



# TECHNOLOGY INFRASTRUCTURE CONSTRUCTION GUIDE SPECIFICATION

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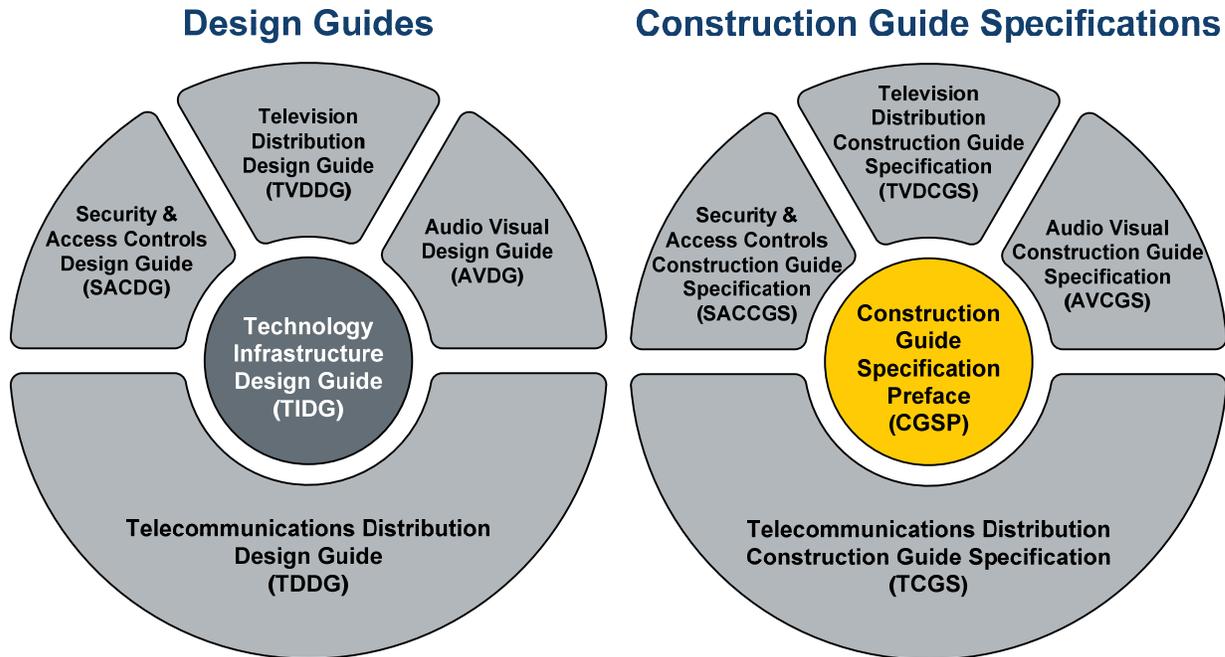
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# 1 Preface

## 1.1 Introduction

- A. The Construction Guide Specification (CGS) is written to communicate the requirements of the Washington State University Pullman (WSUP) campus for the installation of technology infrastructure and systems at WSUP facilities.
- B. The CGS is written for an audience of Architects, Engineers and Designers who are responsible for the design of new or remodeled facilities at WSUP where technology infrastructure currently exists or will be installed. It is intended to assist in developing specifications for a particular project and to communicate WSUP's requirements for the appropriate construction and installation of technology infrastructure and systems at WSUP-owned and leased facilities.
- C. This document also applies to infrastructure designed and installed by WSUP staff, when a formal design is not developed.
- D. The CGS consists of several sections written based on the 2014 Construction Specifications Institute (CSI) format ([www.csinet.org](http://www.csinet.org)), using Master Format, Section Format, and Page Format structuring guidelines. The CGS reflects WSUP and industry standards in effect as of the date of this publication.
- E. The Construction Guide Specification and this Preface (CGSP) belong to a set of documents (depicted below) that comprise the standard design and installation practices for all facets of technology systems and infrastructure at WSUP's facilities. This document forms the core of the Construction Guide Specification document set.
- F. The Construction Guide Specification Preface (CGSP) is a key companion to the Design Guides.
  - Designers shall adapt the various CGS sections "as written" for creating specifications for a particular project according to the instructions in the Design Guides. In other words, Designers shall use the electronic specification section documents (provided by WSUP in Microsoft Word format) and then shall make any project-specific edits to the specifications in those documents.
  - Rewriting sections in the CGS or modifying the format structure or requirements will not be accepted.

# Technology Infrastructure Standards Document Set



- G. It is the responsibility of the Designer of technology infrastructure for WSUP to coordinate with the other designers on a project (architectural, electrical, mechanical, etc.) to determine that other systems are both compatible with and complementary to the technology infrastructure. It is critical to coordinate between disciplines during the design phase of a project, rather than making adjustments in the field during construction.
- H. This document was prepared by Summit Engineering & Consulting, P.S. and by the Information Technology Services department at the Pullman campus of Washington State University. As technology and needs evolve, the document will be periodically updated.
- June 24, 2015 – Originally published

## 1.2 Document Intent

The CGS has been developed with the intent that WSUP standards and practices are followed during the design and construction of technology systems.

Each CGS specification section includes standards, guidelines, products, procedures, processes, and work descriptions/summaries that are common to

many WSUP projects. This information is provided in specification format to serve as a guide to the Engineer/Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP projects. For WSUP staff performing telecommunications work, this information shall be followed to fulfill the requirements of a fully compliant installation.

Each CGS section includes products upon which WSUP has standardized and which were current at the time the specification section was written. When newer products become available, or when a different product appears to be better suited for a particular project, the Designer, Contractor or Installer shall bring this recommendation to the attention of the WSUP TPM for review and final approval before making changes to the CGS section or installing the newer or different product.

The CGS is intended to be a “Guide Specification” rather than a “Master Specification”. The products listed and other information included in each section are not intended to be all-inclusive for any given project. Instead, each specification section is meant to serve as a starting point for developing the specification section for a given project, with content to be added or removed as required. However, all additions and changes must be pre-approved as indicated above.

In addition to implementing WSUP standards and practices, the intent of the CGS is to reduce the time required for WSUP staff to review project specifications. WSUP has determined that following these instructions will reduce the review time required for each project.

Unless otherwise stated, the information in the CGS applies to both new construction and remodel projects and (as appropriate) to leased facilities.

## 1.3 How to Use this Document

The CGS shall be used in conjunction with the corresponding Design Guide (xDG) to produce Construction Documents for bidding or to assist WSUP-selected personnel in the design and administration of small technology infrastructure construction projects.

WSUP will provide the CGS specification sections to the Designer electronically as Microsoft Word documents. The Designer shall then edit the Microsoft Word document for each specification section using the latest version of Microsoft Word, adding or removing content as required to meet the unique needs of a given project.

It is not acceptable to create new specification sections based on the Designer's interpretation of the “intent” of the CGS, or to cut and paste content from CGS sections into other existing specification sections.

***All edits made by the Designer to the original CGS electronic documents shall be made using Microsoft Word's Tracking Changes feature. The specification sections shall be submitted in hardcopy format when required***

**by WSUP during the design review process with the “Final Showing Markup” option selected so that the revision marks are visible in the printed documents to be reviewed. Just prior to bid, when the specifications have been reviewed by the TPMs and approved as final/100% Construction Documents, the “tracking changes” items can be “accepted” and the specifications can be published without any revision markings.**

Red text in gray-shaded boxes in each CGS section is formatted in Microsoft Word as “hidden text” and can be made to appear/disappear on screen and in the printed document using the check boxes on the File / Options / Display dialog box. This hidden text is included to add clarity behind WSUP’s decisions for certain features of the specifications. It is also intended to prompt the Designer about items that may require modification for a particular project. Although this text is generally written in declarative form, the Designer shall consider it guidance only.

**The Designer shall not assume that the content of each CGS specification section in its native form is suitable or sufficient for any given project. The Designer shall be responsible for adding and/or removing content as required to develop a thorough and complete specification section that meets the requirements of the project being designed. The Designer shall be professionally liable for the documents produced for a project, including content from these specifications.**

## 1.4 Copyright

Summit Engineering & Consulting retains the copyright for this document, including the associated specifications. Washington State University Pullman is authorized to edit and adapt the document and specifications. Designers working for WSUP on WSUP’s projects are authorized to edit and adapt the specifications for use on WSUP’s projects. All other rights are reserved.

Summit Engineering & Consulting has authored similar documents for many other organizations. The document is intended (in part) to describe best practices that are found in some segments of the industry. As a result, portions of this document are similar to comparable content in documents previously prepared by Summit Engineering & Consulting for other organizations. This document does not contain any information that is proprietary or confidential to other organizations.

## 1.5 Guide Specification Sections

### 1.5.1 TELECOMMUNICATIONS CONSTRUCTION GUIDE SPECIFICATION SECTIONS

The Telecommunications Construction Guide Specification (TCGS) contains the following specification sections:

**Division 27**

27 05 00	Common Work Results for Communications
27 05 26	Grounding and Bonding for Communications Systems
27 05 33	Conduits and Backboxes for Communications Systems
27 05 36	Cable Trays for Communications Systems
27 11 00	Communications Equipment Room Fittings
27 13 00	Communications Backbone Cabling
27 15 00	Communications Horizontal Cabling
27 15 23	Communications Optical Fiber Horizontal Cabling
27 32 00	Voice Communications Telephone Sets

**Division 33**

33 81 26	Communications Underground Ducts, Manholes, and Handholes
33 82 00	Communications Distribution
33 82 43	Grounding and Bonding for Communications Distribution

**1.5.2 AUDIO/VISUAL CONSTRUCTION GUIDE SPECIFICATION SECTIONS**

The Audio/Visual Construction Guide Specification (AVCGS) contains the following specification sections:

**Division 27**

27 05 00	Common Work Results for Communications
27 41 00	Audio-Video Systems

**1.5.3 SECURITY AND ACCESS CONTROL CONSTRUCTION GUIDE SPECIFICATION SECTIONS**

In the future, WSUP might prepare a Security and Access Control Construction Guide Specification (SACCGS). If this were to be done, it would contain the following specification sections:

**Division 28**

28 05 00	Common Work Results for Electronic Safety and Security
28 13 00	Access Control
28 13 00	Intrusion Detection
28 20 00	Video Surveillance

**1.5.4 GUIDE SPECIFICATION SECTIONS MANAGED BY WSUP FACILITIES SERVICES**

WSUP Facilities Services manages a firestopping specification for all aspects of construction projects on campus. The following specification includes technology-specific firestopping requirements that are unique to technical pathways. The Designer shall verify that this section is included in the Project Manual for a given project, and that it includes firestopping solutions that are consistent with WSUP's firestopping requirements in the TDDG.

**Division 07**

07 27 00	Firestopping
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## PART 1 - GENERAL

### 1.1 SUMMARY

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

- A. Provide all materials and labor for the installation of an inside plant telecommunication system. All materials shall be new, free from defects, of current manufacture, and of the quality specified or shown. Each type of material shall be of the same manufacture throughout the work. This section includes Inside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS) and Television Distribution System.

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications system as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media.
  - 1. The Structured Cabling System shall be tested for and be capable of 1 Gigabit Ethernet operation as specified in IEEE 802.3z.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this section and to all Division 27 Specification Sections.

1.4 STANDARDS AND CODES

Review and edit the following list of references. Check for completeness, currency and applicability to this project – include any other additional relevant references not already noted below. The Designer shall verify whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

- A. Incorporate by reference the latest updates of the applicable portions of the following specifications, standards, codes into this specification section.
1. General:
    - a. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code (NEC)
    - b. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.
    - c. National Fire Protection Association (NFPA) – NFPA 780: Standard for the Installation of Lightning Protection Systems
    - d. National Fire Protection Association (NFPA) – NFPA 75: Standard for the Fire Protection of Information Technology Equipment
    - e. National Electrical Safety Code (NESC)
    - f. Occupational Safety and Health Act (OSHA)
    - g. Washington Industrial Safety and Health Act (WISHA)
    - h. Washington State Rules and Regulations for Installing Electrical Wires and Equipment (RCW 19.28, WAC 296-46 and WAC 296-401A)
    - i. Washington State Department of Labor and Industries Safety Standards for General Safety and Health (WAC 296-24 Volume 1 Part L)
  2. Communications:
    - a. ANSI/TIA - 455: Fiber Optic Test Standards
    - b. ANSI/TIA - 526: Optical Fiber Systems Test Procedures
    - c. ANSI/TIA - 568-C.0: Generic Telecommunications Cabling for Customer Premises
    - d. ANSI/TIA - 568-C.1: Commercial Building Telecommunications Cabling Standard
    - e. ANSI/TIA – 569-B: Commercial Building Standard for Telecommunication Pathways and Spaces
    - f. ANSI/TIA – 606-A: The Administration Standard for Commercial Telecommunications Infrastructure
    - g. ANSI/TIA – 607-B: Commercial Grounding (Earthing) and Bonding for Customer Premises
    - h. ANSI/TIA – 862: Building Automation Systems Cabling Standard for Commercial Buildings
    - i. ANSI/TIA/EIA 942 – Telecommunications Infrastructure Standard For Data Centers
    - j. ANSI/TIA -TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems
    - k. ANSI/TIA -TSB75: Additional Horizontal Cabling Practices for Open Offices
    - l. ANSI/TIA/EIA 758 series – Customer-Owned Outside Plant Telecommunications Cabling Standard
    - m. NECA/FOA 301-1997: Standard for Installing and Testing Fiber Optic Cables
    - n. NECA/BICSI 568-2001: Standard for Installing Commercial Building Telecommunications Systems
    - o. IEEE 802.3 (series): Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit Ethernet Standard
    - p. ISO/IEC IS 11801: Generic Cabling for Customer Premises
    - q. BICSI: BICSI Telecommunications Cabling Installation Manual
    - r. BICSI: BICSI Telecommunications Distribution Methods Manual (TDMM)
    - s. BICSI: BICSI Outside Plant Design Reference Manual (OSPDRM)

- t. BICSI: BICSI Network Design Reference Manual (NDRM)
- 3. Firestopping:
  - a. Firestop Contractors International Association (FCIA), Manual of Practice
  - b. ASTM E 84, "Surface Burning Characteristics of Building Materials".
  - c. ASTM E 119, "Fire Tests of Building Construction and Materials".
  - d. ASTM E 814, "Fire Tests of Through Penetration Firestops".
  - e. ANSI/UL263, "Fire Tests of Building Construction and Materials".
  - f. ANSI/UL723, "Surface Burning Characteristics of Building Materials".
  - g. ANSI/UL1479, "Fire Tests of Through Penetration Firestops".
  - h. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

- B. In case of differences between building codes, state laws, local ordinances, utility company regulations, and the Contract Documents, the most stringent shall govern; this shall not be construed as relieving the contractor from complying with any requirements of the plans or specifications which may be in excess of code requirements and not contrary to same.

### 1.5 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

- A. "ITPM" shall mean the *IT Project Manager* representing Washington State University.
- B. "FSPM" shall mean the *Facilities Services Project Manager* representing Washington State University.
- C. "MCF" shall mean *Main Communication Facility*, a centrally located facility on campus that provides interbuilding cable feeds to the MDF in other buildings.
- D. "MDF" shall mean *Main Distribution Facility*, an area within a building where cabling from other buildings terminates and where intra-building cabling originates.
- E. "IDF" shall mean *Intermediate Distribution Facility*, one or more spaces within a facility that hosts telecommunications equipment, where horizontal cabling terminates and where this cabling cross-connects to backbone/riser cabling.
- F. Inter-building Feeder Cabling shall mean backbone cabling that connects two buildings, typically the MDF of one building with the MCF in another building.
- G. Intra-building Riser Cabling shall mean backbone cabling that connects the MDF and IDFs within a building.

- H. "SCS" shall mean *Structured Cabling System*. The SCS is defined as all required equipment and materials including (but not limited to) ANSI/TIA/EIA 568-B and ISO/IEC 11801 compliant copper station cable (Category 5E, Category 6, Category 6A, etc.) and fiber optic cable (multimode and singlemode), patch cables, stations and station connectors, termination blocks, patch panels, racks/enclosures (such as EIA standard equipment racks, enclosures, and vertical and horizontal cable management hardware), pathway/raceway materials (such as conduit, sleeves, D-rings, surface raceway, ladder rack, cable tray, etc.), and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.
  - I. "UTP" shall mean *Unshielded Twisted Pair* cable.
  - J. "TMGB" shall mean *Telecommunications Main Grounding Busbar*. There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.
  - K. "TGB" shall mean *Telecommunications Grounding Busbar*. There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.
  - L. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.
  - M. "EMT" shall mean *Electrical Metallic Tubing*.
  - N. "RMC" shall mean *Rigid Metal Conduit*.
  - O. "BET" shall mean *Building Entrance Terminal*.
  - P. "Raceway" shall mean any enclosed channel for routing wire, cable or busbars.
  - Q. "Pullbox" shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100 feet or in which there are more than 180 degrees of bends.
  - R. "Junction box" shall mean a pullbox wherein a feeder conduit transitions to multiple distribution conduits.
  - S. "Wire gutter" shall mean a metallic raceway with a square cross-section used for routing wire or cabling.
- 1.6 REQUIREMENTS OF REGULATORY AGENCIES
- A. The entire installation shall comply with the code requirements of all authorities having jurisdiction.
  - B. Contractor shall arrange for all inspections and shall correct non-complying installations.
- 1.7 PERMITS AND FEES
- A. The Contractor, at their expense, shall obtain permits and inspections required for the electrical work on this project. Inspection certificates shall be included in the Operation and Maintenance Manuals. Deliver copies thereof to the Architect/Engineer prior to final acceptance of the work.

1.8 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, “The Contractor shall apply Contractor’s stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Designer prior to start of construction. The Designer shall obtain approval from WSUP prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Designer it remains the Contractor’s responsibility to provide what is required in the Contract Documents”.

- A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Combine product submittals for all products and submit together as a single submittal.
  - 1. Submit a cover letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. State in the letter that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
  - 2. If (in the Contractor’s judgment) the system as designed will not meet the required performance specifications, submit a detailed written description of the reasons.
  - 3. Provide standard manufacturer’s cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.
  - 4. For those items noted as allowing “or equal,” and which are not being provided as specifically named, submit a written description detailing the reason for the substitution, along with standard manufacturer’s cut sheets or other descriptive information.
  - 5. Submit a list of proposed test equipment for use in verifying the installation of the SCS. Proposed test equipment shall meet the criteria as stated in PART 3 – TESTING.
    - a. Submit for each testing device:
      - 1) Manufacturer and product number
      - 2) Documentation from the manufacturer showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer’s recommended calibration period, encompassing the period of time when the testing device will be used on this project.
      - 3) Documentation from the manufacturer showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current ANSI/TIA/EIA testing guidelines.
    - b. Submit proposed copper and fiber cable test forms (see PART 3 – TESTING for more detail).
  
- B. Quality Control Submittals: Provide submittal information for review as follows:
  - 1. Prior to bidding, in accordance with the QUALITY ASSURANCE requirements below, submit the following contractor-qualifications documentation:
    - a. Documentation from the SCS manufacturers demonstrating that the Contractor is trained and certified by the Manufacturers to install, test, and maintain the SCS and is certified by the SCS Manufacturers to provide the SCS Manufacturer’s Warranty (see PART 1 - WARRANTY).
      - 1) TE NetConnect Design & Installation (ND&I) Contractor (for copper).
      - 2) Corning Network of Preferred Installers (NPI) Contractor (for fiber).

- 3) Zhone Expert Partner (for GPON).
  - b. Documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below.
    - 1) A list of the personnel who will be assigned to the project, the type of work they will be performing, and copies of the manufacturers' training certifications for each. If personnel changes are made during the project, submit the above information for any new personnel prior to their commencement of work on the project.
  - c. Documentation demonstrating that the Contractor employs a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The document shall declare that the RCDD is a direct full time employee of the Contractor and that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.
  - d. List of references for no less than five similar projects (in terms of size and construction cost) performed by the Contractor under the Contractor's current business name within the past four years. Detail the following for each project:
    - 1) Project name and location
    - 2) Construction cost
    - 3) A brief description of the project, the components involved, and the SCS manufacturer used on the project.
    - 4) Number of station drops
    - 5) Customer contact names, phone numbers, physical address and email address
- C. Closeout Submittals: Provide submittal information for review as follows:

A telecommunications-specific Operations and Maintenance (O&M) Manual for Communications shall be required for each project. O&M information submitted under other related communications sections (e.g. Conduits and Backboxes for Communications Circuits, Bonding and Grounding for Communications, etc.) shall be included in the O&M Manual and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications.

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description. Provide three bound copies of the O&M Manual for Communications.
2. Records - Maintain at the job site a minimum of one set of As-Built Drawings, Specification, and Addenda. As-Built Drawings shall consist of redline markups of changes to Contract Documents such as drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.
  - a. At the beginning of the work, set aside one complete set of the drawings to be maintained as a complete As-Built Drawings set. Notations shall be done in a neat and legible manner as specified in Division 01 and in accordance with the Architect/Engineer's instructions
  - b. The As-Built Drawings shall be updated daily by the foreman to show every change from the original drawings and the exact locations, sizes and kinds of equipment. Clearly identify system component labels and identifiers on As-Built Drawings. This set of drawings shall not be used for any other purpose and shall be maintained at the job site.
  - c. The actual location and elevation of all buried lines, boxes, monuments, stub-outs and other provisions for future connection shall be shown on the As-Built Drawings and shall be referenced to the building lines or approved bench marks
  - d. Keep As-Built Drawings at the job site and make available to the Owner and Designer at any time.
  - e. Keep As-Built Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).
  - f. Show identifiers for major infrastructure components on As-Built Drawings.

- g. Upon completion of the job, deliver the marked-up As-Built Drawings to the Architect/Engineer.
- 3. Test Reports
  - a. Test reports shall be provided electronically on CDROM. The CDROM shall be labeled with the following information:
    - 1) "Test Results"
    - 2) Project Name
    - 3) Date of Completion
  - b. CDROM shall be organized with folders for each category of test results. Each folder shall be subsectioned for each portion of a building (for example, the portion served by each IDF).
  - c. Test results shall be presented sequentially.
  - d. Details about the test equipment shall be included on the CDROM, including:
    - 1) Manufacturer and model number
    - 2) Date of most recent calibration
    - 3) Test methodology
  - e. Test reports shall be submitted within 3 weeks of Substantial Completion.
  - f. Following a review of the test results by the Owner and Engineer, the Contractor shall resolve any unsatisfactory test results by correcting the installed infrastructure. The corrected infrastructure shall be retested, and the new tests shall be inserted into the overall set of tests.
    - 1) A new CDROM shall be submitted with the entire comprehensive content (described above) included.
    - 2) A new folder titled "Failed Test Results" shall be added to the CDROM and the original unsatisfactory test results shall be stored in this folder.
  - g. See each specification section for specific test requirements for each type of technology infrastructure.

## 1.9 QUALITY ASSURANCE

- A. All Division 27 Contractors:
  - 1. Contractor's employees whose duties include the application of firestopping material shall be trained and certified by the specified firestopping manufacturer. Training and certifications by employee type are required as shown below:
    - a. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation.
    - b. Firestopping Technician: All (100%) shall be trained/certified for installation.
  - 2. Contractors shall be licensed and bonded as a low voltage contractor in accordance with State of Washington requirements, and shall obtain all required permits.
- B. Telecommunications Contractor Qualifications:
  - 1. Contractor shall be trained and certified by the Manufacturers to install, test, and maintain the SCS, and shall be certified by the SCS Manufacturers to provide the SCS Manufacturers' Warranties (see PART 1 - WARRANTY). Provide documentation from the SCS manufacturers demonstrating that the Contractor is trained and certified by the following:
    - a. TE NetConnect Design & Installation (ND&I) Contractor (for copper).
    - b. Corning Network of Preferred Installers (NPI) Contractor (for fiber).

If the project includes GPON, include the following paragraph. Otherwise, delete the Zhone Elite requirement.

    - c. Zhone Elite Certification (for GPON).Contractor shall maintain these certifications throughout the duration of the project.
  - 2. Contractor's employees directly involved with the supervision, installation, testing, and certification of the SCS shall be trained and certified by the selected SCS' manufacturers. Training and certifications by employee type are required as shown below. Provide documentation indicating that the Contractor will have only manufacturer-trained and

manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below. Provide a list of the personnel who will be assigned to the project, the type of work they will be performing, and copies of the manufacturers' training certifications for each. If personnel changes are made during the project, submit the above information for any new personnel prior to their commencement of work on the project. Except where specified otherwise, the following training and certification requirements shall be met by the Contractor at the time of bidding:

- a. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation and testing.
  - b. Test Technicians: All (100%) shall be trained/certified for installation and testing.
  - c. Installation Technicians: Prior to bidding, half (50%) shall be trained/certified for installation. Upon award of the project, the remaining untrained installation technicians shall be trained and certified by the manufacturer at no cost to the Owner.
  - d. Other personnel: Personnel not directly responsible for installation supervision, installation, testing or certifying the SCS (i.e. project managers, cleanup crew, etc.) are not required to be manufacturer-trained and certified. Otherwise, personnel not manufacturer-trained and certified shall not be allowed on the job site.
3. Contractor shall employ a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). Contractor shall continue to employ a minimum of one RCDD throughout the duration of the project.
- a. Provide documentation demonstrating compliance with this requirement.
4. Contractor shall have successfully completed no less than five similar projects (in terms of size and construction cost) under the Contractor's current business name within the past four years.
- a. Provide a list of references with the following details for each project:
    - 1) Project name and location
    - 2) Construction cost
    - 3) A brief description of the project, the components involved, and the SCS manufacturer used on the project.
    - 4) Number of station drops
    - 5) Customer contact names, phone numbers, physical address and email address
5. Contractor shall be capable of dispatching a qualified technician to the Owner's campus within four hours of a request for service during the installation, acceptance and warranty periods.
6. Firms desiring to have their qualifications reviewed pursuant to a determination of their qualifications shall submit documentation of the above requirements not later than ten days prior to the bid opening. Firms that have not been evaluated for qualification shall not bid. Bids from firms that have not been pre-qualified shall be discarded. The following firms have been pre-qualified:
- a. Interwest Technology Systems
  - b. Paramount Communications
  - c. Powercom
  - d. Evergreen

The Designer shall contact the WSUP ITPM and request a list of pre-qualified contractors who are currently in good standing with the University. The Designer shall list these companies, the name of a contact person, and a phone number for each.

C. Audio Visual Contractor Qualifications:

1. Contractor's employees directly involved with the supervision, installation, testing, and certification of the A/V System shall be full-time employees of the contractor for a minimum of one year, and shall have the experience detailed in this section. Provide documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below. Provide a list of the personnel who will be assigned to the project, the type of work they will be performing, and copies of the manufacturers' training certifications for each. If personnel changes are

made during the project, submit the above information for any new personnel prior to their commencement of work on the project.

- a. Supervisors/Project Foremen: All (100%) shall be certified as InfoComm CTS-I.
- b. Technicians: All (100%) shall be certified as:
  - 1) AMX ACE Design Expert (ACE-D)
  - 2) AMX ACE Installation Expert (ACE-I)
  - 3) AMX ACE Programming Expert (ACE-P)
2. Contractor shall have successfully completed no less than three similar projects (in terms of size and construction cost) under the Contractor's current business name within the past four years. The Contractor's project history shall include installation of common audio/visual equipment such as speaker systems, video projection and audio/video routing in a campus-type environment.
  - a. Provide a list of references with the following details for each project:
    - 1) Project name and location
    - 2) Construction cost
    - 3) A brief description of the project, the components involved, and the main audio/visual equipment manufacturers used on the project.
    - 4) Equipment used for the project
    - 5) Customer contact names, phone numbers, and addresses
3. Contractor shall employ a minimum of one InfoComm CTS-I certified technician in current good standing with InfoComm. The CTS-I shall be a direct-full time employee of the Contractor (i.e. a consultant/sub-contractor to the Contractor is not acceptable). Contractor shall continue to employ a minimum of one CTS-I throughout the duration of the project.
  - a. Provide documentation demonstrating compliance with this requirement.
4. Firms desiring to have their qualifications reviewed pursuant to a determination of their qualifications shall submit documentation of the above requirements not later than ten days prior to the bid opening. Firms that have not been evaluated for qualification shall not bid. Bids from firms that have not been pre-qualified shall be discarded. The following firms have been pre-qualified:
  - a. None.

#### 1.10 COORDINATION

- A. References to the "Owner" or "Owner's representative" throughout the Division 27 specification sections shall be interpreted to mean both the WSUP FSPM and the WSUP ITPM. All requirements to seek approval of the Owner require the involvement of the WSUP ITPM.
- B. The Division 27 Contractor shall coordinate work with that of the other contractors doing work in the building and shall examine all drawings, including the several divisions of mechanical, ventilating, structural and general, for construction details and necessary coordination.
- C. Coordinate and schedule connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- D. Coordinate the interruption of electrical systems to any part of the facility in use by the Owner at least 48 hours before interruption of the system.
- E. Special attention is called for the following items and all conflicts shall be reported to the Architect/Engineer before installation for decision or correction:
  1. Location of fixtures, pipes, ducts and other mechanical equipment such that telecommunications and audio/visual outlets, wall-mounted telephone devices, equipment racks and panels and other electrical equipment are mounted in proper relationship to these items.

2. Location of cabinets and counters such that communications work is clear from and in proper relation to these items.
  3. Penetrations of building structure for communications work.
  4. Compliance to Section 110-26 of NEC.
  5. Coordination and provisions for maintaining telephone service to areas in use during construction, especially elevator equipment, fire alarm systems, security systems and emergency systems (comply with General Division Provisions).
  6. Communications equipment shall fit in the space provided on the plan drawings or as specified. Equipment heights shall not exceed those shown or specified. Larger equipment shall not be considered acceptable. Contractor shall be responsible for all clearances around the communications equipment.
- F. Telephone and Internet services required by the Contractor during construction shall be provided by the Contractor. The Owner does not provide any communications utility services for construction projects. At substantial completion, the Owner will assume responsibility for communications utility services to the building and will transfer services at that time. This includes (but is not limited to) the following:
1. Telephone and Internet service for the Jobsite Construction Trailers
  2. Elevator telephone
  3. HVAC system Internet or networking
  4. Internet or networking for other building services.
- G. When conduit, insert or sleeves for outlet boxes and/or conduits are required, Contractor shall fully coordinate the installation thereof with other trades.
- H. Contractor shall coordinate the Division 27 work in other campus buildings that may be required to support the project, such as the Main Communications Facility (MCF), Intermediate Distribution Facilities (IDF), tunnels, vaults, enclosures, etc.
- I. The communications contractor shall take full responsibility for furnishing, installing and troubleshooting all communications systems in the building. The communications contractor shall be responsible for overall coordination of all communications systems and ensuring correct and full operation of all systems and system interfaces. The communications contractor shall coordinate the interfaces between the communications systems and all other systems.

#### 1.11 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DES Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

- A. Provide coordination with the cabling manufacturers to ensure that manufacturers' inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any manufacturer-required modifications and have manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.
- B. The Contractor is solely responsible for all costs associated with scheduling the manufacturer inspection, the inspection itself and any manufacturer-required re-inspections, and for any modifications to the installation as required by the manufacturers.

1.12 WARRANTY

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. The Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Designer shall consider, account for, and advise WSUP regarding any unique warranty situations that may arise from Owner-furnished equipment, Owner-installed equipment, or other situations that may conflict with warranty requirements.

A. Contractor Warranty:

1. Provide a Contractor-endorsed one-year service warranty against defects in materials and workmanship.
  - a. Provide all labor attributable to the fulfillment of this warranty at no additional cost to the Owner.
    - 1) The Contractor Warranty period shall commence upon Owner acceptance of the work.
  - b. This warranty shall not be voided by Owner's move, add and change activities. The resulting parts of any Owner-performed moves, adds and changes do not become part of the warranty. Nothing in this section shall be construed to terminate the warranty by performance of normal maintenance or service on the system or by expanding the system in any manner consistent with the original design and intent for the system.

B. SCS Manufacturer Warranties:

1. Provide SCS Manufacturer extended product, performance, application, and labor warranties that shall warrant all passive components used in the SCS. Additionally, these warranties shall cover components not manufactured by the SCS Manufacturers, but approved by the SCS Manufacturers for use in the SCS (i.e. "Approved Alternative Products"). The SCS Manufacturer warranties shall warrant:
  - a. That the products will be free from manufacturing defects in materials and workmanship.
  - b. That the cabling products of the installed system shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.
  - c. That the installation shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.
  - d. That the system shall be application independent and shall support both current and future applications that use the ANSI/TIA/EIA 568-B and ISO/IEC 11801 component and link/channel specifications for cabling.
2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the Owner.
3. The SCS Manufacturer Warranties shall be provided by the selected SCS Manufacturers and shall be:
  - a. TE 25-year System Warranty.
    - 1) Provide a copy of the warranty registration document to the Owner at the time of submittal to TE.
  - b. Corning 25-year System Warranty.
    - 1) Provide a copy of the warranty registration document to the Owner at the time of submittal to Corning.
4. The SCS Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the manufacturer. The Warranty Certificates shall be issued no later than three months after Owner acceptance of the work.

**PART 2 - PRODUCTS**

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

## 2.1 GENERAL

- A. Products and materials shall be as specified in the pertinent Sections of Division 27. Unless specifically stated as "Or equal", equivalent items are not acceptable. Provide items as specified.
- B. Wherever possible, all materials and equipment used in the installation of this work shall be of the same Manufacturer throughout for each class of material or equipment. Comply with ANSI, IEEE and NEMA standards, where applicable. Materials shall be new, in original manufacturer packaging, and bear the UL label. Material which has been damaged, removed from original packaging, or exposed to potential damage shall not be installed and shall be replaced at no additional cost to the Owner.
- C. Components shall be manufactured by the manufacturers listed in Division 27. Components shall not be intermixed between different manufacturers unless the manufacturer has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the Manufacturer Warranty.
  - 1. Bid only the manufacturers for which the Contractor is certified.
- D. All copper-related components shall be part of the copper SCS product line and all fiber optic-related components shall be part of the fiber optic SCS product line – components shall not be intermixed between manufacturers' SCS product lines. The SCS product lines shall be engineered "end-to-end" – the system and all of its components shall be engineered to function together as a single, continuous transmission path.
- E. Physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths of conduit and/or pathway to be used for routing backbone cabling. Pre-cut materials of insufficient length are the sole responsibility of the Contractor.
- F. Provide materials, devices, equipment or supplies of materials that are inherently non-corrosive or are coated or covered in a manner, acceptable to the Engineer, which renders them non-corrosive. Material that may cause rusting or streaking on a building surface shall not be used.
- G. All cabling and materials that could potentially be installed in ceiling spaces shall be manufacturer-labeled in accordance with NEC 800 to indicate their rating for plenum or non-plenum spaces. Use only plenum-rated materials in plenum-rated spaces.
- H. Provide all incidental and/or miscellaneous hardware (including equipment cables and connectors) not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

- I. Provide cables of the same type or application in the same color throughout the project, unless otherwise indicated. Multiple colors of the same cable type are not acceptable.

## 2.2 TOUCH-UP PAINT

- A. Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. Non-Equipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

## 2.3 TELECOMMUNICATIONS FIRESTOPPING

The Designer shall work with the Architect to coordinate the content in this paragraph with the content in Section 07 27 00 – Firestopping.

- A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:
  1. Specified Tech. Inc.
  2. Hilti
  3. or approved equal.
- B. Fire-Rated Cable Pathways: Device modules shall be comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill:
  1. Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway
- C. Firestop Pillows: Pillows shall be re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag:
  1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows
  2. Hilti CP 657 Firestop Brick

Generally speaking, WSUP prohibits the use of Putty-type firestopping products. However, sometimes an application will require putty. Prior to including putty products in the project, first obtain the approval of the WSUP ITPM. Delete the following paragraph if putty will not be used in the project.

- D. Firestop Putty: Putty products shall be re-enterable, non-curing, moldable substances:
  1. Specified Technologies Inc. (STI)
  2. Hilti

## 2.4 GROUNDING AND BONDING

- A. As specified under Section 27 05 26 – "Grounding and Bonding for Communications Systems."

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

### 3.1 GENERAL

- A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.
- B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.
- C. All work shall comply with the standards, references and codes listed in PART 1 – STANDARDS AND CODES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.
- D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.
- E. Equipment Dimensions and Clearances:
  - 1. Dimensions indicated for communications equipment and dimensions indicated for the installation of communications equipment are restrictive dimensions. Verify that equipment will fit within the indicated locations and spaces. Do not use equipment that impinges upon the required clearance, reduces actual clearance, or exceeds the indicated dimensions:
    - a. Except as approved in writing by the Engineer and the Owner.
  - 2. Do not use arrangements of equipment that impinge upon the required clearance, reduce actual clearances or exceed the space allocation.
- F. Equipment Access:
  - 1. Install equipment so it is readily accessible for operation and maintenance.
  - 2. Access to equipment shall not be blocked or concealed by conduits, supporting devices, boxes, or other items.
  - 3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.
- G. Equipment shall be installed plumb, square and true with the building construction and shall be securely fastened.
- H. Do not provide materials which contain polychlorinated biphenyls, asbestos or other hazardous or detrimental materials. Do not install materials in a manner, location or construction that produces galvanic action or any other materials corroding or eroding action. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete. Outdoor wall mounted equipment and indoor equipment mounted on earth or water bearing walls shall be provided with corrosion resistant spacers to maintain ¼ inch separation between the equipment and the wall. Screen or seal all raceways or other openings into equipment to prevent the entrance of moisture, rodents and insects.
- I. Drawings indicate the approximate location and arrangement of electrical equipment and the approximate location of other equipment requiring electrical work. The general arrangement of panelboards, outlets and other equipment is diagrammatic and approximate as to locations. To avoid interference with structural members and equipment of other trades, it may be necessary to adjust the intended location of electrical equipment. Where minor changes are required because of structural or finish conditions or for the convenience of the Owner, provide such changes without additional expense

to the Owner. Unless specifically dimensioned or detailed, the Contractor may, at his discretion, make minor adjustments in equipment location without obtaining the Engineer's approval. Minor adjustments are defined as a distance not to exceed:

1. 1 ft at grade, floor and roof level in any direction in the horizontal plane.
2. 1 ft for equipment at ceiling level in any direction in the horizontal plane.
3. 1 ft on walls in a horizontal direction within the vertical plane.
4. Changes in equipment location exceeding those defined above require the Engineer's approval.
5. Particular attention shall be paid to door swings, piping, radiation, ductwork, and structural steel:
  - a. In general, waste and vent lines and large pipe mains and ductwork shall be given priority for the locations and space shown.
  - b. No additional compensation will be allowed for the moving of misplaced outlets, wiring, or equipment

J. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

K. Remove surplus material and debris from the job site and dispose of legally.

### 3.2 SCHEDULE

A. At least one week prior to commencement of telecommunications-related work, a Pre-Installation Conference shall be held by the Contractor for the purpose of discussing and coordinating the scope of work with the Owner's IT representatives (ITPM).

B. Provide a time-scaled construction schedule indicating construction phases and deadlines associated with this work. At a minimum, the following tasks shall be shown on the schedule:

1. Start of outside plant ductbank and maintenance hole construction.
2. Dates of outside plant ductbank concealment (concrete and backfill).
3. Start of conduit and box rough-in
4. Start of main campus cable feed to building MDF
5. Start of MDF and IDF build out
6. Start of vertical riser cable installation
7. Start of horizontal cable installation
8. Start of horizontal cable termination
9. Date when elevator telephone service required
10. Date when building automation system (HVAC) will require network service
11. Start of outlet device termination and labeling
12. Start of installation testing – provide IT w/preliminary test results.
13. Start of final inspection process

C. Notify the ITPM if any changes to the schedule are anticipated.

### 3.3 INSTALLATION

A. Install the equipment and materials in a neat and workmanlike manner employing workmen skilled in the particular trade and in accordance with the manufacturer's instructions and industry standards. Maintain adequate supervision of the work by a person in charge at the site during any time that work under this division is in process or when necessary for coordination with other work.

B. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated. Mount enclosures for individual units at fifty-four inches above floors to centerline of controls.

- C. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated, and shall be securely fastened.
- D. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- E. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Attach enclosures with a minimum of three fasteners, and more if the manufacturer so recommends.
  - 1. Attach enclosures mounted on equipment with machine screws or clamps as required. Do not drill equipment frames or sheets without permission of supplier/manufacturer or the Engineer.
  - 2. Stand equipment off wall surfaces a minimum of one-quarter inch where enclosures are mounted on walls in wet areas (outdoors, below grades, etc.) with neoprene, or fiberglass or plastic shim washers.
  - 3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.
- F. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.
- G. Give right of way to raceways and piping systems installed at a required slope.
- H. Make all penetrations of electrical work through walls and roofs water and weather tight.
- I. Install concrete pads and bases according to requirements of Division 03 Section "Cast-in-Place Concrete."

#### 3.4 DEMOLITION

Review any demolition requirements for this project with the WSUP project manager and edit the following paragraph as applicable.

- A. Demolish existing telecommunications equipment, cable, materials, and incidentals no longer in use after installation of and cutover to the new SCS. Demolish all existing devices and cables which are noted for demolition. Demolition includes, but is not limited to:
  - 1. Remove all conduit, conductors, fittings, device boxes, hangers, panels, devices, etc., which are not concealed in the building structure or below grade/slab.
  - 2. Remove existing conductors from conduits, unless otherwise indicated, where existing work is to be abandoned in place. Cut and remove buried raceway indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap and patch surface to match existing finish.
  - 3. Do not remove or damage fireproofing materials. Repair or replace fireproofing removed or damaged.
- B. When demolishing existing surface plastic/metal raceway, patch and/or paint wall to match existing undisturbed wall finish after raceway is removed.
- C. Locate, identify, and protect equipment and materials to remain. Where existing work to remain is damaged in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality at no additional cost to the Owner.
- D. Remove demolished material from the Project site and legally dispose of demolished material.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation and/or reconnection.

- F. Coordinate demolition activities with those pertaining to other Divisions.

### 3.5 SEISMIC REQUIREMENTS

- A. General: Electrical equipment for emergency systems shall be braced to withstand lateral forces that result from earthquakes. The Electrical Contractor shall provide seismic calculations stamped and signed by a registered Structural Engineer confirming size, number and location of all required anchoring hardware. Electrical equipment vendors shall submit weights, dimensions and center of gravity location for all emergency electrical equipment for this purpose.

### 3.6 CUTTING AND PATCHING

- A. Cutting of Existing Structural Work: Holes in existing slabs and concrete walls shall be cored to the minimum size required. Contractor shall submit dimensioned drawings showing dimensioned sizes and locations for all holes to Architect/Engineer for approval before cutting. Where required for conduit installation, grade slabs shall be saw cut to minimum required width. Approval drawings shall be submitted to Architect/Engineer before cutting.
- B. Patching: All holes or chases shall be patched to match adjacent surfaces.

### 3.7 PAINTING

- A. General: All finish painting of electrical equipment shall be as specified in Division 9, unless equipment is herein-after specified to be furnished with factory applied finish coats. Equipment to be field painted shall be supplied with factory applied prime coat.
- B. Touch Up: If factory finish on any equipment furnished under this Division is damaged in shipment or during construction of the building, equipment shall be refinished by Contractor to the satisfaction of the Architect/Engineer.
- C. Concealed Equipment: All uncoated cast iron or steel that will be concealed or will not be accessible when installations are completed shall be given one heavy coat of black asphalt before installation.

### 3.8 CONCRETE WORK

- A. All concrete required for communications work shall be provided under Division 33.

### 3.9 FIRESTOPPING

- A. Comply with requirements in Division 07 – “Firestopping.”

The Designer shall work with the Architect to coordinate the content in this paragraph with the content in Section 07 27 00 – Firestopping.

- B. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
- C. Maintain fire rating of penetrated fire barriers. Fire stop and seal penetrations made during construction.
  1. Provide firestopping material for through and membrane penetrations of fire-rated barriers.
  2. Install firestops in strict accordance with manufacturer’s detailed installation procedures.
  3. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer’s recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply of sealing material in a manner acceptable to the local fire and building authorities.

4. For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.
  5. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.
- D. Fire and smoke stopping cable pathway devices shall be provided for all sleeve penetrations through fire-rated walls and wherever cables (not in conduit) pass through fire-rated walls. Devices shall be arranged singly or in gangs, and installed in strict accordance with the manufacturer's recommendations. Apply the factory supplied gasketing material prior to the installation of the wall plates. Secure wall plates to devices per the equipment manufacturer's recommendations.
1. Putty-type firestopping products are not acceptable.
- E. Fire and smoke stopping cable pathway devices shall be provided for all floor-to-floor firestopping applications.
- F. Firestopping putty and firestopping pillow products shall not be used for vertically oriented applications.

### 3.10 GROUNDING AND BONDING

- A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – STANDARDS AND CODES above, as well as local codes which may specify additional grounding and/or bonding requirements.
- B. Provide grounding and bonding as required under Section 27 05 26 – “Grounding and Bonding for Communications Systems” and as required under other Division 27 sections.

### 3.11 PROTECTION, CARE AND CLEANING

- A. Protection: Provide adequate protection for all finished parts of the materials and equipment against physical damage from any cause during the progress of work and until final completion. Sensitive electrical equipment shall not be installed until major construction is completed.
- B. Care: During construction, properly cap all lines and equipment to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint or work of other trades by covering with polyethylene sheets.
- C. Cleaning: After installation has been completed, clean all systems as follows:
1. Field Painted Items: Clean exterior of conduits, raceways, piping and equipment exposed in completed structure; removing rust, plaster, cement and dirt by wire brushing. Remove grease oil and similar materials by wiping with clean rags and suitable solvents.
  2. Factory Finished Items: Remove grease, oil and dust on factory finished items such as cabinets and racks, and rack-mounted equipment, and leave surfaces clean and polished. Vacuum inside of all electrical equipment and remove dust and debris.
- D. Connections: Prior to energizing, check all electrical connection hardware.

### 3.12 DAMAGE AND REPAIRS

- A. Emergency Repairs: Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the Contractor's warranty or relieving the Contractor of his responsibility during the warranty period.

- B. Responsibility for Damage: Contractor shall be responsible for damage to the grounds, buildings, or equipment due to work furnished or installed under this Division.

### 3.13 SERVICE OUTAGES

- A. Any telephone, data or television service outage required to perform work under this Contract shall be performed at a time that is coordinated with and convenient to the Owner. Submit to the Owner (in writing) for his approval, a schedule showing the dates and times the Contractor desires to perform his work. This schedule shall be submitted no less than five days prior to commencing work. It may be necessary to perform this work at night, on holidays or maintenance shutdowns. The Contractor shall include in his bid all premium time labor costs for this work.

### 3.14 IDENTIFICATION AND LABELING

- A. General: Labeling and administration shall comply with ANSI/TIA/EIA 606 and standard industry practices.
- B. Identifiers shall be defined for all communications features, equipment, racks, terminations, conduits, cable trays, faceplates, cabling and grounding/bonding systems as required in Division 27. Identifiers shall be consistent with the Owner's standard labeling scheme.
- C. Labels shall be prepared using machine-printed equipment, producing indelible text on durable label materials. Handwritten labels are not acceptable.
- D. Labels shall be affixed to each item, showing the identifier of that item, and arranged such that they are readable after cabling has been dressed and secured.
- E. Identifiers shall be shown on As-built Drawings.

### 3.15 TESTING

- A. Test every cable in the project, in accordance with Contract requirements, manufacturer requirements, industry standards, and warranty requirements and as required in Division 27.
- B. Notify the Owner's representative (ITPM) two weeks prior to the start of testing, and invite the Owner's representative to witness the testing.
- C. Prior to the start of testing, submit for Owner review and approval the proposed test procedures, test report forms and timetable for performing the required testing.
- D. Provide test records on a form approved by the Owner and Engineer. Submit the test results for each cable. The records shall include the unique cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Engineer for review and acceptance within three weeks of Substantial Completion.
  - 1. Prepare and submit the test results in Adobe Acrobat PDF electronic form (on a flash drive or CDROM) to the Owner and Designer for review. Handwritten test results will not be accepted.
  - 2. The CDROM shall be labeled with the words "Test Results", the project name, and the date of completion (month and year).
  - 3. Test data on the CDROM shall be organized into three folder categories as follows:
    - a. Inter-building Feeders
    - b. Intra-building Risers
    - c. Intra-building Horizontal

4. Each major heading shall be sub-sectioned by test type. For example, within the Inter-building and Intra-building sections, the following subsections or sub-files shall be created:
  - a. Scanner Test Results (Category 3 or Category 6)
  - b. Fiber Optic Attenuation Test Results
  - c. OTDR Traces
  - d. Power Meter Readings
  - e. Green Light Test Results
5. Test data within each section shall be presented in the sequence listed in the administration records. Information about the test equipment shall also be provided, including:
  - a. the name of the test equipment
  - b. manufacturer
  - c. model number
  - d. the date of the most recent calibration.
6. Test equipment shall be calibrated as often as the manufacturer specifies, or annually, whichever is more frequent.
7. The CDROM shall also include a PDF-printed description of each test method used and the specific settings of the equipment used to perform each type of testing.
8. A copy of all applicable test results shall be submitted (within three weeks of Substantial Completion) to each manufacturer that requires test results pursuant to warranty registration, including TE and Corning.
9. Any test-report anomalies discovered during review by the Owner or Engineer shall be resolved promptly by the Contractor at no additional cost to the Owner. Installation deficiencies shall be corrected, the testing redone and an updated CDROM containing a comprehensive set of all test reports (not just the portion requiring correction) shall be prepared and submitted to the Owner and Engineer.
  - a. The original test reports (showing the unacceptable results) shall also be included on the CDROM in a subfolder under the corresponding category.

- E. Costs of test shall be borne by Contractor. Contractor shall provide all instruments, equipment, labor and materials to complete test. Should tests detect any defective materials, poor workmanship or variance with requirements of Specifications, Contractor shall make any changes necessary and remedy any defects at his expense.

### 3.16 AS-BUILT DRAWINGS

- A. Upon completion and at other times during the progress of the work, when required, remove all surplus materials, rubbish and debris resulting from the work.

### 3.17 PRELIMINARY OPERATION

- A. The Owner reserves the right to operate portions of the communications system on a preliminary basis without voiding the warranty or relieving the Contractor of his responsibilities.

### 3.18 CLEAN-UP

- A. Upon completion and at other times during the progress of the work, when required, remove all surplus materials, rubbish and debris resulting from the work, and dispose of legally.

### 3.19 DEMONSTRATION

- A. Demonstrate equipment in accordance with Division 01.

- B. Provide assistance to the Engineer during the demonstration or observation of equipment by operating devices and equipment, opening enclosures for inspection, checking as-built drawing information, and similar tasks, as necessary in the Engineer's judgment, to verify all work performed.
- C. Acceptance Is Contingent On:
  - 1. Completion of final review and correction of all deficiencies.
  - 2. Satisfactory completion of acceptance tests which demonstrate compliance with all performance and technical requirements of Contract Documents.
  - 3. Satisfactory completion of training program and submission of all manuals and drawings required by Contract Documents.

3.20 OWNER-PROVIDED SERVICES

- A. The Owner will provide the following services:
  - 1. Install station patch cords and/or cross-connect "jumpers" for voice and data.
  - 2. Connections to the Local Exchange Carrier, and Inter-exchange Carrier.
  - 3. Connections to the campus voice, video and data network.

END OF SECTION

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

- A. Provide all materials and labor for the installation of a grounding and bonding system for inside plant telecommunications infrastructure. This section includes requirements for providing a permanent grounding and bonding infrastructure for horizontal and backbone communications circuits, equipment racking, raceways, and cable tray. These requirements are in addition to any that may exist in Section 26 – “Grounding.”

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - “Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations”.

Install - “Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations”.

Provide - “To furnish and install, complete and ready for the intended operation”.

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Grounding and Bonding infrastructure for communications circuits, raceways, and cable trays as hereinafter specified and/or shown on the Contract Documents. The Grounding and Bonding system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in Section 27 11 00 – “Communications Equipment Room Fittings” and Section 33 82 00 – “Communications Distribution.”
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Grounding and Bonding system.

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DIS Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.  
Part 2 - Products

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. Materials shall consist of busbars, supports, bonding conductors and other incidentals and accessories as required.

### 2.2 GROUNDING/BONDING:

- A. Telecommunications Main Grounding Bus Bar (TMGB):
  - 1. Large (20" x 4" x 1/4"), Pre-drilled: CPI 10622-020 or Panduit GB2B0312TPI-1
  - 2. Small (10" x 4" x 1/4"), Pre-drilled: CPI 10622-010
- B. Telecommunications Grounding Bus Bar (TGB):
  - 1. Large (20" x 4" x 1/4"), Pre-drilled: CPI 10622-020 or Panduit GB2B0312TPI-1
  - 2. Small (10" x 4" x 1/4"), Pre-drilled: CPI 10622-010

3. Narrow (13" x 2" x ¼"), Pre-drilled: Erico ERITECH TGB-A12L06PT (for wireless access point application)
  - C. Telecommunications Bonding Backbone (TBB): #2 AWG or #250 kcmil insulated (green in color) copper conductor.
  - D. Grounding Conductor: #6 AWG insulated (green in color) copper conductor.
  - E. Grounding Conductor: #6 AWG bare copper conductor.
- 2.3 LABELS:
- A. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
    1. Labels:
      - a. Panduit Marker Tie (or approved equal)
      - b. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
    2. Hand-carried label maker:
      - a. Brady: ID Pro Plus (or approved equal).

### PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

#### 3.1 GENERAL

- A. Install the grounding and bonding system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA standards.

#### 3.2 INSTALLATION

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. The grounding and bonding infrastructure system shall not make use of the building plumbing system, unless required to do so by the NEC.
  1. Coordinate the installation of the grounding and bonding system with the electrical power distribution system grounding infrastructure.

#### 3.3 GROUND/BONDING:

- A. TMGB: Provide a minimum of one TMGB per main telecommunications room ("MDF") for each building and as shown on the Contract Documents. Install TMGB(s) and directly bond TMGB(s) to electrical service ground and to associated TBB(s). Group protector, busbar bonding, and approved building

grounding conductors toward the left end and leave space for equipment grounding conductors to the right end.

- B. TGB: Provide TGB as shown on the Contract Documents and as required. Directly bond each TGB to its associated TBB (and thence to the TMGB) and to the nearest building structural steel or other permanent metallic system. Group protector, busbar bonding, and approved building grounding conductors toward the left end and leave space for equipment grounding conductors to the right end.
- C. TBB(s): Provide TBB(s) as shown on the Contract Documents and as required to bond TMGB to building main electrical ground and to bond all TGBs to the TMGB.
  - 1. Route along the shortest and straightest path possible with minimal bends.
  - 2. Bends shall be sweeping.
  - 3. Insulate TBB(s) and conductors from their support.
  - 4. TBB(s) shall be continuous (without splices).
- D. Grounding Conductors: Provide grounding conductors as shown on the Contract Documents and as required to bond all non-current carrying metal telecommunications equipment and materials to the nearest TGB.
  - 1. Route along the shortest and straightest path possible with minimal bends.
  - 2. Bends shall be sweeping.
  - 3. Insulate grounding conductors from their support.
  - 4. Grounding conductors shall be continuous (without splices).
  - 5. Bare conductors shall be provided for cable trays, wire mesh trays and wire gutter.
  - 6. Insulated conductors shall be provided in telecommunications rooms.
  - 7. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.
- E. Special Applications:
  - 1. Exterior Wireless Access Point Panels: Provide a Narrow grounding bus bar as shown on the Contract Documents. Install busbars and bond bus bars to associated TBB(s).

#### 3.4 LABELS:

- A. Label TMGB(s) with "TMGB". If the TMGBs are existing and unlabeled, provide labels for each.
- B. Label TGB(s) with "TGB". If the TGBs are existing and unlabeled, provide labels for each.
- C. Label TBB(s) and bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

**END OF SECTION**

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures, processes, preparatory work, or final cleaning.

Note that this section is specific to the communications system and shall be included in the Project Manual in addition to Division 26 - Conduits and Backboxes for Electrical Systems.

When an Electrical Systems section and a Communications Systems section are both in the Project Manual, a statement shall be added to the Conduits and Backboxes for Electrical Systems section similar to the following:

“For Telecommunications Raceway and Boxes, the requirements in Section 27 05 33 - Conduits and Backboxes for Communications Systems shall supercede the requirements in the section where they differ.”

- A. Provide all materials and labor for the installation of a pathway system for inside plant communications circuits. This section includes requirements for horizontal and building backbone raceways, fittings, and boxes specific to communications circuits (cabling) for voice and data.

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner Installed Items). If this paragraph is required for the project, the Designer must take care to clearly define any product warranty issues associated with the split responsibility. Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

Review and edit the following list of definitions for with applicability to this project. Add definitions for unusual terms that are not explained in the Conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

## 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Raceway system as hereinafter specified and/or shown on the Contract Documents. The Raceway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 27 15 00 - Communications Horizontal Cabling.
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the Contract Documents but which are necessary to make a complete working Raceway system.

## 1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in NEC, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation" and with NEC Quality assurance.

## 1.4 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

## 2.1 GENERAL

- A. Materials shall consist of conduit, surface raceway, outlet boxes, fittings, enclosures, pull boxes, and other raceway incidentals and accessories as required for inside plant communications circuits.

## 2.2 MATERIALS

### A. Conduit:

1. EMT: 1 inch minimum conduit size. Flexible metal conduit (FMC) is not acceptable.
  - a. Conduit: Galvanized steel tubing meeting ANSI C80.3.
  - b. Couplings: Steel, cast iron, or malleable iron compression type employing a split, corrugated ring and tightening nut, with integral bushings and locknuts. Indent-type and setscrew-type couplings are not permitted.
  - c. Insulated throat bushings: Arlington EMTxxx or approved equal.
  - d. Ground Wire Clamp: Penn-Union Zinc Die Cast Ground Clamp or approved equal.
2. RMC: 1 inch minimum conduit size.
  - a. Conduit: Hot dipped galvanized steel with threaded ends meeting ANSI C80.1.
  - b. Couplings: Unsplit, NPT threaded steel cylinders with galvanizing equal to the conduit.
  - c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.
  - d. Insulated throat bushings: Arlington RGDxxx or approved equal.
  - e. Ground Wire Clamp: Penn-Union Zinc Die Cast Ground Clamp or approved equal.

- B. Sleeves: EMT conduit, with insulated throat bushings for each end and ground wire clamp on one end.

- C. Weatherhead: Weatherproof fitting for rooftop penetrations, sized appropriate for the application.

- D. Outlet boxes: Minimum 4"x4" size, 2 7/8 inch minimum depth, with extension rings (if needed) and double-gang covers (i.e. mud rings), unless otherwise noted on the Contract Documents. Combined interior depth of outlet box, extension ring and cover shall be a minimum 2-1/2 inches. Stamped steel, deep drawn, galvanized, with knockouts for 1 inch trade size conduit or connector entrance, meeting NEMA OS 1.

1. Acceptable manufacturers for indoor applications:
  - a. Appleton, Raco, Steel City, or equal
2. Acceptable manufacturers for outdoor weatherproof applications:
  - a. Box: 4"x4" Taymac DB5100 with plugs for unused holes
  - b. Cover: Taymac MX6200 with GFCI device configuration
  - c. or equal.

- E. Surface-mounted outlet boxes: Minimum 4"x4" size, 2 3/4 inch minimum depth, supporting double-gang faceplates, unless otherwise noted on the Contract Documents.
  - 1. Acceptable manufacturers for indoor applications:
    - a. Wiremold or equal
- F. Outlet box mounting brackets: Rough-in brackets for mounting multiple device boxes in a single stud space.
  - 1. Acceptable manufacturers for indoor applications:
    - a. Appleton, Raco, Steel City, B-line, or equal
- G. Floor-boxes: See Division 26.
- H. Junction Boxes and Pull Boxes: Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for conduit or connector entrance. Boxes 6"x6"x4" or larger may be code gauge fabricated steel continuously welded at seams and painted after fabrication.
  - 1. Dry locations: meeting NEMA OS 1.
  - 2. Wet locations: meeting NEMA OS 3R.
- I. Miscellaneous Fittings:
  - 1. Locknuts and conduit bushings: Malleable iron
    - a. Appleton, Crouse Hinds, OZ Gedney, or equal
  - 2. Through wall seals and floor seals:
    - a. OZ Gedney FS and WS series.
- J. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb, with footage markings.

Surface-mounted raceway is generally not permitted at WSUP. Prior to designing a solution requiring surface-mounted raceway, the Designer shall first obtain the approval of the WSUP ITPM and FSPM.

## 2.3 GROUNDING AND BONDING

- A. Grounding Conductor: #6 AWG bare copper conductor.
- B. Bonding lugs and screws: UL Listed, NEC compliant, rated for use with grounding and bonding, and sized appropriate for the application.

## 2.4 LABELING AND ADMINISTRATION

- A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.
  - 1. Labels:
    - a. Brady: BradyMaker Wire Marking Labels WML-511-292 (or approved equal)
    - b. Hand-carried label maker: Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

### 3.1 GENERAL

- A. Install the raceway system in a manner ensuring that communications circuits, when installed, are able to fully comply with ANSI/TIA/EIA Standards and NEC.

### 3.2 EXAMINATION

- A. Examine surfaces and spaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Notify the Engineer/Owner of conditions that may adversely affect the installation, subsequent use, or cause the conduits (or circuits to be subsequently installed in the conduits) to not comply with ANSI/TIA/EIA standards.

### 3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Provide a raceway for each circuit indicated. Do not gang raceway into wireways, pullboxes, junction boxes, etc., without specific approval from the Designer. Do not group home runs or circuits without approval from the Designer.
- B. Conduit:
  - 1. Provide EMT unless other conduit as shown on the Contract Documents, as required by Code, or as permitted under these specifications.
  - 2. Provide RMC for outdoor applications and as shown on the Contract Documents, or as required by Code.
  - 3. Install conduit as a complete, continuous system without wires, mechanically secured and electrically connected to metal boxes, fittings and equipment. Blank off unused openings using factory-made knockout seals.
  - 4. Run conduit in the most direct route possible, parallel to building lines. Do not route conduit through areas in which flammable material may be stored.
  - 5. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit. Install horizontal conduit runs above water piping.
  - 6. Keep conduit away from sources of electromagnetic interference as follows:
    - a. 5 inches from fluorescent lighting
    - b. 12 inches from conduit and cables used for electrical power distribution
    - c. 48 inches from motors or transformers
  - 7. Do not exceed 295 feet total length for a given conduit run to be used for distribution cabling (from outlet box to telecommunications room), including intermediate conduits and junction boxes.
  - 8. Install conduit exposed, except in finished areas or unless shown otherwise on the drawings. Do not install conduit below grade/slab unless specifically shown on the Contract Documents as being installed below grade/slab.
  - 9. Install exposed conduit in lines parallel or perpendicular to building lines or structural members except where the structure is not level. Follow the surface contours as much as practical. Do not

- install crossovers or offsets that can be avoided by installing the conduit in a different sequence or a uniform line.
- a. Run parallel or banked conduits together, on common supports where practical.
  - b. Make bends in parallel or banked runs from same centerline to make bends parallel.
10. Conduits concealed above ceilings, furred spaces, etc., which are normally inaccessible may be run at angles not parallel to the building lines.
  11. Wherever practical, route conduit with adjacent ductwork or piping and support on common racks. Base required strength of racks, hangers, and anchors on combined weights of conduit and piping.
  12. Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.
  13. Support conduits as specified in Section 27 05 00 – "Common Work Results for Communications."
    - a. Provide anchors, hangers, supports, clamps, etc. to support the conduits from the structures in or on which they are installed. Do not space supports farther apart than five feet.
    - b. Provide sufficient clearance to allow conduit to be added to racks, hangers, etc. in the future.
    - c. Support conduit within three feet of each outlet box, junction box, gutter, panel, fitting, etc.
  14. Ream conduits to eliminate sharp edges and terminate with metallic insulated grounded throat bushings. Seal each conduit after installation (until cable is installed) with a removable mechanical-type seal to keep conduits clean, dry and prevent foreign matter from entering conduits.
  15. Install a pull string in each conduit prior to the installation of cabling. Pull string shall be secured on each end to prevent inadvertent removal. Provide at least 12 inches of slack at each end of the string.
  16. For conduits entering through the floor of a telecommunications room, terminate conduits 4 inches above the finished floor.
  17. Do not install communications conduits in wet, hazardous or corrosive locations.
  18. Where conduit is shown embedded in masonry, embed conduit in the hollow core of the masonry. Horizontal runs in the joint between masonry units are not permitted.
  19. Where conduit is shown embedded in concrete, embed conduit a minimum of two inches from the exterior of the concrete. Do not place conduit in concrete less than five inches thick.
    - a. One inch trade size conduit shall be used. Conduits sized larger or smaller than one inch trade size conduit are not permitted embedded in concrete.
    - b. Run conduit parallel to main reinforcement.
    - c. Conduit crossovers in concrete are not permitted.
  20. Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.
  21. Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 4 inches above the finished floor.
  22. Where conduits terminate at a cable tray, the conduits shall be consistently terminated no more than 8 inches from the cable tray, and have a visually uniform appearance.
  23. Where several circuits follow a common route, stagger pullboxes or fittings.
  24. Where several circuits are shown grouped in one box, individually fireproof each conduit.
  25. Bend and offset metal conduit with standard factory sweeps or conduit fittings. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
    - a. Conduit sweeps:
      - 1) Sweeps shall not exceed 90 degrees.
      - 2) Do not exceed 180 degrees for the sum total of conduit sweeps for a section of conduit (between conduit termination points).
      - 3) Sweep radius shall be at least 10 times the internal diameter of the conduit.
      - 4) 90-degree condulets (LB's) and electrical elbows are not acceptable.

- 5) A third 90-degree bend is permissible only within 12 inches of the feed end of the conduit (typically near a cable tray) or when the overall length of the conduit run is less than 80 feet.
  - b. Factory-manufactured sweeps are required for bends in conduit larger than 1 inch trade size.
  - c. For bends in 1 inch trade size conduit, field-manufactured bends (using a hydraulic bender with a 1 inch boot) are permitted only when factory-manufactured sweeps are not suitable for the conditions. In all other cases, factory-manufactured sweeps are required. "Hickey-bender" use is prohibited.
26. Connect conduit to hubless enclosures, cabinets and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the nearest practicable point of entry to the enclosure area where the devices are located to which the circuits contained in the conduit will connect.
27. Penetrations for raceways:
- The Designer shall consider requiring approval by a licensed Structural Engineer prior to designing penetrations through building structural components.
- a. Do not bore holes in floor and ceiling joists outside center third of member depth or within two feet of bearing points. Holes shall be 1-¼ inch diameter maximum.
  - b. Penetrate finished walls and finished surfaces with a PVC or sheet metal sleeve with an interior diameter (ID) at least ¼ inch greater than the outer diameter (OD) of the conduit, set flush with walls, pack with fiberglass, seal with silicone sealant and cover with escutcheon plate.
  - c. Penetrate poured-in-place walls and free slabs with a cast iron sleeve (or Schedule 40 PVC black pipe sleeve for above-grade only) with retaining ring or washer. Set sleeves flush with forms or edges of slab. Pack around conduit with fiberglass and seal with silicone sealant.
28. Rooftop conduit stubs shall be terminated with a weatherhead, properly sized for the application.
29. Raceway terminations and connections:
- a. Join conduits with fittings designed and approved for the purpose and make joints tight. Do not use set indent-type or screw-type couplings.
  - b. Make threaded connections waterproof and rustproof by applying a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.
  - c. Make conduit terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
  - d. Cut ends of conduit square using a hand saw, power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Where conduit threads are cut in the field, cut threads to have same effective length, same thread dimensions and same taper as specified for factory-cut threads.
  - e. Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.
  - f. Where conduits are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
30. Install conduit sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
- a. Where conduits pass from warm to cold locations, such as the boundaries of air conditioned or refrigerated spaces and where conduits enter or exit buildings from outdoor areas, including underground ducts or conduit runs.

- b. Where otherwise required by the NEC.
  31. Conduit shall be clean and dry.
- C. Sleeves:
1. All applications:
    - a. Provide sleeves where required, sized as noted on the Contract Documents. Where not noted, sleeve sizing shall be determined by the type and quantity of cable to be routed through the sleeve per TIA/EIA 569A cable capacity standards, plus an additional 100% for future expansion.
    - b. Provide roto-hammering or core drilling where required for installation. Prior to creating penetrations, consult a structural engineer to verify that the penetration will not damage the structural integrity of the wall or floor.
    - c. Seal between sleeve and wall or floor in which the sleeve is installed. Firestop penetration to restore wall or floor to pre-penetration fire-rating.
  2. Riser Applications:
    - a. Riser sleeves and raceways shall be installed through floors terminating 4 inches above finished floor.
    - b. Riser sleeves shall be located no closer than 4 inches and no farther than 6 inches from the wall.
    - c. Riser sleeves shall be spaced with approximately 3 inches space between adjacent sleeves.
- D. Conduit Applications:
1. Unless otherwise indicated in the Contract Documents, conduit shall be provided as follows:
    - a. Penthouse devices shall terminate on the floor immediately below the penthouse.
    - b. Provide raceway sleeves through all fire and smoke separation walls.
    - c. Provide raceways to outlets located inside fixed casework or furnishings. This does not apply to modular "system" furniture.
    - d. Provide conduits from outlets to cable trays. Stubbing conduits up into the ceiling space, with J-hook (or similar) pathway from conduit stub to cable tray is not acceptable.
- E. Wire Gutter:
1. Provide wire gutter as shown on Contract Documents.
  2. Wire gutter shall be routed parallel to and perpendicular to surfaces or exposed structural members, and follow surface contours. Wire gutter shall not be warped during installation such that hinged cover operation is impaired.
  3. Wire gutter color shall be painted according to Architectural requirements.
  4. Wire gutter systems shall be completely installed, including insulating bushings and inserts as required by manufacturer's installation requirements. Unused openings in the surface raceway shall be closed using manufactured fittings.
  5. Wire gutter covers shall open and close without obstruction and shall swing freely on hinges. Closure mechanisms shall securely retain the covers in their closed position.
  6. Wire gutter shall be securely supported by screws or other anchor-type devices at intervals not exceeding 4 feet and with no less than six supports per straight section. Wire gutter shall be securely supported in accordance with the manufacturer's requirements. Tape and glue are not acceptable support methods.
  7. For wire gutter installed in outdoor environments, seal all penetrations against moisture intrusion.
- F. Outlet Boxes:
1. Provide outlet boxes and covers as shown on the Contract Documents and as needed. Verify that the appropriate cover type and depth is provided for each type of wall and finish. Provide extension rings as needed.
  2. Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.

3. Install boxes in dry locations (not wet, corrosive, or hazardous).
  4. Attach boxes securely to building structure with a minimum of two fasteners. Provide attachments to withstand a force of one hundred pounds minimum, applied vertically or horizontally.
  5. Install boxes at the following heights to the bottom of the box, except where noted otherwise:

The Designer shall edit the mounting heights below as is appropriate for each project. Workstation telecommunications outlets shall be mounted at the same height as the electrical power receptacles.

    - a. Wall mounted telephones: 50 inches above finished floor.
    - b. Workstation outlets in office spaces: 4 inches above desktop height.
    - c. Workstation outlets not in office spaces: match height of power outlets, typically 16 inches above finished floor.
    - d. Place boxes for outlets on cabinets, countertops, shelves, and similar boxes located above countertops two inches above the finished surface or two inches above the back splash. Verify size, style, and location with the supplier or installer of these items prior to outlet box installation.
  6. Recessed mounted outlet boxes:
    - a. Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within 1/16th inch for each condition. Set boxes so that box openings in building surfaces are within 1/8th inch of edge of material cut-out and fill tight to box with building materials. Double gang opening shall extend at least to the finished wall surface and extend not more than 1/8th inch beyond the finished wall surface. Provide backing for boxes using structural material to prevent rotation on studs or joists.
    - b. Install floor boxes level and adjust to finished floor surface.
  7. Surface-mounted outlet boxes:
    - a. For boxes surface-mounted on finished walls, provide Wiremold (or similar product) outlet box. Cut box as necessary to accept conduit.
    - b. For boxes surface-mounted on unfinished walls (i.e. electrical rooms, mechanical rooms), provide 4" x 4" (minimum) outlet box with double gang cover.
  8. Outdoor outlet boxes:
    - a. For boxes mounted outdoors, provide weatherproof boxes and covers.
- G. Floor Boxes: See Division 26.
1. For floor boxes with combined power and telecommunications circuits, provide metal dividers to separate power from telecommunications circuits.
- H. Junction Boxes:
1. Provide junction boxes as shown on the Contract Documents and as required.
    - a. Where sizing is not shown on the Contract Documents, size junction box length and depth according to the size of the feeder conduit in the following table:

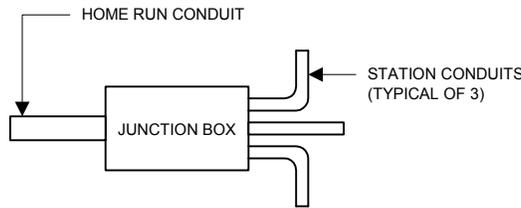
Feeder Conduit Size	Box Length	Box Depth
1"	12"	4"
1-1/4"	12"	4"
1-1/2"	12"	4"
2"	24"	4"
2-1/2"	24"	6"
3"	36"	6"
3-1/2"	48"	6"
4"	60"	6"

- b. Where sizing is not shown on the Contract Documents, size junction box width according to the following formula:
- 1) From the table below, select the width associated with the largest conduit on the distribution side of the box. For each additional distribution conduit, add the "Increase Width" value associated with the size of that distribution conduit to the box width for the largest distribution conduit.
    - a) For example, if the distribution side of the junction box has one 1-1/4" distribution conduit and three 1" distribution conduits, the total distribution-side width would be 6"+2"+2"+2"=10".
  - 2) Repeat the above process for the feeder side of the junction box. Junction boxes are typically fed by a single conduit, therefore unless the box has more than one feeder conduit, the "Increase Width" part of the formula is unnecessary.
    - a) For example, if the feeder side of the junction box has two 2" feeder conduits the total feeder-side width would be 8"+5"=13".
  - 3) The larger of the two width calculations (distribution side vs. feeder side) shall be the width of the junction box to be provided.
    - a) For example, if the distribution-side width were 10" and the feeder-side width were 13", provide a 13" wide junction box.

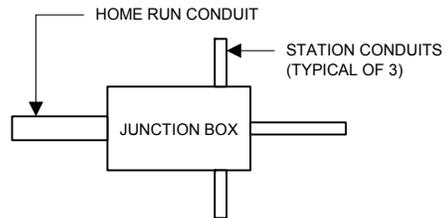
Conduit Size	Box Width	For each additional conduit Increase Width
1"	4"	2"
1-1/4"	6"	3"
1-1/2"	8"	4"
2"	8"	5"
2-1/2"	10"	6"
3"	12"	6"
3-1/2"	12"	6"
4"	15"	8"

2. A junction box may not be substituted for a 90-degree bend. *90 degree condulets (LB's) are not acceptable.*
3. Install junction boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install junction boxes in inaccessible interstitial building spaces.

4. Where junction boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4 feet above grid (mount on wall instead).
5. Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
6. Install junction boxes so that the access door opens from the side where the cable installer will normally work – typically from the bottom (floor side) of the box.
  - a. Where a junction box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.
  - b. Provide a lockable access cover (or junction box door if junction box is exposed) in hard lid ceilings.
7. Install junction boxes such that conduits enter and exit at opposite ends of the box as follows:



CORRECT INSTALLATION



INCORRECT INSTALLATION

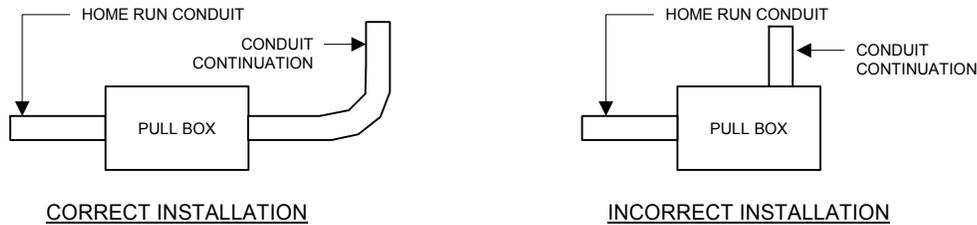
I. Pull Boxes:

1. Provide pull boxes as shown on the Contract Documents and as required.
  - a. Where sizing is not shown on the Contract Documents, size pull boxes as follows:

Size of Largest Conduit	Box Width	Box Length	Box Depth
1"	4"	12"	4"
1-1/4"	6"	12"	4"
1-1/2"	8"	12"	4"
2"	8"	24"	4"
2-1/2"	10"	24"	6"
3"	12"	36"	6"
3-1/2"	12"	48"	6"
4"	15"	60"	6"

- b. Where a pull box is required with conduits 1 inch trade size or smaller, an outlet box may be used as a pull box. Where outlet boxes are used as pull boxes, the outlet boxes shall be dedicated for use as a pull box and shall not host cable termination hardware.
2. A pull box may not be substituted for a 90-degree bend. *90 degree condulets (LB's) are not acceptable.*
3. Install pull boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install pull boxes in inaccessible interstitial building space.
4. Where pull boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4 feet above grid (mount on wall instead).
5. Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
6. Install pull boxes so that the access door opens from the side where the cable installer will normally work (typically from the bottom, or floor side, of the box).
  - a. Where a pull box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.

- b. Provide a lockable access cover (or pull box door if pull box is exposed) in hard lid ceilings.
7. Install pull boxes such that conduits enter and exit at opposite ends of the box as follows:



### 3.4 GROUNDING/BONDING:

- A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, UL 467, ANSI/TIA/EIA standards and the references listed in Section 27 05 00 – “Common Works Results for Communications” PART 1 – STANDARDS AND CODES, as well as local codes which may specify additional grounding and/or bonding requirements.
  - 1. Bond metallic raceway together and to the nearest TGB (as provided under Section 27 05 26 – “Grounding and Bonding for Communications Systems”). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.
- B. Conduits and Sleeves:
  - 1. For conduits and sleeves terminating at a cable tray, provide a bonding conductor to the cable tray grounding conductor, terminated with bonding lugs. Where multiple conduits terminate adjacent to each other, it is permissible to daisy-chain the bonding conductor between conduits and route a single conductor to the cable tray grounding conductor.
  - 2. For conduits and sleeves terminating in a telecommunications room, provide a bonding conductor to the TGB or TMGB in that room. Where multiple conduits terminate adjacent to each other, it is permissible to daisy-chain the bonding conductor between conduits and route a single conductor to the TGB or TMGB.
- C. For Wire Gutter:
  - 1. Provide a continuous grounding conductor running the length of the wire gutter.
  - 2. Bond each section of wire gutter to the grounding conductor.
  - 3. Ensure that the grounding/bonding hardware breaks through painted surfaces.

### 3.5 LABELS:

- A. Conduits: Label each conduit end in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, outlet identifier, etc.). Use the label of the first port of the outlet as the outlet identifier. Indicate conduit length on the label.
  - 1. Where a conduit is intended for future cabling use outside of the Contract, the conduit shall be labeled in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, etc.) along with a sequential number for each spare conduit terminated into a single room. Indicate conduit length on the label.
    - a. Suggestion: The second spare conduit (whether spare or in use) between Room 100 and telecommunications room 1A might be labeled in the telecommunications room as “100 - #2, \_\_\_ feet.” In Room 100 the same conduit might be labeled “1A - #2, \_\_\_ feet.”
- B. Pull Boxes: Label each pullbox with a unique identifier. Identifiers shall be of the form “RN-Y” where “RN” is the room name of the room closest to (or containing) the pull box, and “Y” is the sequential number of the pull box for each “RN”.

1. Example: The second pull box in the vicinity of room "100" would have the label "100-2".

### 3.6 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.7 CLEANING

1. On completion of installation (including outlet fittings and devices), inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

**END OF SECTION**

**PART 1 - GENERAL**

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 SUMMARY

- A. Provide all materials and labor for the installation of a cable tray system for communications infrastructure. This section includes requirements for providing a cable tray system for communications circuits. These requirements are in addition to any that may exist in Division 26 – “Cable Tray.”

1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Cable Tray infrastructure for communications circuits as hereinafter specified and/or shown on the Contract Documents. The Cable Tray system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in Section 27 15 00 — "Communications Horizontal Cabling."
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Cable Tray system.

1.3 STANDARDS AND CODES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the WSUP FSPM and/or the WSUP ITPM assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

- A. The applicable portions of the following specifications, standards, codes and regulations shall be incorporated by reference into this section:
1. ASTM A123 – Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
  2. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.
  3. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.
  4. ASTM A1008 – Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.
  5. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
  6. NEMA VE 1 – Metallic Cable Tray Systems
  7. NEMA VE 2 – Cable Tray Installation Guidelines

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. Materials shall consist of tray sections, tray fittings, connectors, supports, expansion joints, blind end plates, barrier strips, radius drops, bonding conductors and other incidentals and accessories as required. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational and warranted system.
- B. Unless specifically stated as “Or equal”, equivalent items are not acceptable. Provide items as specified.
- C. Physically verify existing site conditions prior to purchase and delivery of the materials.
- D. Except for the use of ladder rack and wire basket tray where indicated, open bottom type cable trays, where cable and wiring are exposed to view are not acceptable.
- E. Structure of trays shall be suitable to support a continuous loading of cables weighing 75 pounds per linear foot, when supported on 12 foot centers, without any deflection exceeding 1/100 of the span, with a safety factor of 1.50.

- F. Interior surfaces shall be smooth and free of offset edges, projections or misalignment. Assembly bolts for end to end connections shall have a pattern which does not cause damage to cable sheaths of jackets. All edges shall be smooth, rounded and de-burred.

## 2.2 SOLID BOTTOM CABLE TRAY

- A. Solid bottom cable tray components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers.
  - 1. The cable tray manufacturer shall be the following:
    - a. PW (Legrand) or pre-approved equal
  - 2. Substitution is not acceptable unless the cable tray manufacturer has been pre-approved prior to bidding. Contractors, in order to obtain approval for cable tray manufacturer substitution, shall submit their request for substitution to the Engineer at least two weeks prior to the bid date. Approval or denial of a substitution request will be based upon the sole judgment of the Engineer.
- B. Cable tray shall be comprised of "C" channel sides and a solid, corrugated bottom.
  - 1. The cable tray product line shall be the following:
    - a. PW (Legrand): SC-1E53-0020-12 (hot-dipped galvanized steel).
    - b. PW (Legrand): SC-1E53-0020-18 (hot-dipped galvanized steel).
    - c. Aluminum tray is not permitted.
  - 2. Width: Widths shall be as shown on the Contract Documents. Where cable tray width is not shown on the Contract Documents, it shall be sized according to the amount of cable to be placed in the trays (as shown on the Contract Documents) plus an additional 100% for future expansion capability.
  - 3. Depth: Depths shall be as shown on the Contract Documents. Where cable tray fill/load depth is not shown on the Contract Documents, it shall be 4 inches.
  - 4. Fittings: Fittings shall be factory manufactured.
  - 5. Lids: Lids shall be provided where shown on the Contract Documents.
- C. Manufacturer's factory fabricated accessories and special transitions shall be provided for all changes in direction, elevation and offsets. Use manufacturer's standard fittings including bolting assemblies for all end to end connections.
  - 1. Field-fabricated transitions shall not be accepted.
- D. Cable tray shall be factory-primed and then painted onsite as indicated in the Contract Documents.

## 2.3 WIRE BASKET (MESH) TRAY

- A. Wire mesh tray components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers.
  - 1. The cable tray manufacturer shall be one of the following:
    - a. B-Line
    - b. Cablofil
  - 2. Substitution is not acceptable unless the cable tray manufacturer has been pre-approved prior to bidding. Contractors, in order to obtain approval for cable tray manufacturer substitution, shall submit their request for substitution to the Engineer at least two weeks prior to the bid date. Approval or denial of a substitution request will be based upon the sole judgment of the Engineer.
- B. For a given manufacturer, all components shall be part of a single cable tray product line – components shall not be intermixed between a manufacturer's cable tray product lines.
  - 1. The cable tray product one shall be one of the following:
    - a. B-Line: Flextray Series
    - b. Cablofil, Inc.: EZ Tray CF54/xxx and CF104/xxx Series

- C. Wire mesh tray shall be constructed of welded wire mesh (high strength steel wires) with a continuous safety edge wire lip. Tray shall be complete with all supports, materials, and incidental and miscellaneous hardware required for a complete cable tray system.
  - 1. Finish: Carbon steel with electro-plated zinc galvanized finish.
  - 2. Width: Widths shall be as shown on the Contract Documents. Where cable tray width is not shown on the Contract Documents, it shall be sized according to the amount of cable to be placed in the trays (as shown on the Contract Documents) plus an additional 100% for future expansion capability.
  - 3. Depth: Depths shall be as shown on the Contract Documents. Where cable tray depth is not shown on the Contract Documents, it shall be 4 inches.
  - 4. Mesh: 2 x 4 inches.
  - 5. Fittings: Fittings shall be field fabricated from straight sections using manufacturer-approved cutting tools and in accordance with manufacturer's instructions.
- D. Wire mesh cutting tools shall be manufacturer-approved with "offset cutting blade" jaws and a minimum 24 inch handle, and able to produce clean cuts without ragged edges.

## 2.4 SUPPORTS

- A. Wall supports shall provide for open side access cable lay-in capability.
  - 1. Solid Tray shall be welded steel, unistrut cantilever brackets:
    - a. 12 inch wide tray: PW (Legrand) G-0205-13
    - b. 18 inch wide tray: PW (Legrand) G-0205-19
  - 2. Wire Basket Tray shall be formed finished steel shapes:
    - a. 12 inch wide tray: B-Line 12 L BRKT
    - b. 18 inch wide tray: B-Line 20 L BRKT
    - c. End Termination: B-Line FTA9WTK
- B. Trapeze-style hangers shall support cable tray from structure above the tray.
  - 1. All-thread
  - 2. Unistrut
- C. Center hanger-style supports are not permitted.

## 2.5 CABLING RADIUS DROP FITTINGS

- A. Solid Tray:
  - 1. PW (Legrand) G-0254-12
  - 2. PW (Legrand) G-0254-18
- B. Wire Basket Tray:
  - 1. B-Line DROP OUT

## 2.6 GROUNDING AND BONDING

- A. Continuous Grounding Conductor: 6 AWG copper conductor, bare (uninsulated), unspliced. Using the cable tray or wire mesh tray as a grounding conductor, with bolted splicing hardware and bonding jumpers is not acceptable
- B. Grounding Lugs:
  - 1. Solid Bottom Tray
    - a. PW (Legrand): 9992-A840-01 with attachment clamp 9999-1873-03
  - 2. Wire Mesh Tray
    - a. B-Line: GROUNDBOLT with Ground Support Clip GROUNDSUPT GL

- b. Cablofil: GNDCL Grounding Lug with B-Line Ground Support Clip GROUNDSUPT GL

## 2.7 FIRESTOPPING MATERIAL

- A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:
  - 1. Specified Tech. Inc. EZ-Path, with ganging brackets.

## 2.8 LABELING AND ADMINISTRATION

- A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  - 1. Labels: Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
  - 2. Label Clips: Cablofil, Inc. (regardless of wire mesh tray manufacturer)
  - 3. Hand-carried label maker: Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

### 3.1 GENERAL

- A. Install the cable tray system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA Standards.

### 3.2 EXAMINATION

- A. Examine surfaces and spaces to receive cable tray for compliance with installation tolerances and other conditions affecting performance of cable tray installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Notify the Engineer/Owner of conditions that may adversely affect the installation, subsequent use, or cause the tray (or circuits to be subsequently installed in the tray) to not comply with ANSI/TIA/EIA standards.

### 3.3 INSTALLATION

- A. Provide cable tray, in the locations and widths shown on the Contract Documents and in accordance with manufacturer's requirements and industry practices (NEMA VE 2). Ensure that the cable tray equipment complies with the requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
  - 1. Cable tray shall be installed plumb, level and square with finished building surfaces.

2. Provide factory-manufactured connection hardware between each cable tray segment. Cable tray segments shall be mutually aligned. Connection hardware shall be installed according to the manufacturer's requirements.
  3. Mount tray at heights indicated on Contract Documents.
  4. Cable tray elevation changes shall be gradual, or as shown on the Contract Documents.
- B. Cable Tray Routing:
1. Route cable tray as shown on the Contract Documents. Where not shown on the Contract Documents, route cable tray in the most direct route possible, parallel to building lines.
  2. Do not route cable tray through areas in which flammable material may be stored or through wet, hazardous or corrosive areas.
- C. Vertical Transitions:
1. Vertical height transitions of cabling that exceed 24 inches shall be supported by cable tray throughout the transition.
- D. Wall Penetrations:
1. Provide wall penetrations where required and as shown on the Contract Documents. Provide roto-hammering, core drilling and saw cutting where required for installation.
  2. Provide slot/sleeves through wall, if wall is not fire-rated. Seal around slot/sleeves, closing up the penetration around the slot/sleeves.
  3. Provide fire-rated cable pathway hardware through wall if the penetration is through a fire-rated wall. Restore fire-rating of wall. Firestopping shall comply with the requirements in Section 07 27 00 – Firestopping.
- E. Cable Tray Clearance Requirements:
1. Clearance requirements for cable tray accessibility:
    - a. Maintain a clearance of 8 inches between top of cable tray and ceiling structure or other equipment or raceway.
    - b. Maintain a clearance of 8 inches between at least one side of cable tray and nearby objects.
    - c. Maintain a clearance of 6 inches between bottom of cable tray and ceiling grid or other equipment or raceway.
  2. Clearance requirements from sources of electromagnetic interference (EMI):
    - a. Maintain a clearance of 5 inches or more from fluorescent lighting.
    - b. Maintain a clearance of 12 inches or more from conduit and cables used for electrical power distribution.
    - c. Maintain a clearance of 48 inches or more from motors or transformers.
    - d. Pathways shall cross perpendicularly to electrical power cables or conduits.
  3. Maintain a clearance of at least 6 inches from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit.
- F. Provide cable tray supports where shown on the Contract Documents. Where not shown on the Contract Documents, provide supports according to the manufacturer's recommendations.
1. Load span criteria: Install tray supports in accordance with the load criteria of L/240, and as shown on the Contract Documents.
  2. Supports shall be attached to structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray's weight and required cable weight and volume.
  3. Where cable trays run adjacent to walls, provide wall-mounted supports.
  4. Provide ceiling-hung supports only where the use of a wall-mounted support is not possible or where shown on Contract Documents. For example, provide ceiling-hung supports where cable tray is not running adjacent to a wall.
  5. Do not attach cable tray supports to ceiling support system or utility support systems.

6. Coordinate bracket installation with General Contractor for blocking and backing support. Framing shall comply with the requirements in Section 06 10 00 – Rough Carpentry.
  7. Attach cable tray to support brackets.
- G. Cable tray shall be installed free of burrs, sharp edges, or projections which may damage cable insulation or cause cuts to cable installation technicians. Cable tray shall be free of denting and other bending damage in surfaces that are intended to be straight and true.
- H. Wire mesh-type cable tray shall be cut with a manufacturer-approved cutter.
1. The choice and position of the jaws at the point where the cut is to be made shall allow shearing as close as possible to the intersection of the steel wires.
  2. Cuts shall ensure the integrity of the galvanic protective layer.
  3. Do not use saws to cut tray.
- I. Wire Mesh Tray Fittings: Provide field-fabricated fittings from straight sections of cable tray using manufacturer-approved tools and in accordance with manufacturer's instructions. Bends shall be long radius. Short radius bends and T-sections shall not be used unless specifically shown on the Contract Documents.
- J. Cable Tray Fittings: Provide factory-fabricated fittings in accordance with manufacturer's instructions. Bends shall be long radius. Short radius bends and T-sections shall not be used unless specifically shown on the Contract Documents.
1. Fittings shall be installed without gaps, such that cabling in the tray will not be visible from below or from the side.
- K. Expansion Joints: Provide cable tray sliding or offsetting expansion joints/fittings where shown on the Contract Documents and where cable tray crosses building expansion joints. Provide bonding jumper except where expansion joints are specifically approved for bonding.
- L. Thermal contraction and expansion: Install cable tray sections with gap settings between cable tray sections that are appropriate for the range of thermal expansion and contraction expected for the space during construction and also during normal occupancy and operation.
1. Conceal any gaps in solid cable tray, such that cabling in the tray will not be visible from below or from the side.
- M. Blind End Plates: Close unused openings using factory-made blind end plates.
- N. Barrier Strips: Provide barrier strips as shown on the Contract Documents
- O. Radius Drops: Provide cable tray radius drops where shown on the Contract Documents and where cable trays cross other telecommunications cable trays or ladder rack.

### 3.4 GROUNDING AND BONDING

- A. Bond metallic raceway (including cable tray) together and to the nearest TGB (as provided under Section 27 05 26 — "Grounding and Bonding for Communications Systems"). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.
- B. Provide a continuous grounding conductor running the length of the cable tray.
1. Bond each tray segment to the conductor using listed hardware.
  2. Cable tray bonding jumpers/splices are not permitted as a substitute for a continuous grounding conductor.
- C. Bonding conductors:

1. Bond distribution conduits and raceways to cable tray.
2. Provide bonding jumpers at expansion joints, sleeves and any other locations where electrical continuity is interrupted.
3. Provide bonding conductor between cable tray and the electrical power distribution system grounding infrastructure.

### 3.5 CLEANING AND PROTECTION

- A. On completion of installation, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.6 TESTING

- A. Test cable trays to ensure electrical continuity of bonding and grounding connections. Demonstrate compliance with maximum grounding resistance per NFPA 70B, Chapter 18.

### 3.7 LABELING AND ADMINISTRATION

- A. Provide the following label every 10 feet along the entire length of the cable tray:
  1. Label shall read "TELECOMMUNICATIONS / LOW VOLTAGE CABLING ONLY".

**END OF SECTION**

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of telecommunications cabinets, racks, frames, enclosures, cable management, and power hardware. This section includes hardware that supports the specified Structured Cabling System (SCS - See Definition Below).

Include this paragraph only if products will be furnished but not installed under this section (perhaps installed under other sections or by the Owner). When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Designer must take care to clearly define any product warranty issues associated with the split responsibility.

- B. Products installed (but not furnished) under this section:  
1. Grounding Conductor

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances associated with telecommunications cabinets, racks, frames, enclosures, cable management, and power hardware to support an ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications Structured Cabling System (SCS) as shown on the Contract Documents.

- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. Racks, rack cable distribution hardware, ladder rack, and other rack and distribution components shall be manufactured by a single manufacturer unless stated otherwise in this Specification or in the Contract Documents. Do not intermix equipment and components between different manufacturers.
1. Rack/Distribution Equipment: Chatsworth Products, Inc. (CPI)

### 2.2 CABLE SUPPORTS

For new construction and full remodel projects, the Designer shall coordinate with the Architect to incorporate the following backboard-related requirements into the architectural specifications for wall treatments and painting. After verifying that the backboard requirements are adequately covered in the architectural specifications, the following paragraph can be deleted.

- A. Backboards:
1. 3/4 inch A-C non-fire-retardant plywood backboards, void free, 2440-mm (8-ft) high unless otherwise noted. 3/4 inch A-C fire-retardant plywood backboards, void free, 2440-mm (8-ft) high unless otherwise noted.
  2. Primer
  3. White-colored satin (washable) paint
- B. Cable Supports:
1. D-Rings:
    - a. Metallic: CPI 10941, 10942, 10943
  2. Saddle-backs
  3. Cable Clamps
- C. Ladder Rack: Complete with fittings including (but not limited to) splice kits, cable radius drop, radius bends, protective end caps, retaining posts, support brackets, foot kits, vertical wall brackets, wall

angles, grounding hardware and other incidental and miscellaneous hardware required for a complete ladder rack system. Ladder rack components shall be manufactured by the selected Rack/Distribution Equipment manufacturer.

1. Unless otherwise indicated, all ladder rack and incidental equipment color shall be:
  - a. In Telecommunications Rooms: Black
  - b. In other rooms: see Section 27 05 36 – “Cable Trays for Communications Systems”.
2. Ladder rack, Cable Runway, 12 inch wide minimum:
  - a. Homaco: TR10-12B
3. Ladder rack protective end caps:
  - a. Homaco: 2-E1-25C-A
4. Vertical Wall Bracket:
  - a. Homaco: P982078B
5. Cable Retaining Posts:
  - a. Homaco
6. Wall Angle Assemblies:
  - a. Homaco: P128240B
7. Triangle Support Wall Bracket for Cable runway:
  - a. Homaco: P139x40H
8. Radius Drops:
  - a. Homaco: TRP8-CM
9. Equipment Rack Junction Plate:
  - a. Homaco: JPxxxx
10. Equipment Rack Guard Rail:
  - a. Homaco: GR-19
11. Cable Fence, 6 inch:
  - a. Homaco: CF-6
12. Ladder rack/cable runway Grounding kits:
  - a. Homaco

### 2.3 EQUIPMENT RACKS/ENCLOSURES

- A. Unless otherwise indicated, equipment racks/enclosures and incidental equipment color shall be:
  1. Black
- B. Unless otherwise indicated, equipment rack/enclosure/wall-mounted brackets and incidental materials and equipment shall be provided by the selected Rack/Distribution Equipment manufacturer. Do not intermix products from different manufacturers.
- C. Free Standing Equipment Racks: EIA-standard 7-foot high x 19-inch wide racks (black), with universal alternating-hole pattern (marked with rack-unit spacing), complete with top angles, self-supporting bases, and mounting holes on both sides of the rails.
  1. Racks:
    - a. CPI: Standard Rack 55053-703
  2. Guard rail: 7 inch deep:
    - a. CPI: 40056-719
  3. Vertical cable management:
    - a. 6 inch wide: Panduit WMPVHC45E
- D. Single sided low profile equipment shelf:
  1. CPI: 40074-700
- E. Lockable storage drawer:
  - a. CPI: 11505-719

- F. Grounding kit and #6 AWG insulated copper conductor grounded to the nearest TGB.
  - 1. CPI: CPI grounding kit
  - 2. B-Line: B-Line grounding kit

- G. Incidental materials required for proper construction, mounting and securing.

## 2.4 GROUNDING AND BONDING

- A. As specified under Section 27 05 26 – “Grounding and Bonding for Communications Systems.”

## 2.5 LABELING AND ADMINISTRATION

- A. Labels:
  - 1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
    - a. Station Cable:
      - 1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
    - b. Backbone Cable:
      - 1) Panduit Marker Tie (or approved equal)
- B. Hand-carried label maker:
  - 1. Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

### 3.1 GENERAL

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. All plumbing, drains, piping, unrelated HVAC ductwork, and other utilities that are not related to telecommunications shall be routed around telecommunications rooms. Only utilities that serve telecommunications rooms shall enter telecommunications rooms.

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer’s requirements.

### 3.2 CABLE SUPPORTS

For new construction and full remodel projects, the Designer shall coordinate with the Architect to incorporate the following backboard-related requirements into the architectural specifications for wall treatments and painting. After verifying that the backboard requirements are adequately covered in the architectural specifications, the following paragraph can be deleted.

- A. Backboards: Provide backboards as shown on Contract Documents. Backboards shall be capable of supporting attached equipment.
1. Mount A-C plywood backboards with the "A" side exposed, with flush or countersunk fasteners, and with the joints butted tight.
  2. Mount backboards 9 inches above finished floor, such that the top of the backboard reaches 8 feet 9 inches above finished floor, unless otherwise indicated.
  3. Paint backboards with a minimum of two coats (over primer) of white colored satin paint.

WSUP prefers to minimize the use of D-Rings. The Designer shall seek case-by-case approval from the ITPM to use D-Rings. Delete the paragraph below if D-Rings are not required/approved for a project.

- B. D-Rings: Provide D-Rings as necessary to route exposed backbone cables in telecommunications rooms and on backboards and for raceway for routing cable in non-exposed open access environments, and as shown in the Contract Documents. D-Rings may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. In telecommunications rooms, mount D-Rings at 12 inch intervals and as shown in the Contract Documents.
1. Size D-Rings as noted in the Contract Documents.
  2. Where not noted, size D-Rings according to the type and quantity of cable to be routed through the ring per TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion, but not less than a minimum of 2 inches in diameter.
  3. D-Rings are not permitted outside of telecommunications rooms unless otherwise indicated in the Contract Documents.
  4. Horizontal cables shall be routed via overhead and vertical ladder racking (not via D-Rings).
- C. Ladder Rack: Provide ladder racking, sized and in locations as shown on the Contract Documents, installed per manufacturer's instructions with flat (rung) side up. Install ladder rack affixed to top of equipment racks at 7 feet 0 inches above finished floor (unless otherwise indicated) to serve as equipment rack bracing.
1. Cut ends of ladder rack square. Ream cut ends to remove burrs and sharp edges. Cap cut ends with manufacturer's recommended caps.
  2. Provide 90-degree horizontal radius bends for each 90-degree change in direction of ladder rack angle.
  3. Provide cable runway grounding kits across ladder rack splices and where ladder racks are connected to equipment racks/cabinets.
  4. Provide cable retaining posts at 2 foot intervals and at each corner and junction as follows:
    - a. The inside of ladder rack (away from wall), where rack is mounted adjacent to a wall.
    - b. Both sides of ladder rack where rack is not mounted adjacent to a wall.
- D. Vertical Ladder Rack: Provide vertically mounted ladder racking attached to walls, anywhere in telecommunications rooms where cabling changes elevation by 24 inches or greater, and also in locations shown on the Contract Documents. Size vertical ladder racking as shown on Contract Documents, 12 inches wide minimum.

### 3.3 EQUIPMENT RACKS/ENCLOSURES

See the WSUP Telecommunications Distribution Design Guide for information on required drawing content, including telecommunications room Plan Views discussed below. Verify with WSUP ITPM whether vented shelves are to be provided for Owner installation.

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Provide EIA racks/cabinets and all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents.
- B. Floor Mount Racks/Cabinets:
  - 1. Using ladder rack, horizontally affix the top of a given rack/cabinet to the wall as shown on the Contract Documents. Bolt horizontal ladder rack to rack/cabinet and to walls. Bolt rack/cabinet to floor.
- C. Free Standing Equipment Racks:
  - 1. Provide guard rails near the base of each rack, both in the front and rear.
  - 2. Coordinate with Owner to identify desired location for shelf. Provide shelf, installed per Owner's direction.
  - 3. Coordinate with Owner to identify desired location for lockable storage drawer. Provide drawer, installed per Owner's direction.
- D. All rack accessories and screws provided with the racks but not installed shall be bagged and left with the rack upon completion for Owner's future use.

#### 3.4 GROUNDING AND BONDING

- A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in Section 27 05 00 – "Common Works Results for Communications" PART 1 – STANDARDS AND CODES, as well as local codes which may specify additional grounding and/or bonding requirements.
  - 1. Provide a minimum of one wall-mountable telecommunications ground bus bar per telecommunications room and as shown on the Contract Documents.
  - 2. Grounding conductor shall be installed to bond all non-current carrying metal telecommunications equipment and materials to the nearest TMGB or TGB (as provided under Section 27 05 26 — "Grounding and Bonding for Communications Systems").
    - a. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.
    - b. Provide ladder rack grounding kits to bond each section of ladder rack and bond ladder rack to racks/cabinets where ladder racks are connected.

#### 3.5 LABELING AND ADMINISTRATION

- A. Telecommunications Rooms: Affix a permanent label with the telecommunications room number on the wall above the light switch inside each telecommunications room. Where telecommunications room names are required in other labels, use the telecommunication room name shown on the Contract Documents.
- B. Racks: Label racks as shown on the Contract Documents. Affix label centered across top cross-member of rack and on the foot-plate. Labels shall read "Rack 1", "Rack 2", "Rack 3", etc. as shown on the Contract Documents.

END OF SECTION

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

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### 1.1 SUMMARY

Review and edit the following list of generic type products for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of an inside plant telecommunication system. This section includes Inside Plant Communications Backbone cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS - See Definition Below).

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications Structured Cabling System (SCS) as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of Gigabit Ethernet operation as specified in IEEE 802.3z.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. SCS components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the manufacturer of the SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the SCS Manufacturer Warranty (see Section 27 05 00 — "Common Works Results for Communications" PART 1 – WARRANTY).
  - 1. Bid only the following SCS Manufacturers and only bid manufacturers for which the Contractor is certified. The SCS Manufacturers shall be the following. Substitution is not acceptable:
    - a. TE, for copper-related products
    - b. Corning, for fiber optic-related products
      - 1) TE fiber optic cabling products are not acceptable.

### 2.2 PATCH PANELS

- A. Copper Backbone Patch Panels: Complete with incidental materials necessary for mounting. Unless otherwise indicated, copper patch panels shall be manufactured by the selected SCS Manufacturer:
  - 1. Shall exceed Category 5e (minimum) transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:
    - a. 24 Port, SL, Straight, Multimedia: TE 1375291-1 with Category 5e connectors TE 1375191-2 (Black) as required
- B. Fiber Patch Panels: Pre-assembled enclosures with connector panels, blank connector panels (for unused connector panel slots), and strain relief, complete with fiber connectors and fiber optic receptacle adapters (see CONNECTORS below), and with incidental materials necessary for mounting. Fiber patch panels shall be manufactured by the selected SCS Manufacturer:
  - 1. Backbone Distribution:
    - a. Corning:
      - 1) Rack mounted patch panels:
        - a) Corning CCH-04U (4U, 72/144 port) (black)
      - 2) Connector Panels:
        - a) Multimode: Corning (12-strand/6-connector) duplex LC, CCH-CP12-A7
        - b) Multimode: Corning (12-strand/6-connector) duplex SC, CCH-CP12-91
        - c) Singlemode: Corning (12-strand/6-connector) duplex LC, CCH-CP12-A9

- d) Singlemode: Corning (12-strand/6-connector) duplex SC, CCH-CP12-59
- e) Singlemode Pigtailed Splice Cassette (12-strand) duplex SC/APC: Corning CCH-CS12-D9-P00RE
- f) Singlemode Pigtailed Splice Cassette (24-strand) duplex LC/APC: Corning CCH-CS24-B3-P00RE

## 2.3 CABLE

### A. General:

- 1. Cables shall be manufactured by the selected SCS Manufacturer.
- 2. Cables shall be marked with the manufacturer's label indicating plenum-rating.

### B. Copper Cable:

- 1. Copper backbone cable shall be ARMM shielded, 24-AWG solid copper conductors, insulated with color-coded PVC, and UL Verified to TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by:
  - a. General Cable
  - b. Superior Essex
  - c. TE
  - d. or approved equal.

### C. Fiber Cable:

- 1. Multimode 50/125  $\mu$ m OM3: Shall be graded index, tight-buffered, extended/high grade with a maximum attenuation of 2.8 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and a minimum effective modal bandwidth of 4700 MHz/km @ 850 nm. Cable shall support 1GB Ethernet for lengths of up to 1000 meters, 10GB Ethernet for lengths up to 550 meters and 100GB for lengths up to 150 meters. Cable shall be manufactured by the selected SCS Manufacturer:
  - a. Corning: Corning MIC and Unitized MIC
- 2. Singlemode 8.3/125  $\mu$ m: Shall be tight-buffered with a maximum attenuation of 0.4 dB/km @ 1300 nm and 0.3 dB/km @ 1550 nm. Cable shall be manufactured by the selected SCS Manufacturer and shall be:
  - a. Corning: Corning MIC and Unitized MIC
- 3. Hybrid/Composite: Multimode and singlemode characteristics and specifications shall conform to the above requirements. Cable shall be manufactured by the selected SCS Manufacturer and shall be:
  - a. Corning: Corning MIC and Unitized MIC

## 2.4 INNERDUCT

### A. Intra-building innerduct shall be 1 inch size, orange, unsplit, corrugated, with pull tape:

- 1. Plenum-rated: Carlon Plenum-Gard CF4x1C-nnnn
- 2. Riser-rated: Carlon Riser-Gard DF4x1C-nnnn

## 2.5 CONNECTORS

### A. Fiber Connectors: Complete with fiber optic receptacle adapters where required for mounting.

- 1. Multimode: Duplex LC, 50/125  $\mu$ m laser-optimized multimode fiber, with a ceramic ferrule:
  - a. Corning LC/APC: Unicam 95-200-94 with Duplex Clip (TRIGGER-BP-D)
- 2. Singlemode: Duplex SC, singlemode fiber with Angle Polish and rotating cam:
  - a. Corning SC/APC: Unicam 95-200-44 with Duplex Clip (95-400-03-BP)

## 2.6 LABELING AND ADMINISTRATION

### A. Labels:

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  - a. Backbone Cable:
    - 1) Panduit Marker Tie (or approved equal)
- B. Hand-carried label maker:
  1. Brady: ID Pro Plus (or approved equal).

### PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

#### 3.1 PATCH PANELS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.
  1. Copper: Size and install rack-mountable patch panels as shown on the Contract Documents. Use patch panels to terminate copper backbone cables.
    - a. Termination:
      - 1) Terminate 2 pairs per jack, on pins 4 & 5 and on pins 3 & 6.
      - 2) The 25<sup>th</sup> pair of each binder group shall be preserved at the end of the patch panel for future use (replace damaged pair or support a 2-pair application).
      - 3) Maintain pair twist ratio for exposed wires at patch panel termination.
    - b. Horizontal Wire Management: Provide horizontal wire management as shown on the Contract Documents.
  2. Fiber: Size and install rack-mountable patch panels as shown on the Contract Documents. Mount intra-building fiber patch panel below outside plant fiber patch panel. Use fiber patch panels to terminate backbone and horizontal fiber optic cables.
    - a. Terminate all fiber optic cabling SC/APC-Duplex.
    - b. Where multiple cables terminate in a patch panel, terminate singlemode fiber on left side of patch panel, and multimode on the right side.

#### 3.2 CABLE

- A. General (applicable to all cable types): Provide non-plenum (CM/CMR, OFNR) rated cable for locations where cable is to be installed in conduit. For cable not installed in conduit, provide plenum (CMP, OFNP) rated cable if cable is installed in a plenum air space environment, otherwise install non-plenum rated cabling. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.
  1. Provide intrabuilding backbone cable in types, sizes, and quantities as shown on the Contract Documents. Install intrabuilding backbone cables between telecommunications rooms within the

- same building. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.
2. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
  3. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.
    - a. Pull all cables simultaneously where more than one cable is being installed in the same raceway.
    - b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
    - c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.
  4. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
  5. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
  6. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable. Install hook-and-loop straps in conformance with the SCS manufacturer's installation recommendations. Do not cause cross-sectional deformation of cabling.
  7. Cable at the backboards:
    - a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
    - b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
    - c. Using the most direct route, secure multi pair cable to the backboard from the cable tray to the termination point. Use of D-rings in this situation is acceptable. Route via a path that will minimize obstruction to future installation of equipment, backboards or other cables.
  8. Cabling in the conduits:
    - a. Where multiple conduits or sleeves are used to carry cabling, fill conduits completely (per fill-ratio requirements) prior to using the next adjacent available conduit. Do not partially fill multiple conduits (and thereby waste space in a conduit) when it would be possible to completely fill that conduit.
  9. Cable in the telecommunications rooms:
    - a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with hook-and-loop straps (Velcro-type).
  10. Cable terminating on patch panels located on racks:
    - a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.
- B. Copper Cable: Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
1. Provide copper cabling in pair counts shown on Contract Documents. Where not shown, provide pair counts according to the following formula:
    - a. 1.5 times the Day 1 strand requirements, rounded up to the next commonly manufactured pair count in increments of 50.
  2. Install intrabuilding backbone cable in the locations shown on the Contract Documents. Provide a service loop long enough in the TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum length of 10 feet at each end.
    - a. Use unshielded, non-plenum multi-pair copper cable for connecting the back side of patch panels to entrance protectors.

- b. For shielded cable, bond one end of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Section 27 05 26 — “Grounding and Bonding for Communications Systems”).
- C. Fiber Cable: Terminate all fiber strands within a fiber cable. The installation of unterminated fiber is not acceptable.
1. Provide fiber optic cabling in strand counts shown on Contract Documents. Where not shown, provide strand counts according to the following formula:
    - a. 1.5 times the Day 1 strand requirements, rounded up to the next commonly manufactured strand count in increments of 12.
  2. Secure fiber optic cable with hook-and-loop straps (similar to Velcro).
  3. Innerduct
    - a. **The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.**
    - b. Innerduct is required for routing inside plant fiber optic backbone cabling through all vertical riser pathways (conduits and sleeves) that exceed 4 feet in length.
    - c. Innerduct is also required for routing inside plant fiber optic backbone cabling through cable trays where larger outside plant cable shares the cable tray.
    - d. Otherwise, innerduct is not required for routing inside plant fiber optic backbone cabling.
    - e. Where innerduct is required, install fiber optic cable in innerduct per manufacturer’s instructions. Innerduct shall terminate within 6 inches of top of each patch panel where fiber optic cable terminates. Secure innerduct with zip-ties at intervals not exceeding 24 inches. Do not use wire or tape.
    - f. See Sections 27 15 00 and 27 15 23 for innerduct requirements related to fiber optic cabling in horizontal and GPON applications, respectively.
  4. Test fiber optic cable on the reel upon delivery to the job site, and again prior to installation. Permanently affix the test results to the reel and submit a copy to the Owner prior to installation. Do not install cables that fail the on-reel test. Replace any cables that fail the on-reel test at no additional expense to the Owner.
    - a. Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.
    - b. Demonstrate that the test results are in harmony with the factory test results as shipped with the reel.
  5. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Section 27 05 26 — “Grounding and Bonding for Communications Systems”).
  6. Provide a service loops as follows:
    - a. Inside the patch panel, store approximately 60 inches of unsheathed fiber prior to termination.
    - b. Attached to the wall, store approximately 20 feet (in innerduct).

### 3.3 CONNECTORS

- A. Fiber Connectors: Provide connectors and adapters per manufacturer recommendations and install into Connector Panels.

### 3.4 LABELING AND ADMINISTRATION

- A. Color Coding: Apply industry standard color coding to cable terminations. Always apply the same color at both ends of any given cable. Cross-connections are generally made between terminations of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:
  1. Orange: Identification of the telecommunication service (telephone company) demarcation point.

2. Green: Identification of network connections on the customer side of the demarcation point.
3. White: Identification of first-level backbone in the building containing the main cross-connect, or may be used to identify the second-level backbone in buildings not containing the main cross-connect.
4. Gray: Identification of the second-level backbone in the building containing the main cross-connect.
5. Brown: Identification of inter-building backbone cables.
6. Yellow: Identification of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
7. Red: Identification of key telephone systems.

B. Cables:

1. Label Locations:
  - a. Affix at each end of the cable, within 24 inches of telecommunications room entrance and again within 24 inches of termination point.
  - b. Inside each tunnel entrance point, exit point and intersection.
  - c. Twice inside each maintenance hole and handhole, at the entrance conduit and exit conduit.
2. Label Colors:
  - a. Brown at source end and green at destination end of cable.
  - b. Stainless steel straps along length of cable.
3. Cables shall be labeled according to the following scheme:

Source Building	Telecom Room at Source	Destination Building	Telecom Room at Destination	Cable Number
a a a a a	- b* b b b b b† b†	c c c c c*	- d* d d d d d† d†	e† e e e e†

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- \* This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
- † This character position should be deleted if not necessary.

The Source Building is typically the MCF. The Destination Building is the customer/outlet-end of the cable.

Three or four-position sequentially numbered Cable Numbers are structured as follows:

- 001-999 for UTP cables
- FM01-FM99 for Multimode Fiber cables
- FS01-FS99 for Singlemode Fiber cables
- X01-X99 for Coax cables
- Z01-Z99 for Composite cables

There is one special case for a prefix character on a cable number: cables that are owned by a third party (not WSU). For example, cables owned by Housing and Dining are labeled with a prefix of "H".

4. Use cable numbering shown on the drawings. For cable numbering that is not shown on the drawings, request numbering assignments from the Owner.
5. Provide labels in the following locations:

- a. In the MDF, on the cable, approximately 12 inches from the protector and from the patch panel.
- b. On the fiber optic patch panel in the MDF and IDFs.
- c. Within 36 inches of the entrance and exit conduits and riser sleeves on the cable sheath.
- d. On the cable sheath adjacent to all splice closures, and at any other location where the cable enters or exits conduits, innerduct, or other wall penetration.

C. Termination Hardware:

- 1. Copper Backbone Building Entrance Protectors:
  - a. General: Label BEPs with a printed adhesive label, as shown on the Contract Documents, matching the cable label content described above.
    - 1) MDF: Use blue label stock.
    - 2) IDFs: Use green label stock.
- 2. Copper Backbone Patch Panels:
  - a. No labeling required.
- 3. Fiber Optic Patch Panels:
  - a. Outside the panel: Label fiber patch panels with a black-on-orange adhesive label and printed adhesive label matching the cable label content described above.
  - b. Inside the Panel (Connector Panels): Label each connector panel with the opposite end termination point and type of the cable terminated at that location, in the form below, referencing the cable numbering discussed above.

Far End Building	Telecom Room at Far End	Cable Number
a a a a a *	b * b b b b b † b †	c † c c c c c †

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- \* This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
  - † This character position should be deleted if not necessary.
- c. Pull-out labeling plate: Each fiber patch panel includes a pull-out labeling plate with space to document the purpose of each fiber optic cable. Apply self-adhesive labels to the plate to matching the cable label content described above.

3.5 TESTING

- A. Provide test records on a form approved by the Owner and Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Designer for review and acceptance within two weeks of Substantial Completion.
  - 1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic PDF format (on flash drive or CDROM) to the Owner and Designer for review. Handwritten test results will not be accepted.
- B. Test the SCS after installation for compliance to all applicable standards as follows:
  - 1. Intrabuilding Backbone Copper: Test all cable pairs for length, shorts, opens, grounds, continuity, polarity reversals, termination order, transposition (wire map), attenuation, and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.

- a. Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.
  - b. Test entire channel, from entrance protection to patch panel.
  - c. Use a TIA/EIA Level III testing instrument, re-calibrated within the manufacturer's recommended calibration period, with the most current software revision based upon the most current TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.
    - 1) Fluke DSP-4000, or approved equal.
2. Fiber: Test fiber optic cable on the reel upon delivery to the job site prior to installation, and again after installation.
- a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:
    - 1) Horizontal Distribution:
      - a) Max Loss = 2.0db (per ANSI/TIA/EIA 568-B)
    - 2) Backbone Distribution:
      - a) Max Loss = [(allowable loss/km) \* (km of fiber)] + [(0.3db) \* (# of connectors)]
      - b) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.
      - c) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).
  - b. Test all strands using a bi-directional end-to-end optical transmission loss test instrument (such as an OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B. Test the polarity of each pair of strands. Record the following measurements: length and attenuation.
    - 1) Calculate attenuation loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.
    - 2) Provide test measurements as follows:
      - a) Multimode Cable: Test at both 850 and 1300nm.
      - b) Singlemode Cable: Test at both 1310 and 1550nm.
  - c. Test results shall conform to:
    - 1) The criteria specified in ANSI/TIA/EIA-568B.
    - 2) The Contractor's calculated loss budget above.
    - 3) The criteria specified in IEEE 802.3ae-2002 (10GBase-X 10 Gigabit Ethernet).
      - a) In addition to the above, perform tests both recommended and mandated by Corning. Tests shall confirm/guarantee compliance to Corning's performance standards and also IEEE 802.3ae-2002 for a maximum end-to-end dB loss of 2.5 dB.
    - 4) The criteria specified in IEEE 802.3ae-2002 (10GBase-X 10 Gigabit Ethernet).
- C. Identify cables and equipment that do not pass to the Owner and Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials. Retest the cable or connection materials at no additional expense to the Owner. Provide a complete revised set of all test results to the Owner and Designer, in the same manner as above. Remove original individual cable test reports that are unacceptable and insert the new corrected cable test reports. Do not simply resubmit the test reports for the corrected cabling only.
1. In addition to the above, if it is determined that the cable is faulty, remove the damaged cable and replace it with a new cable. Cable repairs are not acceptable. The procedure for removing the cable shall be as follows:
    - a. Prior to removal of damaged cable and installation of new cable:
      - 1) Inform the Owner and Designer of the schedule for the removal and installation.
      - 2) Test the new cable on the reel per paragraph B, above.

- 3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
- b. Remove the damaged cable and provide new cable.
- c. After the removal of the damaged cable and installation of the new cable:
  - 1) Test the new cable per the paragraph titled TESTING.
  - 2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
    - a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.
- d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.
  - 1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

### 3.6 CLOSE-OUT

- A. Furnish uninstalled fiber optic cable reel remnants to the Owner.

END OF SECTION

**PART 1 - GENERAL**

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 SUMMARY

Review and edit the following list of generic type products for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of an inside plant telecommunication system. This section includes Inside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS - See Definition Below).

1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications Structured Cabling System (SCS) as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of 10 Gigabit Ethernet operation as specified in TIA/EIA 568-B.2-10 and ISO/IEC 11801:2002/Amd 1:2008.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.

### 1.3 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DIS Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

- A. Provide coordination with the cabling manufacturers to ensure that manufacturers' inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any manufacturer-required modifications and have manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.
- B. The Contractor is solely responsible for all costs associated with scheduling the manufacturer inspection, the inspection itself and any manufacturer-required re-inspections, and for any modifications to the installation as required by the manufacturers.

### PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. SCS components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the manufacturer of the SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the SCS Manufacturer Warranty (see Section 27 05 00 — "Common Works Results for Communications" PART 1 – WARRANTY).
  - 1. Bid only the following SCS Manufacturers and only bid manufacturers for which the Contractor is certified. The SCS Manufacturers shall be the following. Substitution is not acceptable:
    - a. TE, for copper-related products
    - b. Fiber optic-related products: Corning
      - 1) TE Connectivity fiber optic cabling products are not acceptable for non-GPON horizontal fiber optic applications. For GPON applications, see Section 27 15 23 – Communications Optical Fiber Horizontal Cabling.

- B. All copper-related components shall be part of the copper SCS product line – components shall not be intermixed between manufacturers' SCS product lines. The SCS product lines shall be engineered "end-to-end" – the system and all of its components shall be engineered to function together as a single, continuous transmission path.
1. The SCS Product Line shall be the following:
    - a. Category 6 U/UTP Copper Distribution: TE 620 Series solution. Substitution is not acceptable.  

WSUP has standardized on using Category 6 cabling for all projects – no exceptions.

However, some audio visual applications require Category 6A cabling. The Telecommunications Designer shall work with the Audio Visual Designer to determine whether/where Category 6A cabling is required. The Telecommunications Designer shall specify all telecommunications cabling, including that required to serve audio visual system requirements.
    - b. Category 6A F/UTP Copper Distribution: TE XG Series solution. Substitution is not acceptable.

## 2.2 PATCH PANELS

- A. Copper Patch Panels: Shall be complete with pre-manufactured cable management for supporting station cable behind the patch panel, with incidental materials necessary for mounting and wired for T568A.
1. Category 6 Horizontal Distribution Patch Panels (Workstation Patch Panels):
    - a. 24 Port, SL, Straight, Multimedia: TE 1375291-1 with Category 6 connectors TE 1375055-2 (Black) as required  

Category 6A is only required for certain Audio/Visual applications. Verify requirements with AVPM and Audio Visual Designer. Delete the following paragraph if it is not required.
  2. Category 6A Horizontal Distribution Patch Panels (Workstation Patch Panels):
    - a. Category 6A, 24 Port, SL, Shielded, Straight: TE 1933319-2
    - b. Cable Management Bar: TE 557548-1
  3. Horizontal Cable Management Panels
    - a. 2U: Panduit WMPH2E  

Review and edit the following fiber optic products/part numbers as applicable to this project.
- B. Fiber Optic Patch Panels: See Section 27 13 00 – Communications Backbone Cabling.
1. Connector Panels:
    - a. Multimode: Corning (12-strand/6-connector) duplex SC, CCH-CP12-91

## 2.3 CONNECTORS

- A. Copper Connectors (modular jacks): 8-position/8-conductor, insulation displacement connection (IDC), non-keyed, and shall accept modular 8-position/8-conductor plugs, complete with multicolored identification labels/icons for identification, and with a universally color-coded wiring pattern for both T568A and T568B. Copper connectors shall be manufactured by the selected SCS Manufacturer.
1. Category 6 Horizontal Distribution: Shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B.2-10 and ISO/IEC 11801:2002/Amd 1:2008, and shall be part of the UL LAN Certification and Follow-up Program:
    - a. Category 6:
      - 1) TE 1375055-1 (both rear and side cable entry), (Almond)
  2. Category 6A Horizontal Distribution: Shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B.2-10 and ISO/IEC 11801:2002/Amd 1:2008, and shall be part of the UL LAN Certification and Follow-up Program:
    - a. Category 6A:

Category 6A is only required for some Audio Visual applications.

- 1) TE 1711160-2 (rear cable entry) (Orange)
- 2) TE 1711295-2 (side cable entry)

## 2.4 STATIONS

- A. Faceplates: Complete with port identification labels and blank inserts/fillers for covering unused connector openings:
1. Stations to be used for VOIP wall-mount telephones: Brushed stainless steel with stainless steel mounting lugs suitable for supporting wall-mount telephones:
    - a. SEMTRON 1FM-0E-TE-Phone-DP (with CAT6 jack)
    - b. or approved equal.
- Review faceplate material/color and mounting strap color with Architect/Interior Designer for coordination with design.
2. All other stations shall be double-gang standard 4-port faceplates (Almond):
    - a. TE 83935-1 with blank inserts as required 406339-1
  3. All stations without cabling shall be double-gang standard blank faceplates (Almond).
- B. Fiber Optic Outlets:
1. Corning: Single-Panel Housing with SC-Duplex Connector Panel:
    - a. Corning SPH-01P with CCH-CP06-91.
- C. Surface Device Boxes: Surface mount device boxes shall be:
1. Wiremold

## 2.5 CABLE

- A. General: Cables shall be manufactured by the selected SCS Manufacturer. All cables shall be plenum-rated.
- B. Copper Cables: Shall be 4-pair, 23 AWG, with solid copper conductors:
1. Category 6 U/UTP:
    - a. Plenum (CMP): TE TE620P-WTxx (white), plenum-rated.
- Delete the following paragraph if there is no requirement for cabling in slab-on-grade conduit/floor box applications or outdoor conduit applications.
- NOTE: The Mohawk cable is not suitable for direct bury applications.
- NOTE: In order for the Mohawk cabling to be included in under the TE warranty, the Cabling Contractor must submit a form to TE titled "TE Connectivity Product Warranty Deviation" prior to installing the cabling. The ND&I Cabling Contractor can request this form from TE's representatives. See paragraph 3.5.x below for more information.
2. Category 6 U/UTP Indoor/Outdoor Wet Environment Rated:
    - a. Mohawk VersaLAN M59092 (White) (not plenum-rated)
- Delete the following paragraph if Category 6A cabling is not part of this project.
3. Category 6A F/UTP:
    - a. Plenum: TE TE640PF-WTxx (white)
- C. Fiber Cable:
1. Multimode 50/125  $\mu$ m OM3: Shall be graded index, tight-buffered, extended/high grade with a maximum attenuation of 2.8 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and a minimum effective modal bandwidth of 4700 MHz/km @ 850 nm. Cable shall support 1GB Ethernet for

lengths of up to 1000 meters, 10GB Ethernet for lengths up to 550 meters and 100GB for lengths up to 150 meters. Cable shall be manufactured by the selected SCS Manufacturer:

- a. Corning Pretium 300, MIC and Unitized MIC

TE and Commscope will merge in late 2015, after which warranty coverage should be simpler for wet environment cable. Delete the following paragraph if there are no wet environment indoor fiber applications, otherwise additional part number information should be added.

- b. Indoor/Outdoor Wet Environment Rated:
  - 1) Commscope OM3 zipcord

- D. Hook and Loop Cable Managers: Reusable hook and loop straps (similar to Velcro), adjustable tension, roll or spool dispensed:
  - 1. Panduit HLS-15R0
  - 2. SIEMON VCM-xxxx-xxx
  - 3. TE 5/8 inch wide: 1375255-X
  - 4. Or approved equal

## 2.6 LABELING AND ADMINISTRATION

### A. Labels:

- 1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, self-laminating vinyl, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  - a. Copper and Fiber Optic Cables:
    - 1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

### B. Hand-carried label maker:

- 1. Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

## 3.1 PATCH PANELS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.

- 1. Copper: Size and install rack-mountable patch panels as shown on the Contract Documents. Use patch panels to terminate copper horizontal cables. Do not exceed ten 2U-sized patch panels per rack.

2. Fiber Optic: Terminate horizontal fiber optic cabling from all floors in the backbone fiber optic patch panel in the MDF.
3. Horizontal Wire Management: Provide horizontal wire management as shown on the Drawings.

### 3.2 CONNECTORS

- A. Copper Connectors (modular jacks):
1. Provide connectors and install using T568A wiring pattern.
  2. Mount connectors at 90-degrees (i.e. straight, not angled)
  3. Punch down cable using only the selected SCS Manufacturer approved tool, achieving a fully repeatable, self-centering, non-impact mechanical termination process.
  4. Provide bend-limiting strain relief caps on both ends of cable.

### 3.3 STATIONS

- A. Faceplates: Provide faceplates for stations in the locations and gang counts shown on the Contract Documents.
1. Faceplates shall completely conceal outlet boxes, reducer plates, etc.
  2. Faceplates shall provide a snug and sure fit for connectors – loose connectors are not acceptable. Do not over-tighten faceplates such that warping occurs.
  3. Provide screws of sufficient length for each application.
- B. Flush-mount connectors in faceplates.
- C. Fiber Optic Stations: Provide SPH devices. Coordinate final location with Engineer prior to installation.
- Delete the previous paragraph if horizontal fiber is not part of this project.
- D. Surface Device Boxes: Provide surface mount device boxes as required and as shown for surface mounted communications outlets.

### 3.4 CABLE

- A. General (applicable to all cable types): Provide plenum (CMP, OFNP) rated cable for all horizontal applications. Cabling shall bear plenum markings.
1. Provide cabling in types, sizes, and quantities as defined by the Symbol Schedule and as shown on the Contract Documents. Install cable between the station and its associated telecommunications room. Provide one cable per each connector at each station. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.
  2. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
  3. Inspect cabling and termination materials prior to installation. Verify that quality, condition, and product is as specified. Do not install materials that do not meet the specified requirements.
  4. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.
    - a. The minimum bend radius shall be 10x the outside diameter of the cable.
    - b. The pulling tension shall not exceed 25 pounds per cable.
    - c. Pull all cables simultaneously where more than one cable is being installed in the same raceway.
    - d. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
    - e. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.

5. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
  6. Minimize the length of exposed (unjacketed) cable pairs, not to exceed ½ inch.
  7. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
  8. Tie or clamp cabling. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable. Cables shall not rest upon acoustic ceiling grids or panels. Install tie-wraps in conformance with the SCS manufacturer's installation recommendations. Do not over-tighten tie wraps or cause cross-sectional deformation of cabling.
  9. Cabling in conduits:
    - a. Where multiple conduits or sleeves are used to carry cabling, fill conduits completely (per fill-ratio requirements) prior to using the next adjacent available conduit. Do not partially fill multiple conduits (and thereby waste space in a conduit) when it would be possible to completely fill that conduit.
  10. Cabling in cable trays:
    - a. Do not bundle cables together.
    - b. During installation, temporarily install hook-and-loop straps (similar to Velcro) to hold cables in place near outside edges of cable tray around corners. After terminating the cables, remove the straps.
  11. Cabling at backboards:
    - a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
    - b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
    - c. Do not use D-rings to route horizontal cabling. Instead, use vertical ladder racking (securing cabling with hook-and-loop straps) and horizontal ladder racking, using the most direct route to the termination point. Route via a path that will minimize obstruction to future installation of equipment, backboards or other cables.
  12. Cabling in telecommunications rooms:
    - a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with tie-wraps or hook-and-loop straps.
  13. Cabling terminating on patch panels located on racks:
    - a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.
    - b. Wherever possible, terminate cables consecutively according to their far-end termination in intuitively occurring groups (jacks in an outlet, outlets in a room, etc.).
- B. Copper Cable: Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
1. Provide station cable in the locations shown on the Contract Documents. Provide service loops for each outlet (minimum length of 18 inches) stored in the cable tray near the conduit serving the outlet. Provide service loops in telecommunications rooms (minimum length of 10 feet).
    - a. For copper station cabling installed in wet areas, including floor boxes in slab-on-grade applications, use outdoor-rated CAT6 cabling.
    - b. Route station cable that is exposed (not in conduit) to comply with ANSI/TIA/EIA-569 requirements for avoiding potential EMI sources and as follows:
      - 1) 48 inches from motors or transformers
      - 2) 12 inches from conduit and cables used for electrical power distribution
      - 3) 5 inches from fluorescent lighting
    - c. Cabling shall not share raceway with electrical power circuits, except for specifically designed system furniture raceways.

- C. Fiber Optic Cable: Terminate all strands within a cable. Un-terminated cable strands are not acceptable.
1. Provide station cable in the locations shown on the Contract Documents. Provide service loops with a minimum length of 12 inches in outlet boxes and no less than 10 feet in the ER/TR's.
    - a. For workstation outlets with both fiber and copper cabling, terminate fiber optic cabling after copper cabling has been installed and terminated.

Delete the following paragraph if there are no wet environment indoor fiber applications.
    - b. For fiber optic station cabling installed in wet areas, including floor boxes in slab-on-grade applications, use Indoor/Outdoor, plenum-rated, Wet Environment-rated cabling.
  2. Innerduct

The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.

    - a. Innerduct is required for routing horizontal fiber optic cabling through all vertical riser pathways (conduits and sleeves) that exceed 4 feet in length.
    - b. Innerduct is also required for routing horizontal fiber optic cabling through cable trays where larger outside plant cable shares the cable tray.
    - c. Otherwise, innerduct is not required for routing horizontal fiber optic cabling.
    - d. Where innerduct is required, install fiber optic cable in innerduct per manufacturer's instructions. Innerduct shall terminate within 6 inches of top of each patch panel where fiber optic cable terminates. Secure innerduct with zip-ties at intervals not exceeding 24 inches. Do not use wire or tape.
    - e. See Sections 27 13 00 and 33 82 00 for innerduct requirements related to fiber optic backbone cabling in inside plant and outside plant backbone applications, respectively.
- D. Provide hook-and-loop cable managers for managing horizontal cabling in the telecommunications rooms. Cable managers shall be black colored.
1. Cut hook-and-loop cable managers to length, such that the cable bundle is encircled with a 50% overlap.
  2. Cables shall be independently supported, not attached to other existing conduit, piping or equipment.
  3. Zip ties are prohibited.

### 3.5 LABELING AND ADMINISTRATION

- A. Color Coding: Apply industry standard color coding to cable termination fields. Always apply the same color at both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:
1. Orange: Identification of the telecommunication service (telephone company) demarcation point.
  2. Green: Identification of network connections on the customer side of the demarcation point.
  3. Blue: Identification of the horizontal distribution (station) cables. A blue color coding is only required at the telecommunications room end of the cable, not at the station end of the cable.
  4. Brown: Identification of inter-building backbone cables.
  5. Yellow: Identification of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
  6. Red: Identification of key telephone systems.
- B. Horizontal Cables:
1. Label Colors: White.
  2. At Patch Panel:
    - a. Affix label at end of the cable within 4 inches of the cable end near the patch panel termination point (on the rear of the patch panel). Include a clear vinyl adhesive wrapping



1. Copper:
    - a. Horizontal Distribution: Test all pairs of each copper station cable, in accordance with the field test specifications defined in ANSI/TIA/EIA 568-B Category 6, and ANSI/TIA/EIA 568-B standards and ANSI/TIA/EIA-568-C.2. This document will be referred to as the Category 6 Standard. The test equipment shall comply with the accuracy requirements for the level III field testers as defined in the TIA Cat 6 Document. To the extent possible, perform tests with building electrical systems fully powered on (i.e. Lights, HVAC, etc.).
      - 1) Test each end-to-end link (the entire channel from the connector at the station to the connector or termination in the telecommunications room) utilizing sweep tests, for continuity, shield continuity, shorts, polarity, attenuation, installed length, transposition (wire map), mutual capacitance, characteristic impedance, resistance, ACR, Insertion Loss, Pair-to-Pair Near End Crosstalk (NEXT), Power Sum Near End Crosstalk (PSNEXT), Equal Level Far End Crosstalk (ELFEXT), Power Sum Equal Level Far End Crosstalk (PSELFEXT), Return Loss, and presence of AC voltage. Test each cable in both directions.
      - 2) Use a TIA/EIA Level III or higher accuracy level testing instrument, re-calibrated within the manufacturer's recommended calibration period or within one year (whichever is more recent), with the most current software revision based upon the most current ANSI/TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.
        - a) Testing Device: Fluke DTX-1800, Micro-Test, Wirescope or Data Com Technologies, with latest software and hardware releases for TE CAT-6 horizontal distribution cables, or approved equal.
  2. Fiber Optic:
    - a. Horizontal Distribution: Test all strands following the procedure outlined in Section 27 13 00 – Communications Backbone Cabling.
- C. Identify cables and equipment that do not pass to the Owner and Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials. Retest the cable or connection materials at no additional expense to the Owner. Provide a complete revised set of all test results to the Owner and Designer, in the same manner as above. Remove original individual cable test reports that are unacceptable and insert the new corrected cable test reports. Do not simply resubmit the test reports for the corrected cabling only.
1. In addition to the above, if it is determined that the cable is faulty, remove the damaged cable and replace it with a new cable. Cable repairs are not acceptable. The procedure for removing the cable shall be as follows:
    - a. Prior to removal of damaged cable and installation of new cable:
      - 1) Inform the Owner and Designer of the schedule for the removal and installation.
      - 2) Test the new cable on the reel per paragraph B, above.
      - 3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
    - b. Remove the damaged cable and provide new cable.
    - c. After the removal of the damaged cable and installation of the new cable:
      - 1) Test the new cable per the paragraph titled TESTING.
      - 2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
        - a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.
    - d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.

- 1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

APPENDIX

Designer – add a cable labeling schedule to the end of this specification section, and change the red-colored “X” to indicate the number of pages.

The following X pages contain the horizontal cable labeling content for each cable.

END OF SECTION

**Station References and Port Designations**

**Basement (Telecommunications Room 5T)**

Total Ports = 106

Rm Name	58 Outlets		Port Labeling in TR				Port Labeling on Outlet			
	Room #	Ref #	1	2	3	4	1	2	3	4
Trash/Recycle	6LD	101	6LD				5T:1A01			
Anatomy Lobby	01	102	01	01			5T:1A02	5T:1A03		
Anatomy Lobby	01	103	01	01			5T:1A04	5T:1A05		
Anatomy FAC Office	41A	104	41A				5T:1A06			
Anatomy FAC Office	41A	105	41A				5T:1A07			
Anatomy FAC Office	41B	106	41B				5T:1A08			
Anatomy FAC Office	41B	107	41B				5T:1A09			
Anatomy Lab Support	41C	108	41C				5T:1A10			
Anatomy Lab Support	41C	109	41C				5T:1A11			
Corridor	43V	110	43V				5T:1A12			
Shared Flex	43	111	43	43	43		5T:1A13	5T:1A14	5T:1A15	
Shared Flex	43	112	43				5T:1A16			
Shared Flex	43	113	43	43			5T:1A17	5T:1A18		
Shared Flex	43	114	43	43			5T:1A19	5T:1A20		
Anatomy	45	115	45	45	45		5T:1A21	5T:1A22	5T:1A23	
Anatomy	45	116	45	45			5T:1A24	5T:1A25		
Anatomy	45	117	45	45			5T:1A26	5T:1A27		
Anatomy	45	118	45	45			5T:1A28	5T:1A29		
Anatomy	45	119	45				5T:1A30			
Anatomy	45	120	45	45			5T:1A31	5T:1A32		
Anatomy	45	121	45	45			5T:1A33	5T:1A34		
Anatomy	45	122	45	45			5T:1A35	5T:1A36		
Anatomy	45	123	45	45			5T:1A37	5T:1A38		
Anatomy	45	124	45				5T:1A39			
Anatomy	47	125	47	47	47	47	5T:1A40	5T:1A41	5T:1A42	5T:1A43
Anatomy	47	126	47	47			5T:1A44	5T:1A45		
Anatomy	47	127	47	47			5T:1A46	5T:1A47		
Anatomy	47	128	47	47			5T:1B01	5T:1B02		
Anatomy	47	129	47				5T:1B03			
Anatomy	47	130	47	47			5T:1B04	5T:1B05		
Anatomy	47	131	47	47			5T:1B06	5T:1B07		
Anatomy	47	132	47	47			5T:1B08	5T:1B09		
Anatomy	47	133	47	47			5T:1B10	5T:1B11		
Anatomy	47	134	47				5T:1B12			
Anatomy	49	135	49	49	49	49	5T:1B13	5T:1B14	5T:1B15	5T:1B16
Anatomy	49	136	49	49			5T:1B17	5T:1B18		
Anatomy	49	137	49	49			5T:1B19	5T:1B20		
Anatomy	49	138	49	49			5T:1B21	5T:1B22		
Anatomy	49	139	49				5T:1B23			
Anatomy	49	140	49	49			5T:1B24	5T:1B25		
Anatomy	49	141	49	49			5T:1B26	5T:1B27		
Anatomy	49	142	49	49			5T:1B28	5T:1B29		
Anatomy	49	143	49				5T:1B30			
Corridor	47V	144	47V				5T:1B31			
Corridor	45V	145	45V				5T:1B32			
Stair	1SE	146	1SE				5T:1B33			
Vented Waste Storage	37	147	37				5T:1B34			
Shared Flex	43	148	43				5T:1B35			
Anatomy	45	149	45				5T:1B36			
Corridor	10	150	10				5T:1B37			
Vestibule	32	151	32	32	32	32	5T:1B38	5T:1B39	5T:1B40	5T:1B41
Vestibule	32	152	32	32	32	32	5T:1B42	5T:1B43	5T:1B44	5T:1B45
Anatomy	47	153	47				5T:1B46			
Anatomy	49	154	49				5T:1B47			
Vestibule	24	155	24	24	24	24	5T:1C01	5T:1C02	5T:1C03	5T:1C04
Vestibule	24	156	24	24	24	24	5T:1C05	5T:1C06	5T:1C07	5T:1C08
Electrical Room	2A	157	2A	2A			5T:1C09	5T:1C10		
Electrical Room	2B	158	2B	2B			5T:1C11	5T:1C12		

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of an inside plant Gigabit Passive Optical Network (GPON). This section includes Inside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Passive Optical Network as well as the required electronics.

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

Typically GPON infrastructure will be used for all residential facilities. The Designer shall inquire with the WSUP ITPM to determine whether GPON will be used for a particular academic building project.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications Gigabit Passive Optical Network as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common medium, and shall be tested for and be capable of 1 Gigabit Ethernet operation as specified in TIA/EIA 568-B.2-10 and ISO/IEC 11801:2002/Amd 1:2008.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary for a complete working ANSI/TIA/EIA and ISO/IEC compliant GPON.

### 1.3 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DIS Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

- A. Provide coordination with cabling system manufacturer's representatives to ensure that the manufacturer's inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any modifications required by the manufacturer and have the manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.
- B. Contractor is solely responsible for all costs associated with scheduling the manufacturer inspection, the inspection itself and any manufacturer-required re-inspections, and for any modifications to the installation as required by the manufacturers.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

### 2.1 GENERAL

- A. GPON components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the manufacturer of the GPON has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the GPON Manufacturer Warranty (see Section 27 05 00 — "Common Works Results for Communications" PART 1 – WARRANTY).
  - 1. Bid only the following GPON Manufacturers and only bid manufacturers for which the Contractor is certified. Substitution is not acceptable. The GPON Manufacturers shall be the following:
    - a. Fiber optic-related products: TE Connectivity
      - 1) Corning fiber optic cabling products are not acceptable for GPON applications.
- B. All fiber optic-related components shall be part of the fiber optic GPON product line – components shall not be intermixed between manufacturers' GPON product lines. The GPON product lines shall be

engineered “end-to-end” – the system and all of its components shall be engineered to function together as a single, continuous transmission path.

## 2.2 PATCH PANELS

- A. Fiber Patch Panels: Shall be rack mountable and equipped with vertical cable guides and angle-left/angle-right adapters. Patch panels shall support both plug-and-play angled cassettes with bend radius protection and adapter plates.
1. Panels shall be TE TrueNet Fiber Panels (TFP) or TE RMG Series:
    - a. 1RU (Accommodate 2 plug-and-play cassettes): TE TFP-1TT00-000B
    - b. 2RU (Accommodate 4 plug-and-play cassettes): TE TFP-2TT00-000B
    - c. 4RU (Accommodate 8 plug-and-play cassettes): TE TFP-4TT00-000B
    - d. 5RU (Accommodate 12 plug-and-play cassettes): TE TFP-5TT00-000B
    - e. 1RU (Accommodate 3 adapter packs): TE RMG-1000-000B
    - f. 2RU (Accommodate 6 adapter packs): TE RMG-2000-000B
    - g. 4RU (Accommodate 12 adapter packs): TE RMG-4000-000B
  2. Cassettes shall be equipped with 12 SC/APC singlemode adapters on the front with MPO feeder adapters on the rear, and shall be:
    - a. Angle Left: TE TFP-12MPLSA1
    - b. Angle Right: TE TFP-12MPRSA1
  3. Adapter Plates shall be equipped with 12 SC/APC singlemode adapters, and shall be:
    - a. Left: TE TFP-12APLA1
    - b. Right: TE TFP-12APRA1
    - c. RMG SC/APC MPO Cassette: TE 1918447-1
  4. Horizontal Cable Manager shall be:
    - a. TE/ADC ADCCMHIB-2U

## 2.3 VIDEO WAVE DIVISION MULTIPLEXER MODULE

- A. MicroVAM Chassis, 12-Position for up to 24 MicroVam modules:
  1. TE FMT-GVM000000-A72P
- B. Video-WDM Module, Dual MicroVAM 1x2, with 1310/1490 voice/data with 1550 video.
  1. TE OPM-HVJNJ02-VZB

## 2.4 FIBER DISTRIBUTION HUBS

- A. Fiber Indoor Distribution Hubs (iFDH) shall host optical fiber cable terminations and passive optical splitters in a wall-mounted or rack-mounted, UL 1863 Listed, NEMA-12 rated enclosure with rear access. Fiber Distribution Hubs shall include an integrated feeder cable.
- B. Fiber Enclosures with plenum-rated, bend-optimized, MPO-terminated, feeder cable stubs shall be:
1. 72-Port with 9 splitter ports, 12-strand feeder cable stub and 6 MPO adapters for distribution:
    - a. Empty (no feeder cable) TE OLH-MK072J00M0M000
    - b. 100 foot stub length, TE OLH-MK072J00M0MKCA
    - c. 250 foot stub length, TE OLH-MK072J00M0MKEA
    - d. 500 foot stub length, TE OLH-MK072J00M0MKBA
  2. 288-Port with 18 splitter ports, 24-strand feeder cable stub and 24 MPO adapters for distribution:
    - a. Empty (no feeder cable) TE OLH-MK288J00M0M000
    - b. 100 foot stub length, TE OLH-MK288J00M0MKCB
    - c. 250 foot stub length, TE OLH-MK288J00M0MKEB
    - d. 500 foot stub length, TE OLH-MK288J00M0MKBB
  3. 432-Port with 22 splitter ports, 24-strand feeder cable stub and 36 MPO adapters for distribution:
    - a. Empty (no feeder cable) TE OLH-MK432J00M0M000

- b. 100 foot stub length, TE OLN-MK432J00M0MKCB
  - c. 250 foot stub length, TE OLN-MK432J00M0MKEB
  - d. 500 foot stub length, TE OLN-MK432J00M0MKBB
- C. Splitters shall be equipped with bend-optimized fiber, with a wavelength range of 1260 to 1635 nm, with APC/SC pigtails, and shall be:
- 1. 2 x 16 splitter, TE OLS-MPP1P66
  - 2. 2 x 32 WDM splitter, TE OLS-MPP1E66
  - 3. 2 x 32 splitter, TE OLS-MPP12A66

## 2.5 FIBER DISTRIBUTION TERMINALS

- A. Fiber Distribution Terminals (FDT) shall serve as a lockable distribution/consolidation point with an integrated patch field and slack-storage reel. Fiber Distribution Terminals shall be UL 1863 Listed, NEMA-12 rated and be suitable for wall-mounting above ceilings or under accessible floors. Fiber Distribution Terminals shall include an integrated, bend-optimized, fiber feeder cable.
- B. Rapid Fiber Distribution Terminals (Rapid FDT) (with integrated cable reel) shall be:
- 1. 12-strand, loose tube, plenum-rated feeder cable, with MPO termination:
    - a. 100 foot stub length, TE OLR-SJ12J00D1002A
    - b. 200 foot stub length, TE OLR-SJ12J00D2002A
    - c. 300 foot stub length, TE OLR-SJ12J00D3002A
  - 2. 24-strand, loose tube, plenum-rated feeder cable, with MPO termination:
    - a. 100 foot stub length, TE OLR-SJ24J00D1002A
    - b. 200 foot stub length, TE OLR-SJ24J00D2002A
    - c. 300 foot stub length, TE OLR-SJ24J00D3002A
- C. Mini Rapid Distribution Terminals (Mini RDT) (requires separate cable spool) shall be:
- 1. 12-strand, loose tube, plenum-rated feeder cable, with MPO termination:
    - a. 200 foot stub length, TE ODT-SM12J00D0619A
    - b. 300 foot stub length, TE ODT-SM12J00D0929A
    - c. 400 foot stub length, TE ODT-SM12J00D1229A
    - d. 500 foot stub length, TE ODT-SM12J00D1529A

## 2.6 FIBER SPLITTERS

- A. Wall-mounted Fiber Splitter Boxes, for up to 32 fibers:
- 1. Double Sided, Single Door Wall Mount Box, supporting 1 splitter adapter plate and up to 3 SC/APC adapter plates: TE 1435128-1
  - 2. FSB-32 Indoor Enclosure, with SC/APC adapters:
    - a. No splitters, no splice trays: TE OSB-SBJ032000000
    - b. No splitters, with heat shrink splice trays: TE OSB-SBJ232000000
    - c. 2 x 32 splitter installed, no splice trays: TE OSB-SBJ032G10000
    - d. 2 x 32 splitter installed, with heat shrink splice trays: TE OSB-SBJ232G10000
- B. Rack-mounted Splitter Enclosure, 4RU, supporting up to 3 splitter adapter plates (3 fiber inputs) and up to 9 SC/APC adapter plates (96 fiber outputs):
- 1. Rack Mount Enclosure: TE 559552-2
- C. Rack-mounted Splitter Panel:
- 1. Rack Mount Panel, supporting up to 3 splitter adapter plates (3 fiber inputs) and up to 9 SC/APC adapter plates (96 fiber outputs) (1U each, quantity 4 required): TE 1777125-1
  - 2. FMT Rack Mount Splitter Panel, 1U
    - a. 2 x 32 Splitter: TE OPS-FMTSP-GJJ01

- D. Rack-mounted Splitter Drawer, 1U, supporting up to 4 splitter adapter plates:
  - 1. Rack Mount Panel (1U): TE OPS-MPPACCRMPNL
- E. Access Floor-mounted Enclosure, supporting 1 splitter adapter plate (1 fiber input):
  - 1. 32-Fiber EAZ Floor Mount Enclosure: TE 1777215-1
- F. Bracket for Wall-mounting or Furniture-mounting:
  - 1. Bracket: TE 1777126-1, with optional cable ring
- G. SC/APC MPO Cassette:
  - 1. 12-Fiber: TE 1918447-1
- H. SC/APC Adapter Plate:
  - 1. 12-Fiber: TE 559596-3
- I. Splitter with Adapter Plate: Bend-optimized and rugged fiber (54 inch cable length), terminated with SC/APC connectors, shall be:
  - 1. Front input kit (cable assembly and adapter): TE 2111699-1
- J. Optical Splitter Modules, with APC/SC pigtails, for use with TE iFDH, FSB, Splitter Drawers and Splitter Panels:
  - 1. 2 x 16 splitter: TE OLS-MPP1P66
  - 2. 2 x 32 WDM Splitter: TE OLS-MPP1E66
  - 3. 2 x 32 splitter: TE OLS-MPP12A66

## 2.7 CONNECTORS

- A. Fiber Optic Couplers (modular jacks): Shall be TE SL form factor, such that the jacks will snap into the faceplates specified in Section 27 15 00.
  - 1. SC Simplex Coupler, APC, Green: TE 2-1375055-1

## 2.8 STATIONS

- A. Faceplates: See Section 27 15 00.

Reuse existing doublegang faceplates when upgrading existing applications (that already have doublegang faceplates). TE does not manufacture doublegang faceplates with 2 or 4 port **angled** port inserts. Currently, the best that can be done is to reused the existing faceplates with their straight port inserts.

- B. Faceplates: Single gang, angled faceplate
  - 1. 2-ports: TE 1375155-X
  - 2. 4-ports: TE 406185-X.

## 2.9 ELECTRONICS

- A. Optical Network Terminals (ONT) shall be:
  - 1. Zhone zNID GPON Indoor ONT
    - a. Model with Power-over-Ethernet (POE)
    - b. Model that is non-POE
    - c. Model that is non-POE with RF Video
- B. Optical Line Terminals (OLT) shall be:
  - 1. Zhone MXK OLT Chassis

2. Zhone MXK Line Cards

2.10 CABLE

A. General: Cables shall be manufactured by the selected SCS Manufacturer. All cables shall be plenum-rated.

B. Fiber Cable:

1. Fiber cables shall be Singlemode 8.3/125  $\mu$ m OS2, factory-terminated, 3mm yellow jacket, and shall permit a bend radius of 7.5mm without changing cable characteristics. Cable shall be manufactured by the selected SCS Manufacturer and shall be:

a. SC APC to SC APC, plenum-rated, Ivory drop cable: TE PAT-6C6C-PS0GxxxM

b. TE Single Strand SM 3MM Jacket 7-1553409-3

Commscope manufactures a multimode zipcord product that is indoor/outdoor rated, and plenum rated. However, they don't currently manufacture this cable in singlemode. With the pending merger between Commscope and TE expected to culminate in 2015, it is anticipated that a singlemode product can be procured within TE's warranty coverage at some point in the near future.

Delete the following paragraph if there are no wet area applications in the project.

2. For wet environments, fiber cables shall meet the performance and behavioral characteristics described above, be rated for indoor/outdoor use, and be plenum-rated where required.

a. Commscope, zipcord

C. Hook and Loop Cable Managers: Reusable hook and loop straps (similar to Velcro), adjustable tension, roll or spool dispensed:

1. Panduit HLS-15R0

2. SIEMON VCM-xxxx-xxx

3. TE 5/8 inch wide: 1375255-X

4. Or approved equal

2.11 INNERDUCT

A. Intra-building innerduct shall be 1 inch size, orange, unsplit, corrugated, with pull tape:

1. Plenum-rated: Carlon Plenum-Gard CF4x1C-nnnn

2. Riser-rated: Carlon Riser-Gard DF4x1C-nnnn

2.12 LABELING AND ADMINISTRATION

A. Labels:

1. As recommended in ANSI/TIA/EIA 606. Labels shall be permanently inscribed (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.

a. For Station Cable:

1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

B. Hand-carried label maker:

1. Brady: ID Pro Plus (or approved equal).

### PART 3 - EXECUTION

#### 3.1 GENERAL

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Provide a complete functioning GPON infrastructure, including all required components.

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

#### 3.2 PATCH PANELS

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.
1. Fiber Optic: Terminate horizontal fiber optic cabling from all floors on horizontal fiber optic patch panels in the main telecommunications room (MDF).
  2. Horizontal Wire Management: Provide horizontal wire management as shown on the Contract Documents.

#### 3.3 FIBER DISTRIBUTION HUBS

- A. Provide fiber distribution hubs according to locations, elevations, and plan views as shown on the Contract Documents.

#### 3.4 FIBER DISTRIBUTION TERMINALS

- A. Provide fiber distribution terminals according to locations, elevations, and plan views as shown on the Contract Documents.

#### 3.5 FIBER SPLITTERS

- A. Provide fiber splitters as shown on the Contract Documents.

#### 3.6 CONNECTORS

- A. Provide fiber optic couplers for each outlet as shown on the Contract Documents.

#### 3.7 STATIONS

- A. Provide outlets, faceplates, fiber terminations, and ONT devices for each endpoint application as shown on the Contract Documents.

### 3.8 CABLE

- A. General (applicable to all cable types): Provide non-plenum (CM/CMR, OFNR) rated cable for locations where cable is to be installed in conduit. For cable not installed in conduit, provide plenum (CMP, OFNP) rated cable if cable is installed in a plenum air space environment. Otherwise, provide non-plenum-rated (CMR) cabling. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.
1. Horizontal Distribution: Provide station cable in types, sizes, and quantities as defined by the Symbol Schedule and as shown on the Contract Documents. Install cable between the station and its associated telecommunications room. Provide one cable per each connector at each station. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.
  2. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
  3. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.
    - a. Pull all cables simultaneously where more than one cable is being installed in the same raceway.
    - b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
    - c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.
  4. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
  5. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
  6. Tie or clamp cabling. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable. Install tie-wraps in conformance with the GPON manufacturer's installation recommendations. Do not over-tighten tie wraps or cause cross-sectional deformation of cabling.
  7. Cable at the backboards:
    - a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
    - b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
    - c. Do not use D-rings to route horizontal GPON cabling. Instead, use vertical ladder racking (securing cabling with hook-and-loop straps) and horizontal ladder racking, using the most direct route to the termination point. Route via a path that will minimize obstruction to future installation of equipment, backboards or other cables.
  8. Cable in the telecommunications rooms:
    - a. For telecommunications rooms with ladder racking, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with hook-and-loop straps.
  9. Cable terminating on patch panels located on racks:
    - a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.
- B. Fiber Optic Cable:
1. Provide station cable in the locations shown on the Contract Documents. Provide service loops with a minimum length of 12 inches in outlet boxes and no less than 10 feet in the ER/TR's.

Store the remainder of the slack using manufacturer-recommended solutions (reels, cartridges, etc.).

- a. For workstation outlets with both fiber and copper cabling, terminate fiber optic cabling after copper cabling has been installed and terminated.

Commscope manufactures a multimode zipcord product that is indoor/outdoor rated, and plenum rated. However, they don't currently manufacture this cable in singlemode. With the pending merger between Commscope and TE expected to culminate in 2015, it is anticipated that a singlemode product can be procured within TE's warranty coverage at some point in the near future.

Delete the following paragraph if there are no wet area applications in the project.

- b. For fiber optic station cabling installed in wet areas, including floor boxes in slab-on-grade applications, use Indoor/Outdoor Wet Environment-rated cabling.

2. Innerduct

The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.

- a. Innerduct is required for routing horizontal GPON fiber optic cabling through all vertical riser pathways (conduits and sleeves) that exceed 4 feet in length.
- b. Innerduct is also required for routing horizontal GPON fiber optic cabling through cable trays where larger outside plant cable shares the cable tray.
- c. Otherwise, innerduct is not required for routing horizontal GPON fiber optic cabling.
- d. Where innerduct is required, install fiber optic cable in innerduct per manufacturer's instructions. Innerduct shall terminate within 6 inches of top of each patch panel where fiber optic cable terminates. Secure innerduct with zip-ties at intervals not exceeding 24 inches. Do not use wire or tape.
- e. See Sections 27 13 00 and 33 82 00 for innerduct requirements related to fiber optic backbone cabling in inside plant and outside plant backbone applications, respectively.

The Designer shall verify during construction that this form has been submitted by the Contractor.

3.9 LABELING AND ADMINISTRATION

A. Horizontal Cable Labeling:

- 1. Provide white-colored labels.
- 2. Cables at Patch Panel end:
  - a. Affix label at end of the cable within 4 inches of the cable end near the patch panel termination point (on the rear of the patch panel). Include a clear vinyl adhesive wrapping applied over the label in order to permanently affix the label to the cable. Using transparent tape to affix labels to cables is not acceptable.
  - b. Affix a second label on the front side of the patch panel adjacent to the screen-printed jack number where the cable terminates.
  - c. Cables shall be labeled according to the following scheme:

aaaaa

aaaaa = Room Number where outlet is located

- 3. Cables at Outlet end:
  - a. Affix label at end of the cable within 4 inches of the cable end near the jack. Include a clear vinyl adhesive wrapping applied over the label in order to permanently affix the label to the cable. Using transparent tape to affix labels to cables is not acceptable.
  - b. Affix a second label on the exterior of the faceplate, adjacent to the jack corresponding to the cable.



- 3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
- b. Remove the damaged cable and provide new cable.
- c. After the removal of the damaged cable and installation of the new cable:
  - 1) Test the new cable per the paragraph titled TESTING.
  - 2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
    - a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.
- d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.
  - 1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

Designer – add a cable labeling schedule to this section for horizontal copper and horizontal fiber, similar to the example provided.

Change the red-colored “X” to indicate the number of pages.

#### APPENDIX

The following X pages contain the horizontal cable labeling content for each cable.

END OF SECTION

**Station References and Port Designations**

**Basement (Telecommunications Room 5T)**

Total Ports = 106

Rm Name	58 Outlets		Port Labeling in TR				Port Labeling on Outlet			
	Room #	Ref #	1	2	3	4	1	2	3	4
Trash/Recycle	6LD	101	6LD				5T:1A01			
Anatomy Lobby	01	102	01	01			5T:1A02	5T:1A03		
Anatomy Lobby	01	103	01	01			5T:1A04	5T:1A05		
Anatomy FAC Office	41A	104	41A				5T:1A06			
Anatomy FAC Office	41A	105	41A				5T:1A07			
Anatomy FAC Office	41B	106	41B				5T:1A08			
Anatomy FAC Office	41B	107	41B				5T:1A09			
Anatomy Lab Support	41C	108	41C				5T:1A10			
Anatomy Lab Support	41C	109	41C				5T:1A11			
Corridor	43V	110	43V				5T:1A12			
Shared Flex	43	111	43	43	43		5T:1A13	5T:1A14	5T:1A15	
Shared Flex	43	112	43				5T:1A16			
Shared Flex	43	113	43	43			5T:1A17	5T:1A18		
Shared Flex	43	114	43	43			5T:1A19	5T:1A20		
Anatomy	45	115	45	45	45		5T:1A21	5T:1A22	5T:1A23	
Anatomy	45	116	45	45			5T:1A24	5T:1A25		
Anatomy	45	117	45	45			5T:1A26	5T:1A27		
Anatomy	45	118	45	45			5T:1A28	5T:1A29		
Anatomy	45	119	45				5T:1A30			
Anatomy	45	120	45	45			5T:1A31	5T:1A32		
Anatomy	45	121	45	45			5T:1A33	5T:1A34		
Anatomy	45	122	45	45			5T:1A35	5T:1A36		
Anatomy	45	123	45	45			5T:1A37	5T:1A38		
Anatomy	45	124	45				5T:1A39			
Anatomy	47	125	47	47	47	47	5T:1A40	5T:1A41	5T:1A42	5T:1A43
Anatomy	47	126	47	47			5T:1A44	5T:1A45		
Anatomy	47	127	47	47			5T:1A46	5T:1A47		
Anatomy	47	128	47	47			5T:1B01	5T:1B02		
Anatomy	47	129	47				5T:1B03			
Anatomy	47	130	47	47			5T:1B04	5T:1B05		
Anatomy	47	131	47	47			5T:1B06	5T:1B07		
Anatomy	47	132	47	47			5T:1B08	5T:1B09		
Anatomy	47	133	47	47			5T:1B10	5T:1B11		
Anatomy	47	134	47				5T:1B12			
Anatomy	49	135	49	49	49	49	5T:1B13	5T:1B14	5T:1B15	5T:1B16
Anatomy	49	136	49	49			5T:1B17	5T:1B18		
Anatomy	49	137	49	49			5T:1B19	5T:1B20		
Anatomy	49	138	49	49			5T:1B21	5T:1B22		
Anatomy	49	139	49				5T:1B23			
Anatomy	49	140	49	49			5T:1B24	5T:1B25		
Anatomy	49	141	49	49			5T:1B26	5T:1B27		
Anatomy	49	142	49	49			5T:1B28	5T:1B29		
Anatomy	49	143	49				5T:1B30			
Corridor	47V	144	47V				5T:1B31			
Corridor	45V	145	45V				5T:1B32			
Stair	1SE	146	1SE				5T:1B33			
Vented Waste Storage	37	147	37				5T:1B34			
Shared Flex	43	148	43				5T:1B35			
Anatomy	45	149	45				5T:1B36			
Corridor	10	150	10				5T:1B37			
Vestibule	32	151	32	32	32	32	5T:1B38	5T:1B39	5T:1B40	5T:1B41
Vestibule	32	152	32	32	32	32	5T:1B42	5T:1B43	5T:1B44	5T:1B45
Anatomy	47	153	47				5T:1B46			
Anatomy	49	154	49				5T:1B47			
Vestibule	24	155	24	24	24	24	5T:1C01	5T:1C02	5T:1C03	5T:1C04
Vestibule	24	156	24	24	24	24	5T:1C05	5T:1C06	5T:1C07	5T:1C08
Electrical Room	2A	157	2A	2A			5T:1C09	5T:1C10		
Electrical Room	2B	158	2B	2B			5T:1C11	5T:1C12		

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

- A. Provide all materials and labor for the installation of specialty telephone equipment.

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, specialty telephone equipment, and necessary appurtenances to provide complete, permanent emergency telephone systems as hereinafter specified and/or shown on the Contract Documents. The systems shall be compatible with the Owner's existing emergency telephone systems and with the local E911 emergency call handling center.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary for a complete working system.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

## 2.1 AREA OF REFUGE 2-WAY COMMUNICATION EMERGENCY TELEPHONES

Verify whether an Area of Refuge device is required for the project. If not, delete this paragraph and the corresponding paragraph in Part 3 below.

- A. Flush-mounted enclosure shall be ADA compliant.
  - 1. Enclosure:
    - a. GAI-Tronics, Model 397-001 Flush mount.
  - 2. Single button auto-dial (911) with speakerphone.
    - a. GAI-Tronics "Red Alert" Emergency Telephone, Model 397-001 Flush mount.
  - 3. Mounting and equipment shall be ADA compliant.

## 2.2 OUTDOOR RESCUE CALL STATIONS

Verify whether Outdoor Rescue Call Stations are required for the project. If not, delete this paragraph and the corresponding paragraph in Part 3 below.

- A. Pedestal type exterior phones with blue light strobe, 114 inches tall, weather-resistant, durable powder-coated 3/16 inch cold-rolled steel, architectural bronze finish for exterior use, labeled with "EMERGENCY" on all four sides. Equipment shall be ADA compliant.
  - 1. GAI-Tronics Model 234 Stanchion
- B. Single button auto-dial (911) with speakerphone.
  - 1. GAI-Tronics "Red Alert" Emergency Telephone, Model 397-001 Flush mount.
- C. Blue strobe light beacon.
  - 1. GAI-Tronics Model 530-001
- D. 8-ft #6 copper grounding rod

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

### 3.1 GENERAL

- A. Perform all work in accordance with manufacturer's instructions and as required below.
- B. Install all equipment in an arrangement ensuring that access to the equipment remains ADA compliant.

### 3.2 AREA OF REFUGE 2-WAY COMMUNICATION EMERGENCY TELEPHONES

- A. Provide a 2-way communication emergency enclosure and telephone unit for each Area-of-Refuge location.
- B. Electrical:
  - 1. Provide power conduit and circuits as shown on Contract Documents and as required by manufacturer.
  - 2. Provide bonding jumper between outlet box or conduit and telephone.
- C. Telecommunications:
  - 1. Provide telecommunications conduits, outlet boxes and circuits as shown on Contract Documents and as required by manufacturer.
  - 2. Provide patch cord between outlet and telephone.

### 3.3 OUTDOOR RESCUE CALL STATIONS

- A. Provide one outdoor rescue call station unit for each location noted on Contract Documents.
- B. Concrete Base:
  - 1. Provide concrete base as shown on Contract Documents and as required by manufacturer.
  - 2. The freestanding unit shall be mounted onto four bolts that are set in concrete.
  - 3. Standard 3/4 x 24 inch galvanized anchor bolts with galvanized nuts and washers shall be used per manufacturer requirements.
  - 4. Unit shall be mounted one-half inch above the concrete to allow air movement.
- C. Electrical:
  - 1. Provide power conduit and circuits as shown on Contract Documents and as required by manufacturer.
  - 2. Provide ground rod. Bond steel housing to grounding rod.
- D. Telecommunications:
  - 1. Provide copper telecommunications cable as shown on Contract Documents and as required for device operation.
  - 2. Provide entrance protection at building entrance.
  - 3. Bond cable shield to the grounding busbar at building entrance and to grounding rod.

### 3.4 COMMISSIONING

- A. Work with the Owner's designated Telecommunications Representative to identify suitable telephone circuits for each telephone device. Connect telephone circuits to telephones and verify that calls can successfully be placed.

### 3.5 TESTING

- A. Testing of all cable and devices shall be conducted by the Contractor in accordance with manufacturer's requirements and shall demonstrate that the devices interoperate with the Owner's existing systems.

- B. All tests shall be coordinated through and witnessed by the Owner's designated Telecom Representative.

END OF SECTION

## PART 1 - GENERAL

This section of the Audio/Visual Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University (Pullman) Audio/Visual projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Audio/Visual projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials, software, cabinets, racks, enclosures, cabling, connectors, power hardware, equipment and labor for the installation of audio/visual systems.

### 1.2 QUALITY ASSURANCE

- A. See section 27 05 00 for Audio/Visual contractor pre-qualification requirements.

### 1.3 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances associated with audio/visual equipment cabinets, racks, frames, enclosures, cable management, and power hardware to support standards-compliant audio/visual systems as shown on the Contract Documents.
- B. The work shall include all materials, equipment, software, and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working system, compatible with and complementary to the existing campus systems.
- C. Provide the systems listed below and as shown on the Contract Drawings, unless otherwise indicated:
  - 1. Wiring and cabling
  - 2. Equipment racks, cabinets, and enclosures

3. Furniture
4. Amplifiers
5. Microphones
6. Speakers
7. Assistive listening devices
8. DVD players
9. Video cameras
10. Projection screens
11. Video projectors
12. Video panels
13. Video conferencing systems
14. Interactive display devices
15. Digital signage
16. Interactive door signage
17. A/V scaling switchers
18. Touch panels
19. Room control software
20. Window shade control
21. Lighting control
22. Equipment mounts
23. Lecture capture systems
24. Audio DSP (Digital Signal Processor)

#### 1.4 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01300 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01300 or this section should include a statement similar to the following, “The Contractor shall apply Contractor’s stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Designer prior to start of construction. The Designer shall obtain approval from WSUP prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Designer it remains the Contractor’s responsibility to provide what is required in the Contract Documents”.

- A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Combine product submittals for all products and submit together as a single submittal.
1. Submit a cover letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. State in the letter that the Contractor has reviewed the specified items, and agrees that they are applicable to this project in all respects.
  2. Provide standard manufacturer’s cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.
  3. For those items noted as allowing “or equal,” and which are not being provided as specifically named, submit a written description detailing the reason for the substitution, along with standard manufacturer’s cut sheets or other descriptive information.

- B. Preliminary Schematic Wiring Diagrams: Provide a schematic wiring diagram for each audio/visual application. The diagrams shall show all equipment with equipment model numbers. The diagrams shall also show all cables and wiring connections, indicating cable/wire types.
- C. As-built Schematic Wiring Diagram: Upon successful operation of each audio/visual application, provide a schematic wiring diagram for each building and room having an audio/visual application. The diagrams shall show all equipment with equipment models and serial numbers. The diagrams shall show all cables and wiring connections, indicating cable/wire type and wire labeling.
1. For rooms that have identical audio/visual systems (including wire numbers), a single drawing will be sufficient as long as it lists the building and rooms to which it applies.
  2. Sometimes name and number changes occur during construction. Before creating drawings and labeling, verify that the room names and numbers are correct.
- D. Operation, Installation and Maintenance Manuals: At the conclusion of the project, provide electronic copies of the Operation, Installation and Maintenance Manuals for each piece of audio/visual equipment. Each document shall be provided in Adobe Acrobat PDF format on a CDROM or DVDROM. Each PDF file shall be an original document prepared by the manufacturer. For each document that is not available from a manufacturer's website, scan the hard-copy documentation provided with the equipment.
1. Organize the PDF files on the CDROM or DVDROM in a folder structure as follows:
    - a. Each room per building shall have a separate folder containing all documents for the equipment in that room.
    - b. The folders shall be named in the following format: "BUILDING – NAME - ###" where BUILDING is the name of the building, NAME is the name (and/or number) of the room, and ### is the room number.
  2. Provide to the Owner a single set of hard-copy printed documentation for each piece of audio/video equipment. Organize the documentation in a 3-ring (or similar) binder. Dispose of all other copies of the original printed documentation after verification that the electronic (PDF) version of each is stored on the CDROM or DVDROM.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

## 2.1 GENERAL

- A. Unless specifically stated as "Or equal," equal items are not acceptable. Provide items as specified. Pre-approval is required for all "or equal" substitutions.
- B. Provide batteries for all hand-held remote controls.

## 2.2 GROUNDING AND BONDING

- A. See Section 27 05 26 – "Grounding and Bonding for Communications Systems."

## 2.3 STANDARD CABLE ASSEMBLIES/PATCH CORDS

- A. General: The cabling listed below shall be used where referenced in this specification section. Cable colors shall be used consistently throughout as indicated.
- B. Standard Audio Cabling:
  - 1. Non-plenum rated cabling shall be 22 AWG, solid, twisted pair, shielded with 22 AWG drain wire, neutral colored, unless otherwise indicated:
    - a. Belden 8761
    - b. or commercial grade equal from Gepco.
  - 2. Plenum-rated cabling shall be 22 AWG, stranded, twisted pair, shielded with drain wire, white colored, unless otherwise indicated:
    - a. Belden 82761
    - b. or commercial grade equal from Gepco.
  - 3. Permitted terminations shall be:
    - a. XLR: Neutrik or Switchcraft.
    - b. RCA: Neutrik or Switchcraft.
    - c. 3.5mm TRS: Switchcraft 35HDBAU.
    - d. Screw-type (Phoenix): typically supplied by equipment manufacturer.
    - e. Screw-type (open): typically supplied by equipment manufacturer.
    - f. Drain wire sleeved with Teflon or PVC sleeving as appropriate.
- C. Standard Video Cabling:
  - 1. Non-plenum rated cabling shall be RG-59/U, 20 AWG, black colored, unless otherwise indicated:
    - a. Belden 1505A
    - b. or commercial grade equal from Gepco.
  - 2. Plenum-rated cabling shall be RG-59/U, 20 AWG, black colored, unless otherwise indicated:
    - a. Belden 1506A
    - b. or commercial grade equal from Gepco.
  - 3. Permitted terminations shall be:
    - a. BNC, 75-ohm, compression: Belden DB1BNC
    - b. BNC, 75-ohm with a crimp plug: MilesTek 10-03001-240, AMP, or Canare.
    - c. BNC-to-RCA Adapter: MilesTek, Switchcraft. or Canare.
- D. Standard RGBHV Cabling:
  - 1. Plenum rated cabling shall be 25 AWG, five copper conductors, solid, tinned, black colored, unless otherwise indicated:
    - a. Belden 1279P
    - b. or commercial grade equal from Gepco.
  - 2. Permitted terminations shall be:
    - a. BNC, 75-ohm, compression: Belden DB1BNC

- b. BNC, 75-ohm with a crimp plug: MilesTek 10-03001-240, Canare BCP-C55A, or AMP.
- E. Standard Television Cabling:
- 1. Non-plenum rated cabling shall be RG-6, 18 AWG, HD-SDI rated, white colored, unless otherwise indicated:
    - a. Belden 1694A
    - b. or commercial grade equal from Gepco.
  - 2. Plenum-rated cabling shall be RG-6, 18 AWG, HD-SDI rated, white colored, unless otherwise indicated:
    - a. Belden 1695A
    - b. or commercial grade equal from Gepco.
  - 3. Permitted terminations shall be:
    - a. BNC, 75-ohm with a crimp plug: MilesTek 10-03001-240, AMP, or Canare.
    - b. BNC-to-RCA Adapter: MilesTek, Switchcraft, or Canare.
- F. Standard HDMI Cabling:
- 1. Pre-manufactured HDMI cables shall be commercial grade and less than 30 feet long, from:
    - a. Kramer K-Lock Series
    - b. Comprehensive Cable Pro AV/IT series with ProGrip
    - c. or pre-approved equal.
  - 2. Where HDMI applications would require lengths exceeding 50 feet, provide active baluns with Category 6 Cabling per Section 27 15 00 – “Communications Horizontal Cabling,” installed and terminated by the certified telecommunications contractor.
    - a. Active baluns shall be:
      - 1) Atlona AT-HDTX and AT-HDRX
      - 2) AMX DX-TX (FG1010-310) and DX-RX (FG1010-500)
      - 3) or pre-approved equal.
- G. Standard HDBaseT Cabling:
- 1. Cabling shall be Shielded Category 6A Cabling per Section 27 15 00 – “Communications Horizontal Cabling,” installed and terminated by the certified telecommunications contractor.
  - 2. Permitted terminations shall be as shown in the Contract Documents, including:
    - a. Outlets, jacks and faceplates for Category Cabling per Section 27 15 00 – “Communications Horizontal Cabling.”
    - b. 12-port wall-mounted TE/AMP patch panel, matching the cable type specified in Section 27 15 00 – “Communications Horizontal Cabling.”
      - 1) or pre-approved equal.
- H. Standard DVI-A Cabling:
- 1. Pre-manufactured DVI-A cables shall be commercial grade cables and shall be Class 2 where required for higher bandwidth signals, from:
    - a. Kramer
    - b. Gepco
    - c. Comprehensive Cable
    - d. Cables 2 Go (C2G)
    - e. or pre-approved equal.
- I. Standard DVI-D Cabling:
- 1. Pre-manufactured DVI-D cables shall be commercial grade cables and shall be Class 2 where required for higher bandwidth signals, from:
    - a. Kramer

- b. Gepco
  - c. Comprehensive Cable
  - d. Cables 2 Go (C2G)
  - e. or pre-approved equal.
- J. Standard USB Cabling:
- 1. Pre-manufactured USB cables shall be commercial grade, from:
    - a. Gepco
    - b. Comprehensive Cable
    - c. Cables 2 Go (C2G)
    - d. or pre-approved equal.
- K. Standard Contact Closure Cabling:
- 1. Plenum-rated cabling shall be 18 AWG, stranded, three conductor, natural colored, shielded with drain wire, unless otherwise indicated:
    - a. Belden 6300FE
    - b. or commercial grade equal from Gepco.
- L. Standard Screen Control System Cabling:
- 1. Projection screen control cables shall be 18 AWG, plenum rated, stranded, three conductor, shielded with drain wire, white colored:
    - a. Belden 6301FE
    - b. or commercial grade equal from Gepco.
  - 2. 3-wire RS232 cables shall be 22 AWG, plenum rated, stranded, twisted pair, shielded with 22 AWG drain wire, white colored.
    - a. Belden 82761
    - b. or commercial grade equal from Gepco.
  - 3. 4-wire RS422 and RS485 control cables shall be 22 AWG, plenum rated, stranded, two twisted pairs, natural colored, with termination hardware as required by the equipment.
    - a. Belden 82723
    - b. or commercial grade equal from Gepco.
  - 4. AMX AXLink cable shall be plenum-rated, 22 AWG, stranded, one twisted pair shielded (data), and 18 AWG two conductor (power) with 24 AWG drain wire, black colored, with termination as specified by AMX:
    - a. Liberty AXLink-P wire
    - b. or commercial grade equal from Gepco.
  - 5. AMX Network shall be Category Cabling per Section 27 15 00 – “Communications Horizontal Cabling” with RJ45 connectors, installed and terminated by the certified telecommunications contractor.
  - 6. IR control cables shall be 22 AWG, stranded, twisted pair, shielded with 22 AWG drain wire, gray-colored and terminated with a Screw-type (Phoenix) termination. Cables shall include IR Emitter provided by Room Control System manufacturer.
    - a. Belden 9451
    - b. or commercial grade equal from Gepco.
  - 7. RS232 control cabling and AMX RS232 control cabling shall be Category Cabling per Section 27 15 00 – “Communications Horizontal Cabling” with RJ45 connectors, installed and terminated by the certified telecommunications contractor.
- M. Standard Speaker Wiring:
- 1. Speaker wiring shall be 14 AWG, stranded, two conductor, unshielded, white or gray-colored, and plenum-rated (regardless of the plenum rating of the space):
    - a. Belden 6100UE
    - b. or pre-approved commercial grade equal from Gepco.
  - 2. Permitted terminations shall be as required by the attached device:
    - a. Spring clip

- b. Screw-type (banana plug)
- c. Speakon
- d. XLR

- N. Standard Cable Management:
- 1. Hook-and-loop straps (Velcro style).

## 2.4 EQUIPMENT RACKS/ENCLOSURES

### A. A/V Equipment Rack (Full-Height):

- 1. A/V Equipment Rack shall have a capacity of 40U, shall be 32" deep, black powder coated with a vented rear door. The rack shall include all necessary mounting hardware and grounding/bonding hardware.
- 2. Equipment Rack: Lowell LSER-4032.
- 3. Power Strip: Tripplite PDU 1215. The power strip shall not have a user-facing on/off switch.
- 4. Cable Management: Lowell CMV Series (vertical).
- 5. Drawer: Lowell UDE Series.
- 6. Solid Blank Panels: Lowell SEP or SP Series.
- 7. Vented Blank Panels: Lowell SVSP Series.
- 8. Security Covers: Lowell SSC Series.
- 9. Shelf: Lowell US Series, 14" deep.

### B. A/V Equipment Rack (In-Casework applications):

- 1. A/V Equipment Rack shall have a capacity of 10U (minimum), shall be 18" deep, black powder coated with removable side panels. The rack shall include all necessary mounting hardware and grounding/bonding hardware.
- 2. Equipment Rack:
  - a. Lowell LDTR-1018
- 3. Swivel Casters:
  - a. Lowell C2S
- 4. Power Strip: Tripplite IBAR-12 with surge suppression.
- 5. Cable Management: Lowell CMV Series (vertical).
- 6. Drawer: Lowell UDE Series.
- 7. Solid Blank Panels: Lowell SEP or SP Series.
- 8. Vented Blank Panels: Lowell SVSP Series.
- 9. Security Covers: Lowell SSC Series.
- 10. Shelf: Lowell US Series, 14" deep.

### C. A/V Equipment Rack (In-Podium applications):

- 1. A/V Equipment Rack shall have a capacity of 14U, shall be 21" deep, black powder coated without sides, back or top panels. The rack shall include all necessary mounting hardware and grounding/bonding hardware.
- 2. Equipment Rack: Lowell LXR-1421.
- 3. Power Strip: Tripplite PDU 1215. The power strip shall not have a user-facing on/off switch.
- 4. Exhaust Fans:
  - a. Lowell FW2-3T
  - b. Middle Atlantic UQFP-4
- 5. Cable Interface Panel:
  - a. 19-Inch Rack Adapter shall be Kramer RK-6T:

Discuss with the AVPM which of the following inputs are required:

- 1) HDMI
- 2) DisplayPort

- 3) 3.5mm audio input
- 4) DB15 VGA video input
- 5) RJ45 Ethernet
- 6) RCA auxiliary video and audio inputs (Yellow/Red/White)
- 7) USB (quantity three)
- 8) XLR female microphone
6. Solid Blank Panels: Lowell SEP or SP Series.
7. Vented Blank Panels: Lowell SVSP Series.
8. Security Covers: Lowell SSC Series.
9. Shelf: Lowell US Series, 14" deep.

D. Exhaust Fans for A/V Equipment Racks:

1. Lowell
2. Middle Atlantic

E. Mesh Sleeve for routing exposed cables:

1. Braided, expandable plastic mesh sleeve, black colored, sized appropriately for the application (typically 1" and 1-1/2" diameter):
  - a. TechFlex, Panduit or equal.

## 2.5 FURNITURE

A. Cable Access Cubby for Conference Room Tables:

The Designer shall discuss with the AVPM whether Conference Room Tables shall be specified here or whether another procurement vehicle will be used. If the AVPM directs that tables shall be included in this specification, the Designer shall work with the AVPM to determine the parameters.

- Materials and Color shall match building décor.

Regardless of whether the tables are specified here, the Cable Access Cubby is required in this specification.

1. Table-top cable access cubby shall be:
2. Connectors for cable access cubby shall be:

Discuss with the AVPM which of the following inputs are required:

- a. HDMI
- b. 3.5mm audio input
- c. HD15 XGA video input
- d. Electrical Power

B. Instructor Podiums:

Verify that detailed drawings have been provided depicting how the podiums shall be constructed.

1. Podiums shall be as shown in the Contract Documents:

The Designer shall discuss with the AVPM whether Instructor Podiums shall be specified here or whether another procurement vehicle will be used. If the AVPM directs that Podiums shall be included in this specification, the Designer shall work with the AVPM to determine the parameters.

- Materials and Color shall match building décor. Desktop Surface materials and colors shall be selected by Facilities Services Interior Designers.

- a. Size: XXXXXX
- b. Material: XXXXXX

- c. Color: XXXXXX
- d. Manufacturer and model: XXXXXX
2. Computer security cable and lock:
  - a. Kensington
  - b. or pre-approved equal.

## 2.6 AUDIO SYSTEMS

- A. Mono system amplifiers shall provide 75 watts per channel output, be Class A/B rated, with appropriate inputs, and rack-mount brackets. The amplifier shall support 4, 8 and 16 ohm speakers and shall also have intrinsic 70V speaker outputs.
  1. Mono system amplifiers shall be Peavey Crest PA 150.
  2. Cables shall be Standard Audio Cabling with XLR plugs, RCA plugs, spring clip, or Screw-type (open) terminals.
- B. Stereo system amplifiers shall provide 75 watts per channel output, be Class A/B rated, with appropriate inputs and rack-mount brackets. The amplifier shall support 4, 8 and 16-ohm speakers. Amplifiers shall be:
  1. Crest Peavey or Biamp MT series.
  2. Cables shall be Standard Audio Cabling with Phoenix terminals or Screw-type (open) terminals.
- C. Digital Signal Processing (DSP) systems shall be:
  1. Biamp Nexia/Audia.
  2. Cables shall be Standard Audio Cabling with XLR plugs, RCA plugs, spring clip, or Screw-type (open) terminals.
- D. Speakers:
  1. For Speech: 70 Volt, monaural audio speakers, suitable for ceiling mounting. Speakers shall be:
    - a. Pure Resonance Audio VCA series 2'x2' ceiling tile speakers.
    - b. Pure Resonance Audio PRA series in-ceiling speakers.
    - c. QSC AD-C series.
  2. For Content: 4 ohm or 8 ohm stereo audio speakers, suitable for ceiling mounting or hanging. Speakers shall be:
    - a. QSC AD-S series for surface mounting.
    - b. QSC AD-C series for ceiling-tile mounting.
    - c. Pure Resonance Audio VCA series 2'x2' ceiling tile speakers.
    - d. Pure Resonance Audio PRA series in-ceiling speakers.
  3. Mounting hardware shall be either included with speakers or inherently mountable.
  4. Wiring shall be Standard Speaker Wiring with standard terminations.
- E. Assistive Listening Devices:
  1. Transmitter:
    - a. Williams Sound WIR TX90 with:
      - 1) Power supply
      - 2) Power cable
      - 3) Wall/ceiling mounting kit
      - 4) ADA wall plaque
  2. Receivers:
    - a. Mono Headset Receiver: Williams RX18, with rechargeable batteries.
    - b. Ear Tips: EAR 240
  3. 5-bay Receiver Charging Station:
    - a. Williams CHG 518

- F. Microphones:
1. Ceiling-hung microphones shall be:
    - a. Polycom Ceiling Array
    - b. Crown PZM-11
    - c. or pre-approved equal.
  2. Desk-mounted microphones shall be push-to-talk with built-in logic:
    - a. Shure MX-392C
    - b. or pre-approved equal.
  3. Wireless Microphones shall be UHF, tunable and able to automatically identify available radio frequencies:
    - a. Shure BLX4R rack-mount receiver with external antennas.
    - b. Shure WL 185 lapel microphone
    - c. Shure BLX1 bodypack transmitter
    - d. RF Cables shall be:
      - 1) Antenna extension cable: RG-58 with BNC connectors on both ends.
      - 2) Antenna mount: BNC barrel connector.
  4. Cables shall be Standard Audio Cabling with Phoenix terminals, XLR, or ¼" balanced phono.

## 2.7 VIDEO SYSTEMS

- A. Blu-ray Player Devices:
1. Blu-ray players shall be region-free:
    - a. Panasonic, Sony, LG
    - b. or pre-approved equal.
  2. 1U Rack-mounted Shelf.
  3. Cables shall be Standard HDMI Cables.
- B. Video Cameras:
1. Table-top Document Camera: White, HD, 1080p/60fps, HDMI output.
    - a. Cameras shall be Epson DC-20 or pre-approved equal.
    - b. Cables shall be Standard HDMI cables.
  2. Classroom Camera: HD, 1080p/30fps, HDMI output, with wall mount bracket. PTZ is required.
    - a. Polycom Eagle Eye, or pre-approved equal.
    - b. Cables shall be Polycom Eagle Eye Cables, or Polycom adapters.
  3. Lecture Capture: SD/HD, 1080p/60fps, with wall mount bracket. PTZ is not required.
    - a. Vaddio WallView SD70 Series, or pre-approved equal.
    - b. Cables shall be two Standard Category 6, per Section 27 15 00.
  4. Camera Tracking System: HD, 1080p/60fps, with wall mount bracket. PTZ is required.
    - a. Polycom Director Series
    - b. Cables shall be Polycom Eagle Eye Cables, Polycom adapters, Belden 1277P, or Category 6 per Section 27 15 00.
- C. Video Conferencing Endpoints:
1. Shall be High Definition Video Conferencing Endpoint (VCE):
    - a. Polycom Real Presence Group Series
    - b. or pre-approved equal.
- D. Video Distribution Amplifiers:
1. HDMI Amplifier:
    - a. Kramer VM-4HC
    - b. Kramer VM-4HXL
    - c. pre-approved equal

2. Mounting shelves shall be:
    - a. Lowell US Series, 14" deep
    - b. Kramer rack adapters
    - c. or pre-approved equal.
- E. HDMI/HDBaseT Extenders:
1. Transmitter / Receiver Pair shall be:
    - a. Atlona AT-HDTX / AT-HDRX
    - b. AMX DX-TX / DX-RX
    - c. or pre-approved equal.
  2. Mounting shelves shall be:
    - a. Lowell US Series, 14" deep
    - b. Kramer rack adapters
    - c. or pre-approved equal.

## 2.8 VIDEO DISPLAYS

- A. Projection Screens:
1. All projection screens shall be manufactured by Da-Lite (specified below), or their pre-approved equivalent from Draper.

**Discuss with the AVPM whether a projection surface is desired in lieu of projection screens. Some options include IdeaPaint, Wall Talkers and matte finished paint.**

**If screens are desired, specify the sizes and model numbers. Consider the following when sizing the screens:**

- **The height of the projected image shall be not less than 1/6 the distance to the farthest viewing position in the room.**

2. Motorized Screens:
  - a. Motorized projection screens shall be **Electric Tensioned Advantage** or **Tensioned Contour** product line.

**Screen Surfaces typically used at WSU Pullman include:**

- **Standard Surface: Da-Mat Gain 1.0, Viewing Angle 60 degree.**
- **HD Progressive: Gain 1.1, viewing angle 85 degree. HD progressive is ideal for applications that require a small increase in gain due to screen size and projector brightness. HD Progressive 1.1 is an ideal choice for large audiences and is formulated for High Resolution Projectors.**

- b. Motorized projection screens shall have a 16:10 aspect ratio and a **Standard Da-Mat** or **HD Progressive Screen Surface**.
- c. Other required options include:
  - 1) Screens shall be electrically operated and support low-voltage control via the built-in SCB-100 screen controller.
  - 2) Motor shall be 120VAC and silent. 220VAC motors are not acceptable.
  - 3) Cases and trim kits shall be white.
  - 4) Internal junction box.
  - 5) Without video projector interface.

**Typical screen sizes used at WSU Pullman include:**

- **57.5' x 92" VA (109" diag.)**
- **60" x 96" VA (113" diag.)**
- **65" x 104" VA (123' diag.)**

- 69" x 110" VA (130" diag.)
- 72.5" x 116" VA (137" diag.)
- 87" x 139" VA (164" diag.)
- 100" x 160" VA (189" diag.)
- Where larger screens are required, discuss with the AVPM

- d. XXX" Screen: Da-Lite XXXXXXXX.
  - e. XXX" Screen: Da-Lite XXXXXXXX.
  - f. XXX" Screen: Da-Lite XXXXXXXX.
  - g. or pre-approved equal models from Draper.
3. Manual Screens:
- a. Projection screens shall be Advantage Manual with CSR, Model C with CSR, or Model C product line.
  - b. Manual projection screens shall have a 16:10 aspect ratio and a Standard Da-Mat Screen Surface.
  - c. Cases and trim kits shall be white.

**Typical screen sizes used at WSU Pullman include:**

- 50" x80" VA (94" diag.)
- 57.5' x 92" VA (109" diag.)
- 60" x 96" VA (113" diag.)
- Where larger screens are required, discuss with the AVPM

- d. XXX" Screen: Da-Lite XXXXXXXX.
  - e. XXX" Screen: Da-Lite XXXXXXXX.
  - f. XXX" Screen: Da-Lite XXXXXXXX.
  - g. or pre-approved equal models from Draper.
4. Projection screen mounts shall be manufactured by the screen manufacturer, and shall be wall-mounted or ceiling-mounted as shown on the Contract Documents. A ceiling trim kit shall be provided where shown on the Contract Documents.
- a. 10in/14in Wall Brackets, Wall Brackets (White) (1 pair): Da-Lite 40957.
  - b. 10in/24in Wall Brackets, Wall Brackets (White) (1 pair): Da-Lite 40933.
  - c. Unistrut/all-thread ceiling mount.
  - d. Ceiling Opening Trim Kit: Da-Lite 9638x.
  - e. or pre-approved equal.

B. Video Projectors:

- 1. Ultra Short-throw Video projector shall be 3LCD-type, WXGA+ or better, with a minimum of 2500 ANSI lumen output, and shall have IP connectivity, RS232 control, and HDMI video input:
  - a. Panasonic PT-CW230E (or latest equal model meeting these specifications)
  - b. or pre-approved equal.
- 2. Standard-throw Classroom Video projectors shall be 3LCD-type, WXGA+ or better, with a minimum of 4500 ANSI lumen output, and shall have IP connectivity, RS232 control, and HDMI video input:
  - a. Panasonic PT-DX500U (or latest equal model meeting these specifications)
  - b. or pre-approved equal.
- 3. Standard-throw Auditorium Video projectors shall be 3LCD-type, WXGA+ or better, with a minimum of 6000 ANSI lumen output, and shall have IP connectivity, RS232 control, and HDMI video input:
  - a. Panasonic PT-DW640 (or latest equal model meeting these specifications)
  - b. or pre-approved equal.
- 4. Video projector cables:
  - a. Data: One Category 6 cable (per Section 27 15 00, by Telecommunications Contractor) running between an outlet near the projector and the telecommunications room.

- b. Control: One Category 6 cable (per Section 27 15 00, by Telecommunications Contractor) running between an outlet near the projector and an outlet near the A/V Equipment Rack.
  - c. Video: One Category 6A cable (per Section 27 15 00, by Telecommunications Contractor) running between an outlet near the projector and an outlet near the A/V Equipment Rack, with any necessary baluns or extenders required to support HDMI/DisplayPort via Category 6A cabling.
  - d. Video: One Belden 1279p running between an outlet near the projector and an outlet near the A/V Equipment Rack.
5. Video projector mounts shall be:
- a. Chief Manufacturing RPAU universal mount
  - b. or pre-approved equal.
- C. Video Panels:
- 1. Video Wall:
    - a. Panels shall be commercial grade, with LED backlighting, LCD, damage-resistant glass, and sized 46" (diagonally measured) with DVI inputs. Panels shall accept RS232 control and IP connectivity, with direct input selection ability.
      - 1) Video Panels shall be Planar LX46HD or current equal 46" model, with:
        - a) Mounting brackets included by the manufacturer.
        - b) Planar Quad Controller Module.
        - c) Planar Power Supply Module.
        - d) Planar Video Extender.
        - e) Planar cabling
      - 2) or pre-approved equal from Sharp or NEC.
  - 2. Digital Signage:
    - a. Panels shall be commercial grade, LCD, sized not less than 55" (diagonally measured) with HDMI inputs.

Plasma video panels are only acceptable where glare will not be problematic.

      - 1) Video Panels shall be NEC Series
      - 2) or pre-approved equal.
    - b. Mount for Owner-provided digital media player.
  - 3. Classrooms and Conference Rooms:
    - a. Panels shall be commercial grade, LCD, sized not less than 55" (diagonally measured) with HDMI inputs.

Plasma video panels are only acceptable where glare will not be problematic.

      - 1) Video Panels shall be NEC Series
      - 2) or pre-approved equal.
  - 4. Wall-mounting bracket shall be full-articulating with locking security features:

For panels 52" or larger, the wall shall be reinforced for mounting purposes, typically requiring a 4x8 sheet of fire-treated 5/8" plywood attached to the wall studs beneath a layer of gypsum board.

    - a. For panel sizes 24" to 65":
      - 1) Chief LTMU or NEC Flush
      - 2) or pre-approved equal.
  - 5. Ceiling-mounting bracket:
    - a. For panel sizes 42" to 71":
      - 1) Chief XCM1U
      - 2) or pre-approved equal.
  - 6. Video Panel Cables:
    - a. Cables shall be HDMI except where distances exceed HDMI's limitations, in which case cables shall be HDBaseT.
  - 7. Video Panel Interface Box:

8. Video Panel Remote Interface:
  - a. FSR, Inc. PWB-100
  - a. AMX Novara MCP-106
  - b. Required Features:
    - 1) HDMI Interface
    - 2) Video Panel On/Off
    - 3) Volume Up/Down
    - 4) HDMI Input Select

## 2.9 AUDIO-VIDEO CONTROLS AND SWITCHING

- A. Audio/Video Scaling Switcher:
  1. Switching matrix shall be the Kramer, Sierra Video, or AMX Enova DGX family of products.
  2. Switch cables:
    - a. Audio/video cables shall be RGBHV, HDMI, and HDBaseT.
    - b. Audio cables shall be Standard Audio Cable terminated with Screw-type (Phoenix) or 3.5mm TRS connectors.
    - c. Control wiring shall be Ethernet, RS232 and IR.
- B. Touch Panel Interface:
  1. Touch panel shall be 10.1" size, be powered via Power-Over-Ethernet (POE), operate via Ethernet, and shall have a desktop mount.
    - a. Touch panel shall be: AMX MXT-1000 Modero X
    - b. or pre-approved equal.
  2. Control wiring shall be Ethernet via Category 6 cabling per Section 27 15 00 or Polycom POL-300-70-002 or AMX AXLink.

## 2.10 PRESENTATION WIRELESS REMOTE CONTROL

- A. Presentation wireless remote control devices with batteries shall provide page-up/page-down functions, have a red laser pointer, and connect to the Owner-provided computer via a USB port in a Plug-and-Play fashion.
  1. Logitech R400
  2. or pre-approved equal.

## 2.11 LABELING AND ADMINISTRATION

- A. Equipment Labels:
  1. As recommended in ANSI/TIA/EIA 606. Permanent polyester, not subject to fading or erasure, permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  2. Printable on a Laser Printer:
    - a. 2.00 x 0.5 inches: LSL-84-602
    - b. or approved equal.
  3. Printable on a Hand-carried Label Maker:
    - a. 0.5 inches high: Brady M71C-500-595-WT
    - b. or approved equal.
  4. Hand-carried label maker:
    - a. Brady BMP71
    - b. or approved equal.
- B. Cable Labels:

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, self-laminating vinyl, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  - a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal).
2. Hand-carried label maker:
  - a. Brady: ID Pro Plus (or approved equal).

### **PART 3 - EXECUTION**

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

#### **3.1 GENERAL**

- A. All audio/visual systems and applications shall be arranged, assembled, wired and configured identically to other applications in similar rooms within this project. Component arrangement, wire numbering, wire routing, etc. shall all be consistent throughout the project.
- B. All cables shall be unspliced and not coupled.
- C. The rooms listed below are designated with the application functions indicated. For each room listed, provide the equipment, cabling and functionality defined for each application.

	General University Classrooms (GUC)				Active Lecture Halls (ALH)				Conference Rooms										Digital Signage				
	223	333	337	436	110A	110B	110C	110D	101	301	304	202	403	120J	125	441	303	302	10	41	100N	330	0W
A/V Equipment	223	333	337	436	110A	110B	110C	110D	101	301	304	202	403	120J	125	441	303	302	10	41	100N	330	0W
A/V Equipment Rack (Full-Height)									1														
A/V Equipment Rack (In-Casework applications)														1	1	1	1	1					
A/V Equipment Rack (In-Podium applications)	1	1	1	1	1	1	1	1	1	1	1												
Cable Access Cubby for Conference Room Tables														1	1	1	1						
Instructor Podiums	1	1	1	1	1	1	1	1	1	1	1												
Mono system amplifiers	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1					
Stereo system amplifiers	1	1	1	1	1	1	1	1	2	1	1			1	1	1	1	1					1
Digital Signal Processing (DSP)										1	1						1						
Speakers (Speech)	4	4	4	4	4	4	4	4	12	4	4			4	4	4	4	2					
Speakers (Content)	2	2	2	2	2	2	2	2	5	2	2			2	2	2	2	2					4
Assistive Listening Devices	2	2	2	2	2	2	2	2	6	2	2			2	2	2	2						
Microphones (Ceiling-hung)										12	12					1	1						
Microphones (Desktop)												1	1	1	1	1		1					
Microphones (Wireless)	1	1	1	1	1	1	1	1	1	1	1					1	1	1					
Video Cameras (Document)	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1					
Video Cameras (Classroom)	1	1	1	1	1	1	1	1	2	2	2					1	1	1					
Video Cameras (Lecture Capture)										1	1							1					
Video Camera Tracking System										1	1					1	1						
Video Conferencing Endpoints										1	1					1	1						
Projection Screens	1	1	1	1	1	1	1	1	3					1	1	1	2						
Video Projectors (Ultra Short-throw)																1							
Video Projectors (Standard-throw Classroom)	1	1	1	1	1	1	1	1		1	1			1	1		2						
Video Projectors (Standard-throw Auditorium)									3														
Video Panels	1	1	1	1	1	1	1	1	4	2	2	1	1	1	1	2	1	4	1	1		1	
Video Panel Remote Interface												1	1										
Video Wall																					1		
Audio/Video Scaling Switcher	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1					
Touch Panel Interface	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1					

- D. In addition to the major equipment listed above, provide all equipment shown on the Drawings or listed in the specification, as required for a complete, operational system.
- E. Configure, program, adjust and tune all equipment according to manufacturer requirements such that it will perform as required. From the perspective of users of the audio/visual systems, all systems shall be installed to look, feel and operate similarly to all of the existing facilities throughout the Owner's campus.
- F. Any accessory hardware (including adapters, batteries, brackets, cables, connectors, covers, dongles, remote controls, and tools) that is provided by the manufacturer with equipment, but which does not become permanently installed, shall be furnished to the Owner.

- G. Furnish to the Owner one set of original packaging material for each piece of audio/visual equipment.

### 3.2 GROUNDING AND BONDING

- A. Grounding conductor shall be installed to bond all non-current-carrying metal equipment and materials to the nearest telecommunications grounding system (as provided under Section 27 05 26 – “Grounding and Bonding for Communications Systems”). Ground conductor shall be run directly to the cable tray grounding conductor, and shall not rely upon metallic conduit for a grounding path.
  - 1. Ensure that active electronic equipment is properly grounded per manufacturer’s requirements.

### 3.3 STANDARD CABLE ASSEMBLIES/PATCH CORDS

Verify that all cables required for the project are defined in under “Standard Cable Assemblies/Patch Cords. For special case cables (only used for a single piece of equipment) specify the cable with the equipment it serves.

- A. Provide all patch cables, cords and connectors required for a completely functional system. Cable lengths shall be kept to practical minimum lengths (not more than 25 ft.), while providing slack for three connector reterminations of the cable on each end of the cable. Avoid long cables that require slack coils. Where slack coils are required, store slack coil under the base of A/V Equipment Rack.
- B. All wiring and cables shall be free of grounds and shorts.
- C. All wiring and cables shall be properly supported with strain relief measures.
- D. The use of nylon tie wraps (“zip-ties”) is prohibited everywhere, with the following exceptions:
  - 1. In above-ceiling wire basket cable trays, tie wraps shall be used in the corners (where the cable tray turns) to maintain orderly cable grooming.
  - 2. Permanently affixed power wiring.
- E. A/V Equipment Racks:
  - 1. After the system has been completely tested, neatly bundle and dress cables using Velcro-style straps to secure cables against lacing bars in a neat and workmanlike manner. Provide sufficient cable slack such that equipment can be serviced without binding or kinking the cables.
- F. Instructor Consoles:
  - 1. After the system has been completely tested, neatly bundle and dress cables using Velcro-style straps with screw-attached bases to secure cables against the underside of the console in a neat and workmanlike manner.
- G. Mesh Sleeves:
  - 1. Provide mesh sleeves as listed below, with the ends of the sleeves telescoped/rolled back into the sleeve approximately 4 inches to prevent fraying, and secured with an overwrapping tie-wrap at each end:
    - a. Anywhere cables would be exposed to public view.
    - b. Between floor boxes and conference tables.
  - 2. Prevent mesh sleeves from pulling out of their termination point, thus keeping cabling concealed and protected inside the sleeves.

3. Do not use tape, tie wraps, or Velcro-style straps to bundle cables inside mesh sleeves and conduits. Cables shall be loose inside mesh sleeves and conduits, allowing them to be individually pulled out and replaced without disturbing the other cables.

### 3.4 EQUIPMENT RACKS/ENCLOSURES

- A. Provide junction panels, racks, cabinets, and enclosures with all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents.
- B. A/V Equipment Racks, Cabinets and Enclosures:
  1. Provide racks, cabinets and enclosures as shown on the Contract Documents.
  2. Assemble racks and install components as shown and ensure that all moving parts (doors, drawers, latches, etc.) function as intended.
  3. Provide exhaust fans as shown on the Contract Documents and as required for reliable operation of the equipment.
  4. Coordinate the installation of power outlets and data boxes that will serve the A/V equipment.

### 3.5 FURNITURE

- A. Provide cable access cubbies with the specified connectors in each designated conference table location, cut-in and mounted as shown on the Contract Documents.
- B. Provide Instructor Podiums as shown on the Contract Documents.
  1. Provide computer security cable, attached securely to the A/V Equipment Rack.
  2. Protect furniture from damage prior to Owner Acceptance. Repair or replace any damaged furniture.
  3. Provide documentation, maintenance, and warranty information associated with furniture to the Owner.

### 3.6 AUDIO SYSTEMS

- A. Maintain the following minimum separation distances:
  1. 24" between all ceiling-hung speakers and pendant microphones.
  2. 24" between all pendant microphones and air ducts (return or discharge).
  3. 12" between all pendant microphones and video projection paths.
  4. 12" between all pendant speakers and video projection paths.
  5. 12" between all pendant lighting and video projection paths.
- B. Amplifiers and Digital Signal Processors:
  1. Provide amplifiers and digital signal processors with any required input modules, fully configured as required, and installed in equipment rack as shown on the Contract Documents.
  2. Provide cabling and wires.
- C. Speakers:
  1. Provide speakers and mounting hardware, installed as shown on the Contract Documents.
  2. Provide cabling and wires.
- D. Assistive Listening Systems:
  1. Provide a transmitter in each designated space.
  2. Provide mounts, cabling and wires.

3. Table 219.3 in the 2010 ADA Standards for Accessible Design provides the following information about the number of receivers and the number of hearing-aid compatible receivers required depending on the number of seats in a given room:

Seating Capacity of Assembly Area	Minimum Number of Required Receivers	Minimum Number of Receivers Required to be Hearing-aid Compatible
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats*	2
201 to 500	2, plus 1 per 25 seats over 50 seats*	1 per 4 receivers or fraction thereof
501 to 1000	20, plus 1 per 33 seats over 500 seats*	
1001 to 2000	35, plus 1 per 50 seats over 1000 seats*	
2001 and over	55, plus 1 per 100 seats over 2000 seats*	

\* or fraction thereof.

Provide the number of receiver sets required by ADA (above) for each space, with batteries, delivered to the Owner during system demonstration.

The Designer shall inquire with the WSUP AVPM about the quantity of Charger Stations that are required for a given project.

4. Provide **X** charger stations (total for project), delivered to the Owner during system demonstration.

E. Microphones:

1. Provide all microphones shown on the Contract Documents. Provide mounts, cabling and wires.
2. For wireless microphones:
  - a. Provide receivers, installed in A/V Equipment Rack as shown on the Contract Documents.

The Designer shall work with the WSUP AVPM to determine the desired frequency range for each wireless microphone application, and shall specify this here:

- 1) Configure the wireless microphone receivers to operate in the following frequency ranges:

Room Name	Room #	Frequency Range
room name	###	MHz

- b. Install the antennas in top rear of the A/V Equipment Rack, using manufacturer-provided external antenna mounting bracket.
  - c. Connect the antenna extension cables between the barrel connectors and the antenna connections on the receiver. Attach the antennas to the exterior ends of the barrel connectors.
  - d. Furnish body pack transmitters, wireless microphones and associated cables, stored in the drawer in each A/V Equipment Rack.
3. For ceiling-hung microphones:
  - a. Provide grommet through the ceiling tile that matches the color of the tile.

### 3.7 VIDEO SYSTEMS

- A. Blu-ray Player Devices:
1. Provide shelves, installed in equipment rack as shown on the Contract Documents.
  2. Provide Blu-ray player, attached to shelf.
  3. Provide cables and wires.
- B. All Cameras:
1. Provide cameras, mounted as shown on the Contract Documents.
  2. Provide mounts, cables and wires.
- C. Video Conferencing Endpoints:
1. Provide video conferencing endpoints, installed in conference rooms as shown on the Contract Documents.
  2. Provide mounts, cabling and wires.
  3. Configure system to integrate with the equipment in the conference room.
- D. Video Distribution Amplifiers:
1. Provide Video Distribution Amplifiers as shown on the Contract Documents.
  2. Provide rack-mounted shelving and attach devices to shelf.
  3. Provide cables and wires.
- E. HDMI/HDBaseT Extenders:
1. Provide HDMI/HDBaseT Extenders as shown on the Contract Documents.
  2. Provide rack-mounted shelving and attach devices to shelf.
  3. Attach remote end devices using sticky-back hook-and-loop strips.
  4. Provide cables and wires.

### 3.8 VIDEO DISPLAYS

- A. Projection Screens:
1. Provide projection screens installed as shown on the Contract Documents.  

**Add room numbers and screen sizes, coordinated with Part 2 content above.**

    - a. For Rooms **XXX, XXX, XXX and XXX**      **Screen size**
    - b. For Rooms **XXX, XXX, XXX and XXX**      **Screen size**
    - c. All other rooms requiring screens      **Screen size**
  2. Screens shall be mounted as close as possible to the wall (preferably not more than 4" away from the wall) while also permitting the projection surface to clear any obstructions on the wall (such as whiteboard and pen tray).
  3. Do not provide manual control switches.
  4. Provide mounts, power, control raceways and wiring as shown on the Contract Documents.
- B. Video Projectors:
1. Provide video projector mounts, attached to structure as shown on the Contract Documents. Position mounts such that:
    - a. The projector is located the proper distance from the projection surface or screen.
    - b. The projector achieves peak performance without the use of specialty lenses.
    - c. The projector achieves peak performance without the use of keystoneing and with only minor use of image adjustment features (contrast, etc.).
  2. Provide video projectors, attached to the projector mounts. Adjust and focus projector to properly display on projection screen.
  3. Provide cables and wires.

4. Verify that lighting and other ceiling-hung objects do not obstruct the image on the screen. Under the direction of the Owner and A/V Engineer, resolve any physical obstructions (such as lighting or other obstructing objects) prior to making any adjustments to the projector, projector mount location or projection screen.

C. Video Panels:

1. Provide video panel mounting brackets, attached to wall as shown on the Contract Documents.
2. Provide video panels, attached to the mounting brackets. Adjust angle and tilt of panel for optimal viewing angle.
3. Provide cables and wires.
4. For video panels designated for use as digital signage, provide two baluns (one for the video panel and one for the telecommunications room).
5. For video wall panels, provide all associated equipment that is required for a functioning Planar Clarity Matrix video wall system, including the Quad Controller Module, Power Supply Module, Video Extenders, and all required cabling.

### 3.9 AUDIO-VIDEO CONTROLS AND SWITCHING

A. Audio/Video Scaling Switchers:

1. Provide switchers, installed in equipment rack as shown on the Contract Documents.
2. Provide cabling and wires.
3. Provide all required configuration and programming.

B. Touch Panel Interface:

1. Provide Touch Panel Interface devices in locations and quantities shown on the Contract Documents.
2. The Owner will furnish to the Contractor sample software used to configure its existing touch panel interfaces.
3. The A/V Contractor shall edit and adapt that code for use in the Touch Panel Interfaces being provided. The A/V Contractor shall maintain the look-and-feel, the programming structure and existing style, to be consistent with the Owner's standard practices.

C. Computer Software Interface:

1. The Owner will furnish to the Contractor a sample layout of the operator/user control interface that is currently in use at the Owner's facilities.
2. The A/V Contractor shall edit and adapt that code for use in the desktop interfaces required in the Contract Documents. The A/V Contractor shall maintain the look-and-feel, the programming structure and existing style, to be consistent with the Owner's standard practices.

- D. Provide fully documented, uncompiled copies of all control programming (AMX or Visual Studio) to the Owner in native electronic format on CDROM during Demonstration and Training.

### 3.10 PRESENTATION WIRELESS REMOTE CONTROL

- A. Provide one presentation wireless remote control with batteries, stored in the drawer in each A/V Equipment Rack.

### 3.11 LABELING AND ADMINISTRATION

A. Cables:

1. Label Location: Affix at each end of the cable, not less than 1 inch or more than 3 inches from the connector, aligned such that the label is readable without adjusting the cable.

2. Include a clear vinyl adhesive wrapping applied over the label, in order to permanently affix the label to the cable and prevent smudges to label text. Using transparent tape to affix labels to cables is not acceptable.
3. Label Content: Labels shall be formatted all uppercase, with a dash between the item type and two-digit sequential number, and spaces between each segment, as follows:

CABLETYPE - ## EQUIPTYPE - ## PORTTYPE - ##

For example, the first RS232 control cable, connected to RS232 port #1 on AMX Controller number 1 would be given the following label:

RS232-01 IC-01 OUT-01

- B. Cabling Color Scheme:
  1. Use a consistent color scheme throughout the project, matching the existing scheme in the building.
- C. Grounding/Bonding Conductors:
  1. Label bonding conductors: "WARNING! BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.12 TESTING

- A. All functions and features shall be verified operational. Demonstrate operation of each space to the A/V Engineer and the Owner's Representatives.
- B. Configure, program, adjust, and tune equipment such that it will perform as required.
- C. Replace underperforming or non-performing equipment and cables.

### 3.13 WARRANTY REGISTRATION

- A. Submit equipment warranty registration forms to the equipment manufacturers on behalf of the Owner. Coordinate with the Owner to obtain appropriate contact information for the forms and documentation.

### 3.14 DEMONSTRATION AND TRAINING

- A. Provide 4 hours of demonstration and training to Owner's Representatives.

Verify that WSU Pullman does indeed wish to have 4 hours of demonstration provided.  
Will there be multiple demonstration sessions?

END OF SECTION

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of a pathway system for outside plant communications circuits. Work in this section includes excavation and trenching, conduit (raceway) construction, cutting and patching, concrete, maintenance hole and handhole construction, and landscaping.

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. WSUP frequently has the Contractor furnish patch cords, but uses their IT staff to install. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Designer must take care to clearly define any product warranty issues associated with the split responsibility.

- B. Products installed (but not furnished) under this section -

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, WSUP may pre-purchase fiber, but have the Contractor install. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Designer must take care to clearly define any product warranty issues associated with the split responsibility.

1. Grounding Conductor

1.2 STANDARDS AND CODES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the WSUP Project Manager and/or the WSUP IT Project Manager assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and specify the edition and addenda below accordingly.

- A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.
1. General:
    - a. WSDOT/APWA 2008 Standards Specifications for Road, Bridge and Municipal Construction (APWA Standard Specifications)
  2. Concrete:
    - a. Reinforcement:
      - 1) ACI 301: Structural Concrete for Buildings
      - 2) ACI SP-66: American Concrete Institute - Detailing Manual
      - 3) ANSI/ASTM A82: Cold Drawn Steel Wire for Concrete Reinforcement
      - 4) ANSI/AWS D1.4: Structural Welding Code for Reinforcing Steel
      - 5) ANSI/AWS D12.1: Reinforcing Steel Welding Code
      - 6) ASTM A615: Deformed and Plain Billet Steel Bars for Concrete Reinforcement
      - 7) AWS D12: Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction
    - b. Cast-in-Place:
      - 1) ACI 212.3R: Chemical Admixtures for Concrete
      - 2) ACI 301: Structural Concrete for Buildings
      - 3) ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
      - 4) ACI 305R: Hot Weather Concreting
      - 5) ACI 306R: Cold Weather Concreting
      - 6) ACI 347: Guide to Formwork for Concrete
      - 7) ASTM C33: Concrete Aggregates
      - 8) ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
      - 9) ASTM C94: Ready-Mixed Concrete
      - 10) ASTM C150: Portland Cement
      - 11) ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete
      - 12) ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
      - 13) ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
      - 14) ASTM C260: Air Entraining Admixtures for Concrete
      - 15) ASTM C309: Standard Specifications for Liquid Membrane Forming Compound for Curing Concrete
      - 16) ASTM C494: Chemical Admixtures for Concrete
    - c. Pre-Cast:
      - 1) ASTM C478: Standard Specification for Precast Reinforced Concrete Manholes Sections
      - 2) ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Utility Structures
      - 3) ASTM C858: Standard Specification for Underground Precast Concrete Utility Structures
      - 4) ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures

- 5) ASTM C1037: Standard Practice for Inspection of Underground Precast Concrete Utility Structures
  - 6) ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
3. Trenching and Backfill:
- a. ASTM D1557: Test Method for Laboratory Compaction Characteristics Using Modified Effort

### 1.3 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

- A. Aggregate: Mineral materials such as sand or stone used in making concrete
- B. Backfill: Earth material used specifically for filling and grading excavations back to a finished state. Backfill is placed on top of the bedding surrounding encased ductbanks and direct-buried conduits.
- C. Base: Earth material used specifically to level and grade a subgrade for the subsequent placement of encased ductbanks, direct-buried conduit, maintenance holes and handholes. Base material is placed on top of the subgrade and beneath the bedding surrounding encased ductbanks, conduits, maintenance holes or handholes.
- D. Bedding: Earth material used specifically for filling excavations. Bedding is placed around encased ductbank, conduits, maintenance holes or handholes. Bedding is placed on top of the base and beneath the backfill.
- E. Fill: The collective term for base, bedding, and backfill.
- F. Handhole (HH): A structure similar to a small maintenance hole through which cable can be pulled, but not large enough for a person to fully enter to perform work.
- G. Maintenance Hole (MH): A vault located in the ground or earth as part of an underground conduit system and used to facilitate placing, connectorization, and maintenance of cables as well as the placing of associated equipment, in which it is expected that a person will enter to perform work.
- H. RNC: Rigid Non-Metallic Conduit (PVC)
- I. PSC: PVC Coated Rigid Steel Conduit.

J. RGC: Rigid Galvanized Steel Conduit

#### 1.4 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Outside Plant pathway system as hereinafter specified and/or shown on the Contract Documents. The Pathway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in Section 33 82 00 — "Communications Distribution".
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant pathway system.

#### 1.5 SUBMITTAL INFORMATION

Review and edit the following list of submittals as applicable to this project. Note that the submittals listed below are specific to this section only. Division 1, Section 01 30 00 (or equivalent) – Submittals should include general administrative requirements (e.g. schedule, number of copies, distribution, etc.). Either Section 01 30 00 or this section should include a statement similar to the following, "The Contractor shall apply Contractor's stamp, sign, or initial certifying that review, verification of required Products, and coordination of information is in accordance with the requirements of the work and Contract Documents.

Any deviations from the Contract Documents or specified product data shall be clearly noted, and must be approved by the Designer prior to start of construction. The Designer shall obtain approval from WSUP through the Standards Variance Request (SVR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Designer it remains the Contractor's responsibility to provide what is required in the Contract Documents".

- A. Quality Assurance/Control Submittals: Provide submittal information for review as follows:
  - 1. Submit a copy of the delivery receipt for each concrete delivery. Include date, strength ordered, and location used.

#### 1.6 SEQUENCING

State any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for OSP Site Work as described in this specification section as well as other General Contractor specific work, and a second bid package for the Structured Cabling System. The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

Coordinate this paragraph with the conditions of the contract and Division 1 requirements to ensure that no statements are made that will limit or void those conditions. A thorough understanding of the warranties applicable on this project is required. The Designer shall consider and account for unique warranty situations that may arise from owner furnished equipment, owner installed equipment, or other situations that may conflict with warranty requirements.

- A. Coordinate the installation of underground telecommunications ducts and maintenance holes with the installation of other underground utilities.
- B. Prior to concrete encasement of ductbanks, contact the Owner and Engineer to schedule observation of the conduits.

**PART 2 - PRODUCTS**

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

- A. Materials shall consist of fill, topsoil, concrete formwork, concrete, raceway, maintenance holes, handholes and other incidentals and accessories as required.

2.2 BASE, BEDDING AND BACKFILL

- A. Use of on-site soils for base, bedding, and backfill is not acceptable.
- B. Base: Readily compactable and meeting the following gradation requirements.
  - 1. Maintenance Holes and Handholes (provide gravel):

Sieve Size	Percent Passing
1 inch Square	100
¼ inch Square	25 - 80
U.S. No. 200	15 max
Sand Equivalent	30 min

- 2. Trenches (provide sand):

Sieve Size	Percent Passing
U.S. No. 10	35 - 100
U.S. No. 20	20 - 80
U.S. No. 40	10 - 55

U.S. No. 100	0 - 10
U.S. No. 200	0 - 3

C. Bedding: Same as Base for Trenches, above.

D. Backfill:

1. Maintenance Holes and Handholes - Same as Base for Maintenance Holes and Handholes, above.
2. Trenches

Sieve Size	Percent Passing
½ inch Square	100
¼ inch Square	65 - 100
U.S. No. 10	40 - 100
U.S. No. 50	3 - 50
U.S. No. 100	0 - 4
U.S. No. 200	0 - 3

### 2.3 CAST-IN-PLACE CONCRETE

A. Formwork:

1. Forms: Metal or plywood in good condition
  - a. Form Release Agent: Burke Form Coating (or equal)
2. Gypsum board

B. Reinforcement:

1. Reinforcing Steel: ASTM A615, Grade 40. Uncoated, free from rust, dirt, and loose scale.
2. Tie Wire: 18 gauge 40 or heavier black annealed wire.
3. Embedded Anchor Bolts: Mild galvanized steel, cold bent.

C. Concrete:

1. Cement: Different types of cement, including the same type of cement provided by more than one manufacturer, are not acceptable: Cement shall conform to:
  - a. ASTM C150-7, type 1.
  - b. 2500 psi. minimum compressive at 28 days per ASTM C39.
  - c. 4 inches maximum slump per ASTM C-143.
2. Aggregate:
  - a. Course: ASTM C33-71 with a maximum size of 1-¼ inch.
  - b. Fine: ASTM C33-71.
3. Water: Fresh, clean, potable and not detrimental to concrete.
4. Admixtures:
  - a. Air Entrainment: Conform to ASTM C260 and ASTM C173 or C231 with 5% to 7% air entrainment.
  - b. Other: Not allowed without prior approval from the Designer.
5. Curing Compound: Conform to ASTM C309. Free from petroleum resins or waxes. Formulated for sealing, surface hardening, and curing concrete.

### 2.4 CONDUIT AND DUCTBANKS

A. Conduit

1. Rigid Non-Metallic Conduit (RNC):
  - a. UL listed, NEMA TC2 Schedule 40 or 80 rigid polyvinyl chloride (PVC) approved for direct burial without concrete encasement
  - b. Fittings: NEMA TC3, matched to conduit and material.
2. Rigid Galvanized Steel Conduit (RGC):
  - a. Rigid steel conduit hot-dipped galvanized inside and out with threaded ends meeting ANSI C80.1.
  - b. Couplings: Unsplit, NPT threaded with galvanizing equal to (and compatible with) conduit. Running thread or set screw threaded fittings (except for three piece and watertight split couplings) are not acceptable.
  - c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.
3. PVC Coated Rigid Steel Conduit (PSC):
  - a. NEMA RN 1 rigid steel conduit coated with rigid polyvinyl chloride (PVC).
  - b. Fittings: NEMA RN 1.
4. Fittings:
  - a. Sweeps: Factory manufactured with a single arc of not less than a 15 foot radius. Sweeps shall be either PVC Coated Rigid Steel or fiberglass.
  - b. End Caps (Plugs): Pre-manufactured and water-tight. Tape is not an acceptable end cap or cover.
5. Pull Ropes: ¼ inch polypropylene with a minimum tensile strength of 200 pounds.
6. Muletape Pull cord with footage marks: WPxxxP

B. Ductbanks:

1. Conduit Spacers/Supports: High-density plastic interlocking spacers/supports. Spacers shall be:
  - a. Underground Devices Inc.: WUNPEECE
2. Warning Tape: 6 inch wide metallic warning tape, orange in color.
3. Grounding/Bonding: #2 AWG bare copper ground

2.5 LANDSCAPING:

- A. Topsoil: Imported from off construction site.

2.6 LABELING AND ADMINISTRATION

A. Labels

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, waterproof and legible. Paint and other marking substances are acceptable.

**PART 3 - EXECUTION**

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

3.1 EXCAVATING, TRENCHING AND FILL

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Excavation:

1. Do not excavate when the outside temperature is less than 35° F or when there is standing water or snow on the subgrade.
2. Where crossing of concrete or asphalt is required, saw cut and remove surface material prior to excavating. Remove concrete in complete sections from control joint to control joint regardless of the width of the excavation. Restore concrete and asphalt surfaces following excavation to match existing depth, strength, color, and type of material.
3. If an adjacent structure may be compromised or damaged by excavation work, underpin the structure as required. If the structural integrity is in question, obtain an evaluation and recommendation from a registered structural Designer employed by the Contractor prior to proceeding with the work.
4. Maintain adequate separation between the excavation and adjacent underground utilities. Locate excavations such that ductbanks, maintenance holes, and handholes have a minimum separation of 12 inches between the ductbank and/or MH/HH and the nearest underground utility after installation. For gas lines, a minimum separation of 18 inches is required. For water lines, a minimum separation of 36 inches is required. Contact the Designer prior to proceeding if minimum separation distances cannot be achieved.
5. Protect excavations at the end of the work shift. Cover with steel sheets and barricade prior to leaving the job site, in accordance with all applicable rules, regulations, building codes, and ordinances.
6. Install, operate and maintain pump or dewatering equipment as necessary to prevent water from accumulating in the excavation.
7. Excavation Depth/Width
  - a. MH/HH: Excavate to a sufficient depth to cover the overall assembled height of the vault plus the added height of risers, covers and bedding material consisting of a minimum 6 to 12 inches of base. Excavate to a sufficient width to provide a minimum of 6 inches clearance around each side of the MH/HH.
  - b. Trenches: Excavate to a sufficient depth to provide a minimum of 24 inches cover over the conduit or ductbank formation and to allow for the proper alignment of conduits into the MH/HH. Excavate to a sufficient width to provide a minimum of 6 inches to each side of the ductbank formation.
8. Over-excavate, fill, and compact any soft spots in the subgrade.
9. Run trench excavation true and as straight as possible. Clear trenches of stones and soft spots.
10. Slope trench grade to fall 3 inches per 100 feet in general and ¼ inch per foot where possible.
  - a. Slope trench toward lower MH/HH or from high points toward MH/HH at both ends.
  - b. Slope trench away from building entrances.

B. Fill:

1. Drain and/or pump groundwater and surface water from the recipient area prior to the placement of fill.
2. Do not place frozen fill.
3. Base:
  - a. Scarify and moisture-condition the subgrade bed to receive fill prior to placing materials.
  - b. Moisture-condition base material to within 3 percent of optimum moisture content and place in loose, horizontal layers.
  - c. Level the subgrade bed using sand for trenches and gravel for MH/HH as necessary to form an even base.
4. Bedding: Do not exceed 4 inch depth of bedding lifts/layers before compacting
5. Backfill: Do not exceed 6 inches depth of backfill lifts/layers before compacting.

6. Compaction: Compact using a vibratory plate or roller or other mechanical device. Compaction through jetting and/or pounding is not acceptable. Compact per APWA Standard Specification Paragraph 7-10.3 (11).
  - a. Bedding: Compact material to a dense state equaling at least 95% of the maximum dry density per ASTM D1557.
  - b. Backfill: Compact material up to 2 feet below the finished grade with a minimum relative compaction of 90% of the maximum dry density per ASTM D1557. Compact material from 2 feet below the finished grade up to the finished grade with a minimum relative compaction of 95% of the maximum dry density per ASTM D1557.

The Designer shall coordinate with local WSUP authorities to determine whether WSUP wishes to have the fill material from the trenching deposited elsewhere on the site or hauled away. Review and edit the following waste disposal requirements to accommodate WSUP's fill material removal wishes as applicable to this project.

- C. Waste Disposal: Remove excavation materials and other construction debris from the site in a timely manner and dispose of legally.

### 3.2 CAST-IN-PLACE CONCRETE

- A. Construct concrete in accordance with the applicable portions of the specifications, standards, codes and regulations (latest editions and/or amendments) listed in Section 1, STANDARDS AND CODES.

- B. Formwork:

1. Construction:
  - a. Forms: Use the most advantageous panel sizes and panel joint locations. Neat patches and minor surface imperfections are permitted. Form surfaces in true planes within ¼ inch in 10 feet. Clean forms and remove debris prior to pouring concrete. Make braces unyielding and tight to prevent leakage. Maintain formwork construction tolerances complying with ACI 347. Formwork shall be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials. Use chamfer strips fabricated to produce uniform smooth lines and tight edge joints for exposed corners and edges. Note: chamfer strips are not required for concrete encased ductbank corners and edges.
    - 1) Gypsum board shall not be used for forms except to form concrete encased ductbank.
  - b. Reinforcement: Construct reinforcement in accordance with ACI SP-6. Weld reinforcement in accordance with ANSI/AWS D1.4 or ANSI/AWS D12.1. Accurately position, support, and secure reinforcement against displacement. Support reinforcement by metal/plastic chairs, runners, bolsters, spacers, hangers, or other incidental materials as required.
  - c. Where metal or plywood forms are used, coat the forms with a form release agent prior to placement of concrete. Coat faces and edges of forms applied at a rate of 500 to 550 square feet per unit.
  - d. Curved Surfaces: Use only curved forms for constructing curved structures and surfaces.
2. Slope: For flatwork, construct forms with 1% side slope to both south and east sides.
3. Joints:
  - a. Control: Build into form.
  - b. Expansion: Build expansion joints into form, premolded ½ inch thick, and conforming to ASTM D1751. Seal the top ½ inch of expansion joints with an approved joint sealer.
4. Removal: Remove forms after concrete has cured (see Curing below) for 7 days or after concrete has attained a compressive strength of 2000 psi.
  - a. Where gypsum board forms are used to form concrete encased ductbank they can be left in place and backfilled after the specified curing period.

- C. Concrete:

1. Transport: Comply with ACI 304. Transport concrete from the mixer to the construction location via methods preventing separation of materials.
2. Application:
  - a. Prior to placement, inspect and complete formwork construction, reinforcement, and items to be embedded or cast-in.
    - 1) Provide rebar between ductbanks and pre-cast vaults and also at cold-joints in ductbanks to prevent differential settling forces from damaging conduits or cabling.
  - b. Deposit concrete in forms in layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer on the preceding layer while the preceding layer is still plastic. Cold joints are not acceptable.
  - c. Deposit concrete in a plastic condition and uniformly work around reinforcements.
  - d. Consolidate concrete using internal machine vibration (stinger) during pouring.
  - e. Once concrete work has commenced, work continuously until the work segment and/or section has been completed.
  - f. Cold Weather: Protect concrete from damage caused by frost, freezing, or low temperatures in compliance with ACI 306R. When temperature is below 40° F, heat water and aggregates before mixing to obtain a concrete mixture of not less than 50° F and not more than 80° F.
  - g. Hot Weather: Protect concrete from damage caused by hot weather in compliance with ACI 305R. When temperature is above 90° F chill water before mixing to obtain a concrete mixture of not more than 90° F. Cover reinforcing steel with water-soaked burlap if it becomes too hot immediately before placement of concrete. Temperature of steel shall not exceed the ambient air temperature.
3. Curing:
  - a. Curing method and rate of application shall be according to manufacturer's recommendations.
  - b. Protect concrete from premature drying, rain, excessive temperatures, and mechanical injury during the curing period.
  - c. Cure concrete for 7 days in accordance with ACI 301 and keep continuously moist during this time. Maintain concrete temperature between 50° and 90° F during the curing period.
  - d. Provide curing and sealing compound to exposed slabs, sidewalks, curbs, etc. as soon as final finishing operations are complete (within 2 hours). Re-coat areas subjected to heavy rainfall within 3 hours of the initial application.
4. Finish:
  - a. Consolidate, level and screen surfaces for evenness and uniformity. Remove excess concrete. Fill low spots. Float the surface after water sheen has disappeared from surface.
  - b. Finish flatwork with a special tool to match patterned finish of adjacent existing concrete.
  - c. Tool edges, control, and expansion joints to make finish work straight and even.
5. Ductbanks:
  - a. Reinforce ductbanks along full length with formed sides. Install reinforcement at each corner of the conduit spacers/supports.
  - b. Do not pour concrete against trench walls. Consolidate concrete during placement using an internal concrete vibrator.
  - c. Provide each MH/HH penetration with reinforcing bars tied to MH/HH reinforcement. Dowel reinforcement in foundation wall of building penetrations.
  - d. Secure conduit spacers/supports and reinforcing to prevent movement during concrete placement. Use stakes and/or tie wire to minimize floating and spreading.
6. Protection for exposed concrete: Cover exposed concrete (i.e. sidewalk, driveway, etc.) with plywood, weighted with concrete blocks or similar heavy object in order to prevent surface damage.
7. Bond and ground reinforcement bars to the nearest approved ground.

### 3.3 CONDUITS AND DUCTBANKS

#### A. Conduits:

1. Outdoor underground: Provide either
  - a. RNC Schedule 40 (Type 1).
  - b. RGC with half lapped wrap of Scotchrap No. 51 plastic tape or a coat of Kopper's Bitumastic No. 505 (minimum 20 mil thickness).
2. Outdoor exposed: Provide RGC.
3. Transitions: Transition to PSC at stub up locations. Transition to PSC for building entrances a minimum of 10 feet before reaching building foundation. Transitioning back to RNC after passing 5 feet inside the building foundation is acceptable.
4. Sweeps:
  - a. Shallow curves comprised of continuous lengths of individual straight RNC conduit are permissible with a minimum sweep radius of 40 feet.
  - b. Where the conduit sweep radius is less than 40 feet, sweeps shall be factory-manufactured bends with a minimum of 48 inch radius. Bending conduit in the field using manual or mechanical methods is not acceptable.
  - c. Do not exceed 90 degrees for an individual sweep.
  - d. Where unique construction requirements for bend radius or arc length do not permit the use of factory-manufactured sweeps, sweeps shall be field-manufactured using factory-recommended equipment. The internal diameter of the sweep shall not be changed during the sweep field-manufacturing process.
  - e. A conduit section shall have not more than the equivalent of two 90-degree sweeps (a total of 180 degrees) between pull points. The 180-degree maximum shall include kicks and offsets. Where it is not possible to construct a section of conduit within the 180-degree sweep maximum, an intermediate MH/HH shall be installed.
  - f. Two 90-degree sweeps separated by less than 10 feet is not permissible.
  - g. Construct sweeps for conduits within a common ductbank parallel, measured from the same center-point.
  - h. Do not install LB's, condulets, or 90 degree electrical elbows.
5. Fittings:
  - a. Cut conduit ends square and ream to remove burrs and sharp ends. Extend conduits the maximum distance into fittings, couplings, and/or connectors. Tighten fittings securely and seal watertight (see Sealing, below).
  - b. End Caps (Plugs): Provide end caps on conduit ends throughout construction to prevent the intrusion of water or debris. Install end caps on conduit that is not directly being worked on during the work day and on conduits at night. Leave end caps in place upon final completion of the work.
  - c. End Bells: Provide end bells for terminating conduit in maintenance holes and handholes. Install protective end bells on conduits flush with MH/HH walls. Do not use TERM-A-DUCT.
6. Sealing: Apply a watertight, conductive thread compound (for PSC) or solvent-type cement (for RNC) to make conduit connections waterproof and rustproof. Seal and grout conduit terminations in maintenance holes and handholes to ensure that voids in the joints are filled. Seal conduit terminations in buildings until used for cable.
7. Cleaning: After installation, and within five days prior to releasing conduit for cabling installation, clean each conduit with a wire brush and swab. Clean each conduit a minimum of two times in the same direction and swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for conduit sections connected to buildings.
8. Test Mandrels: Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the conduit. Pull the test mandrel after backfilling but prior to the replacement of landscaping. Repair or replace any conduit that does not prove out at no cost to the Owner.
9. Conduit Entrances:

- a. MH/HH: Conduit entrances at opposite ends of a maintenance hole or handhole shall be at the same level and in the same position with respect to the side walls. Ensure that each conduit leaving a MH/HH in any position enters the next MH/HH in the same relative position.
  - b. Buildings: Terminate conduits 4 inches above the finished floor.
  10. Length: Unless otherwise shown on the Contract Documents, do not exceed 600 feet of ductbank between pulling points. Contact the Designer prior to proceeding if a ductbank section will exceed 600 feet.
    - a. Record the length of each conduit on the As-Built drawings.
  11. Pull Ropes & Muletape Pull Cord: Install in each conduit longer than 10 feet immediately after the conduit has been cleaned and mandreled. Leave a minimum of 10 feet looped, tied-off, and labeled at each end of the conduit.
  12. Protection: Insure that after installation the conduit coatings and finishes are without damage. Repair as follows:
    - a. PVC Coated Rigid Steel Conduit: Patch nicks and scrapes in PVC coating after installing conduits.
    - b. Rigid Non-metallic Conduit: Repair damage with matching touchup coating recommended by the manufacturer.
- B. Ductbanks:
1. Unless otherwise noted on the Contract Documents or required for sweep radius, construct ductbanks without concrete encasement. Where shown as concrete encased, use concrete encased RNC (see CAST-IN-PLACE CONCRETE, above).
  2. Encased in Concrete:
    - a. See CAST-IN-PLACE CONCRETE, above.
  3. Conduit Spacers/Supports: Place supports on 8 foot centers if encased in concrete and 5 foot centers otherwise. Interlock spacers horizontally only. Stagger spacers encased in concrete at least 6 inches vertically.
  4. Warning Tape: Install metallic warning tape half the distance between the top of the ductbank and finished grade.
  5. Grounding/Bonding: Install ground wire along length of ductbank. Bond to grounding electrodes of MH/HH and to building service grounds.
  6. Slope ductbank grade to fall 3 inches per 100 feet in general and ¼ inch per foot where possible.
    - a. Slope ductbank toward lower MH/HH or from high points toward MH/HH at both ends.
    - b. Slope ductbank away from building entrances.

### 3.4 LABELING AND ADMINISTRATION

- A. Outside Plant Conduits:
1. Conduits shall be labeled by permanently marking the maintenance hole wall adjacent to each conduit. The markings shall indicate the maintenance hole name/number or building name where the opposite end of the conduit terminates.
- B. Outside Plant Maintenance Holes:
1. Maintenance holes shall be labeled by permanently marking the wall of the maintenance hole in a location that is as high as possible while remaining visible and readable from above ground. Preferably, the location should be higher than the groundwater level in the maintenance hole. The markings shall indicate the maintenance hole name/number.

### 3.5 LANDSCAPING

- A. Topsoil: Provide imported topsoil for excavations in grass and/or landscaped areas. Provide loosely compacted topsoil to a depth of 4 inches or depth of excavation for excavations less than 12 inches. Restore existing grades where disturbed. Rake and smooth topsoil following proper placement.

Installation shall be approved by the Owner prior to placing sod. Place topsoil per APWA Paragraph 8-01.3(2).

- B. Provide sod for grass areas disturbed by construction activity and replace shrubbery and trees damaged, removed or disturbed by construction activity. The use of seed/hydroseed is only acceptable when approved in advance by the Owner and the Designer prior to installation.

**END OF SECTION**

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

- A. Provide all materials and labor for the installation of a customer-owned outside plant telecommunication system. This section includes Customer-Owned Outside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Outside Plant Structured Cabling System (OSP-SCS - See Definition Below).

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

- B. Products installed (but not furnished) under this section:

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, WSUP may pre-purchase fiber, but have the Contractor install. When products are furnished "By Owner" consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

Consider including paint for backboards, grounding conductors, and any other items that are installed under this section but not furnished under this section.

1. Grounding Conductor

## 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA and ISO/IEC compliant communications Outside Plant Structured Cabling System as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of Gigabit Ethernet operation as specified in IEEE 802.3z.
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Outside Plant Structured Cabling System.

## 1.3 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

- A. "OSP-SCS" shall mean *Outside Plant - Structured Cabling System*. The OSP-SCS is defined as all required equipment and materials including, but not limited to, ANSI/TIA/EIA and ISO/IEC compliant copper and fiber optic cable (multimode and singlemode), connectors, splices, splice closures and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.
- B. "MH" shall mean *Maintenance Holes* used for the routing of outside plant communications cables.
- C. "HH" shall mean *Handholes* used for the routing of outside plant communications cables.
- D. "TMGB" shall mean *Telecommunications Main Grounding Busbar*. There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.
- E. "TGB" shall mean *Telecommunications Grounding Busbar*. There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

- F. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.

#### 1.4 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DIS Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

- A. Provide coordination with OSP-SCS manufacturer's representatives to ensure that the manufacturer's inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any modifications required by the manufacturer and have the manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.
- B. The Contractor is solely responsible for all costs associated with scheduling the OSP-SCS manufacturer's inspection, the inspection itself and any required re-inspections, and for any modifications to the installation as required by the OSP-SCS manufacturer.

### PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

#### 2.1 RACEWAY

Review and edit the following products/part numbers as applicable to this project. If section numbers and titles are referenced, verify for accuracy.

- A. As specified under Section 33 81 26 – "Communications Underground Ducts, Manholes and Handholes", and Section 27 05 33 – "Conduits and Backboxes for Communications Systems" except where noted below.
- B. Outside plant innerduct shall be 1 ¼ inch size, orange, thin-wall, unsplit, corrugated, with pull tape:
  1. Carlon Riser-Gard DG4X1C-nnnn

## 2.2 EQUIPMENT RACKS/ENCLOSURES

- A. As specified in Section 27 11 00 – “Communications Equipment Room Fittings.”

## 2.3 TERMINATION EQUIPMENT

- A. Voice Backbone Copper Building Entrance Protectors (BEPs): Complete with lockable covers and plug-in protector modules for each pair terminated on the chassis. Protector modules shall provide over-voltage and sneak current protection. BEPs and protectors shall be manufactured by the following manufacturers:
1. Circa Enterprises, Inc.
    - a. 1880ECA1 Series
      - 1) Less than or equal to 6-pair to be terminated: 1880ENA1NSC-6 (for Emergency / PATS Phone)
      - 2) 7-pair to 25-pair to be terminated: 1880ECA1-25G
      - 3) 26-pair to 50-pair to be terminated: 1880ECA1-50G
      - 4) 51-pair to 100-pair to be terminated: 1880ECA1-100G
      - 5) 101-pair to 200-pair to be terminated: 1880ENA1/NSC-200
    - b. Solid-state over-voltage protectors with sneak current protection. Protectors shall be:
      - 1) Balanced: 4B1E (PTC)
- B. Fiber Optic Patch Panels: See Section 27 13 00.

## 2.4 CABLE

- A. Outdoor Cable: Rated for outdoor use, duct installation, and/or direct burial installation as dictated by the application.
1. Copper Cable:
    - a. Backbone: Shielded, with 24-AWG solid copper conductors insulated with color coded PVC. UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Insulated with filled foam skin-DEPIC and conform to RUS 7 CFR 1755.890 (REA PE-89). Cable shall be manufactured by or listed as an “approved alternative product” by the selected OSP-SCS Manufacturer:
      - 1) Essex:
        - a) Inter-building Shielded Copper Cable, Outside Plant PIC: SEALPIC-FSF
      - 2) General Cable:
        - a) Filled Foam Skin QUALPETH Cable, Spec. 2007
    2. Fiber Optic Cable: All-dielectric, meeting or exceeding ANSI/TIA/EIA and industry standards including Bellcore GR-20-CORE specifications. Cables and fan-out kits shall be manufactured by the selected OSP-SCS Manufacturer:
      - a. 8.3/125 micron Singlemode: All-dielectric with a maximum attenuation of 0.4 dB/km at 1300 nm and 0.3 dB/km at 1550 nm.

Verify whether Outdoor or Indoor/Outdoor cable will be required for the project. Consult the WSUP ITPM as well as maintain compliance with the NEC 50-ft rule.

        - 1) Corning LANscape:
          - a) Indoor/Outdoor rated: FREEDM
          - b) Outdoor rated: ALTOS
- B. Lubricant:
1. Dyna-Blue
  2. American Polywater
- C. Cable Messenger

1. Messenger Strands shall be stranded steel, not stressed beyond 60% of rated breaking strength per Rule 251 of the National Electrical Safety Code, and sized such that the cable load will not exceed 25% of its rating.
  - a. 3/8 inch minimum, or larger as required, with required mounting, termination and grounding/bonding hardware.
2. Cable Lashing Supports
  - a. Stainless Steel, 10 inch long: Belden PPC Diamond Construction Hardware 34-08912
  - b. Or other similar part number if different length is required.

D. Pull Ropes: ¼ inch polypropylene with a minimum tensile strength of 200 pounds.

E. Muletape Pull cord with footage marks: WPxxxP

## 2.5 GROUNDING AND BONDING

- A. As specified under Section 27 05 26 – “Grounding and Bonding for Communications Systems” and Section 33 82 43 – “Grounding and Bonding for Communications Distribution.”

## 2.6 LABELING AND ADMINISTRATION

### A. Labels

1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.
  - a. Inside Telecommunication Rooms:
    - 1) Brady: BradyMaker Wire Marking Labels WML-511-292 (or approved equal)
  - b. Outside Plant: Waterproof
    - 1) 316 grade stainless steel strap ½ inch wide, embossed with punch-pressed characters, attached to the cable sheath with stainless steel lashing wire.
      - a) Panduit: METS3-X
    - 2) Black-on-Orange Reflective lettering
      - a) 3M 5005
2. Hand-carried label maker:
  - a. Panduit: MEHT187 (or approved equal).
  - b. Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

### 3.1 GENERAL

- A. Store all materials so as to be protected from the elements. Pathway materials (conduit, fittings, maintenance holes, etc.) are permitted to be stored outdoors if stacked on boards to avoid direct contact with the ground. The Contractor shall be responsible for any deteriorating effects on the materials due

to improper storage (or outdoor storage) prior to installation including damage caused by prevailing weather conditions.

### 3.2 DEMOLITION

The Engineer/Designer shall coordinate with local WSUP authorities to determine whether WSUP wishes to retain certain demolished material or wishes to have it hauled away. Review any demolition requirements for this project with the WSUP project manager and edit the following paragraph or create a similar paragraph as applicable.

- A. Demolish existing telecommunications equipment, cable, materials, and incidentals no longer in use after installation of the new OSP-SCS.
  - 1. Mandrel, clean, and cap outside plant conduits left empty after demolition of outside plant cables.
    - a. Clean each conduit with a wire brush, swab, and prove out with a minimum 16 inch long test mandrel that is  $\frac{1}{4}$  inch smaller than the inside diameter of the duct. Clean conduit a minimum of two times in the same direction. Swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings.
  - 2. Properly and legally dispose of demolished materials.
- B. Coordinate the demolition schedule with the Owner. Do not proceed with demolition prior to approval from the Owner.

### 3.3 RACEWAY

- A. Provide and install as specified under Section 33 81 26 – “Communications Underground Ducts, Manholes and Handholes”, and Section 27 05 33 – “Conduits and Backboxes for Communications Systems” except where noted.

### 3.4 TERMINATION EQUIPMENT

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. Copper Building Entrance Protectors: Provide BEPs in types, sizes and quantities as shown on the Contract Documents and as required for protection of building-to-building copper circuits. Where not shown, provide BEPs for each building-to-building copper cable.
- B. Provide BEPs in sufficient quantity to protect each pair of each cable plus an additional 10% for future use. Install BEPs per manufacturer’s instructions.
  - 1. Bond each BEP’s protector ground lug to the nearest TGB with a #6 AWG copper grounding conductor.

### 3.5 GROUNDING AND BONDING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project. Verify and edit referenced section titles.

- A. Bond non-current carrying metal telecommunications equipment and materials to the nearest TGB (if within a building – as specified under Section 27 05 26 – “Grounding and Bonding for Communications Systems”) or the nearest grounding conductor if in the outside plant – as specified under Section 33 81 26 – “Grounding and Bonding for Communications Distribution.”
  - 1. Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

- B. Bond both ends of each outside plant copper cable.

List additional grounding/bonding product installation requirements above as applicable to this project.

### 3.6 CABLE

- A. General (applicable to all cable types):

1. Test Mandrels: Clean each conduit with a wire brush and swab with clean rags a minimum of two times in the same direction until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings. Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the duct.
2. Install cables in compliance with ANSI/TIA/EIA requirements, BICSI practices, and manufacturers recommendations. Adhere to the requirements detailed in the manufacturer's recommendations and ANSI/TIA/EIA Standards relating to bending radius, pulling tension, other mechanical stresses, and pulling speed.
  - a. Monitor pulling tension on runs of 300 feet or longer. Acceptable monitoring devices are:
    - 1) Winch with a calibrated maximum tension
    - 2) Breakaway link (swivel)
    - 3) In-line tensiometer
3. Set up cable reels on the same sides of maintenance holes and hand holes as the conduit sections in which cables are to be placed. Level and align reels with conduit sections to prevent twisting of cables during installation into conduits. Pull cables into conduits from tops of reels in long smooth bends. Do not pull cables into conduits from bottoms of reels. Use a cable feeder guide (shoe) of suitable dimensions between the cable reel and the face of the duct to protect the cable and to guide it into the duct. Carefully inspect the cables for sheath defects as the cables are payed off the reel. If defects are found during the pulling operation or if the cable on the reel binds, twists, or does not pay off freely, stop the pulling operation immediately and notify the Owner's representative.
4. Cables of 1-¼ inch diameter or larger shall be equipped with factory installed pulling eyes, or install a core hitch on site. Use pulling grips for cables smaller than 1-¼ inches in diameter. Do not pound grips into the cable sheath to prevent the grips from slipping. Use a ball-bearing based swivel between the pulling-eyes or grips and the pulling strand.
5. Once pulling begins, and tension is applied to the cable, continue the pull at a steady rate. If it is necessary to stop the pull at any point, the tension shall not be released unless it is necessary to do so.
6. Do not splice cables unless specifically noted on the Contract Documents, or to accomplish a transition between outdoor-rated cabling and indoor rated cabling in accordance with the 50-foot rule.
  - a. Where it is possible to terminate outdoor-rated cabling within 50 feet of exposure inside a building, directly terminate the outdoor-rated cabling without a splice transition to indoor-rated cabling.
  - b. Do not use tape with splices.
  - c. The Contractor shall coordinate with Owner to review all splices prior to closure.
7. For new ductbank, install cables in the lowest available conduit in a duct bank, working up as additional cables are installed. For existing ductbanks, do not place cables in ducts other than those indicated on the Contract Documents.
8. Where cables are pulled through maintenance holes or handholes:
  - a. Select the same duct at both sides of maintenance holes or handholes unless specifically noted on the Contract Documents.
  - b. Avoid changes in duct selections, especially in elevations, to ensure that no damage occurs to the cable sheaths and that pulling tensions are kept as low as possible.
  - c. Loop cable once around the perimeter of maintenance hole or handhole. Avoid blocking conduits with cable loop. Provide cable racking hardware to support cables inside maintenance holes and handholes. Maintain a sufficient length of cable in each

- maintenance hole or handhole to properly rack the cable. Rack cables in maintenance holes and handholes as soon as practicable, but within one week after cable installation.
- d. After cabling has been installed, racked and labeled, photograph the interior of the maintenance hole or handhole, starting with the north wall. Provide photographs to the Owner as part of the As-built documentation.
9. Where cables are pulled through tunnels:
    - a. Provide messenger strand through full length of route, attached to tunnel structure per manufacturer guidelines. Messenger strand shall be sized appropriately for the cable load it is intended to carry, such that its load does not exceed 25% of the strand's rating.
    - b. Suspend cables from designated messenger strand using stainless steel lashings at intervals not exceeding 4 feet, with sag between suspension points not exceeding 1 inch.
    - c. Provide bonding for one end of each messenger strand segment.
  10. When more than one cable is being installed in a conduit, pull all cables through the conduit simultaneously.
  11. Where practicable, feed cables into ducts from the end of the duct that creates the least sidewall pressure on a bend during installation (i.e. feed cable from the end closest to the bend).
  12. Use pulling compound or lubricant where necessary. Use lubricants that are compatible with the cable jacket material and in accordance with the manufacturer's recommendations. Do not use soap-based lubricants. Where cable is pulled through a maintenance hole or handhole, re-lubricate the cable prior to feeding into the next duct. Immediately after cables have been installed, clean lubricant from exposed cables in maintenance holes and handholes and at termination points using dry rags.
  13. Seal cable ends with end caps immediately after installation and until terminated in a termination enclosure to prevent moisture entry into the core of filled cables and to prevent damage during installation.
  14. Provide a service loop in the equipment room or telecommunications room long enough to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 25 feet at each end.
  15. Comply with the NEC 50-ft rule when installing outdoor-rated cable (i.e. do not exceed 50 feet of exposed outdoor-rated cable length within a building).
  16. Cabling in the conduits:
    - a. Where multiple conduits are used to carry cabling, fill conduits completely (per fill-ratio requirements) prior to using the next adjacent available conduit. Do not partially fill multiple conduits (and thereby waste space in a conduit) when it would be possible to completely fill that conduit.
  17. Cable at the backboards:
    - a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
    - b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
    - c. Using the most direct route, secure multi pair cable to the backboard from the cable tray to the termination source. Use of D-rings in this situation is acceptable. Route via a path that will minimize obstruction to future installation of equipment, backboards or other cables.
  18. Cable in the Telecommunications Rooms:
    - a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with hook-and-loop straps (similar to Velcro).
  19. Building Entrances: Seal conduits (both in-use and spare) that enter the building from the outside plant to prevent intrusion of water, gases, insects and rodents.
  20. Provide pull ropes as required to accomplish cable pull. At completion of cable pull, a pull rope shall remain in conduit for additional new cabling if the conduit has capacity for additional new cabling.

- B. Copper Cable:
1. Provide copper cable in quantities and pair counts as shown on the Contract Documents.
  2. Test copper cable on the reel upon delivery to the job site prior to installation. Permanently affix test results to the reel and provide a copy to the Owner prior to installation. Do not install cables that fail. Replace failing cables at no additional expense to the Owner.
    - a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.
    - b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.
  3. Route outside plant copper cables to the BEP, enter the top-left side, and terminate cable in BEP.
  4. Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
  5. For shielded cable, bond the shield at both ends to the ground lug on the Building Entrance Protector.
- C. Fiber Cable:
1. Test fiber optic cable on the reel upon delivery to the job site, and again prior to installation. Permanently affix the test results to the reel and submit a copy to the Owner prior to installation. Do not install cables that fail the on-reel test. Replace any cables that fail the on-reel test at no additional expense to the Owner.
    - a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.
    - b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.
  2. Provide fiber optic cable in quantities, strand counts, and types, as shown on the Contract Documents. Provide cable with fan-out kits for both ends.
  3. Secure fiber optic cable with hook-and-loop straps (similar to Velcro).
  4. Terminate all fiber strands within a fiber cable.
  5. For shielded cable, bond the shield at both ends to the TGB.
- D. Innerduct:
1. Innerduct
    - a. Innerduct is required for routing outside plant fiber optic backbone cabling through all ductbank, conduit and sleeve pathways that exceed 4 feet in length.
    - b. Otherwise, innerduct is not required for routing outside plant fiber optic backbone cabling.
    - c. Do not provide innerduct through underground tunnels.
    - d. Where innerduct is required, install fiber optic cable in innerduct per manufacturer's instructions. Innerduct shall terminate within 6 inches of top of each patch panel where fiber optic cable terminates. Secure innerduct with zip-ties at intervals not exceeding 24 inches. Do not use wire or tape.
    - e. See Sections 27 15 00 – Communications Horizontal Cabling and 27 15 23 – Communications Optical Fiber Horizontal Cabling for innerduct requirements related to fiber optic cabling in horizontal and GPON applications, respectively.
  2. Provide innerduct for all interbuilding fiber optic cable runs through ductbanks, maintenance holes and handhole application.

The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.

### 3.7 LABELING AND ADMINISTRATION

- A. Color Coding: Apply industry standard color coding to cable termination fields. Always apply the same color to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:

1. Orange: Identification of the telecommunication service (telephone company) demarcation point.
2. Green: Identification of network connections on the customer side of the demarcation point.
3. White: Identification of first-level backbone in the building containing the main cross-connect, or may be used to identify the second-level backbone in buildings not containing the main cross-connect.
4. Gray: Identification of the second-level backbone in the building containing the main cross-connect.
5. Blue: Identification of the horizontal distribution (station) cables. A blue color coding is only required at the telecommunications room end of the cable, not at the station end of the cable.
6. Brown: Identification of inter-building backbone cables.
7. Yellow: Identification of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
8. Red: Identification of key telephone systems.

B. Cable:

1. Cables shall be labeled according to the following scheme:

Source Building	Telecom Room at Source	Destination Building	Telecom Room at Destination	Cable Number
a a a a a	- b* b b b b b <sup>†</sup> b <sup>†</sup>	c c c c c c*	- d* d d d d d <sup>†</sup> d <sup>†</sup>	e <sup>†</sup> e e e e <sup>†</sup>

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- \* This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
- † This character position should be deleted if not necessary.

The Source Building is typically the MCF. The Destination Building is the customer/outlet-end of the cable.

Three or four-position sequentially numbered Cable Numbers are structured as follows:

- 001-999 for UTP cables
- FM01-FM99 for Multimode Fiber cables
- FS01-FS99 for Singlemode Fiber cables
- X01-X99 for Coax cables
- Z01-Z99 for Composite cables

There is one special case for a prefix character on a cable number: cables that are owned by a third party (not WSU). For example, cables owned by Housing and Dining are labeled with a prefix of "H".

2. Use cable numbering shown on the drawings. For cable numbering that is not shown on the drawings, request numbering assignments from the Owner.
3. Provide labels in the following locations:
  - a. In the MCF and MDF, approximately 12 inches above the protector: metallic strap label on the cable sheath.
  - b. On the fiber optic patch panel in the MCF and MDF: Black-on-orange adhesive label and printed adhesive label.
  - c. Twice in each maintenance hole and handhole within 36 inches of the entrance and exit conduits: metallic strap label on the cable sheath.
  - d. At each tunnel intersection and entry/exit point: metallic strap label on the cable sheath.

- e. On the cable sheath adjacent to all splice closures, and at any other location where the cable enters or exits conduits, innerduct, or other wall penetration: metallic strap label on the cable sheath.

C. Termination Equipment:

1. Copper Building Entrance Protectors:

- a. Outside the BEP: Label each BEP (in the MCF and MDF) with black-on-orange adhesive label matching the cable label content described above.
- b. Inside the BEP: Label each BEP (in the MCF and MDF) with a printed adhesive label matching the cable label content described above.

2. Fiber Patch Panels:

- a. Outside the panel: Label fiber patch panels with a black-on-orange adhesive label and printed adhesive label matching the cable label content described above.
- b. Inside the Panel (Connector Panels): Label each connector panel with the opposite end termination point and type of the cable terminated at that location, in the form below, referencing the cable numbering discussed above.

<u>Far End</u>	<u>Telecom Room</u>	<u>Cable</u>
<u>Building</u>	<u>at Far End</u>	<u>Number</u>
a a a a a <sup>*</sup>	- b <sup>*</sup> b b b b b <sup>†</sup> b <sup>†</sup>	- c <sup>†</sup> c c c c <sup>†</sup>

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- \* This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
- † This character position should be deleted if not necessary.

- c. Inside the Panel (pull-out labeling plate): Each fiber patch panel includes a pull-out labeling plate with space to document the purpose of each fiber optic cable. Apply self-adhesive labels to the plate to matching the cable label content described above.

D. Grounding/Bonding Conductors: Label bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 TESTING

A. Provide test records on a form approved by the Owner and Engineer/Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Engineer/Designer for review and acceptance within two weeks of Substantial Completion.

- 1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic PDF format (on flash drive or CDROM) to the Owner and Engineer/Designer for review. Handwritten test results will not be accepted.

B. Test the SCS after installation for compliance to all applicable standards as follows:

- 1. Copper Backbone Distribution: Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.

- a. Test all cable pairs for length, shorts, opens, grounds, continuity, polarity reversals, termination order, transposition (wire map), attenuation, and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.
  - b. Test entire channel, from termination block to termination block.
  - c. Use a TIA/EIA Level III testing instrument (or higher accuracy level), re-calibrated within the manufacturer's recommended calibration period or within one year (whichever is more recent), with the most current software revision based upon the most current TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.
    - 1) Fluke DSP-4000 with latest software and hardware releases, or approved equal.
2. Fiber: Test fiber cable on the reel upon delivery to the job site, again prior to installation, and again after installation.
- a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:
    - 1) Backbone Distribution:
      - a)  $\text{Max Loss} = [(\text{allowable loss/km}) * (\text{km of fiber})] + [(.3\text{db}) * (\# \text{ of connectors})]$
      - b) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.
      - c) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).
    - 2) Test all strands using a bi-directional end-to-end Optical Transmission Loss Test Instrument (OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B, and the Corning LANscape field testing guidelines (latest edition). Test the polarity of each pair of strands. Record the following measurements: length and attenuation.
      - 1) Calculate loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.
      - 2) Provide test measurements as follows:
        - a) Multimode Cable: Test at both 850 and 1300nm.
        - b) Singlemode Cable: Test at both 1310 and 1550nm.
    - 3) Test results shall conform to:
      - 1) The criteria specified in ANSI/TIA/EIA-568-B
      - 2) The Contractor's calculated loss budget above
      - 3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)
        - a) In addition to the above, perform tests both recommended and mandated by Corning LANscape. Tests shall confirm/guarantee compliance to Corning LANscape Ethernet 1000B-X performance, and IEEE 802.3z for a maximum end-to-end dB loss of 2.5 dB.
      - 4) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)
- C. Identify cables and equipment that do not pass to the Owner and Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials. Retest the cable or connection materials at no additional expense to the Owner. Provide a complete revised set of all test results to the Owner and Designer, in the same manner as above. Remove original individual cable test reports that are unacceptable and insert the new corrected cable test reports. Do not simply resubmit the test reports for the corrected cabling only.
1. In addition to the above, if it is determined that the cable is faulty, remove the damaged cable and replace it with a new cable. Cable repairs are not acceptable. The procedure for removing the cable shall be as follows:
    - a. Prior to removal of damaged cable and installation of new cable:
      - 1) Inform the Owner and Designer of the schedule for the removal and installation.
      - 2) Test the new cable on the reel per paragraph B, above.

- 3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
- b. Remove the damaged cable and provide new cable.
- c. After the removal of the damaged cable and installation of the new cable:
  - 1) Test the new cable per the paragraph titled TESTING.
  - 2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
    - a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.
- d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.
  - 1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

END OF SECTION

## PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

### 1.1 SUMMARY

- A. Provide all materials and labor for the installation of a grounding and bonding system for outside plant telecommunications infrastructure. This section includes requirements for providing a permanent grounding and bonding infrastructure for communications ductbanks, maintenance holes, handholes, and splice closures. These requirements are in addition to any that may exist in Division 26 and Division 27.

### 1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Grounding and Bonding infrastructure for outside plant telecommunications circuits, termination hardware, raceways, and spaces as hereinafter specified and/or shown on the Contract Documents. The Grounding and Bonding system shall support an ANSI/TIA/EIA and ISO/IEC compliant outside plant communications cabling system as specified in section 33 82 00 – “Communications Distribution.”
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Grounding and Bonding system.

### 1.3 DEFINITIONS

- A. “OSP-SCS” shall mean *Outside Plant - Structured Cabling System*. The OSP-SCS is defined as all required equipment and materials including, but not limited to, ANSI/TIA/EIA and ISO/IEC compliant copper and fiber optic cable (multimode and singlemode), connectors, splices, splice closures and other

incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.

- B. "MH" shall mean *Maintenance Holes* used for the routing of outside plant communications cables.
- C. "HH" shall mean *Handholes* used for the routing of outside plant communications cables.
- D. "TMGB" shall mean *Telecommunications Main Grounding Busbar*. There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.
- E. "TGB" shall mean *Telecommunications Grounding Busbar*. There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.
- F. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

- G. "OSPBB" shall mean *Outside Plant Bonding Backbone*. The OSPBB is a conductor used to connect the grounding and bonding hardware in maintenance holes and hand holes, and also to the TMGB.

## PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

- A. Materials shall consist of busbars, supports, bonding conductors and other incidentals and accessories as required.

2.2 GROUNDING/BONDING:

1. Telecommunications Main Grounding Bus Bar (TMGB):
  - a. Large (20" x 4" x 1/4"), Pre-drilled: CPI 10622-020
  - b. Small (10" x 4" x 1/4"), Pre-drilled: CPI 10622-010
2. Telecommunications Grounding Bus Bar (TGB):
  - a. Large (20" x 4" x 1/4"), Pre-drilled: CPI 10622-020
  - b. Small (10" x 4" x 1/4"), Pre-drilled: CPI 10622-010
3. Outside Plant Bonding Backbone: #2 AWG non-insulated stranded copper conductor.
4. Grounding Conductor: #6 AWG insulated (green in color) copper conductor.

2.3 LABELS:

- A. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
1. Labels:
    - a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
    - b. Panduit Marker Tie (or approved equal)
  2. Hand-carried label maker:
    - a. Brady: ID Pro Plus (or approved equal).

**PART 3 - EXECUTION**

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

3.1 INSTALLATION

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

- A. The grounding and bonding infrastructure system shall not make use of the building plumbing system, unless required to do so by the NEC.
1. Coordinate the installation of the grounding and bonding system with the electrical power distribution system grounding infrastructure.

3.2 GROUND/BONDING:

- A. Outside Plant Bonding Backbone: Provide an OSPBB running continuously through each section of ductbank. Bond the OSPBB for each ductbank section to each other and also the grounding and bonding hardware in each MH and HH. Bond the OSPBB to the TMGB in each building where a ductbank terminates.
- B. Bond all equipment having grounding lugs and contained in MHs and HHs to the OSPBB.
- C. TMGB: Provide a minimum of one TMGB per telecommunications room for each building and as shown on the Contract Documents. Install TMGB(s) and directly bond TMGB(s) to electrical service ground and to associated TBB(s). Group protector, busbar bonding, and approved building grounding conductors toward the left end and leave space for equipment grounding conductors to the right end.
- D. TBB(s) and Grounding Conductors: Provide TBB(s) and grounding conductors as shown on the Contract Documents and as required to bond all non-current carrying metal telecommunications equipment and materials to the nearest TGB. Use TBB(s) to connect the TMGB to each TGB. Route along the shortest and straightest path possible with minimal bends. Bends shall be sweeping. Insulate TBB(s) and conductors from their support. TBB(s) and grounding conductors shall be continuous (without splices).
  - 1. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.

3.3 LABELS:

- A. Label TMGB(s) with "TMGB". If the TMGBs are existing and unlabeled, provide labels for each.
- B. Label TGB(s) with "TGB". If the TGBs are existing and unlabeled, provide labels for each.
- C. Label TBB(s) and OSPBB(s) "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

**END OF SECTION**