### B. Backbone Cable Testing

1. Complete end-to-end test results for all copper UTP cables installed are required.
2. All multi-pair copper cable pairs installed shall be tested to TIA/EIA 568A, Category 3 or Category 6 equivalent performance specifications. In addition, provide loop resistance measurements in ohms and dB loss at 1KHz, 8KHz, and 256KHz.
3. The Owner is to be notified at least 24 hours prior to testing to allow observation at the Owner's discretion. If the Owner confirms his intention to observe, a reasonable starting time shall be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.
4. 100% of all pairs in backbone copper cables shall be tested for continuity and wire-map.
5. Testing Format: Test Results must be submitted in two (2) formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in Excel format with the following fields:
  - ER/TR RM # / RM # of drop / Port # / all relevant test information in as many fields as necessary.
6. All test results are to be recorded and submitted to the Owner.

##### C. Cable And Termination Panel Labeling Backbone Cable Testing

Label the installed cables in accordance with Section 27 05 53

D. Cable Support

1. Provide cable supports and clamps to attach cables to backboards and walls.
2. Attach horizontal and vertical backbone cables at 2 foot intervals using Owner approved supports; such as D-rings or jumper troughs utilized for wire management.
3. Attach cables to manhole racks using Owner approved methods
4. Backbone cabling shall be secured to the cable/ladder tray following manufacturer recommended procedures, and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).

E. As-built Drawings

1. CAD Files: Provide CAD files in .dwg format showing floor plans with room numbers and actual backbone cabling and pathway locations and labeling. The deliverable is required within 5 business days of final cable testing.
2. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours showing installation progress marked and backbone cable labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

**END of SECTION**

## 27 13 23 Communication Optical Fiber Backbone Cabling

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Optical Fiber Backbone Cables called for in the Contract Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for Optical Fiber Backbone Cables.
- B. Included in this section are the minimum composition requirements and installation methods for the following:
  - Intra Building Backbone (Inside buildings (ISP))
  - Inter Building Backbone (Between buildings (OSP))

#### 1.3. General Specifications

- A. Cables shall be designed for Point To Point applications and shall provide a high level of protection for optical fiber installed in building applications.
- B. Higher optical fiber count cables shall utilize a sub-unitized design with color-coded subunits for easy identification.

#### 1.4. Cable Performance Specifications

Cables shall comply with the applicable standards per cable type:

- Bellcore, fiber distributed data interface (FDDI), and EIA standards
- ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable
- Telcordia, GR-20-CORE, Generic Requirements for Optical Fiber and Optical Fiber Cable
- Telcordia, GR-409-CORE, Generic Requirements for Indoor Fiber Optic Cables
- Telcordia requirements for superior armored cable
- TIA/EIA-568-C .1
- TIA/EIA-568-C.3
- ISO/IEC 11801
- CENELEC EN-50173
- EN 187105

#### 1.5. General - Multimode Fiber

- A. Cable shall support current and next generation LAN, SAN, and WAN applications through laser-optimized 50/125 micrometer optical fibers and shall extend distance of low-cost 850 nanometer vertical cavity surface-emitting laser (VCSEL) based electronics

- B. Cable shall support dual speed 1 gigabit per second/10 gigabits per second ports, allowing incremental upgrades of switches and servers with less disruption
- C. Optical fibers shall be differential mode delay (DMD) tested using a high-resolution test bench that exceeds fiber optic test procedure (FOTP) 220 standards and independently certified by UL.
- D. Cable shall also support existing and legacy multi-mode applications that traditionally operate in 850 and 1300 nanometer regions.

1.6. OM3 Multimode Fiber Specification

- A. The OM3 Multimode Fiber SCS shall comply with the following standards

ISO/IEC 11801:2010  
 EN 50173-1:2011  
 EN 50173-2:2010  
 ANSI/TIA-568-C  
 IEC 60603-7-4  
 IEEE 802.3 applications as outlined in section (b)  
 Local/National Codes and Regulations

- B. The OM3 Multimode Fiber SCS shall be capable of supporting, at minimum, the following IEEE Ethernet applications:

802.3j	10BASE-F 10 Mb/s
802.3j	10BASE-FL 10 Mb/s
802.3u	100BASE-FX 100 Mb/s
802.3u	100BASE-SX 100 Mb/s
802.3z	1000BASE-SX 1000 Mb/s
802.3ae	10GBASE-SR 10Gb/s
802.3aq	10GBASE-LRM 10Gb/s with EDC
802.3ba	40GBASE-SR4 40 Gb/s
802.3ba	100GBASE-SR10 100 Gb/s

- C. Additionally the OM3 Multimode Fiber SCS shall be capable of supporting the following Fiber Channel Applications Standards, per Technical Committee 11 of INCITS:

1GFC
2GFC
4GFC
8GFC
10GFC
16GFC

- D. The multimode fibers shall fully meet or exceed the OM3 fiber specifications in:

EN 50173-1:2011  
 ISO/IEC 11801:2010

IEC/EN 60793-2-10 (A1a fiber)  
ANSI/TIA-492AAAC standards

- E. The OM3 multimode fiber shall be manufactured with an inside vapor deposition process such as the MCVD (Modified Chemical Vapor Deposition) or PCVD (Plasma Clad Vapor Deposition) processes. Multimode fibers produced with outside vapor deposition processes, such as OVD or VAD, will not be accepted. Inside vapor deposition manufacturing processes results in superior control of Refractive Index Profile required for high bandwidth.
- F. The OM3 multimode fiber shall comply with the following physical specifications:

Cladding Diameter	125 μm
Cladding Diameter Tolerance	±1.0 μm
Cladding NonCircularity, maximum	1%
Coating Diameter (Colored)	254 μm
Coating Diameter (Uncolored)	245 μm
Coating Diameter Tolerance (Colored)	±7 μm
Coating Diameter Tolerance (Uncolored)	±10 μm
Coating/Cladding Concentricity Error, maximum	6 μm
Core Diameter	50.0 μm
Core Diameter Tolerance	±2.5 μm
Core/Clad Offset, maximum	1.5 μm
Numerical Aperture	0.200 ± 0.015
Zero dispersion wavelength	1297 – 1316 nm
Zero dispersion slope	≤ 0.105 ps/nm <sup>2</sup> -km
Maximum DMD (note: must comply with at least one of the 6 templates specified below)	Meets or exceeds TIA/EIA-492AAAC-A and IEC 60793-2-10 A1a.2
850 nm	See attached templates
1300 nm	0.88 s/m

- G. The OM3 multimode fiber shall meet the following requirements:

Maximum Fiber <b>Cabled</b> Loss	3.0 dB/km at 850 nm* 1.0 dB/km at 1300 nm*
Minimum Effective Modal Bandwidth	2000 MHz.km at 850 nm (DMD, laser) 500 MHz.km at 1300 nm (DMD, laser)

Minimum overfilled Modal Bandwidth	1500 MHz.km at 850 nm (OFL) 500 MHz.km at 1300 nm (OFL)
Operating Temperature Range (cabled fiber)	-20°C to 50°C (-4°F to 122°F)*
Storage Temperature Range (cabled fiber)	0°C to 50°C (32°F to 122°F) for LSZH -40°C to 65°C (-40°F to 149°F) for others
Maximum Pulling Tension	90 kg
Minimum Tensile Strength	0.7 GPa (100,000 psi)

\* **NOTE: this value reflects cabled fiber loss. Un-cabled fiber values will not be accepted**

- H. The OM3 multimode fibers shall be color coded to facilitate individual fiber identification. Color coding shall follow industry standard TIA-598-C Optical Fiber Cable Color Coding
- I. The coating shall be mechanically strippable.
- J. The OM3 fiber shall meet a minimum of one of the DMD templates listed below, accounting for the wider inner and outer mask specifications when compared with TIA 492AAc and IEC 60793-2-10 standards:

Template	850 nm DMD-Inner Mask (ps/m) Radius from 0 to 18 μm)	850 nm DMD-Outer Mask (ps/m) Radius from 0-23 μm
1	≤ 0.23	≤ 0.70
2	≤ 0.24	≤ 0.60
3	≤ 0.25	≤ 0.50
4	≤ 0.26	≤ 0.40
5	≤ 0.27	≤ 0.35
6	≤ 0.33	≤ 0.33

- K. The OM3 multimode fiber shall be tested in accordance with:  
IEC/EN 60793-1-49  
ANSI/TIA-455-220-A  
ANSI/TIA-492AAAC-A
- L. The following additional enhancements to the DMD tests must be made to ensure high bandwidth:

Enhancement to IEC/EN 60793-1-49 and ANSI/TIA-492AAAC-A standards	
Parameters	Test Requirement
Speed of Laser	5 ps pulse width
Scan Resolution (Radial Increment)	1 μm
Inner Mask Radial Coverage	0 – 18 μm (no central hole)
Number of Quadrants Tested	4 quadrants
Test Length	300 meters

- M. The Cable Manufacturer must have the capability to test DMD for cabled product. Third party verification of the DMD test bench must be provided with the bid response.

## 1.7. OS2 Single-mode 8.3 Micrometer Fiber

- A. The OS2 Single-mode Fiber SCS shall comply with the following standards

ISO/IEC 11801:2010  
 EN 50173-1:2011  
 EN 50173-2:2010  
 ANSI/TIA-568-C  
 IEC 60603-7-4  
 IEEE 802.3 applications as outlined in section (iii)  
 Local/National Codes and Regulations

- B. The OS2 optical fiber glass shall be manufactured from ultra-pure synthetic silica glass. Single-mode fibers manufactured from natural quartz will not be accepted.

- C. The OS2 Single-mode Fiber SCS shall be capable of supporting, at minimum, the following IEEE Ethernet applications:

100M	100BASE-LX10
1G	1000BASE-LH
	1000BASE-BX10
	1000BASE-LX10
	1000BASE-PX10-D
	1000BASE-PX10-U
	1000BASE-PX20-D
	1000BASE-ZX
10G	10GBASE-LR
	10BASE-LX4
	10GBASE-ER
40G	40GBASE-LR4
100G	100GBASE-LR4

- D. The OS2 single-mode Fiber SCS shall be capable of supporting the following Fiber Channel Applications Standards, per Technical Committee 11 of INCITS:

1GFC
2GFC
4GFC
8GFC
10GFC
16GFC

- E. The OS2 single-mode fibers shall fully meet or exceed the specifications in:

EN 50173-1:2011  
 ISO/IEC 11801:2010  
 IEC/EN 60793-2-50 (b1.3 fiber)  
 ANSI/TIA-492CAAB  
 ITU-T G.652.D

- F. The OS2 single-mode fiber shall comply with the following physical specifications:

<b>Physical Characteristics</b>	
Cladding Diameter	125.0 ± 0.7 μm
Core/Clad Offset	≤ 0.5 μm
Coating Diameter (Uncolored)	245.0 ± 10 μm
Coating Diameter (Colored)	254.0 ± 7 μm
Coating/Cladding Concentricity Error, Max.	12 μm
Clad Non-Circularity	≤ 1.0 %

- G. The OS2 single-mode fiber shall comply with the following mechanical specifications:

<b>Mechanical Characteristics</b>	
Proof Test	100 kpsi (0.69 Gpa)
Coating Strip Force	0.3 – 2.0 lbf (1.3 – 8.9 N)
Fiber Curl	≥ 4 m
Dynamic fatigue Parameter (nd)	≥ 18
Macrobending, Max. (100 turns)	0.05 dB (1,310/1550 nm @50mm) 0.05 dB (1,625 nm @ 60 mm)
Macrobending, Max. (1 turn @32 mm mandrel)	0.05 @1,550 nm

- H. The OS2 single-mode fiber shall comply with the following mechanical specifications:

<b>Optical Characteristics, Wavelength Specific</b>			
	1310 nm	1385 nm	1550 nm
Max Attenuation Loose Tube Cable	0.34 dB/km	0.31 dB/km	0.22 dB/km
Max Attenuation Tight Buffer Cable	0.50 dB/km	0.50 dB/km	0.50 dB/km
Mode Field Diameter	9.2 ± 0.3 μm	9.6 ± 0.6 μm	10.4 ± 0.5 μm
Group Refractive Index	1.467	1.468	1.468
Dispersion, Max.	3.5 ps/(nm-km) from 1,285 to 1,330 nm		18 ps/(nm-km)

- I. The OS2 single-mode fiber shall comply with the following optical and environmental specifications:

<b>Optical Characteristics, General</b>	
Points defects, Max.	0.10dB
Cut-Off Wavelength	≤ 1260
Zero Dispersion Wavelength	1,302 – 1,322 nm
Zero Dispersion Slope, max.	0.090 ps/[km-nm-nm]

Polarization Mode Dispersion Link Design Value	≤ 0.06 ps/sqrt (km)
Backscatter Coefficient	-79.6/-82.1 dB @ 1310/1550 nm
Index of Refraction	1.466/ 1.467 @ 1310/1550 nm

<b>Environmental Characteristics</b>	
Temperature Dependence -76°F to 185°F (-60°C to 85°C)	≤ 0.05dB
Temperature humidity Cycling 14°F to 185°F (-10°C to 85°C) up to 95% RH	≤ 0.05dB
Water Immersion, 73.4°F (23°C)	≤ 0.05dB
Heat Aging, 185°F (85°C)	≤ 0.05dB

## 2. PRODUCTS

### 2.1. Intra Building Backbone (ISP)

- A. Indoor Cables - All cable shall be listed for use indoors per the National Electrical Code (NFPA-70) and shall meet one of the following, per bid document.
1. **Indoor Riser Rated Tight Buffer** - UL-listed OFNR: Tight buffer optical fibers, aramid strength yarn, and riser-rated outer jacket.
  2. **Indoor Plenum Rated Tight Buffer** UL-listed OFNP cable: Tight buffer optical fibers, aramid strength yarn, and plenum-rated outer jacket.
  3. **Indoor Low Smoke/Zero Halogen Riser Rated Tight Buffer** LSZH cable: Solid copper conductors with non-halogen HDPE insulation and low smoke, zero halogen, compound jacket to achieve LSZH rating.
  4. **Indoor Armored Riser Rated Tight Buffer** - UL-listed OFCR: Tight buffer optical fibers, aramid strength yarn, a riser-rated jacket, aluminum interlocking armor with an overall riser-rated sheath jacket to provide additional protection and security.
  5. **Indoor Armored Plenum Rated Tight Buffer** UL-listed OFCP cable: Tight buffer optical fibers, aramid strength yarn, a plenum-rated outer jacket, aluminum interlocking armor with an overall plenum-rated sheath jacket to provide additional protection and security.

### 2.2. Inter Building Stranded Backbone (OSP)

- A. All cable shall be manufactured and constructed for use in the Outside Plant Environment and shall meet one of the following, per bid document.
1. Outside Plant (OSP) loose tube all dielectric - Dielectric design with MDPE sheath jacket and no metallic elements to provide environmental protection.
  2. Outside Plant (OSP) loose tube metallic sheath - Metallic sheath design with MDPE sheath jacket to provide environmental protection. Metallic armor of corrugated polymer coated steel tape to provide added crush protection. Armor shall meet Telcordia requirements for superior armored cable.
- B. Buffer tubes and optical fibers

1. Industry standard buffer tubes stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits.
  2. Optical fibers shall be industry-standard color coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes
- C. Water blocking
1. OSP Fiber Cables are available as either fully dry or dry core with gel in the buffer tubes. The bid document will specify the cable type.
    - a. Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications in cable and buffer tubes.
    - b. Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications with gel filled buffer tubes.

### 2.3. Intra Building Backbone Indoor/outdoor(ISP/OSP)

- A. Indoor/Outdoor Cables - All cable shall be listed for use indoors per the National Electrical Code (NFPA-70) and shall meet both of the following, per bid document.
1. **Indoor Riser Rated Tight Buffer** - UL-listed OFNR: Tight buffer optical fibers, aramid strength yarn, and riser-rated outer jacket.
  2. **Indoor Low Smoke/Zero Halogen Riser Rated Tight Buffer** UL-listed OFN(LS) cable: Solid copper conductors with non-halogen HDPE insulation and low smoke, zero halogen, compound jacket to achieve LSZH rating

### 2.4. Approved Manufacturer

- A. Basis for Design Specifications: CommScope SYSTIMAX TeraSPEED or LazrSPEED multimode optical fiber (OM2+, OM3, OM4) unless otherwise noted, in strand-count identified on Telecommunications Drawing and/or the Bid Document, and with the appropriate jacket material [OFNR, OFNP, OFN (LS) ] for the pathway in which the cable will be routed.
1. Approved Manufacturer:
 

Example Catalog/Manufacturer Part Number (Note: contact CommScope Representative for assistance for construction of Trunk Catalog/Part numbers.)

    - i. CommScope

R-144-DS-8W-FMUYL ([760018887](#))

144 Fiber, Riser Rated, Distribution Cable, Singlemode

D-072-LN-8W-F12NS ([760053892](#))

72 Fiber, Single Jacket All-Dielectric, Gel-Free, Outdoor Stranded Loose Tube Cable, Singlemode

D-048-LA-8W-F12NS ([760053314](#))

48 Fiber, Single Jacket/Single Armor, Gel-Free, Outdoor Stranded Loose Tube Cable, Singlemode

O-024-CA-8W-F12NS ([760003954](#))  
Single Jacket/Single Armor, Gel-Filled, Outdoor Central Tube Cable,  
Singlemode

### 3. EXECUTION

#### 3.1. Installation

##### A. General - Inter And Intra Building Fiber Backbone Cable

1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
2. Provide all necessary products for installation of Fiber Backbone cablings to include cable attachments, etc.
3. Backbone cable shall be installed following industry standard practices.
4. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for fiber cables per manufacturer's specifications.
5. All installations shall comply with:
  - ANSI/TIA/EIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA/EIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

##### B. Backbone Cable Testing

1. Complete end-to-end test results for all Fiber Optic cables installed are required.
2. All fiber optic cable must be visually inspected and optically tested on the reel upon delivery to the installation site. Using an Optical Time Domain Reflectometer (OTDR), an access jumper with like fiber, a pigtail, and a mechanical splice, all fibers shall be tested for continuity and attenuation.
3. Testing for continuity and attenuation on the reel must confirm factory specifications to ensure that the fiber optic cable was not damaged during shipment. The test results must match the results of the factory-attached tag on the reel, or the fiber shall not be used. Reel data sheet must be provided showing test results.
4. End to end (bi-directional) test measurements shall be provided for single-mode and multimode fibers (2 wavelengths per test are required). Test results must be submitted for review as part of the installation inspection requirements. Test results shall be in paper form and electronic form, and

must contain the names and signatures of the technicians performing the tests.

5. Testing shall be performed on 100% of the fibers in the completed end-to-end system. ANSI/TIA-568-A, Annex H, provides the technical criteria and formulae to be used in fiber optic testing. Note however, that all UH fiber must be tested, rated and guaranteed for Ethernet GigaSPEED 1000B-X performance.
  6. Additionally, all fiber optic cable links must pass all installation and performance tests both recommended and mandated by the cable manufacturer.
  7. The Owner is to be notified at least 24 hours prior to testing to allow observation at the Owner's discretion. If the Owner confirms his intention to observe, a reasonable starting time shall be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.
  8. Testing Format: Test Results must be submitted in two (2) formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in Excel format with the following fields:
    - ER/TR RM # / RM # of drop / Port # / all relevant test information in as many fields as necessary.
  9. All test results are to be recorded and submitted to the Owner.
- C. Cable And Termination Panel Labeling Backbone Cable Testing
- Label the installed cables in accordance with Section 27 05 53
- D. Cable Support
1. Provide cable supports and clamps to attach cables to backboards and walls.
  2. Attach horizontal and vertical backbone cables at 2 foot intervals using Owner approved supports; such as D-rings or jumper troughs utilized for wire management.
  3. Attach cables to manhole racks using Owner approved methods
  4. Backbone cabling shall be secured to the cable/ladder tray following manufacturer recommended procedures, and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).
- E. As-built Drawings
1. CAD Files: Provide CAD files in .dwg or .dgn formats showing floor plans with room numbers and actual backbone cabling and pathway locations and labeling. The deliverable is required within 5 business days of final cable testing.
  2. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours showing installation progress marked and backbone cable labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

**END of SECTION**

## 27 13 50 Communications OSP Fiber Splice Closures

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Outside Plant Fiber Splice Closures called for in the Bid Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for OSP Fiber Splice Closures.
- B. OSP Closures are to be designed for aerial, buried and manhole applications and to be used with all types of Optical Fiber, Single-mode and Multimode.
- C. A Closure line with different sizes of OSP Closures is required to accommodate a range of fiber counts and cable sizes.
- D. The OSP Closure line is to have several different sizes to accommodate up to 384 fiber single fusion splices and to accept loose tube and central tube cables, both armored and all dielectric.
- E. The Outside Plant Fiber Splice Closure must have at least one set of Express Ports to allow mid span splicing of one cable.
- F. The Outside Plant Fiber Splice Closure must have at least two Drop Ports.
- G. The Outside Plant Fiber Splice Closure must have a grommet system that allows for more than one cable per Drop Port, depending on cable size.
- H. The Outside Plant Fiber Splice Closure must have a tray system that allows the use of multiple trays. Tray count is dependent on the number of fibers to be spliced.
- I. The Outside Plant Fiber Splice Closure tray system must allow for easy access to all trays: top, inner and bottom.
- J. The Outside Plant Fiber splice closures are to be designed:
  - a) to comply with Telcordia GR-20 for environmental sealing and water immersion
  - b) to allow grounding and bonding for use with Armored Cable and Optical Ground Wire (OPGW)
  - c) for re-entry and not require the use of an encapsulant
  - d) with a flash testing port
  - e) with a security locking tab
  - f) with an operating temperature: Operating Temperature -40 °C to +66.5 °C (-40 °F to +151.7 °F)

#### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or

Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual
  - ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable
  - Telcordia, GR-20-CORE, Generic Requirements for Optical Fiber and Optical Fiber Cable

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate layout and installation of Splice Closures with other installations.

## 2. PRODUCTS

### 2.1. Closure for 2 to 48 fibers

- A. Dimensions
  - 1. Diameter: 127.0 mm (5.0 in)
  - 2. Length: 515.6 mm (20.3 in)
- B. Mechanical Specifications
  - 1. Cable Entry Drop Port Size: 25.0 mm (1.0 in)
  - 2. Cable Entry Drop Port, quantity: 2
  - 3. Cable Entry Express Port Size: 25.0 mm (1.0 in)

- 4. Cable Entry Express Port, quantity: 2
- C. Approved Manufacturer: CommScope

OFE-CLS-J-012 [9703128/00](#)

### 3. EXECUTION

#### 3.1. Installation

- D. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
- E. Splice Closures and Cables shall be installed following industry standard practices.
- F. Slack cable is mandatory and shall be stored properly for the application.
- G. Splice Closures shall be supported with the proper hardware for the application. Use of the appropriate Pole, Aerial and Maintenance Hole Hardware from the manufacturer shall be used.
- H. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for OSP cables per manufacturer's specifications.

**END of SECTION**

**27 15 00      Communications Horizontal Cabling**

**27 15 13      Communication Copper Horizontal Cabling**

**1. GENERAL**

**1.1. Work Includes**

Provide all labor, materials, and equipment for the complete installation of all Copper Horizontal Cabling applications called for in the Bid Documents.

**1.2. Scope of Work**

- A. This section includes the minimum requirements for Copper Horizontal Cables.
- B. Horizontal (to desktop) cable shall consist of Category 5E, 6 or 6A copper cable for all Data and Voice applications for an **End to End Solution**.
- C. At corporate, engineering and campus facilities, horizontal cabling to typical work area outlets (including offices, cubicles and conference rooms) shall consist of four Category 5e or Category 6 cables serving each outlet. At field sales offices, horizontal cabling to typical work area outlets shall consist of two Category 5e or Category 6 cables serving each outlet.
- D. Outlets for wall-mounted or other “telephone only” installations shall consist of one Category 5e cable as a minimum.
- E. Outlets for wireless access points (APs) shall consist of two Category 5e or 6 cables as a minimum.

**1.3. Quality Assurance**

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,

ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings  
ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications  
NFPA 70 – National Electric Code  
BICSI – Telecommunications Distribution Methods Manual  
TIA/EIA-568-C.1 – Commercial Building Telecommunications Cabling Standard  
TIA/EIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards  
ISO/IEC 11801 - Generic Cabling for Customer Premises  
CENELEC EN-50173 - Generic Cabling Systems

#### 1.4. Cable Construction (by Type):

- A. Listed CMR cable: Solid copper conductors with high-density polyolefin insulation and an overall low smoke polyvinyl chloride (PVC) jacket to achieve a riser (i.e., non-plenum) rating by applicable NEC requirements.
- B. Listed CMP cable: Solid copper conductors with fluorinated ethylene propylene (FEP) insulation and an overall low smoke PVC jacket to achieve plenum rating by applicable NEC requirements.
- C. LSZH cable: Solid copper conductors with non-halogen high-density polyethylene (HDPE) insulation and a low smoke, zero halogen, compound jacket to achieve a LSZH rating by applicable IEC standards
- D. LC cable: Solid copper conductors with FEP fluoropolymer insulation and overall FEP fluoropolymer jacket to achieve CMP 50 rating by UL standards
- E. OSP outdoor cable rated for wet locations: Solid copper conductors with polyethylene insulation, polyolefin fluted center member with flooding compound, and black polyethylene jacket
- F. Comply with following general physical specifications:
  - 1. Maximum pulling tension: 110 Newton's (25 pound-force)
  - 2. Operating temperature: –20 to 60 degrees C [–4 to 140 degrees F]

#### 1.5. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.6. Coordination

Coordinate layout and installation of cable tray with other trades.

## 2. PRODUCTS

### 2.1. Data Communications Horizontal Cabling (Category 5e/Class D)

- A. Category 5 Enhanced (5e) Unshielded Twisted-Pair (UTP) Cable

1. All Cables shall be of round construction
2. Each cable shall contain 4 color coded pairs
3. Cable shall be listed for the environment where it will be installed (Plenum, Riser, LSZH, etc.)
4. Approved Manufacturer:
  - a.

Systemax or other approved end to end solution

- B. Category 5e horizontal cabling shall provide the following Margin to the specification when installed in a 4 connector Channel.

Test Parameter	Guaranteed Margins/Values
Attenuation	5%
Pair-Pair NEXT	3dB
PSNEXT	5.5dB
Pair-Pair ELFEXT	4.5 dB
PSELFEXT	5.5dB
Return Loss	1dB
Delay	580-546.9ns <sup>2</sup>
Delay Skew	30ns

1. All guarantees described in this document are subject to the terms and conditions of the SYSTIMAX Extended Product Warranty and Applications Assurance Program
2. Phase Delay is frequency dependent

- C. Category 5e horizontal cabling shall meet or exceed the performance specifications listed in the following table when installed in a 4 connector Channel.

Freq (MHz)	Atten (dB)	pr-pr NEXT (dB)	ACR (dB)	PS NEXT (dB)	PS ACR (dB)	pr-pr ELFEXT (dB)	PS ELFEXT (dB)	Return Loss (dB)	Phase Delay (ns)	Delay Skew (ns)
1	2.1	66.3	64.2	66.1	64.0	61.8	59.8	18.0	580	30
4	4.2	56.6	52.4	56.2	52.0	49.8	47.8	18.0	562	30
8	6.0	51.6	45.6	51.2	45.2	43.8	41.8	18.0	557	30
10	6.7	50.0	43.3	49.6	42.9	41.8	39.8	18.0	555	30
16	8.6	46.6	38.0	46.2	37.6	37.8	35.8	18.0	553	30
20	9.6	45.0	35.4	44.6	35.0	35.8	33.8	18.0	552	30
25	10.4	43.4	33.0	42.9	32.5	33.9	31.9	17.0	551	30
31.25	12.2	41.7	29.5	41.2	29.0	31.9	29.9	16.0	550	30
62.5	17.6	36.6	19.0	36.1	18.5	25.9	23.9	13.1	549	30
100	22.8	33.1	10.3	32.6	9.8	21.9	19.9	11.0	548	30

125	25.8	31.5	5.7	30.9	5.1	19.9	17.9	10.1	547	30
155.5	29.1	29.8	0.7	29.2	0.1	18.0	16.0	9.1	547	30

1. The table provides reference values only. All parameters comply with the governing equations over the entire frequency range.
2. All values and equations apply to worst-case channels utilizing four-pair 61C+ or 61B series cables with full cross-connects consolidation points and work area outlets (4 connections in a channel) for the length up to 100 meters.

## 2.2. Data Communications Horizontal Cabling (Category 6/ClassE)

### A. Category 6/Class E Unshielded Twisted-Pair (UTP) Cable

1. All Cables shall be of round construction
2. Each cable shall contain 4 color coded pairs
3. Cable shall be listed for the environment where it will be installed (Plenum, Riser, LSZH, etc.)
4. Approved Manufacturer:
  - a.

Systemax or other end to end solution equivalent.

- B. Category 6 horizontal cabling shall provide the following Margin to the specification when installed in a 4 connector Channel:

Electrical Parameter (1-250MHZ)	Guaranteed Margins to Category 6 Class E Channel Specifications
Insertion loss	5%
NEXT	6 dB
PSNEXT	7.5 dB
ELFEXT	6 dB
PSELFEXT	8 dB
Return Loss	4 dB

- C. Category 6 horizontal cabling shall meet or exceed the performance specifications listed in the following table when installed in a 4 connector Channel.

Guaranteed Channel Performance Specifications for 4-Connection GigaSPEED XL7 U/UTP Systems										
Freq (MHz)	Insertion Loss (dB)	NEXT (dB)	ACR (dB)	PSNEXT (dB)	PSACR (dB)	ELFEXT (dB)	PSELFEXT (dB)	Return Loss (dB)	Delay (ns)	Delay Skew (ns)
1.0	2.0	71.0	69.0	69.5	67.5	69.3	68.3	23.0	580	30
4.0	3.8	69.0	65.2	68.0	64.2	57.2	56.2	23.0	562	30
8.0	5.4	64.2	58.8	63.1	57.7	51.2	50.2	23.0	557	30
10.0	6.0	62.6	56.6	61.5	55.5	49.3	48.3	23.0	555	30
16.0	7.6	59.2	51.6	58.1	50.4	45.2	44.2	22.0	553	30
20.0	8.6	57.6	49.1	56.5	47.9	43.2	42.2	21.5	552	30
25.0	9.6	56.0	46.4	54.8	45.2	41.3	40.3	21.0	551	30

31.25	10.8	54.4	43.6	53.2	42.4	39.4	38.4	20.5	550	30
62.5	15.6	49.4	33.7	48.1	32.4	33.3	32.3	18.0	549	30
100.0	20.2	45.9	25.7	44.6	24.3	29.3	28.3	16.0	548	30
200.0	30.0	40.8	10.8	39.4	9.4	23.2	22.2	13.0	547	30
250.0	34.1	39.1	5.0	37.7	3.5	21.3	20.3	12.0	546	30

1. The table provides reference values only. All parameters comply with the governing equations over the entire frequency range.
  2. All values and equations apply to worst-case channels utilizing four-pair 71E series cables with full cross-connects, consolidation points and work area outlets (4 connectors in a channel) for any channel lengths up to 100 meters.
- D. Category 6 horizontal cabling shall provide the following Margin to the specification when installed in a 6 connector Channel

Electrical Parameter (1-250MHZ)	Guaranteed Margins to Category 6 Class E Channel Specifications
Insertion loss	4%
NEXT	4 dB
PSNEXT	5.5 dB
ELFEXT	4 dB
PSELFEXT	6 dB
Return Loss	2 dB

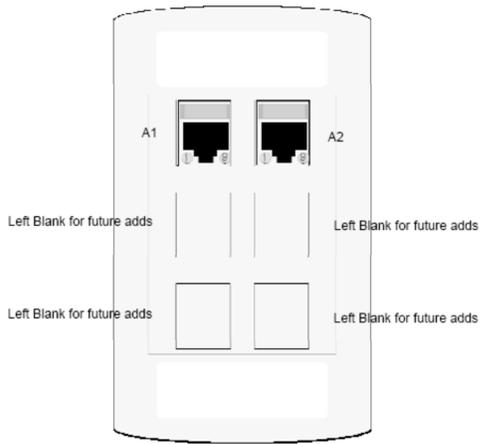
- E. Category 6 horizontal cabling shall meet or exceed the performance specifications listed in the following table when installed in a 6 connector Channel.

Guaranteed Channel Performance Specifications for 6-Connection GigaSPEED XL7 U/UTP Systems										
Freq (MHz)	Insertion Loss (dB)	NEXT (dB)	ACR (dB)	PSNEXT (dB)	PSACR (dB)	ELFEXT (dB)]	PSELFEXT (dB)	Return Loss (dB)	Delay (ns)	Delay Skew (ns)
1.0	2.1	69.0	66.9	67.5	65.4	67.3	66.3	21.0	580	30
4.0	3.9	67.0	63.2	66.0	62.1	55.2	54.2	21.0	562	30
8.0	5.4	62.2	56.7	61.1	55.7	49.2	48.2	21.0	557	30
10.0	6.1	60.6	54.5	59.5	53.4	47.3	46.3	21.0	555	30
16.0	7.7	57.2	49.5	56.1	48.4	43.2	42.2	20.0	553	30
20.0	8.7	55.6	47.0	54.4	45.8	41.2	40.2	19.5	552	30
25.0	9.7	54.0	44.3	52.8	43.1	39.3	38.3	19.0	551	30
31.25	10.9	52.4	41.5	51.2	40.3	37.4	36.4	18.5	550	30
62.5	15.8	47.4	31.6	46.1	30.3	31.3	30.3	16.0	549	30
100.0	20.4	43.9	23.5	42.6	22.1	27.3	26.3	14.0	548	30
200.0	30.3	38.8	8.5	37.4	7.1	21.2	20.2	11.0	547	30
250.0	34.5	37.1	2.6	35.7	1.2	19.3	18.3	10.0	546	30

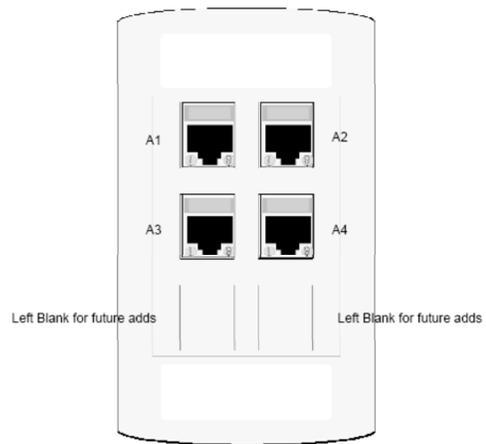
1. The table provides reference values only. All parameters comply with the governing equations over the entire frequency range.
  2. All values and equations apply to worst-case channels utilizing four-pair 71E series cables with up to 6 embedded connections in a channel for any channel lengths up to 100 meters.
- F. All horizontal cabling will be color coded for purpose
1. Blue – Data
  2. Yellow- Clinical Engineering
  3. Violet- TV
  4. Green- Nurse Call
  5. Gray- ASCOM

### 3. Execution

1. All locations should utilize 6 port faceplates to allow for growth to existing locations. Blank covers should fill unused openings.
2. Standard outlets in office and work areas will be installed according to the following color code.
  1. Ivory- standard office work station
  2. Yellow- Clinical support, patient monitoring
  3. Violet- Television
  4. Blue- to be used in areas that are shared spaces and not owned by Spectrum Health, in the case of a condo unit that is using similar color faceplates.
3. Faceplates will be configured to amount of cables indicated on the design prints and in accordance with faceplate ports numbering.
  1. 2 port locations, ports will occupy openings 1 & 2 on a 6 port faceplate. 3 port locations will occupy openings 1, 2, 3 on a 6 port faceplate.
  2. 4 ports will occupy openings 1-4 on a 6 port faceplate etc.
4. Modular furniture will utilize flex mode faceplates that are designed to support the specific furniture manufacturer, i.e. Steele Case, Haworth, Herman Miller.
5. Any changes to faceplate configuration will be up to the discretion of the TIS Telecommunications Data representative assigned to the project.



6 Port faceplate configured for 2 ports of universal use.



6 Port faceplate configured for 4 ports of universal use.

**END of SECTION**

## 1. GENERAL

### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Optical Fiber Horizontal Cabling applications called for in the Bid Documents.

### 1.2. Scope of Work

- A. This section includes the minimum requirements for Optical Fiber Horizontal Cables.
- B. At corporate, engineering, field sales offices and campus facilities, horizontal cabling to typical work area outlets (including offices, cubicles and conference rooms) shall consist of two or more strands of fiber serving each outlet.
- C. When deemed as a requirement, fiber to the desktop shall require a minimum of 4 strands of fiber. All other fiber optic applications shall be specified with a minimum 100% growth allocation.
- D. Unless otherwise stated in the Bid and/or Engineering Documents, all horizontal (to desktop) cable shall consist of OM3 or OM4 laser optimized 50/125 micrometer micron optical fibers and shall extend distance of low-cost 850 nanometer vertical cavity surface-emitting laser (VCSEL) based electronics, supporting following list of application standards.
  1. Cable shall support dual speed 1 gigabit per second/10 gigabits per second ports, allowing incremental upgrades of switches and serving with less disruption.
  2. Optical fibers shall be differential mode delay (DMD) tested using a high-resolution test bench that exceeds fiber optic test procedure (FOTP) 220 standards and independently certified by UL.
  3. The optical fiber shall couple sufficient power from light emitting diode (LED) sources to support legacy applications such as Ethernet, token ring, FDDI, Fast Ethernet, and ATM. In addition, 50 micrometer core size shall be directly compatible with laser-based applications, as follows:
    - a. Ethernet from 10 megabits per second to 10 gigabits per second
    - b. Fiber channel from 1 to 10 gigabits per second
    - c. ATM/synchronous optical networking (SONET)/synchronous digital hierarchy (SDH) from OC-1 to OC-192

### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where

“approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:

- ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,

- TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,

- ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

- ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

- NFPA 70 – National Electric Code

- BICSI – Telecommunications Distribution Methods Manual

- Bellcore, fiber distributed data interface (FDDI), and EIA standards

- ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable

- Telcordia’s Generic Requirements for Optical Fiber and Optical Fiber Cable

- Telcordia requirements for superior armored cable

- TIA/EIA-568-C.1 – Commercial Building Telecommunications Cabling Standard

- TIA/EIA-568-C.3 – Optical Fiber Cabling Components Standard

- ISO/IEC 11801 - Generic Cabling for Customer Premises

- CENELEC EN-50173 - Generic Cabling Systems

#### 1.4. Cable Construction (by Type):

- A. Listed OFNP cable: fiber buffer and cable jacket materials that have low smoke, low flame propagation characteristics that achieve a plenum rating by applicable NEC requirements.
- B. Listed OFNR cable: fiber buffer and cable jacket materials that have low smoke, low flame propagation characteristics that achieve a plenum rating by applicable NEC requirements.
- C. LSZH cable: fiber buffer and cable jacket materials that have non-halogen , low smoke, low flame propagation characteristics that achieve a OFN-LS rating by applicable NEC and IEC requirements.

#### 1.5. Submittals

Provide product data for the following:

Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

## 1.6. Coordination

Coordinate layout and installation of cable tray with other installations.

## 2. PRODUCTS

### 2.1. Indoor UL Rated, Tight Buffered Distribution Cable

- A. Basis for Design Specifications: CommScope SYSTIMAX optical fiber cable, in strand-count identified on the bid document, and with the appropriate jacket material (OFNR, OFNP or LSZH) for the global region in which the cable will be installed.
- B. Cable construction:
  - 1. Tight buffer optical fibers, aramid strength yarn, and UL rated outer jacket.
  - 2. Available in either Plenum, Riser or LSZH listing
  - 3. Sheath color-coded to optical fiber type and printed with relevant cable information on cable
- C. Approved Manufacturer: CommScope Systimax or End to End solution equivalent

Example Catalog/Manufacturer Part Number

[P-012-DS-5M-FSUAQ](#) (plenum 12f for NAR)

[N-024-DS-5K-FSUAQ](#) (24F LSZH for EMEA)

[R-006-DS-5L-FSUAQ](#) (6F Riser for APAC and CALA)

### 2.2. Indoor Armored, UL Rated, Tight Buffered Distribution Cable

- A. Basis for Design Specifications: CommScope SYSTIMAX optical fiber cable, in strand-count identified on the bid document, and with the metallic armor of the appropriate jacket material (OFNR, OFNP, LSZH) for the global region in which the cable will be installed.
- B. Cable construction:
  - 1. Tight buffer optical fibers, aramid strength yarn, and UL rated jacket.
  - 2. Interlocking armor spiraling around premises distribution style cable, with an overall sheath jacket to provide additional protection and security
  - 3. Aluminum armor
  - 4. Available in either Plenum, Riser or LSZH listing
  - 5. Sheath color-coded to optical fiber type and printed with relevant cable information on cable
- C. Approved Manufacturer: CommScope Systimax or End to End solution equivalent

Example Catalog/Manufacturer Part Number

[P-012-DZ-5M-FSUAQ](#) (plenum 12F for NAR)

[N-024-DZ-5K-FSUAQ](#) (24F LSZH for EMEA)

[R-006-DZ-5L-FSUAQ](#) (6F Riser for APAC and CALA)

2.3. OM3 Multimode Fiber Specification

- A. The OM3 Multimode Fiber SCS shall comply with the following standards
  - ISO/IEC 11801:2010
  - EN 50173-1:2011
  - EN 50173-2:2010
  - ANSI/TIA-568-C
  - IEC 60603-7-4
  - IEEE 802.3 applications as outlined in section (b)
  - Local/National Codes and Regulations

- B. The OM3 Multimode Fiber SCS shall be capable of supporting, at minimum, the following IEEE Ethernet applications:

802.3j	10BASE-F 10 Mb/s
802.3j	10BASE-FL 10 Mb/s
802.3u	100BASE-FX 100 Mb/s
802.3u	100BASE-SX 100 Mb/s
802.3z	1000BASE-SX 1000 Mb/s
802.3ae	10GBASE-SR 10Gb/s
802.3aq	10GBASE-LRM 10Gb/s with EDC
802.3ba	40GBASE-SR4 40 Gb/s
802.3ba	100GBASE-SR10 100 Gb/s

- C. Additionally the OM3 Multimode Fiber SCS shall be capable of supporting the following Fiber Channel Applications Standards, per Technical Committee 11 of INCITS:

1GFC
2GFC
4GFC
8GFC
10GFC
16GFC

- D. The multimode fibers shall fully meet or exceed the OM3 fiber specifications in:
  - EN 50173-1:2011
  - ISO/IEC 11801:2010
  - IEC/EN 60793-2-10 (A1a fiber)
  - ANSI/TIA-492AAAC standards

- E. The OM3 multimode fiber shall be manufactured with an inside vapor deposition process such as the MCVD (Modified Chemical Vapor Deposition) or PCVD (Plasma Clad Vapor Deposition) processes. Multimode fibers produced with outside vapor deposition processes, such as OVD or VAD, will not be accepted. Inside vapor deposition manufacturing processes results in superior control of Refractive Index Profile required for high bandwidth.

- F. The OM3 multimode fiber shall comply with the following physical specifications:

Cladding Diameter	125 μm
Cladding Diameter Tolerance	±1.0 μm
Cladding NonCircularity, maximum	1%
Coating Diameter (Colored)	254 μm
Coating Diameter (Uncolored)	245 μm
Coating Diameter Tolerance (Colored)	±7 μm
Coating Diameter Tolerance (Uncolored)	±10 μm
Coating/Cladding Concentricity Error, maximum	6 μm
Core Diameter	50.0 μm
Core Diameter Tolerance	±2.5 μm
Core/Clad Offset, maximum	1.5 μm
Numerical Aperture	0.200 ± 0.015
Zero dispersion wavelength	1297 – 1316 nm
Zero dispersion slope	≤ 0.105 ps/nm <sup>2</sup> -km
Maximum DMD (note: must comply with at least one of the 6 templates specified below 850 nm 1300 nm)	Meets or exceeds TIA/EIA-492AAAC-A and IEC 60793-2-10 A1a.2 See attached templates 0.89 s/m

G. The OM3 multimode fiber shall meet the following requirements:

Maximum Fiber <b>Cabled</b> Loss	3.0 dB/km at 850 nm* 1.0 dB/km at 1300 nm*
Minimum Bandwidth	2000 MHz.km at 850 nm (DMD, laser) 500 MHz.km at 1300 nm (DMD, laser) 1500 MHz.km at 850 nm (OFL) 500 MHz.km at 1300 nm (OFL)
Operating Temperature Range (cabled fiber)	-20°C to 50°C (-4°F to 122°F)*
Storage Temperature Range (cabled fiber)	0°C to 50°C (32°F to 122°F) for LSZH -40°C to 65°C (-40°F to 149°F) for others
Maximum Pulling Tension	90 kg
Minimum Tensile Strength	0.7 GPa (100,000 psi)

\* **NOTE: this value reflects cabled fiber loss. Un-cabled fiber values will not be accepted**

H. The OM3 multimode fibers shall be color coded to facilitate individual fiber identification. Color coding shall follow industry standard TIA-598-C Optical Fiber Cable Color Coding

- I. The coating shall be mechanically strippable.
- J. The OM3 fiber shall meet a minimum of one of the DMD templates listed below, accounting for the wider inner and outer mask specifications when compared with TIA 492AAAc and IEC 60793-2-10 standards:

Template	850 nm DMD-Inner Mask (ps/m) Radius from 0 to 18 μm)	850 nm DMD-Outer Mask (ps/m) Radius from 0-23 μm
1	≤ 0.23	≤ 0.70
2	≤ 0.24	≤ 0.60
3	≤ 0.25	≤ 0.50
4	≤ 0.26	≤ 0.40
5	≤ 0.27	≤ 0.35
6	≤ 0.33	≤ 0.33

- K. The OM3 multimode fiber shall be tested in accordance with:

IEC/EN 60793-1-49  
ANSI/TIA-455-220-A  
ANSI/TIA-492AAAC-A

- L. The following additional enhancements to the DMD tests must be made to ensure high bandwidth:

Enhancement to IEC/EN 60793-1-49 and ANSI/TIA-492AAAC-A standards	
Parameters	Test Requirement
Speed of Laser	5 ps pulse width
Scan Resolution (Radial Increment)	1 μm
Inner Mask Radial Coverage	0 – 18 μm (no central hole)
Number of Quadrants Tested	4 quadrants
Test Length	301 meters

- M. Third party verification of the DMD test bench must be provided with the bid response.

#### 2.4. OS2 Single-mode 8.3 micrometer Fiber

- A. The OS2 Single-mode Fiber SCS shall comply with the following standards

ISO/IEC 11801:2010  
EN 50173-1:2011  
EN 50173-2:2010  
ANSI/TIA-568-C  
IEC 60603-7-4  
IEEE 802.3 applications as outlined in section (iii)  
Local/National Codes and Regulations

- B. The OS2 optical fiber glass shall be manufactured from ultra-pure synthetic silica glass. Single-mode fibers manufactured from natural quartz will not be accepted.

- C. The OS2 Single-mode Fiber SCS shall be capable of supporting, at minimum, the following IEEE Ethernet applications:

100M	100BASE-LX10
1G	1000BASE-LH
	1000BASE-BX10
	1000BASE-LX10
	1000BASE-PX10-D
	1000BASE-PX10-U
	1000BASE-PX20-D
	1000BASE-ZX
10G	10GBASE-LR
	10BASE-LX4
	10GBASE-ER
40G	40GBASE-LR4
100G	100GBASE-LR4

- D. The OS2 single-mode Fiber SCS shall be capable of supporting the following Fiber Channel Applications Standards, per Technical Committee 11 of INCITS:

1GFC
2GFC
4GFC
8GFC
10GFC
16GFC

- E. The OS2 single-mode fibers shall fully meet or exceed the specifications in:

EN 50173-1:2011  
 ISO/IEC 11801:2010  
 IEC/EN 60793-2-50 (b1.3 fiber)  
 ANSI/TIA-492CAAB  
 ITU-T G.652.D

- F. The OS2 single-mode fiber shall comply with the following physical specifications:

Physical Characteristics	
Cladding Diameter	125.0 ± 0.7 μm
Core/Clad Offset	≤ 0.5 μm
Coating Diameter (Uncolored)	245.0 ± 10 μm
Coating Diameter (Colored)	254.0 ± 7 μm
Coating/Cladding Concentricity Error, Max.	12 μm
Clad Non-Circularity	≤ 1.0 %

- G. The OS2 single-mode fiber shall comply with the following mechanical specifications:

Mechanical Characteristics	
Proof Test	100 kpsi (0.69 Gpa)
Coating Strip Force	0.3 – 2.0 lbf (1.3 – 8.9 N)
Fiber Curl	≥ 4 m
Dynamic fatigue Parameter (nd)	≥ 18
Macrobending, Max. (100 turns)	0.05 dB (1,310/1550 nm @50mm) 0.05 dB (1,625 nm @ 60 mm)
Macrobending, Max. (1 turn @32 mm mandrel)	0.05 @1,550 nm

H. The OS2 single-mode fiber shall comply with the following mechanical specifications:

Optical Characteristics, Wavelength Specific			
	1310 nm	1385 nm	1550 nm
Max Attenuation Loose Tube Cable	0.34 dB/km	0.31 dB/km	0.22 dB/km
Max Attenuation Tight Buffer Cable	0.50 dB/km	0.50 dB/km	0.50 dB/km
Mode Field Diameter	9.2 ± 0.3 μm	9.6 ± 0.6 μm	10.4 ± 0.5 μm
Group Refractive Index	1.467	1.468	1.468
Dispersion, Max.	3.5 ps/(nm-km) from 1,285 to 1,330 nm		18 ps/(nm-km)

I. The OS2 single-mode fiber shall comply with the following optical and environmental specifications:

Optical Characteristics, General	
Points defects, Max.	0.10dB
Cut-Off Wavelength	≤ 1260
Zero Dispersion Wavelength	1,302 – 1,322 nm
Zero Dispersion Slope, max.	0.090 ps/[km-nm-nm]
Polarization Mode Dispersion Link Design Value	≤ 0.06 ps/sqrt (km)
Backscatter Coefficient	-79.6/-82.1 dB @ 1310/1550 nm
Index of Refraction	1.466/ 1.467 @ 1310/1550 nm

Environmental Characteristics	
Temperature Dependence -76°F to 185°F (-60°C to 85°C)	≤ 0.05dB
Temperature humidity Cycling 14°F to 185°F (-10°C to 85°C) up to 95% RH	≤ 0.05dB
Water Immersion, 73.4°F (23°C)	≤ 0.05dB
Heat Aging, 185°F (85°C)	≤ 0.05dB

### 3. EXECUTION

#### 3.1. Installation

- A. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
- B. Cable shall be installed following industry standard practices.
- C. Horizontal cabling shall be installed from the work area outlet location to the nearest Telecommunications Space.
- D. Horizontal cabling shall be terminated on a patch panel in the telecommunication space which is the same category rating as the Cable. i.e. Cat 6 cable terminates on Cat 6 panels.
- E. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer's specifications.
- F. Contractor shall test all horizontal links per the ANSI/TIA-568 Requirements.
- G. All wiring will in walls or soffits will be installed in 1¼ metal conduit.
- H. All exposed wiring shall be installed in metal surface raceway.
- I. All wiring above ceilings shall be installed in cable tray or open top cable hangars or "J" hooks.
- J. Cable above accessible ceilings shall be supported every 5' from cable support attached to building structure.
- K. Do not untwist cable pairs more than 0.5 in. when terminating.
- L. The contractor will be responsible for replacing all cables that do not pass Category 6 requirements.
- M. Maximum Length shall be 100 meters (295ft).
- N. Cables shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
- O. Install cable in a neat and workman like manner. Neatly bundle and tie with Velcro straps in closets.
- P. Do not install category 6 cables with more than 25 lbs. pull force as specified in EIA/TIA and BICSI practices.
- Q. Cable jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper, shall be replaced.
- R. Fire stops all openings where cable is installed through a fire barrier with a specified solution.
- S. All fire stop locations will be labeled with the specified solution, dated and photographed.
- T. Cable color will be identified by intended use of the attached equipment

- I Blue- standard network and voice support for phones, PC's, and printers.
- II Yellow- clinical support, patient monitoring.
- III Violet- Television
- IV Green- Nurse Call
- V Grey- ASCOM Wireless

**END of SECTION**

## 27 15 43 Communications Faceplates and Connectors

### 27 15 43.10 Communications Copper Jack/Information Outlets and Connectors

#### 1. GENERAL

##### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Jack/Information outlets and connections called for in the Bid Documents.

##### 1.2. Scope of Work

- A. This section includes the minimum requirements for Jack/Information outlets and Connectors.
- B. The channel performance for the installation shall meet or exceed the requirements of ANSI/TIA-568 and ISO/IEC 11801 for the specified Category.
- C. The Jack/Information outlets shall match the category of the cabling
- D. All jacks/information outlets shall meet UL 94 V-O

##### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual
  - Bellcore, fiber distributed data interface (FDDI), and EIA standards

ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant  
Communications Cable  
Telcordia's Generic Requirements for Optical Fiber and Optical Fiber Cable  
TIA/EIA-568-C .1  
TIA/EIA-568-C.2  
TIA/EIA-568-C.3  
ISO/IEC 11801  
CENELEC EN-50173

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate installation of Jack/Information outlets and connectors with other trades.

## 2. PRODUCTS

### 2.1. General

- A. All products will be compliant to RoHS 2002/95/EC
- B. All products will be designed, manufactured and/or distributed under this quality management system: ISO 9001:2008
- C. Telecommunications jacks shall be 8-position/8-conductor modular outlets accepting industry standard modular RJ45 type plugs and insulation displacement conductor (IDC) terminations.
- D. The Universal design shall support T568A and T568B wiring and shall have universal wiring labels, including color-coded insert identification labels to ensure accurate identification.
- E. Color shall be specified or selected by Owner's Representative from manufacturer's standard colors.
- F. Provide crosstalk cancellation with compensation and alien crosstalk mitigation using printed wiring board materials and compensation technology.
- G. Jack shall be backward compatible with lower category cords and cables.
- H. Low-profile wire cap shall protect against contamination and secure connection. Jacks shall be suitable for:
  - 1. Modular patching applications or as modular TO
  - 2. Installation without special faceplates at either 45- or a 90-degree angle in manufacturer's modular faceplates and frames, including those on surface-mounted boxes
- I. Dimensions
  - 1. Depth: 30.48 mm (1.20 in)

2. Height : 20.32 mm (0.80 in)
  3. Width : 20.32 mm (0.80 in)
- J. Electrical Specifications
1. Contact Resistance Variation, maximum: 20 mOhm
  2. Contact Resistance, maximum: 100 mOhm
  3. Current Rating : 1.5 A @ 20 °C, 1.5 A @ 68 °F
  4. Dielectric Withstand Voltage, RMS, conductive surface : 1500 Vac @ 60 Hz
  5. Dielectric Withstand Voltage, RMS, contact-to-contact : 1000 Vac @ 60 Hz
  6. Insulation Resistance, minimum : 500 MOhm
- K. Environmental Specifications
1. Flammability Rating: UL 94 V-0
  2. Operating Temperature: -10 °C to +60 °C (+14 °F to +140 °F)
  3. Relative Humidity : Up to 95%, non-condensing
  4. Safety Standard: cUL , UL
  5. Storage Temperature: -40 °C to +70 °C (-40 °F to +158 °F)
- L. Mechanical Specifications
1. Conductor Type: Solid, Stranded (7 strands)
  2. Material Type: Copper alloy, High-impact, flame retardant, thermoplastic
  3. Outlet/Module Contact Plating: Precious metals
  4. Plug Insertion Life, minimum: 750 times
  5. Plug Insertion Life, test plug: IEC 60603-7 compliant plug
  6. Plug Retention Force, minimum: 30 lbf, 133 N
  7. Rear Termination Contact Plating: Precious metals
  8. Rear Termination Type: IDC
  9. Wiring: T568A or T568B
  10. Can be mounted either at 90 degrees (straight) or 45 degrees (angled)
  11. Angled feature eliminates the need for special faceplates

## 2.2. Category 5 Enhanced (5e)/Class D Outlets

- A. Pair splitters and wider channel for enhance conductor placement and termination
- B. Optional Plastic Icons (M61A) and Dust Covers (M20A) available in several colors
- C. Backward compatible with Category 5 and 3 cords
- D. Approved Manufacturer:
  - a. Category 6/Class E Outlets
- A. GigaSPEED® XL MGS400 Series Category 6 U/UTP Information Outlet
- B. Electrical performance guaranteed to meet or exceed TIA/EIA 568-C.2 Category 6 and ISO/IEC Category 6/Class E specifications.
- C. Optional Plastic Icons (M61A) and Dust Covers (M20A) available in several colors
- D. Backward compatible with Category 5e, 5 and 3 cords and cables, however optimal performance achieved when used with GigaSPEED XL GS8E patch cords.

- E. Can support network line speeds in excess of 1 gigabit per second.
- F. Qualifies for a 20-year product and applications assurance warranty when included as part of a certified SYSTIMAX GigaSPEED XL channel.
- G. Approved Manufacturer: Commscope Systimax or End to End solution equivalent.

### 2.3. Installation

- A. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
- B. Jack/Information outlets and Connectors shall be installed following industry standard practices.
- C. Horizontal cabling shall be terminated on a Jack/Information outlet which is the same category rating as the Cable. i.e. Cat 6 cable terminates on Cat 6 Jack/Information outlets.
- D. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer's specifications.
- E. Contractor shall test all horizontal links per the ANSI/TIA-568 Requirements.

**END of SECTION**

## 27 15 43.15 Communications Fiber Connectors, Adapters and Adapter Panels

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Fiber Connectors, Adapters and Adapter Panels called for in the Bid and Engineering Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for Fiber Connectors, Adapters and Adapter Panels.
- B. The performance for the installation shall meet or exceed the requirements of ANSI/TIA-568 and ISO/IEC 11801 and other requirements as noted in this specification for the specified Fiber Type.
- C. The connectors and adapters shall match the fiber type of the cabling
- D. All connectors and adapters shall meet UL 94 V-O

#### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual
  - Bellcore, fiber distributed data interface (FDDI), and EIA standards

ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable  
Telcordia's Generic Requirements for Optical Fiber and Optical Fiber Cable  
TIA/EIA-568-C.3 – Optical Fiber Cabling Components Standard  
ISO/IEC 11801 - Generic Cabling for Customer Premises  
CENELEC EN-50173 - Generic Cabling Systems

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate installation of Jack/Information outlets and connectors with other trades.

## 2. PRODUCTS

### 2.1. General

- A. All products will be:
  - 1. Compliant to RoHS 2002/95/EC
  - 2. Designed, manufactured and/or distributed under this quality management system: ISO 9001:2008

### 2.2. LC Fiber Adapters

- A. Multimode adapter for use with 62.5/125 OM1 Fiber
  - 1. Color – Beige
  - 2. Alignment Sleeve Material - Phosphorous bronze
  - 3. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)
    - a. Multimode adapter for use with 50/125 OM2+,OM3 and OM4 Fiber
  - 1. Color – Aqua
  - 2. Alignment Sleeve Material - Phosphorous bronze
  - 3. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)
    - a. Single-mode adapter for use with G.652.D or G.652.D, OS2 fiber
  - 1. Color – Blue
  - 2. Alignment Sleeve Material - Zirconia
  - 3. Approved Manufacturer  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)

B. Keyed Hybrid adapter for use with Single-mode or Multimode Keyed Connectors

1. Color – per key
2. For use with Keyed connectors only
3. Offer a tamper-proof design, reducing the chance of unauthorized connections.
4. Ten connector-adapter combinations must exist, identified by color
5. The connector and adapter colors must match for a connection to be possible
6. Alignment Sleeve Material - Zirconia
7. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters)

- a. CommScope SYSTIMAX
  - [KFA-LC02-KRD 760057216 LC Duplex Keyed Adapter, Red, Single Pack](#)
  - [KFA-LC02-KVI 760090662 LC Duplex Keyed Adapter, Violet, Single Pack](#)

### 2.3. LC Fiber Connectors

A. Multimode Connector for use with OM1, OM2+, OM3 and OM4 fiber

1. Color – Beige
2. Ferrule Geometry - Pre-radiused
3. Ferrule Material - Zirconia
4. Performance meets or exceeds ANSI/TIA/EIA-568-C.3 standard
5. Insertion Loss, typical - 0.17 dB
6. Return Loss, minimum - 20.0 dB
7. Insertion Loss Change, mating - 0.30 dB
8. Insertion Loss Change, temperature - 0.30 dB
9. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

- a. CommScope SYSTIMAX
  - [MFC-LCR-16-BG 760034140 LC Connector simplex for 1.6 mm Fiber Cordage, multimode](#)
  - [MFC-LCR-09-BG 760034181 Behind The Wall LC Connector for 0.9 mm Buffered Fiber, multimode](#)
  - [MDC-LCR-16-BG 760034157 Pre-Radiused LC Duplex Connector for 1.6 mm Fiber Cordage, multimode](#)

B. Single-mode Connector for use with G.652.D or G.652.D, OS2 fiber

1. Color – Blue
2. Ferrule Geometry - Pre-radiused
3. Ferrule Material - Zirconia
4. Performance meets or exceeds ANSI/TIA/EIA-568-C.2 standard
5. Insertion Loss, typical - 0.20 dB
6. Return Loss, minimum - 55.0 dB

7. Insertion Loss Change, mating - 0.30 dB
8. Insertion Loss Change, temperature - 0.30 dB
9. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

a. CommScope SYSTIMAX

[SFC-LCR-16-BL 760034173](#) Pre-Radiused LC Connector simplex for 1.6 mm Fiber Cordage

[SFC-LCR-09-BL 760034199](#) Behind The Wall Pre-Radiused LC Connector for 0.9 mm Buffered Fiber

[SDC-LCR-16-BL 760091439](#) Pre-Radiused LC Connector duplex for 1.6 mm Fiber Cordage

C. Keyed Multimode Connector for use with OM1, OM2+, OM3 and OM4 fiber

1. Color – per key
2. For use with Keyed adapters
3. Offer a tamper-proof design, reducing the chance of unauthorized connections.
4. Ten connector-adapter combinations must exist, identified by color
5. The connector and adapter colors must match for a connection to be possible
6. Ferrule Geometry - Pre-radiused
7. Ferrule Material - Zirconia
8. Performance meets or exceeds ANSI/TIA/EIA-568-C.3 standard
9. Insertion Loss, typical - 0.17 dB
10. Return Loss, minimum - 20.0 dB
11. Insertion Loss Change, mating - 0.20 dB
12. Insertion Loss Change, temperature - 0.30 dB
13. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

a. CommScope SYSTIMAX

[MFC-LCR-16-KBR 760102384](#) Keyed LC Connector for 1.6 mm Fiber Cordage, multimode, brown

[MFC-LCR-09-KBR 760102608](#) Behind The Wall Keyed LC Connector for 0.9mm Fiber Cordage, multimode, brown

D. Keyed Single-mode Connector for use with G.652.D or G.652.D, OS2 fiber

1. Color – per key
2. For use with Keyed adapters
3. Offer a tamper-proof design, reducing the chance of unauthorized connections.
4. Ten connector-adapter combinations must exist, identified by color

5. The connector and adapter colors must match for a connection to be possible
6. Ferrule Geometry - Pre-radiused
7. Ferrule Material - Zirconia
8. Performance meets or exceeds ANSI/TIA/EIA-568-C.2 standard
9. Insertion Loss, typical - 0.20 dB
10. Return Loss, minimum - 55.0 dB
11. Insertion Loss Change, mating - 0.30 dB
12. Insertion Loss Change, temperature - 0.30 dB
13. Approved Manufacturer:

(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

a. CommScope SYSTIMAX

[SFC-LCR-16-KAQ 760102699](#) Pre-Radiused Keyed LC Connector for 1.6 mm Fiber Cordage, simplex single-mode, aqua

[SFC-LCR-16-KRO 760102707](#) Pre-Radiused Keyed LC Connector for 1.6 mm Fiber Cordage, simplex single-mode, rose

E. LC Connectors with mechanical splice

1. Color coded per industry standard requirements to aide in identification during and after installation
2. Factory pre-polished for field installation
3. Mechanical splice technology
4. Must include a factory pre-cleaved fiber stub and a proprietary index-matching gel
5. Options for singlemode and multimode fibers
6. Compatible with 250µm and 900µm optical fibers
7. Performance exceeds ANSI/TIA/EIA-568-C.2 standard
8. Complete tool kit with cleaning solution, wipes, and scrap fiber container designed for quick setup and tear-down
9. Factory-installed wedge clip shall be included with each connector; wedge is discarded upon completion of the termination
10. Translucent wedge shall enable the use of a common VFI to provide a "pass/fail" signal once physical contact is achieved
11. Capability to be re-terminated if the first installation fails
12. Shall not require a custom termination kit
13. Approved Manufacturer:

(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

a. CommScope

[MFC-LCF-09-5X 760117887](#) LazrSPEED Fiber Qwik II-LC Connector™, Aqua. Fiber Types: OM2+, OM3, OM4.1 per pack

[MFC-LCF-09-5X-25 760117911](#) LazrSPEED Fiber Qwik II-LC Connector, Aqua. Fiber Types: OM2+, OM3, OM4. 25 per pack

SFC-LCF-09-8X [760117895](#) TeraSPEED Fiber Qwik II-LC Connector™, Blue  
Fiber Types: G.652.D, G.657.A1 or G.652.D, G.657.A1 | OS2. 1 per pack

SFC-LCF-09-8X-25 [760117929](#) TeraSPEED Fiber Qwik II-LC Connector, Blue  
Fiber Types: G.652.D, G.657.A1 or G.652.D, G.657.A1 | OS2. 25 per pack

MFC-LCF-09-6X [760117903](#) OptiSPEED Fiber Qwik II-LC Connector™, Beige  
Fiber Type: OM1. 1 per pack

MFC-LCF-09-6X-25 [760117937](#) OptiSPEED Fiber Qwik II-LC Connector™,  
Beige Fiber Type: OM1. 25 per pack

## 2.4. SC Fiber Adapters

- A. Multimode adapter for use with 62.5/125 OM1 Fiber
  - 1. Color – Beige
  - 2. Alignment Sleeve Material - Phosphorous bronze
  - 3. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)
    - a. Multimode adapter for use with 50/125 OM2+,OM3 and OM4 Fiber
      - 1. Color – Aqua
      - 2. Alignment Sleeve Material - Phosphorous bronze
      - 3. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)
        - a. Single-mode adapter for use with G.652.D or G.652.D, OS2 fiber
          - 1. Color – Blue
          - 2. Alignment Sleeve Material - Zirconia
          - 3. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper adapters and connectors)

## 2.5. SC Fiber Connectors

- A. Multimode Connector for use with OM1, OM2+, OM3 and OM4 fiber
  - 1. Color – Beige
  - 2. Ferrule Geometry - Pre-radiused
  - 3. Ferrule Material - Zirconia
  - 4. Performance meets or exceeds ANSI/TIA/EIA-568-C.3 standard
  - 5. Insertion Loss, typical - 0.30 dB
  - 6. Return Loss, minimum - 20.0 dB
  - 7. Insertion Loss Change, mating - 0.30 dB
  - 8. Insertion Loss Change, temperature - 0.30 dB
  - 9. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see

CommScope representative for assistance in selecting the proper connectors)

a. CommScope SYSTIMAX

[MFC-SCR-30-BG 760007047](#) SC Connector simplex for 3.0 mm Fiber Cordage, multimode

[MFC-SCR-09-BG 760007070](#) Behind The Wall LC Connector for 0.9 mm Buffered Fiber, multimode

[MDC-SCR-30-BG 760112284](#) Pre-Radiused LC Duplex Connector for 3.0 mm Fiber Cordage, multimode

B. Single-mode Connector for use with G.652.D or G.652.D, OS2 fiber

1. Color – Blue
2. Ferrule Geometry - Pre-radiused
3. Ferrule Material - Zirconia
4. Performance meets or exceeds ANSI/TIA/EIA-568-C.2 standard
5. Insertion Loss, typical - 0.30 dB
6. Return Loss, minimum - 55.0 dB
7. Insertion Loss Change, mating - 0.30 dB
8. Insertion Loss Change, temperature - 0.30 dB
9. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)

a. CommScope SYSTIMAX

[SFC-SCR-30-BL 760007096](#) Pre-Radiused SC Connector simplex for 3.0 mm Fiber Cordage

[SFC-SCR-09-BL 760007112](#) Behind The Wall Pre-Radiused SC Connector for 0.9 mm Buffered Fiber

[SDC-SCR-30-BL 760112326](#) Pre-Radiused SC Connector duplex for 3.0 mm Fiber Cordage

C. SC Connectors with mechanical splice

1. Color coded per industry standard requirements to aide in identification during and after installation
2. Factory pre-polished for field installation
3. Mechanical splice technology
4. Must include a factory pre-cleaved fiber stub and a proprietary index-matching gel
5. Options for singlemode and multimode fibers
6. Compatible with 250µm and 900µm optical fibers
7. Performance exceeds ANSI/TIA/EIA-568-C.2 standard
8. Complete tool kit with cleaning solution, wipes, and scrap fiber container designed for quick setup and tear-down
9. Factory-installed wedge clip shall be included with each connector; wedge is discarded upon completion of the termination

10. Translucent wedge shall enable the use of a common VFI to provide a "pass/fail" signal once physical contact is achieved
11. Capability to be re-terminated if the first installation fails
12. Shall not require a custom termination kit
13. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper connectors)
  - a. CommScope

MFC-SCF-09-5X [760117945](#) LazrSPEED Fiber Qwik II-SC Connector, Aqua. Fiber Types: OM2+, OM3, OM4. 1 per pack

MFC-SCF-09-5X-25 [760117978](#) LazrSPEED® Fiber Qwik II-SC Connector, Aqua. Fiber Types: OM2+, OM3, OM4. 25 per pack

SFC-SCF-09-8X [760117952](#) TeraSPEED Fiber Qwik II-SC Connector, Blue Fiber Types: G.652.D, G.657.A1 or G.652.D, G.657.A1 | OS2. 1 per pack

SFC-SCF-09-8X-25 [760117986](#) TeraSPEED Fiber Qwik II-SC Connector, Blue Fiber Types: G.652.D, G.657.A1 or G.652.D, G.657.A1 | OS2. 25 per pack

MFC-SCF-09-6X [760117960](#) OptiSPEED Fiber Qwik II-SC Connector, Beige Fiber Type: OM1. 1 per pack

MFC-SCF-09-6X-25 [760117994](#) OptiSPEED Fiber Qwik II-SC Connector, Beige Fiber Type: OM1. 25 per pack

### 3. EXECUTION

#### 3.1. Installation

- A. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
- B. Fiber Connectors, Adapters and Adapter Panels shall be installed following industry standard practices.
- C. Horizontal cabling shall be terminated on a Fiber Connectors, Adapters and Adapter Panels which is designed for the fiber type of the cable. i.e. Singlemode cable terminates on Singlemode Connectors and Adapters.
- D. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer's specifications.
- E. Contractor shall test all horizontal links per the Relevant Standards and Requirements.

**END of SECTION**

## 27 15 43.20 Multimedia audio/video connectors and adapters

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all audio/video connectors and adapters called for in the Bid Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for audio/video connectors and adapters.
- B. The performance for the installation shall meet or exceed the requirements of ANSI/TIA-568 and ISO/IEC 11801 for the specified Category.
- C. The audio/video connectors and adapters shall match the type of cabling installed.
- D. All audio/video connectors and adapters shall meet UL 94 V-O

#### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual
  - TIA/EIA-568-C.1 – Commercial Building Telecommunications Cabling Standard

TIA/EIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards  
TIA/EIA-568-C.3 – Optical Fiber Cabling Components Standard  
ISO/IEC 11801 - Generic Cabling for Customer Premises  
CENELEC EN-50173 - Generic Cabling Systems

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate installation of Jack/Information outlets and connectors with other trades.

### 2. PRODUCTS

#### 2.1. General

- A. All products will be:
  - 1. Compliant to RoHS 2002/95/EC
  - 2. Designed, manufactured and/or distributed under this quality management system: ISO 9001:2008

### 3. EXECUTION

#### 3.1. Installation

- A. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
- B. Jack/Information outlets and Connectors shall be installed following industry standard practices.
- C. Horizontal cabling shall be terminated on a Jack/Information outlet which is the same category rating as the Cable. i.e. Cat 6 cable terminates on Cat 6 Jack/Information outlets.
- D. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer's specifications.
- E. Contractor shall test all horizontal links per the ANSI/TIA-568 Requirements.

**END of SECTION**

## 27 15 43.25 Work Area Faceplate/Wall Plates and Surface Mount Boxes

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Faceplate/wall plates and Surface mount Boxes called for in the Bid Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for Faceplate/wall plates and Surface mount Boxes.
- B. All Faceplates and Surface Mount boxes shall be constructed of high-impact, flame retardant; UL rated 94 V-0 Thermoplastic.
- C. Faceplates and SMB shall be designed to accept the CommScope SYSTIMAX information outlets.
- D. Number of outlets per faceplate shall be as detailed on the Telecommunications Drawings.

#### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

TIA/EIA-568-C.1 – Commercial Building Telecommunications Cabling Standard  
TIA/EIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards  
TIA/EIA-568-C.3 – Optical Fiber Cabling Components Standard  
ISO/IEC 11801 - Generic Cabling for Customer Premises  
CENELEC EN-50173 - Generic Cabling Systems

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate installation of Faceplate/wall plates and Surface mount Boxes with other trades.

## 2. PRODUCTS

### 2.1. Faceplates and Surface Mount Boxes (SMB)

A. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper faceplates and SMBs)

a. CommScope

[M13FP-262](#) – Single Gang Flexible Frame White  
[M30FP-2RJ45-262](#) – Double port adapter for Flexible frame white  
[M30FP-BLANK-262](#) – Double Blank adapter for Flexible Frame white  
[M102SMB-B-262](#) – 2 port surface mount box white  
[M104SMB-B-262](#) – 4 port surface mount box white  
[630B8](#) – Stainless Steel wall Phone jack (T-568B)  
[M81LS-LS](#) – 4 port faceplate for LC M81LS-XX fiber spools

### 2.2. Dust Covers for Faceplates and Surface Mount Boxes (SMB)

A. Dust Covers shall be dual purpose blank covers designed for use with modular outlets and faceplates. They shall be used to cover the outlet opening of all empty faceplate openings and unpopulated jacks to protect the wires from collecting dust.

B. Approved Manufacturer:  
(Following Catalog Number/Part numbers are provided as examples, see CommScope representative for assistance in selecting the proper faceplates and SMBs)

a. CommScope

M20AP-246 [107067860](#) Ivory cover for empty faceplate openings

M21A-246 [108066457](#) Ivory cover for unpopulated jacks

### 3. EXECUTION

#### 3.1. Installation

1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
2. Faceplate/wall plates and Surface mount Boxes shall be installed following industry standard practices.
3. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer's specifications.
4. Contractor shall test all horizontal links per the ANSI/TIA-568 Requirements.

**END of SECTION**

**27 16 00 Communications Connecting Cords, Devices and Adapters**

**27 16 19 Communications Patch Cords, Station Cords, and Cross-Connect Wire**

**27 16 19.02 Copper Patch Cords**

**1. GENERAL**

**1.1. Work Includes**

Provide all labor, materials, and equipment for the complete installation of all Copper Patchcords into the approved patch panels called for in the Bid Documents.

**1.2. Scope of Work**

- A. This section includes the minimum requirements for Copper Patch Cords.
- B. All Patch/Equipment Cords shall be new.
- C. On new installations, Patch/Equipment Cords shall be made by the same manufacturer as the Horizontal Cable used in the new installation.
- D. Patch/Equipment Cords shall be available in multiple colors. Colors required are to be detailed in the Bid Documents.
- E. All Patch/Equipment Cords shall be factory manufactured and tested for compliance to the appropriate standards and performance.
- F. Patch/Equipment Cord length shall be determined by the end user.
- G. Patch/Equipment Cords shall be installed using proper cable management.
- H. Minimum bend radius shall not be exceeded.

**1.3. Quality Assurance**

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:

ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,

TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,  
ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings  
ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications  
NFPA 70 – National Electric Code  
BICSI – Telecommunications Distribution Methods Manual  
ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable  
Telcordia, GR-20-CORE, Generic Requirements for Optical Fiber and Optical Fiber Cable

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate layout and installation of Patch/Equipment Cords with other trades.

## 2. PRODUCTS

### 2.1. Category 5 Enhanced (5e) Cords

- A. The Modular Patch Cords shall meet or exceed Attenuation and NEXT Category 5 and Category 5e specifications for patch cords as specified in ISO/IEC 11 801, CENELEC, EN50173 and ANSI/TIA-568-C.2.
  - 1. Approved Manufacturer:  
(The following Catalog/Part number is shown as an example, contact your CommScope Representative to specify correct Catalog/Part numbers)
- B. The IDC Patch Cords shall meet or exceed Attenuation and NEXT Category 5 and Category 5e specifications for patch cords as specified in ISO/IEC 11 801, CENELEC, EN50173 and ANSI/TIA-568-C.2.
  - 1. Approved Manufacturer:  
(The following Catalog/Part numbers are shown as examples, contact your CommScope Representative to specify correct Catalog/Part numbers)

### 2.2. Category 6 /Class E Patch Cords

- A. The Modular Patch Cords shall meet or exceed TIA ANSI/TIA-568-C.2 Category 6 and ISO/EIC Category 6/Class E specifications and shall be fully backward compatible with Category 5e and 5 connectors.
  - 1. Approved Manufacturer:  
(The following Catalog/Part numbers are shown as examples, contact your CommScope Representative to specify correct Catalog/Part numbers)

- B. The IDC Patch Cords shall meet or exceed TIA ANSI/TIA-568-C.2 Category 6 and ISO/EIC Category 6/Class E specifications and shall be fully backward compatible with Category 5e and 5 connectors.
  - 1. Approved Manufacturer:  
(The following Catalog/Part numbers are shown as examples, contact your CommScope Representative to specify correct Catalog/Part numbers)

### 3. EXECUTION

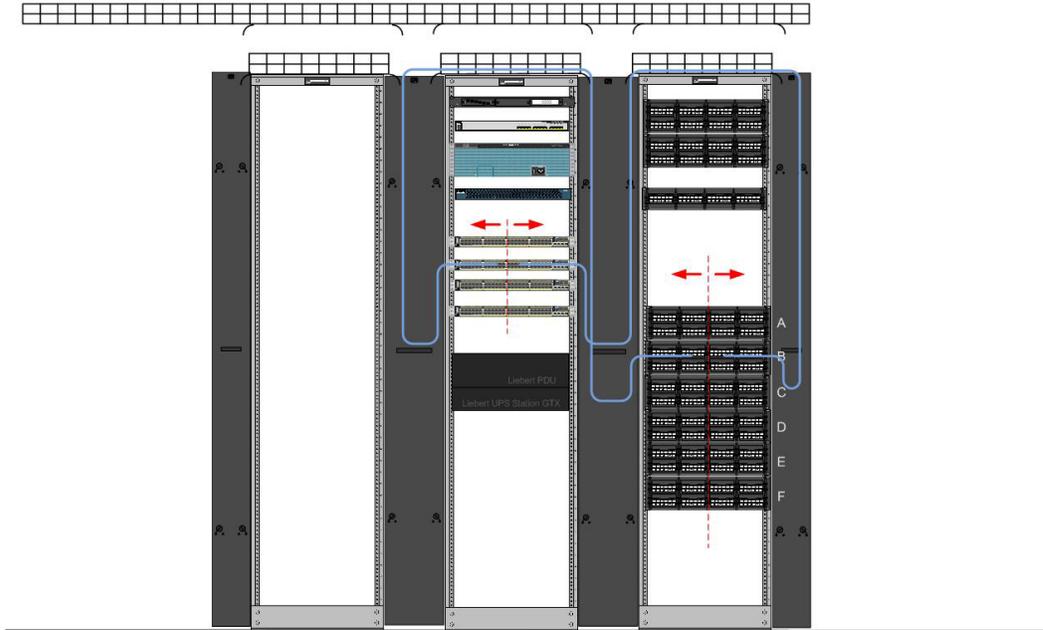
#### 3.1. Installation

- A. Copper Jumpers/patch cables
  - 1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
  - 2. Cable shall be installed following industry standard practices.
  - 3. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for copper cables per manufacturer's specifications.
  - 4. All installations shall comply with:
    - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
    - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
    - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
    - NFPA 70 – National Electric Code
    - BICSI – Telecommunications Distribution Methods Manual
- B. Patch cords will identify use in the closet by the following colors:
  - Blue: Data communications
  - Black: Analog/TDM voice communications
  - Gray: Ascom Communications
  - Yellow: Clinical Engineering /Patient Monitoring
  - Violet: TV/Entertainment services
  - Red: Crossover Data cable
  - Green: Nurse Call
- C. Patch Cords use at the end user stations will identify use by the following colors:
  - Gray: Peripheral equipment, PC, Printer, Phone
  - Yellow: Clinical Engineering /Patient Monitoring
  - Violet: TV/Entertainment services
  - Black: TDM/Analog Phones

- D. Patch cords will be run in a uniform manner by dividing each patch panel down the middle as outline in Drawing 1.1.

### Drawing 1.1

EXP-MDF		Floor		Spectrum Health Site Name		Date	Approval Pending
				MDF Rack Design			



Picture 1.1 Rack Patching.



Picture 2.1 Switch Patching



**END of SECTION**

## 27 16 19.03 50 Micron Multimode Optical Fiber Cords and Pigtails

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all 50 Micron Multimode Optical Fiber Cords and Pigtails into the approved patch panels called for in the Bid Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for Fiber Patch Cords.
- B. All Patch/Equipment Cords shall be new.
- C. On new installations, Patch/Equipment Cords shall be made by the same manufacturer as the Horizontal Cable used in the new installation.
- D. Patch/Equipment Cords shall be available in multiple colors. Colors required are to be detailed in the Bid Documents.
- E. All Patch/Equipment Cords shall be factory manufactured and tested for compliance to the appropriate standards and performance.
- F. Patch/Equipment Cord length shall be determined by the end user.
- G. Patch/Equipment Cords shall be installed using proper cable management.
- H. Minimum bend radius shall not be exceeded.

#### 1.3. Quality Assurance

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,

ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings  
ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications  
NFPA 70 – National Electric Code  
BICSI – Telecommunications Distribution Methods Manual  
ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable  
Telcordia, GR-20-CORE, Generic Requirements for Optical Fiber and Optical Fiber Cable

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

#### 1.5. Coordination

Coordinate layout and installation of Fiber Cords and Pigtails with other trades.

## 2. PRODUCTS

### 2.1. Optical Fiber Patch Cords and Pigtails

To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords and pigtails shall be available with the following options as indicated on the bid document.

### 2.2. Termination types:

- A. LC Patch cord outside diameters:
  - 1. Simplex: 1.6 mm (0.063 in)
  - 2. Duplex: 1.6 mm x 3.3 mm (0.063 in x 0.130 in)
  - 3. Pigtails: Ruggedized and tight-buffered optical fiber, 0.9 mm (0.035 in) outside diameter
- B. SC and ST Patch cord outside diameters:
  - 1. Simplex: 3.0 mm (0.118 inches)
  - 2. Duplex: 3.0 mm x 5.9 mm (0.063 in x 0.232 in)
  - 3. Pigtails: Ruggedized and tight-buffered optical fiber, 0.9 mm (0.035 in) outside diameter
- C. Lengths: As specified in the bid document
- D. Basis for Design Specifications: CommScope SYSTIMAX LazrSPEED 550 multimode optical fiber, with the appropriate jacket material (OFNR or OFNP) for

the pathway in which the cable will be routed. NOTE: All CommScope 50 micron optical jumpers are constructed using OM4 fiber.

E. Approved Manufacturer

1. CommScope SYSTIMAX

Example Catalog/Manufacturer Part Number (Note: contact CommScope Representative for assistance for construction of Trunk Catalog/Part numbers.)

[FEXLCLC42-MXMxxx](#)– A 2 fiber optic jumper, riser, LazrSPEED 550 Multimode glass with LC connectors on both ends. Substitute xxx in part number with actual length in meters.

### 3. EXECUTION

#### 3.1. Installation

A. Fiber Optic Jumpers/patch cables

1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
2. Cable shall be installed following industry standard practices.
3. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for fiber cables per manufacturer's specifications.
4. All installations shall comply with:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code
  - BICSI – Telecommunications Distribution Methods Manual

**END of SECTION**

## 27 16 19.05 Single-mode Optical Fiber Cords and Pigtails

### 1. GENERAL

#### 1.1. Work Includes

Provide all labor, materials, and equipment for the complete installation of all Single-Mode Optical Fiber Cords and Pigtails into the approved patch panels called for in the Bid Documents.

#### 1.2. Scope of Work

- A. This section includes the minimum requirements for Fiber Patch Cords.
- B. All Patch/Equipment Cords shall be new.
- C. On new installations, Patch/Equipment Cords shall be made by the same manufacturer as the Horizontal Cable used in the new installation.
- D. Patch/Equipment Cords shall be available in multiple colors. Colors required are to be detailed in the Bid Documents.
- E. All Patch/Equipment Cords shall be factory manufactured and tested for compliance to the appropriate standards and performance.
- F. Patch/Equipment Cord length shall be determined by the end user.
- G. Patch/Equipment Cords shall be installed using proper cable management.
- H. Minimum bend radius shall not be exceeded.

#### 1.3. Quality Assurance

- I. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- J. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- K. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- L. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
  - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
  - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
  - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - NFPA 70 – National Electric Code

BICSI – Telecommunications Distribution Methods Manual  
ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant  
Communications Cable  
Telcordia, GR-20-CORE, Generic Requirements for Optical Fiber and Optical  
Fiber Cable

#### 1.4. Submittals

Provide product data for the following:  
Manufacturers cut sheets, specifications and installation instructions for all  
products (submit with bid).

#### 1.5. Coordination

Coordinate layout and installation of Fiber Cords and Pigtailed with other trades.

## 2. PRODUCTS

### 2.1. Optical Fiber Patch Cords and Pigtailed

To maintain channel integrity, optical fiber patch cords and pigtailed shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords and pigtailed shall be available with the following options as indicated on the bid document.

### 2.2. Termination types:

- M. LC Patch cord outside diameters:
  - 1. Simplex: 1.6 mm (0.063 in)
  - 2. Duplex: 1.6 mm x 3.3 mm (0.063 in x 0.130 in)
  - 3. Pigtailed: Ruggedized and tight-buffered optical fiber, 0.9 mm (0.035 in) outside diameter
- N. SC and ST Patch cord outside diameters:
  - 1. Simplex: 3.0 mm (0.118 inches)
  - 2. Duplex: 3.0 mm x 5.9 mm (0.063 in x 0.232 in)
  - 3. Pigtailed: Ruggedized and tight-buffered optical fiber, 0.9 mm (0.035 in) outside diameter
- O. Lengths: As specified in the bid document
- P. Basis for Design Specifications: CommScope SYSTIMAX TeraSPEED Single-mode optical fiber, with the appropriate jacket material (OFNR or OFNP) for the pathway in which the cable will be routed.
- Q. Approved Manufacturer  
Example Catalog/Manufacturer Part Number (Note: contact CommScope Representative for assistance for construction of Trunk Catalog/Part numbers.)
  - 1. CommScope

[FEWLCLC42-JXMxxx](#) – A 2 fiber optic jumper, riser, TeraSPEED Single mode glass, with LC connectors on both ends. Substitute xxx in part number with actual length in meters. part number with actual length in meters.

### 3. EXECUTION

#### 3.1. Installation

- R. Fiber Optic Jumpers/patch cables
1. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.
  2. Cable shall be installed following industry standard practices.
  3. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for fiber cables per manufacturer's specifications.
  4. All installations shall comply with:
    - ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
    - TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
    - ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    - ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
    - NFPA 70 – National Electric Code
    - BICSI – Telecommunications Distribution Methods Manual

**END of SECTION**

## 27 52.13 Patient Monitoring and Telemetry Communications Horizontal Cabling

### 1.1 Summary

#### Scope:

1. Patient monitoring and telemetry communications horizontal cabling is defined as horizontal cabling that supports life monitoring systems that are directly related to the care and support of the patient.
2. Patient related cabling will be installed according to the specifications provided by a certified vendor and in accordance with the FDA testing and approvals.

### 1.2 Quality Assurance

1. Quality assurance will be supported by selected equipment manufacturer representatives.
2. All documentation supporting manufacturer specifications will be supplied to the cabling installer prior to the start of the project.
3. The cabling vendor will be responsible to coordinate with the equipment representatives to meet any installation milestones or benchmarks for certification.

### 1.3 Submittals.

1. Submittals are based on the design considerations and specifications of the manufacturer provided information.

### 1.4 Execution

1. Installation of cabling for patient monitoring and telemetry systems will be installed in accordance with the requirements previously identified in this document for horizontal cabling.
2. Manufacturer's specifications will be followed in the event the specifications supersede Spectrum Health practices.
3. Patient monitoring UTP cable will be terminated on its own patch panel in the TIS closet.
4. UTP cabling will be identified as yellow in color.

**END of SECTION**

## 27 51 13.13 Paging Communications Horizontal Cabling

### 1.1 Summary

#### Scope:

1. Paging communications may be referred to as a public address system, and may be used for voice messages, and life safety.
2. Noise masking will also be included in the public address system to provide an artificial sound barrier for privacy in an open office environment, or check in/check out area.

### 1.2 Quality assurance

1. Quality will be assessed and measured by the overall adjustment to the system to audibly hear and understand announcements and warnings.
2. Sound masking will be measured on its ability mask ambient noise without impacting staff and patients who are trying to communicate within the confines of their designated areas.

### 1.3 Submittals

1. Manufacturers design specifications will be submitted for review of technical information and compatibility with existing phone systems.

### 1.4 Execution

1. Installation of a public address system will be based on a centrally amplified 70V system.
2. Install shielded 18 AWG two conductor cable for speaker backbone cabling.
3. Speaker placement will be based on 55db ambient noise in office and clinical areas. Anything below 70db placement will be placed at a distance of twice the ceiling height.
4. Speaker installation will require supporting back braces for ceiling tiles.
5. Baffles may be required to suppress ambient levels above the ceiling.

**End of Section**

## 27 52 23 Nurse Call and Intercom Communications Horizontal Cabling

### General

#### 1.1 Summary

##### Scope:

1. Nurse call will be installed in a similar manner as horizontal cabling. This is a serial based system and will be chained in series. The system will be built according to design from ICOMM Corporation.
2. This section will include the minimum requirements for the following.
  - I Category 5E UTP cable
  - II RJ 45 Category 5E terminations
  - III Category 3 UTP 2 & 3 pair cable for serial communications.

#### 1.2 Quality Assurance

1.3 Nurse call quality assurance will be monitored by ICOMM.

1.4 ICOMM Corporation will supply all documentation to cabling vendor for installation procedures.

#### 1.5 Submittals

5. Submittals will be in accordance with specified materials identified by Rauland Nurse Call systems and ICOMM

#### 1.6 Execution

##### Nurse Call:

1. Contractor will supply and install Category 5E cable according to riser diagrams provided by ICOMM Corporation.
2. All Nurse Call cable will be green in color.
3. Category 5E cable will be run and supported every 5ft. by "J" hooks, or in cable tray.
4. Category 5E cable will be routed from identified telecommunication room to locations identified on riser diagram and coiled.
5. ICOMM Corporation will be responsible for terminations per installation guidelines of Rauland Nurse Call systems.

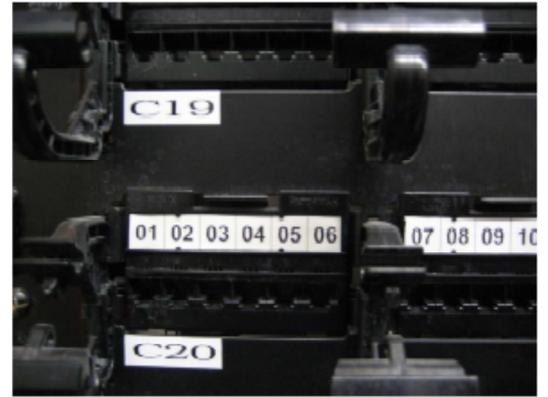
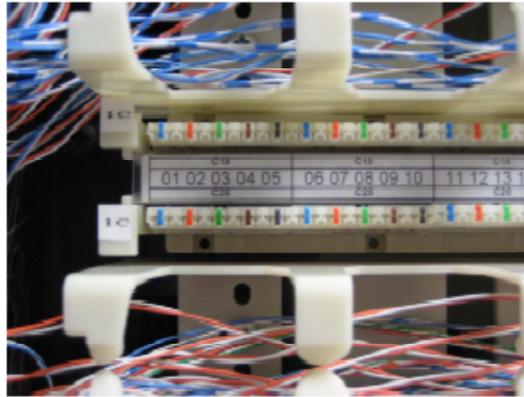
1. ASCOM cabling will be gray cable to the radios and attached to its own patch panel in the closet.



2. A dedicated 50 pair will be run to each closet from the PBX or MDF and terminated to its own patch panel with two pair per port, terminated on the Blue and Green pair.



3. Feed panels will be labeled with a trunk identifier that matches the same feed location on the 110 punch field in the MDF.



**END of SECTION**

## 28 0000 Electronic Safety and Security

### 28 1000 Access Control

This section is located in Division 28, but will be addressed here for low voltage requirements per Spectrum Health's needs.

#### Part 1 General

##### 1.1 Scope Summary

- A. Access Control systems will refer to secure doorways with limited access by SH employee ID badge. Access will be determined by supervisor's requirements.

##### 1.2 Quality Assurance

- A. Design will provide and properly labeled by Knight Watch Inc.
- B. Cables will be routed, and labeled by specifications provided by Knight Watch Inc.
- C. Cables will be routed in low voltage cable trays and pathways.
- D. Any cable not properly identified will be traced at cabling vendors expense.

##### 1.3 Submittals

- A. Knight Watch Inc. will provide all designs, specification documents to cable vendor prior to start of the project, including drawings with location id labeled on the print.
- B. Any communications between cabling vendor and Knight Watch will be copied to Spectrum Health project management.
- C. Notification to any construction schedule will be verified by Spectrum Health project management staff to coordinate priorities and resources.

#### Part 2 Products

- 2.1 See Section 28 1300 for details of products.

#### Part 3 Execution

##### 3.1 Installation:

- A. Route Belden 558AFS (658GMS for plenum environments) Composite access control cable or equivalent to each door location.
- B. Route white casing 22/2 cable to door contact.
- C. Route blue casing 22/4 cable for request to exit.
- D. Route orange casing 22/6 shielded for card reader.
- E. Route gray casing 18/4 for door hardware (door strike, electric latch retraction)
- F. The cable is to be installed to the enclosure above each door and individual cables installed to each device.
- G. An 18/2 wire will be required to the Knight Watch enclosure for panic button Hardware.
- H. An 18/2 cable will be required to the Knight Watch enclosure for remote release button.
- I. Cables to be installed from door location to the Knight Watch enclosure. (located in the TIS closet) Cables will be labeled on each end with door number per each floor drawing.
- J. Cable length AC-1 to door – 300ft max.

### 3.2 Conduit Requirements:

- A. Card Reader: 1 – ¾” conduit from 4 square deep with single gang mud ring (mounted vertical) to above cable tray.
- B. Door Strike: 1 – ½” conduit from strike opening in door frame to above cable tray.
- C. Electric Latch Retraction: Wire to door crash bar via door frame from accessible ceiling tray.
- D. Door Contact: 1 – ½” conduit from accessible ceiling to top off door frame opening.
- E. Request to Exit (motion): 1 – ¾” conduit from 4 square deep with single gang mud ring (mounted horizontal) to above cable tray.
- F. Request to Exit (pushbutton): 1 – ¾” conduit from 4 square deep with single gang mud ring (mounted vertical) to above cable tray.
- G. Panic Button: ½” flexible raceway from panic button location to accessible ceiling tray.
- H. Remote Release Button: ½” raceway from remote release button to accessible ceiling tray.

**End of Section**

## 28 2000 Electronic Surveillance

This section is located in Division 28, but will be addressed here for low voltage requirements per Spectrum Health's needs.

### Part 1 General

#### 3.1 Scope Summary

- A. Surveillance systems will refer to secure PTZ cameras, fixed cameras, IP based cameras used for security to monitor specific environments.

#### 3.2 Quality Assurance

- A. Design will be provided and properly labeled by Knight Watch Inc.
- B. Cables will be routed, and labeled by specifications provided by Knight Watch Inc.
- C. Cables will be routed in low voltage cable trays and pathways.
- D. Any cable not properly identified will be traced at cabling vendors expense.

#### 3.3 Submittals

- A. Knight Watch Inc. will provide all designs, specification documents to cable vendor prior to start of the project, including drawings with location id labeled on the print.
- B. Any communications between cabling vendor and Knight Watch will be copied to Spectrum Health project management.
- C. Notification to any construction schedule will be verified by Spectrum Health project management staff to coordinate priorities and resources.

### Part 2 Products

- 2.1 See Section 28 1300 for details of products.

### Part 3 Execution

#### 3.1 Cable/raceway requirements:

- A. IP-PTZ security camera:
  - 1. 1 – CAT6 and 1 – 16/2 cables installed to each camera location to Spectrum's data rack location.
  - 2. CAT6 cable shall be terminated into a biscuit jack and coiled in the ceiling if it is a drop ceiling.
  - 3. Cat 6 cables will be terminated in a back box with a normal wall face plate if it is a hard ceiling.
  - 4. The Camera will have its own separate back box if needed for support, not to be mounted over the cable back box.
  - 5. 16/2 cable to be installed from camera to power supply location for power. Power to power supply by electrical.
  - 6. Installation, testing, and certification shall be completed before Knight Watch to install camera.
  - 7. Cable shall be labeled with patch panel letter and port number at camera location. Port number location must be sent to Knight Watch for IP address request before Knight Watch will arrive onsite to install cameras.
  - 8. Conduit/rough-ins by others. To be determined based on camera location.
  - 9. Cable length camera to switch location – 300ft maximum

10. Patch cords will be provided by the cable vendor per quote in the project, but installed by Knight Watch at device location. Spectrum TIS will maintain patches in the network closet.

B. P-Fixed POE security camera:

1. 1 – CAT6 cable installed to each camera location to Spectrum’s data rack location.
2. CAT6 cable shall be terminated into a biscuit jack and coiled in the ceiling if it is a drop ceiling.
3. Cat 6 cable will be terminated in a back box with a normal wall face plate if it is a hard ceiling.
4. The Camera will have its own separate back box if needed for support, not to be mounted over the cable back box.
5. Installation, testing, and certification shall be completed before Knight Watch to install camera.
6. Cable shall be labeled with data patch panel letter, and port number at camera location. Port number location must be sent to Knight Watch for IP address request before Knight Watch shall schedule onsite installation of cameras.
7. Conduit/rough-ins by others. To be determined based on camera location.
8. Cable length camera to switch location – 300ft maximum
9. Patch cords will be provided by the cable vendor per quote in the project, but installed by Knight Watch at device location. Spectrum TIS will maintain patches in the network closet.

**End of Section**

## HIPAA COMPLIANCE

- A. Closets will be secure at all times, card or key access only.
- B. Closet will be locked when not in direct site of the door.
- C. Authorized personnel only in network closets.
- D. Doors will not be propped or taped open for access.

## **27 53 13 - Network Clock System (New Construction/Systems)**

### **SNS Network Clock System**

## **27 53 13 - 72MHz GPS Wireless Systems (Existing system)**

### **Butterworth/100 Michigan Campus and Blodgett Only**

#### **Primex Wireless, Inc.**

#### **PART 1.0 GENERAL**

##### **1.1 GENERAL REQUIREMENTS & SCOPE**

- A. Provide a complete new Power-Over-Ethernet Network Clock System using Primex Network SNS Time Synchronization System.
- B. Provide all system equipment, devices, accessories, and material in accordance with these specifications, drawings, and manufacturer's instructions for a complete and operating system.
- C. All bids shall be based on the equipment as specified herein at a minimum. The model designations are that of Primex, Inc. No alternate clock systems are allowed with review and approval from Spectrum Health IS and facilities departments.

##### **1.2 SECTION INCLUDES**

- A. Network Appliance and Software Platform
- B. System Devices
  - Analog Clocks
  - Digital Clocks
  - Digital Personal Series LCD Clocks
  - Digital Elapsed Timers
  - Digital Code Blue Timers

##### **1.3 RELATED SECTIONS**

- A. Division 26 "Spectrum Health Electrical"
- B. Division 27 "Communications from Spectrum Health IS"

##### **1.4 REFERENCES**

- A. National Fire Protection Association (NFPA): 1. NFPA 70 - National Electrical Code (NEC).
- B. Manufacturer Installation instructions and User Guides.

## 1.5 DEFINITIONS

This section provides commonly used terms within this specification.

- A. Provide means furnish and install
- B. **NTP:** Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.
- C. **SNS:** Synchronous Network System
- D. **AMP:** Application Management Platform
- E. **POE:** Power Over Ethernet

## 1.6 SYSTEM DESCRIPTION

This section describes the system as specified.

- A. System communicates over a wired Ethernet for synchronization, data collection, alerting, scheduling, data backup, and user access.
- B. This system shall not be utilized in exam rooms, operating rooms, etc. without prior authorization from the Spectrum Health IS and facilities departments.
- C. System can be programmed to automatically generate email alerts to notify staff of device statuses, including reminder and escalation notifications.
- D. System distributes device firmware upgrades, including time zone offset and Daylight Savings changes, at the time system devices connect and communicate diagnostic information to the server appliance.
- E. Device firmware performs diagnostics on battery life, time accuracy, and sends this data to system appliance.
- F. Manufacturer offers extended System Maintenance Agreements for device firmware upgrades; however, Spectrum Health has a master agreement with ICOMM; therefore, Spectrum Health will not be purchasing extended maintenance agreements.
- G. System software revisions are provided under the manufacturer Software Maintenance Agreement. Contact Spectrum Health Asset Management for software agreement.
- H. The server appliance software logs clock NTP synchronization.
  - I. Time signals originate from the system configured Network Time Protocol (NTP) source.
  - J. Clocks shall be networked over an wired Ethernet network.
  - K. Clocks maintain internal reference so that failure of the master NTP system will not cause clocks to fail. Clocks will continue indicating accurate time within plus or minus 0.35 seconds in 24-hours.

## 1.7 SYSTEM COMPONENTS

This section describes the system network appliance and devices as specified.

- A. **Locally Configured System:** Standard 19-inch wide 2U rack space appliance that logs and monitors data transmitted from the system devices over the owner's network to the system.
- B. **Virtually Configured System:** Virtually-configured system appliance that logs and monitors data transmitted from the system devices over the owner's network to the system.

- C. Hosted System: The system software is installed, hosted, and accessed entirely from a remotely managed server. The system logs and monitors data transmitted from the system devices over the owner's network to the hosted system.
- D. Clocks: IP addressable digital or analog NTP synchronized clocks with automated monitoring, alerting, and reporting firmware.

## **1.8 REGULATORY REQUIREMENTS**

- A. Equipment and components furnished shall be complaint with Spectrum Health existing software. Coordinate with Spectrum Health IS for exact requirements. .
- B. System shall be installed in compliance with local and state authorities having jurisdiction.
- C. Electrical Components, Devices, and Accessories: Listed and labeled per NFPA 70 by qualified testing agency.
- D. Regulatory Requirements: System design and installation shall comply with the following:
  - National Electric Code (NEC).
  - Underwriters Laboratory (UL) standards.
  - Local codes and regulations.

## **1.9 SUBMITTALS**

- A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors, styles, sizes, and finishes of clocks.
  - B. Shop Drawings: Showing the following. 1. Diagram of proposed system showing system platform appliance, communication pathway, and schedule of individual device locations. 2. Indicate integration with the Owner's network and servers. Include a line diagram of network relationships. Show system power requirements.
  - C. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed in the work at location directed.
  - D. Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions.
  - E. Submittals shall be distributed to the Spectrum Health construction project manager who shall distribute them to Spectrum Health IS and off-site team.
- A. Information submittal: Warranty.
  - B. Information submittal: System Maintenance Proposal.
  - C. Closeout documentation (Operation and Maintenance Manuals)

## **1.10 SUBSTITUTIONS**

- A. Substitutions are not allowed.

### **1.11 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer of Ethernet connected system with a minimum of five years record of satisfactory manufacturing and support of systems comparable to basis of design system.

### **1.12 DELIVERY STORAGE AND HANDLING**

- A. Deliver all components to the site in the manufacturer original packaging.
- B. Packaging shall contain manufacturer name and address, product identification number, and other related information.
- C. Store equipment in finished building, unopened containers until ready for installation.

### **1.13 PROJECT SITE CONDITIONS**

This section describes the Project Site Conditions for equipment specified.

- A. Clocks and/or Timers shall not be installed until painting and other finish work in each room is complete.
- B. System design is integrated with owner wired network.
- C. Conductors and Cables: Comply with requirements of Division 26 and 27.
- D. Signal and Control Circuits: Manufacturer's recommended stranded, single conductors, or twisted-pair cables.
- E. Data Circuits: Category 6e minimum, twisted-pair cable. D. Plenum Cable: Listed and labeled for plenum installation. Refer to Spectrum Health IS Division 27 for specific requirements.

### **1.14 SYSTEM STARTUP**

- A. System start-up shall be scheduled and coordinated with Spectrum Health IS. Contact the assigned Spectrum Health IS project manager.

### **1.15 WARRANTY**

- A. Provide a one year limited warranty on all system devices.
- B. Provide five-year extended clock warranty.

### **1.16 SOFTWARE MAINTENANCE**

- A. Software Maintenance Agreement: Refer to Spectrum Health and ICOMM master software and services agreement.

## **PART 2.0 PRODUCTS**

The system is specified as described in this section.

### **2.1 MANUFACTURER**

System shall be manufactured by:

#### **U.S.:**

Primex Wireless, Inc., 965 Wells Street, Lake Geneva, WI 53147

Phone: (800) 537-0464 | Fax: (262) 248-0061 | Email: info@primexwireless.com |  
www.primexwireless.com

### **2.2 SEQUENCE OF OPERATION**

The system shall perform in the sequence of operation as described.

- A. Configure and install system appliance detailed in manufacturer installation instructions.
- B. Configure and install system devices per model specifications detailed in manufacturer installation instructions.

### **2.3 EQUIPMENT**

The system shall include all equipment as specified.

#### **Locally Configured System**

- A. System Software Platform and Network Appliance: Standard 19-inch wide 2U rack space appliance that synchronizes and logs data from system devices over Owner's existing network with signals from the NTP server.
- B. The system stores diagnostic information and event logs from the system's devices and forwards this data to assigned personnel by e-mail.
- C. The system enables firmware upgrades, stores system device diagnostics and logs and performs data backup.
- D. Network Time Protocol Server Software: [Integrate with Owner's existing NTP server] and/or [Provide NTP Operating System and Middleware Components].

#### **Virtually Configured System**

- A. System Software Platform: Virtually-configured software platform that synchronizes and logs data from system's devices over Owner's network and is synchronized by an NTP server.
- B. System stores diagnostic information and event logs from the system's devices and forwards this data to assigned personnel by email.

- C. The system enables device firmware upgrades, stores device diagnostics and logs and performs data backup.
- D. Network Time Protocol Server Software: [Integrate with Owner's existing NTP server] and/or [Provide NTP Operating System and Middleware Components].

### **Hosted System**

- A. Hosted System Platform: system software is installed, hosted, and accessed entirely from a remote server managed by vendor/supplier.
- B. System logs and monitors data transmitted from the system devices over the owner's network to the system.ce that synchronizes and logs data from system devices over Owner's existing network with signals from the NTP server.
- C. The system stores diagnostic information and event logs from the system devices and forwards this data to assigned personnel by e-mail.
- D. The system enables firmware upgrades, stores system device diagnostics and logs and performs data backup.
- E. Network Time Protocol Server Software: [Integrate with Owner's existing NTP server] and/or [Provide NTP Operating System and Middleware Components].

### **Analog Clocks**

Analog Clocks shall meet the below specifications.

- A. Analog clocks shall be wall mounted.
- B. Face shall be white. Hour and minute hands shall be black.
- C. Clock faces shall be customized by manufacturer to display Spectrum Health..
- D. Clocks shall have a tamper proof/theft resistant clock-lock mounting slots.
- E. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time.
- F. Clock shall have either a battery-power, 120 VAC or Power Over Ethernet (PoE) IEEE 802.3af compliant power supply built into the clock assembly.
- G. If power is interrupted, the clock will stop until power resumes. Upon resumption of power, the clock will self-correct to the current time.
- H. Electric (AC) models will include a cord with pigtail.
  - I. Battery-Operated: Spectrum Health Butterworth and Blodgett GPS 72 MHz Only
    1. Battery-operated analog clocks shall have up to a 4-year battery life. Battery life is based on common operating conditions and may vary due to installed site conditions.
    2. Installer will furnish clock batteries in accordance with manufacturer instructions.
    3. Battery-operated analog clocks shall remember the time during changing of batteries.

### **SUPPLY MODELS**

Per specifications, supply the following model(s):

### Traditional Series Analog Clock Models

Description	Note
12.5" (31.75cm) Black	SNS5Z155. Exact model numbers shall be verified with Spectrum Health IS and ICOMM prior to purchase.

### Traditional Series Analog Clock Electric Models

**Specifier Note: Some off-site locations may require 120-volt clocks due to budget or infrastructure constraints. Verify exact requirements with Spectrum Health IS and facilities.**

Description
12.5" (31.75cm) 100-240 VAC, Black – Model SNS7A306
12.5" (31.75cm) 100-240 VAC, Black, Dual-Sided - Confirm model number prior to purchase.

## **PART 3.0 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.
- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- D. AC-powered devices: Verify that electrical power outlet is near location of clock or timer and the outlet is operational and properly grounded.

### **3.2 INSTALLATION**

- A. General: Install system in accordance with applicable codes.
- B. System equipment shall be installed in accordance with manufacturer written instructions.
- C. Provide all system equipment necessary for a complete and operable system.
- D. Comply with requirements of Division 26 and 27.
- E. Off-site:
- F. Cables: Install cables in raceways and cable trays except within consoles, cabinets, desks, and except in accessible ceiling spaces and framed partitions where exposed wiring is allowed by Owner. Conceal cable installation where possible.
- G. Hospitals (Butterworth and Blodgett Only)

### **Analog Clocks**

- A. Furnish all equipment necessary for a complete and operational system.
- B. Perform the following operations with each clock:
  - 1. Configure and set clock to correct time in accordance with manufacturer instructions.
  - 2. Observe clock until valid signals are received and clock adjusts itself to correct time.
  - 3. Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location.

### **3.3 FIELD INSPECTION**

- A. Inspection: Make observations to verify that system devices and components are properly labeled.
- B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.

### **3.4 MANUFACTURER SERVICES**

- A. Installation and user guides shall be provided.

- B. Commissioning General: Provide manufacturer system commissioning in accordance with manufacturer written recommendations. Perform operational testing to verify compliance with requirements. Adjust as required.
- C. Manufacturer to provide specified level of commissioning services.
- D. Onsite commissioning: system topology and deployment training, AMP software set-up and configuration, device configuration, training on system functionality, verification of network routing, and device installation training.
- E. Installation and full onsite commissioning: system topology and deployment training, AMP software set-up and configuration, device configuration, training on system functionality, verification of network routing, device installation training, and device installation.

### **3.5 CLEANING**

- A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by manufacturer.
- B. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

### **3.6 DEMONSTRATION**

- A. Initial Demonstration and Training: provide demonstration and training for owner facility staff in administering system.
- B. Demonstrate maintenance procedures for system devices.
- C. Demonstrate monitoring of system software, methods for modifying default profiles and groupings, adding or deleting system devices, and modifying settings for system monitoring and testing.

### **3.7 PROTECTION**

- A. Protect finished installation until final acceptance of the project.

### **3.8 TESTING**

**All devices must be tested at their operational location**

**End of Section**

## Summary of Part Numbers

### Copper products

OUTDOOR MULTI-PAIR DATA CABLE, 25 PAIR (999903004)  
OUTDOOR MULTI-PAIR DATA CABLE, 50 PAIR (999903005)  
OUTDOOR MULTI-PAIR DATA CABLE, 100 PAIR (999903006)  
OUTDOOR MULTI-PAIR DATA CABLE, 200 PAIR (999903010)  
1010 025 (106824329) 25 PAIR RISER RATED  
1010 050 (106824378) 50 PAIR RISER RATED  
1010 100 (106824469) 100 PAIR RISER RATED  
2010 025 (107765992) 25 PAIR PLENUM RATED  
2010 050 (107766040) 50 PAIR PLENUM RATED  
2010 100 (107766057) 100 PAIR PLENUM RATED  
3010 025 (760010900) 25 PAIR LZSH RATED  
3010 100 (760010918) 100 PAIR LZSH RATED

### Fiber products

R-144-DS-8W-FMUYL (760018887)  
144 FIBER, RISER RATED, DISTRIBUTION CABLE, SINGLEMODE  
D-072-LN-8W-F12NS (760053892)  
72 FIBER, SINGLE JACKET ALL-DIELECTRIC, GEL-FREE, OUTDOOR STRANDED LOOSE TUBE CABLE, SINGLEMODE  
D-048-LA-8W-F12NS (760053314)  
48 FIBER, SINGLE JACKET/SINGLE ARMOR, GEL-FREE, OUTDOOR STRANDED LOOSE TUBE CABLE, SINGLEMODE  
O-024-CA-8W-F12NS (760003954)  
SINGLE JACKET/SINGLE ARMOR, GEL-FILLED, OUTDOOR CENTRAL TUBE CABLE, SINGLEMODE  
OFE-CLS-J-012 9703128/00  
P-012-DZ-5M-FSUAQ (PLENUM 12F FOR NAR)  
N-024-DZ-5K-FSUAQ (24F LSZH FOR EMEA)  
R-006-DZ-5L-FSUAQ (6F RISER FOR APAC AND CALA)  
P-012-DS-5M-FSUAQ (PLENUM 12F FOR NAR)  
N-024-DS-5K-FSUAQ (24F LSZH FOR EMEA)  
R-006-DS-5L-FSUAQ (6F RISER FOR APAC AND CALA)  
KFA-LC02-KRD 760057216 LC DUPLEX KEYED ADAPTER, RED, SINGLE PACK  
KFA-LC02-KVI 760090662 LC DUPLEX KEYED ADAPTER, VIOLET, SINGLE PACK  
MFC-LCR-16-BG 760034140 LC CONNECTOR SIMPLEX FOR 1.6 MM FIBER CORDAGE, MULTIMODE  
MFC-LCR-09-BG 760034181 BEHIND THE WALL LC CONNECTOR FOR 0.9 MM BUFFERED FIBER, MULTIMODE  
MDC-LCR-16-BG 760034157 PRE-RADIUSED LC DUPLEX CONNECTOR FOR 1.6 MM FIBER CORDAGE,  
MULTIMODE  
SFC-LCR-16-BL 760034173 PRE-RADIUSED LC CONNECTOR SIMPLEX FOR 1.6 MM FIBER CORDAGE  
SFC-LCR-09-BL 760034199 BEHIND THE WALL PRE-RADIUSED LC CONNECTOR FOR 0.9 MM BUFFERED FIBER

SDC-LCR-16-BL 760091439 PRE-RADIUSED LC CONNECTOR DUPLEX FOR 1.6 MM FIBER CORDAGE  
MFC-LCR-16-KBR 760102384 KEYED LC CONNECTOR FOR 1.6 MM FIBER CORDAGE, MULTIMODE, BROWN  
MFC-LCR-09-KBR 760102608 BEHIND THE WALL KEYED LC CONNECTOR FOR 0.9MM FIBER CORDAGE,  
MULTIMODE, BROWN  
SFC-LCR-16-KAQ 760102699 PRE-RADIUSED KEYED LC CONNECTOR FOR 1.6 MM FIBER CORDAGE, SIMPLEX  
SINGLE-MODE, AQUA  
SFC-LCR-16-KRO 760102707 PRE-RADIUSED KEYED LC CONNECTOR FOR 1.6 MM FIBER CORDAGE, SIMPLEX  
SINGLE-MODE, ROSE  
MFC-LCF-09-5X 760117887 LAZRSPEED FIBER QWIK II-LC CONNECTOR™, AQUA. FIBER TYPES: OM2+,  
OM3, OM4.1 PER PACK  
MFC-LCF-09-5X-25 760117911 LAZRSPEED FIBER QWIK II-LC CONNECTOR, AQUA. FIBER TYPES: OM2+,  
OM3, OM4. 25 PER PACK  
SFC-LCF-09-8X 760117895 TERASPEED FIBER QWIK II-LC CONNECTOR™, BLUE FIBER TYPES: G.652.D,  
G.657.A1 OR G.652.D, G.657.A1 | OS2. 1 PER PACK  
SFC-LCF-09-8X-25 760117929 TERASPEED FIBER QWIK II-LC CONNECTOR, BLUE FIBER TYPES: G.652.D,  
G.657.A1 OR G.652.D, G.657.A1 | OS2. 25 PER PACK  
MFC-LCF-09-6X 760117903 OPTISPEED FIBER QWIK II-LC CONNECTOR™, BEIGE FIBER TYPE: OM1. 1 PER  
PACK  
MFC-LCF-09-6X-25 760117937 OPTISPEED FIBER QWIK II-LC CONNECTOR™, BEIGE FIBER TYPE: OM1. 25  
PER PACK  
MFC-SCR-30-BG 760007047 SC CONNECTOR SIMPLEX FOR 3.0 MM FIBER CORDAGE, MULTIMODE  
MFC-SCR-09-BG 760007070 BEHIND THE WALL LC CONNECTOR FOR 0.9 MM BUFFERED FIBER, MULTIMODE  
MDC-SCR-30-BG 760112284 PRE-RADIUSED LC DUPLEX CONNECTOR FOR 3.0 MM FIBER CORDAGE,  
MULTIMODE  
SFC-SCR-30-BL 760007096 PRE-RADIUSED SC CONNECTOR SIMPLEX FOR 3.0 MM FIBER CORDAGE  
SFC-SCR-09-BL 760007112 BEHIND THE WALL PRE-RADIUSED SC CONNECTOR FOR 0.9 MM BUFFERED FIBER  
SDC-SCR-30-BL 760112326 PRE-RADIUSED SC CONNECTOR DUPLEX FOR 3.0 MM FIBER CORDAGE  
MFC-SCF-09-5X 760117945 LAZRSPEED FIBER QWIK II-SC CONNECTOR, AQUA. FIBER TYPES: OM2+,  
OM3, OM4. 1 PER PACK  
MFC-SCF-09-5X-25 760117978 LAZRSPEED® FIBER QWIK II-SC CONNECTOR, AQUA. FIBER TYPES: OM2+,  
OM3, OM4. 25 PER PACK  
SFC-SCF-09-8X 760117952 TERASPEED FIBER QWIK II-SC CONNECTOR, BLUE FIBER TYPES: G.652.D,  
G.657.A1 OR G.652.D, G.657.A1 | OS2. 1 PER PACK  
SFC-SCF-09-8X-25 760117986 TERASPEED FIBER QWIK II-SC CONNECTOR, BLUE FIBER TYPES: G.652.D,  
G.657.A1 OR G.652.D, G.657.A1 | OS2. 25 PER PACK  
MFC-SCF-09-6X 760117960 OPTISPEED FIBER QWIK II-SC CONNECTOR, BEIGE FIBER TYPE: OM1. 1 PER  
PACK  
MFC-SCF-09-6X-25 760117994 OPTISPEED FIBER QWIK II-SC CONNECTOR, BEIGE FIBER TYPE: OM1. 25  
PER PACK  
FEXLCLC42-MXMxxx— A 2 FIBER OPTIC JUMPER, RISER, LAZRSPEED 550 MULTIMODE GLASS WITH LC  
CONNECTORS ON BOTH ENDS. SUBSTITUTE XXX IN PART NUMBER WITH ACTUAL LENGTH IN METERS.

FEWLCLC42-JXMxxx – A 2 FIBER OPTIC JUMPER, RISER, TERASPEED SINGLE MODE GLASS, WITH LC CONNECTORS ON BOTH ENDS. SUBSTITUTE XXX IN PART NUMBER WITH ACTUAL LENGTH IN METERS. PART NUMBER WITH ACTUAL LENGTH IN METERS.

### Other products

RK3-45A (MID 760082479), BLACK

RK3-52A (MID 760082487), BLACK

VCM-SS-84-12B (760089458) 12" SINGLE SIDE, VERTICAL CABLE MANAGEMENT, BLACK DOOR

VCM-DS-84-6B (760089375) 12" DOUBLE SIDE, VERTICAL CABLE MANAGEMENT, BLACK DOOR

VCM-SS-84-6B (760089425) 6" SINGLE SIDE, VERTICAL CABLE MANAGEMENT, BLACK DOOR

VCM-DS-84-6B (760089342) 6" DOUBLE SIDE, VERTICAL CABLE MANAGEMENT, BLACK DOOR

CR-SLR-10L12W (760085647) 10FT LONG, 12" WIDE, BLACK

CR-SLR-10L18W (760085654) 10FT LONG, 18" WIDE, BLACK

CR-SLR-10L24W (760085662) 10FT LONG, 24" WIDE, BLACK

CR90FCB-12W (760085530) 12 INCH (305 MM) W

CR90FCB-18W (760085548) 18 INCH (457 MM) W

CR90FCB-24W (760085555) 24 INCH (610 MM) W

CRBSK (760083899) BUTT SPLICE KIT

CRTJSK (760084046) JUNCTION SPLICE KIT

CRRP-8H (760083980) CABLE RETAINING POSTS

CRPECK (760084012) LADDER RACK END CAPS

CRDK-12W (760083956) RADIUS DROPS

M20AP-246 107067860 IVORY COVER FOR EMPTY FACEPLATE OPENINGS

M21A-246 108066457 IVORY COVER FOR UNPOPULATED JACKS

M13FP-262 – SINGLE GANG FLEXIBLE FRAME WHITE

M30FP-2RJ45-262 – DOUBLE PORT ADAPTER FOR FLEXIBLE FRAME WHITE

M30FP-BLANK-262 – DOUBLE BLANK ADAPTER FOR FLEXIBLE FRAME WHITE

M102SMB-B-262 – 2 PORT SURFACE MOUNT BOX WHITE

M104SMB-B-262 – 4 PORT SURFACE MOUNT BOX WHITE

630B8 – STAINLESS STEEL WALL PHONE JACK (T-568B)

M81LS-LS – 4 PORT FACEPLATE FOR LC M81LS-XX FIBER SPOOLS