

Telecommunications Construction Guide Specification

Telecommunications Infrastructure Standards – Revision 3

Central Washington University

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Prepared by: _____
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1 PREFACE

The Telecommunications Construction Guide Specification (TCGS) is written for designers of Central Washington University (CWU) telecommunications distribution systems. It is intended to assist designers in developing project specifications that communicate CWU's requirements for the construction of telecommunications distribution systems at their facilities.

The TCGS was developed (in 2005) from CWU's previous version of its telecommunications infrastructure standard specifications in use at that time. It has been updated to reflect the methods, materials and industry standards that have evolved since the previous version was published.

The TCGS is written based on the Construction Specifications Institute (CSI) 1995 format, using MasterFormat, Section Format, and Page Format¹ structure. The TCGS reflects CWU and industry standards in effect as of this publication. As of this writing, CWU has not adopted the 2004 edition of CSI's MasterFormat for its construction specifications.

1.1 DOCUMENT INTENT

CWU has developed the TCGS with the intent that its standards and practices are followed during the design and construction of telecommunications distribution infrastructure.

Each TCGS specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many CWU telecommunications 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 CWU telecommunications projects.

The TCGS is intended to be a "Guide Specification," and not a "Master Specification." The products listed and other information included in each section is not intended to be all-inclusive for any given project. Instead, the TCGS is meant to serve as a starting point for developing the telecommunications-related project specification sections. Content shall be added or removed by the Designer as required.

In addition to following CWU standards and practices, another intent of the TCGS is to reduce the time required for CWU to review telecommunications project specifications. CWU expects that consistently formatted and structured specifications will reduce the amount of time needed by CWU staff and RCDD Consultants to review the telecommunications specifications for each project.

Unless otherwise stated, the information in the TCGS applies to both new

¹ For more information on CSI and the Master Format, contact the Construction Specifications Institute at: 601 Madison Street, Alexandria, VA 22314. Phone: (800) 689-2900 Email: csimail@csinet.org; Internet: www.csinet.org

construction and remodel projects.

1.2 HOW TO USE THIS DOCUMENT

The TCGS shall be used in conjunction with the Telecommunications Distribution Design Guide (TDDG) to produce Construction Documents for bidding or to assist CWU selected personnel in the design and administration of small telecommunications construction projects.

CWU has standardized on the format and content of the specification sections that are included in the TCGS. CWU will provide the TCGS' specification sections to the Designer electronically as Microsoft Word documents. The Designer shall then edit each electronic specification section using Microsoft Word 2003 (or more recent versions), adding and/or removing content where 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 TCGS or to cut and paste content from TCGS sections into other existing specification sections.

In order to assist CWU staff with the specification review process, all edits to the original TCGS electronic documents shall be made using Microsoft Word's Tracking Changes feature. The specification sections shall be submitted in hardcopy format when required by CWU during the design review process with the "Final Showing Markup" option selected so that the revision marks are visible in the documents to be reviewed.

Text in shaded boxes in each TCGS section is formatted in Microsoft Word as "hidden text" and can be made to not appear on screen and/or not appear in the printed document by selecting the appropriate check boxes in the Tools/Options menu. The hidden text is included to aid the Designer in understanding areas of the Guide Specification 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 TCGS 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.***

1.3 SPECIFICATION SECTIONS

The TCGS contains the following 6 specification sections:

- 16108 – Outside Plant Communications Site Work
- 16131 – Raceway and Boxes for Communications Circuits
- 16137 – Cable Tray for Communications Circuits
- 16453 – Bonding and Grounding for Telecommunications
- 16740 – Inside Plant Communications Circuits
- 16741 – Outside Plant Communications Circuits

SECTION 16108 – OUTSIDE PLANT COMMUNICATIONS SITE WORK

SECTION 16108 — OUTSIDE PLANT COMMUNICATIONS SITE WORK

1 PART 1 — GENERAL

PART 1 — GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University 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 CWU 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 may edit this section (adding and/or removing content where required) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this Guide Specification 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 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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

- 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.

1.2 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.
- B. Related Sections

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Raceway and Boxes for Communications Circuits"
3. Division 16 Section — "Grounding and Bonding for Telecommunications"

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

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. CWU 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.

- D. 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, CWU 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.

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

- E. Provide Unit Prices for:

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. For example, unit prices may be requested for trenching, conduit, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the CWU Project Manager and/or the CWU IT Specialist 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. National Electrical Code (NEC)
- b. National Electrical Safety Code (NESC)
- c. Washington Industrial Safety and Health Act (WISHA)
- d. Occupational Safety and Health Act (OSHA)
- e. WSDOT/APWA 2004 Standards Specifications for Road, Bridge and Municipal Construction (APWA Standard Specifications)

2. Communications:

- a. ANSI/TIA/EIA - 758 : *Customer-owned Outside Plant Telecommunications Cabling Standard*

- b. ANSI/TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*
 - c. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
 - d. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
 - e. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
 - f. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*
 - g. BICSI: *BICSI Telecommunications Cabling Installation Manual (CIM)*
 - h. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*
 - i. BICSI: *BICSI Customer-Owned Outside Plant Design Manual (CO-OSP)*
3. 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) ASTM C33: *Concrete Aggregates*
 - 7) ASTM C39: *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*
 - 8) ASTM C94: *Ready-Mixed Concrete*
 - 9) ASTM C150: *Portland Cement*

- 10) ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete
- 11) ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- 12) ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- 13) ASTM C260: Air Entraining Admixtures for Concrete
- 14) ASTM C309: Standard Specifications for Liquid Membrane Forming Compound for Curing Concrete
- 15) 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)

4. Trenching and Backfill:

- a. ASTM D1557: Test Method for Laboratory Compaction Characteristics Using Modified Effort

1.4 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 an excavation's 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

1.5 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 16741 (or equivalent) - "Outside Plant Communications Circuits".
- 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.

1.6 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 CWU through the Alternative Design Request (ADR) 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. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.
1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
 2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.
 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.
- B. 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.
- 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. Raceway and Boxes 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. The requirement that the Contractor provide an O&M Manual for Communications should be stated in the Outside Plant Communications Circuits section or in Inside Plant Communications Circuits.

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.
2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
- b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.

- c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

State any requirements for coordinating work with potentially unusual or specifically required sequencing. CWU 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 CWU 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.

1.8 CONTRACTOR 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. 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. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.
 - 1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.
 - a. The Contractor Warranty period shall commence upon Owner acceptance of the work.

2 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.

The following paragraphs include products that do not indicate that they allow “or equal” substitutions. If the Designer wishes to use other products, a request to consider an alternative product shall be submitted in writing to the CWU ITS Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. 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

Review and edit the following products/part numbers as applicable to this project.

- A. Use of on-site soils for base, bedding, and backfill is not acceptable.
- B. Base: Readily compactible and meet the following gradation requirements.

- 1. For Maintenance Holes and Handholes (provide gravel):

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

- 2. For 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. For Maintenance Holes and Handholes - Same as Base - For Maintenance Holes and Handholes, above.

- 2. For Trenches

Sieve Size	Percent Passing
½" Square	100
¼" 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

Review and edit the following products/part numbers as applicable to this project.

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- $\frac{1}{4}$ ".
 - 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.

List additional products above as applicable to this project.

2.4 CONDUIT AND DUCTBANKS

Review and edit the following products/part as applicable to this project.

A. Conduit

1. Rigid Non-Metallic Conduit (RNC):
 - a. UL listed, NEMA TC2 and TC6 Schedule 40 or 80 rigid polyvinyl chloride (PVC) approved for direct burial without concrete encasement
 - b. Fittings: NEMA TC3 and TC9, 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.
 - 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.
- B. Ductbanks:
1. Conduit Spacers/Supports: High-density plastic interlocking spacers/supports. Spacers shall be:
 - a. Underground Devices Inc.: WUNPEECE
 2. Warning Tape: 6" wide metallic warning tape, orange in color.
 3. Grounding/Bonding: #2 bare copper ground

List additional products to the above information as applicable to this project.

2.5 UNDERGROUND SPACES

Review and edit the following products/part numbers as applicable to this project.

- A. General: Underground spaces include Maintenance Holes (MH) and Handholes (HH). Incidental and miscellaneous equipment supplied with a MH or HH shall be supplied by the same manufacturer.
- B. Maintenance Holes: Precast, conform to ASTM C478 and other ASTM standards and specifications as listed in REFERENCES above. Complete with concrete floors, lockable covers, permanently installed ladders, pulling eyes, and 12" diameter closed sumps.
 1. Sizes and Types:

The Designer shall include MH sizes as required for the project. The size described below is an example to indicate specification language and detail.

- a. Utility Vault Company: 4484-TA 5'-0" W x 9'-0" L x 7'-2" H (exterior dimensions). Complete with Alternate Top Section 4484-T42E, Center Section 4484-MT, Base Section 4484-BT, and section gaskets. Equipped with (3) galvanized "C" imbedded channels per longitudinal side. Manufactured with conduit entry knockouts: 4" TERM-A-DUCT '90.
 - b. Utility Vault Company: 467TA 4'-10" W x 6'-10" L x 8'-0" H (exterior dimensions). Complete with Top Section 467-T42C-TA, Base Section 467-B-TA, and section gaskets. Equipped with (4) galvanized "C" imbedded channels per longitudinal side. Manufactured with conduit entry knockouts: 4" TERM-A-DUCT '90.
2. Covers and Frames: Covers shall be circular cast ductile iron, shall be engraved with 1/8" high letters stating "COMMUNICATIONS", and shall conform to AASHTO H20 loading if located in a roadway and to AASHTO H10 loading otherwise. Cover frames shall be cast ductile iron, conforming to the same AASHTO requirements as the covers.
 - a. Utility Vault Company, 30" Diameter Casting with 10" high Frame
 3. Racking and Hardware: Galvanized.
 4. Risers:
 - a. 4 inch high: Utility Vault Company No. 4204
 - b. 6 inch high: Utility Vault Company No. 4206
 - c. 12 inch high: Utility Vault Company No. 4212

The Designer shall include HH sizes as required for the project. The size described below is an example to indicate specification language and detail.

- C. Handholes: Precast, conform to ASTM C478 and other ASTM standards and specifications as listed in REFERENCES above. Complete with concrete floors, lockable covers, pulling eyes, and 12" diameter closed sumps.
 1. Sizes and Types:
 - a. Utility Vault Company: 444-LA 4'-0" W x 4'-0" L x 4'-0" H (exterior dimensions). Complete with Cover Section 44-332P, Base Section 444-BL, and section gaskets. Equipped with one (1) galvanized "C" channel per longitudinal side and one (1) galvanized pulling iron per corner (four (4) total). Manufactured with conduit knockouts: 4" TERM-A-DUCT '90.
 - b. Utility Vault Company: 504-LA 4'-8" W x 4'-8" L x 4'-0" H (exterior dimensions). Complete with Cover Section 55-332P, Base Section 504-BL, and section gaskets. Equipped with one (1) galvanized "C" channel per longitudinal side and one (1) galvanized pulling iron per corner (four (4) total). Manufactured with conduit knockouts: 4" TERM-A-DUCT '90.
 - c. Utility Vault Company: 25-TA 2'-3" W x 5'-2.5" L x 2'-7.5" H (exterior dimensions). Complete with Cover Section 38/25-T, Base Section 25-T, and section gaskets. Equipped with one (1) galvanized "C" channel per longitudinal side and one (1) pulling insert per end (two (2) total).
 2. Covers: Rectangular diamondplate covers, equipped with a self latching stainless steel slam lock, recessed lift inserts, lock down bolts, shall be labeled with 1/8" high letters stating "COMMUNICATIONS". Shall conform to AASHTO H20 loading if located in a roadway and to AASHTO H10 loading otherwise.

3. Racking and Hardware: Galvanized

D. Grounding:

1. ¾" x 10' copperclad steel ground rods
2. #4/0 pigtail for connection to interior ground conductors.

List additional products to the above information as applicable to this project.

2.6 FIRESTOPPING MATERIAL:

A. 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.

Review and edit the following products/part numbers as applicable to this project.

2.7 LABELS:

A. 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. Hand-carried label maker:
 - a. Brady: ID Pro Plus (or approved equal).
2. Labels:
 - a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

2.8 LANDSCAPING:

Review and edit the following products/part as applicable to this project.

A. Topsoil: Imported from off construction site.

3 PART 3 — EXECUTION

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 it is desirable to use other products, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

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 -- REFERENCES 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. 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.
- F. Remove surplus material and debris from the job site and dispose of legally.

3.2 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 twelve (12) inches between the ductbank and/or MH/HH and the nearest underground utility after installation. For gas lines a minimum separation of eighteen (18) inches is required. For water a minimum separation of thirty-six (36) inches is required. Contact the Designer prior to proceeding if minimum separation distances can not 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. For 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 six (6) to twelve (12) inches of base. Excavate to a sufficient width to provide a minimum of six (6) inches clearance around each side of the MH/HH.
 - b. For trenches: Excavate to a sufficient depth to provide a minimum of twenty-four (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 six (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" 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 three (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" depth of bedding lifts/layers before compacting
 5. Backfill: Do not exceed 6" 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 two (2) feet below the finished grade with a minimum relative compaction of 90% of the maximum dry density per ASTM D1557. Compact material from two (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 CWU authorities to determine whether CWU 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 CWU'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.

3.3 CAST-IN-PLACE CONCRETE

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. Construct concrete in accordance with the applicable portions of the specifications, standards, codes and regulations (latest editions and/or amendments) listed in Section 1, References.
- B. Formwork:
1. Construction:
 - a. Forms: Use the most advantageous panel sizes and panel joint locations. Neat patches and minor surface imperfections will be 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" thick, and conforming to ASTM D1751. Seal the top ½" 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.
 - b. Deposit concrete in forms in layers not deeper than 24" 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.

3.4 CONDUITS AND DUCTBANKS

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. 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 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 $\frac{1}{4}$ 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 Drawings, do not exceed 600 feet of ductbank between pulling points. Contact the Designer prior to proceeding if a ductbank section will exceed 600 feet.
11. Pull Ropes: Install in each conduit immediately after the conduit has been cleaned and mandreled. Leave a minimum of 10 feet looped and tied off 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 eight (8) foot centers if encased in concrete and five (5) foot centers otherwise. Interlock spacers horizontally only. Stagger spacers encased in concrete at least six (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" 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.

3.5 UNDERGROUND SPACES

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 maintenance holes and handholes in the sizes and locations shown on the Drawings.
- B. Precast maintenance holes and handholes shall be free from damaged joint surfaces, cracks, or other damage that would permit infiltration. Repair of defects is not acceptable. MH/HH and incidental and miscellaneous equipment (such as cable racking brackets and supports) shall be supplied by a single manufacturer.
- C. Install MH/HH according to manufacturer's instructions.
- D. Covers and Frames: Provide 30" wide x 10" high circular frames/covers and provide with minimum 4" and maximum 12" high circular maintenance hole entrance riser sections as required. Use the riser sections to maintain the top of the cover 1" above the existing ground line or finished grade. Taper pavement surfaces up to the top of the maintenance cover. Provide lock-down bolts. Covers and frames shall be of uniform quality, free from blowholes, porosity, shrinkage, distortion, cracks and other defects. Repair of defects is not acceptable. Mating surfaces between covers and frames shall be machine-finished to ensure a non-rocking fit.
- E. Setting and Placement: Remove water from excavation and properly install bedding material prior to setting the MH/HH. Clean MH/HH section seal surfaces so that they are free from dirt or other material.
 1. Set MH/HH in place by lowering each section into the excavation, ensuring that the section is level, plumb, and firmly positioned, and ensuring that the section gasket/seal is properly installed and watertight prior to setting the next section.

2. Carefully set the MH/HH to ensure that the rim or lid elevation is set one inch above finished grade. For vaults located in paved areas, taper pavement up to the MH/HH rim.
- F. Knockouts: Open conduit entry knockouts with care preserving the TERM-A-DUCT sidewalls. Glue conduits entering the vault to the opened TERM-A-DUCTs with PVC cement. Preserve intact the conduit entry knockouts that are not intended for current use.
- G. Grouting: Apply grout in a manner to insure filling of voids in the joints being sealed. Apply grouting to conduit entrances, risers, and covers in addition to any other voids.
- H. Racking and Hardware: Install racking and hardware and incidental materials. Provide three (3) cable racks per longitudinal side (six (6) racks total) per maintenance hole. Provide eight (8) 7-½" cable support arms per manhole. Provide additional incidental hardware for mounting racks and cable support arms.
- I. Risers: Provide riser sections that are a minimum of 4" high and a maximum 12" high, sized for the MH entrance. Provide riser sections in quantities sufficient to meet the minimum and maximum height requirements discussed above.
- J. Grounding/Bonding: Provide a minimum of one ¾" x 10' copperclad steel ground rods, and one #4/0 pigtail for connection to interior ground conductors. Bond metallic hardware in the vault to the pre-cast bonding tabs. Bond the bonding tabs to the ground rod.
- K. Cleaning: Clean and dry the MH/HH after construction activity is complete and prior to releasing the MH/HH to the Owner for the Owner's use.

3.6 LANDSCAPING

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. Topsoil: Provide imported topsoil for excavations in grass and/or landscaped areas. Provide loosely compacted topsoil to a depth of 4" or depth of excavation for excavations less than 12". 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 shall be approved by the Owner and the Designer prior to installation.

END OF SECTION

SECTION 16131 – RACEWAY AND BOXES FOR COMMUNICATIONS CIRCUITS

SECTION 16131 — RACEWAY AND BOXES FOR COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University 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 CWU 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) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this Guide Specification 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 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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

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

1.2 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 16130 (or equivalent) - Raceway and Boxes for Electrical Circuits. When an Electrical Circuits section and a Telecommunications Circuits section are both in the Project Manual, a statement shall be added to the Raceway and Boxes for Electrical Circuits section similar to the following:

"For Telecommunications Raceway and Boxes, the requirements in Section 16131 - Raceway and Boxes for Telecommunications Circuits shall supercede the requirements in this 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.
- B. Related Sections:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the Contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Grounding and Bonding for Telecommunications"
3. Division 16 Section — "Inside Plant Communications Circuits"

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

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.

D. 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. 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 Conductors
2. Firestopping Material
3. Labels

E. Provide Unit Prices for:

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.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the CWU PM and/or the CWU IT Specialist assigned to the project whether the latest edition and/or addenda of each required reference is appropriate and shall 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. National Electrical Code (NEC)
 - b. National Electrical Safety Code (NESC)

- c. Washington Industrial Safety and Health Act (WISHA)
 - d. Occupational Safety and Health Act (OSHA)
2. Communications:
- a. ANSI/TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*
 - b. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
 - c. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
 - d. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
 - e. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*
 - f. BICSI: *BICSI Telecommunications Cabling Installation Manual*
 - g. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

1.4 DEFINITIONS

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".

- A. "EMT shall mean Electrical Metallic Tubing.
- B. "RMC" shall mean Rigid Metal Conduit.
- C. "SMR" shall mean Surface Metal Raceway.
- D. "Raceway" shall mean any enclosed channel for routing wire, cable or busbars.
- E. "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.
- F. "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.

- G. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to the TGBs.
- H. "Pullbox" shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100' or in which there are more than 180 degrees of bends.
- I. "Junction box" shall mean a pullbox wherein a feeder conduit transitions to multiple distribution conduits.

1.5 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 16740 - Inside Plant Communications Circuits.
- 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.

1.6 SUBMITTALS

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 CWU through the Alternative Design Request (ADR) 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. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.
 1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
 2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.
 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.

B. 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 this section shall be included in the O&M Manual for Communications and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in Inside Plant Communications Circuits or in Outside Plant Communications Circuits.

1. O&M Manual for Communications - At the completion of the project, submit all 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.
2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
- b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
- c. Keep Record Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

1.7 CONTRACTOR 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 CWU 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. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.
 1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.
 2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

1.8 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."
- C. Comply with NEC.

1.9 COORDINATION

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

2 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.

The products listed in this Guide Specification throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that products required by the design are specified with equal or greater detail to the following paragraphs. The Designer shall also verify that the most current part number of each specified product is used.

2.1 GENERAL

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

2.2 MATERIALS

Review and edit the following list of products/part numbers as applicable to this project.

- A. Conduit:
 1. EMT. 1" 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.
 2. RMC. 1" 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.
- B. Sleeves: EMT conduit, with insulated throat bushings for each end
- C. Surface Raceway: Wiremold V2400 series – Two piece, steel, single channel surface raceway.
 1. Fittings: "FO" suffix with Category 6 and fiber optic compliant bend radii
 2. Color: Match (as close as possible) the finish of the mounting surface.
 3. Single-Gang Surface-mounted Outlet Boxes: V2444
 4. Double-Gang Surface-mounted Outlet Boxes: V2444-2

- D. Outlet boxes: Minimum 4"x4" size, 2 1/8" minimum depth, with extension rings (if needed) and single 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". Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for 1" trade size conduit or connector entrance, meeting NEMA OS 1.
1. Acceptable manufacturers:
 - a. Appleton, Raco, Steel City, or equal
 2. Wiremold Extra Deep Switch and Receptacle Box: V5744-2 (two gang)
- E. Floor-boxes: Deep, rectangular, and constructed of cast-iron, with brushed brass covers. When floor boxes serve both communications and power, metal dividers are required for separating power from communications. Floor boxes shall be:
1. 1-Gang: Hubbell B2436xx
 2. 2-Gang: Hubbell B4233xx
 3. 3-Gang: Hubbell B4333xx
- F. 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: NEMA OS 3R.
- G. Miscellaneous Fittings:
1. Locknuts and conduit bushings: Malleable iron
 - a. Appleton, Crouse Hinds, OZ Gedney, or equal
 2. Through wall seals and floor seals shall be:
 - a. OZ Gedney FS and WS series.
- H. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

Additional products shall be added to the above list as applicable to this project.

If firestopping material is specified in another section, the Designer shall reference that section in Part 1 - General above as a related section, and delete the following paragraph in its entirety.

2.3 FIRESTOPPING

- A. 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.

Review and edit the following products/part numbers as applicable to this project.

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. Hand-carried label maker:
 - a. Brady: ID Pro Plus (or approved equal).
 2. Labels:
 - a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

Additional products shall be added to the above list as applicable to this project.

3 PART 3 - EXECUTION

Ensure that products listed under 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.

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

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Designer shall ensure that products required by the design are specified in Part 2 with corresponding installation requirements specified in Part 3.

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 (NEC) 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 -- REFERENCES 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. Install the raceway system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.
- F. 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.
- G. Remove surplus material and debris from the job site and dispose of legally.

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.

3.3 INSTALLATION

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

- 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. Install EMT unless other conduit is shown on the Contract Documents, is required by Code, or is permitted under these specifications.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. 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
 - 6. Do not exceed 90 meters 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.
 - 7. 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.
 - 8. 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.

9. Conduits concealed above ceilings, furred spaces, etc., which are normally inaccessible may be run at angles not parallel to the building lines.
10. 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.
11. Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.

Verify for accuracy the section number and title referenced below.

12. Support conduits as specified in Section 16050 "Basic Electrical Materials and Methods."
 - 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.
13. 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.
14. Install a pull string in each conduit.
15. For conduits entering through the floor of a telecommunications room, terminate conduits 4 inches above the finished floor.
16. Do not install communications conduits in wet, hazardous or corrosive locations.
17. 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.
18. 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.
19. Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.
20. Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 4" above the finished floor.
21. Where conduits terminate at a cable tray, the conduits shall be consistently terminated no more than 8" from the cable tray, and have a visually uniform appearance.
22. Where several circuits follow a common route, stagger pullboxes or fittings.
23. Where several circuits are shown grouped in one box, individually fireproof each conduit.

24. 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.
 - 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" 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.
25. 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.
26. 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 1/4" 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.
27. 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.
28. 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.
29. Conduit shall be clean and dry.

Add conduit product installation requirements to the above information as applicable to this project.

C. Sleeves:

- 1. 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.
- 2. Provide roto-hammering or core drilling where required for installation.
- 3. 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.

D. Surface Raceway:

- 1. Provide surface raceway for all surface mounted telecommunications outlet boxes and as shown on the Contract Documents.
- 2. Surface raceway shall be routed parallel to and perpendicular to surfaces or exposed structural members, and follow surface contours.
- 3. Surface raceway color shall match as closely as possible the existing wall finish. Do not paint Surface Raceway.
- 4. Surface raceway 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. Surface raceway shall have a minimum two inch radius control at all bend points.
- 6. Surface raceway shall be securely supported by screws or other anchor-type devices at intervals not exceeding 10 feet and with no less than two supports per straight raceway section. Surface

raceway shall be securely supported in accordance with the manufacturer's requirements. Tape and glue are not acceptable support methods.

7. Mechanically and electrically continuous surface raceway shall be bonded and grounded.

E. Outlet Boxes:

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

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: 46 inches above finished floor.
 - b. Workstation outlets: 16 inches above finished floor.
 - c. 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 one-sixteenth inch for each condition. Set boxes so that box openings in building surfaces are within one-eighth inch of edge of material cut-out and fill tight to box with building materials. Single gang opening shall extend at least to the finished wall surface and extend not more than 1/8 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 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"x4" (minimum) outlet box with single gang cover.

Add outlet box product installation requirements to the above information as applicable to this project.

F. Floor Boxes:

1. Provide floor boxes as shown on the Contract Documents.
2. Set device boxes plumb, level, square and flush with floor, within 1/16" tolerance for each condition.
3. For floor boxes with combined power and telecommunications circuits, provide metal dividers to separate power from telecommunications circuits.

G. Junction Boxes:

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

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:

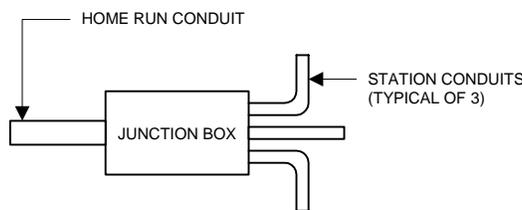
Feeder Conduit Size	Box Length	Box Depth
1"	12"	4"
1-1/4"	12"	4"
1-1/2"	12"	4"
2"	24"	4"
2-1/2"	24"	6"
3	36"	6"
3-1/2"	48"	6"
4"	60"	6"

- 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".

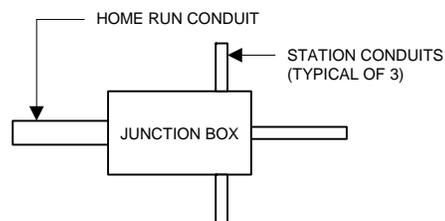
- 3) The larger of the two width calculations (distribution side vs. feeder side) shall be the width of the junction box to be provided.
 - a) For example, if the distribution-side width were 10" and the feeder-side width were 13", provide a 13" wide junction box.

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' 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

Add junction product installation requirements to the above information as applicable to this project.

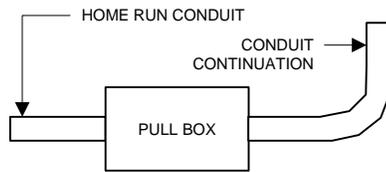
H. Pull Boxes:

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

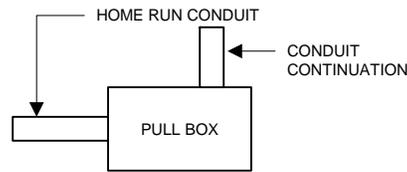
1. Provide pull boxes as shown on the Contract Documents and as required.
 - a. Where sizing is not shown on the Contract Documents, size pull boxes as follows:

Size of Largest Conduit	Box Width	Box Length	Box Depth
1"	4"	12"	4"
1-¼"	6"	12"	4"
1-½"	8"	12"	4"
2"	8"	24"	4"
2-½"	10"	24"	6"
3	12"	36"	6"
3-½"	12"	48"	6"
4"	15"	60"	6"

- b. Where a pull box is required with conduits 1" 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' 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:



CORRECT INSTALLATION



INCORRECT INSTALLATION

Add pullbox product installation requirements to the above information as applicable to this project.

I. Firestopping:

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

1. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
2. Maintain fire rating of penetrated fire-rated walls. Firestop and seal each penetration made during construction.
 - a. Provide firestopping material for through and membrane penetrations of fire-rated barriers.
 - b. Installation shall be performed in strict accordance with manufacturer’s detailed installation procedures.
 - c. 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.

Add firestop product installation requirements to the above information as applicable to this project.

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

J. Grounding/Bonding: 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 – REFERENCES above, 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 Division 16 Section — “Grounding and Bonding for Telecommunications”). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

Add grounding/bonding product installation requirements to the above information as applicable to this project.

3.4 LABELS:

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

- 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 (use the label of the first port of the outlet as the outlet identifier), etc.). 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 "Room 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".
- C. Pull Strings: Label each pull string in a clear manner by designating the location of the other end of the pull string (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.).
1. Where a pull string is installed in a conduit intended for future cabling use outside of the Contract, the pull string shall be labeled similar to the spare conduit in which it is installed.

Add label product installation requirements to the above information as applicable to this project.

3.5 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.

3.6 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

SECTION 16137 – CABLE TRAY FOR COMMUNICATIONS CIRCUITS

SECTION 16137 — CABLE TRAY FOR TELECOMMUNICATIONS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University 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 CWU 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) for use with a particular project, but shall not create a new specification section based on the "intent" of the TCSG, or cut and paste content from TCSG sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this Guide Specification 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 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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

- 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.

1.2 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 Section 16 – "Cable Tray."
- B. Related Sections

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 7 Section — "Firestopping"
2. Division 10 Section — "Cutting and Patching"
3. Division 16 Section — "Basic Electrical Materials and Methods"
4. Division 16 Section — "Raceway and Boxes for Communications Circuits"
5. Division 16 Section — "Inside Plant Communications Circuits"

6. Division 16 Section — "Outside Plant Communications Circuits"

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

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.

D. 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, CWU 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.

E. Provide Unit Prices for:

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. For example, unit prices may be requested for grounding busbars, grounding conductors, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the CWU Project Manager and/or the CWU IT Specialist 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 these specifications.

1. General:

- a. National Electrical Code (NEC)
- b. National Electrical Safety Code (NESC)
- c. Washington Industrial Safety and Health Act (WISHA)
- d. Occupational Safety and Health Act (OSHA)
- e. ASTM A123 – Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- f. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.
- g. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.
- h. ASTM A1008 – Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.

- i. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - j. NEMA VE 1 – Metallic Cable Tray Systems
 - k. NEMA VE 2 – Cable Tray Installation Guidelines
2. Communications:
- a. TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*
 - b. TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
 - c. TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
 - d. TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
 - e. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*
 - f. BICSI: *BICSI Telecommunications Cabling Installation Manual*
 - g. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

1.4 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. "EMT shall mean Electrical Metallic Tubing.
- B. "RMC" shall mean Rigid Metal Conduit.
- C. "Raceway" shall mean any enclosed channel for routing wire, cable or busbars.
- 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 the TGBs.
- G. "Pullbox" shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100' or in which there are more than 180 degrees of bends. Pullboxes shall have no more than one conduit entering and one conduit exiting the box.
- H. "Junction box" shall mean a pullbox wherein a conduit run transitions from a feeder conduit to multiple distribution conduits.

1.5 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 16740 - Inside Plant Communications Circuits.
- 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.

1.6 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 CWU through the Alternative Design Request (ADR) 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. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.
 - 1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
 - 2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.
 - 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.

B. 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 this section shall be included in the O&M Manual for Communications and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in Inside Plant Communications Circuits or in Outside Plant Communications Circuits.

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.
2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
- b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
- c. Keep Record Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. CWU 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 CWU 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.

1.8 CONTRACTOR 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 CWU 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. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.
 1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

2 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.

The following paragraphs include products that do not indicate that they allow “or equal” substitutions. If the Designer wishes to use other products, a request to consider an alternative product shall be submitted in writing to the CWU ITS Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that products required by the design are specified with equal or greater detail to the following paragraphs. 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. 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 one of the following:

Some projects might require cable tray to be routed through visible areas of the building. CWU may wish to use solid cable tray rather than welded wire tray for such projects. Where this is the case, it may be necessary to specify another type of tray from other manufacturers, including but not limited to Thomas and Betts, Cooper B-Line, PW Industries, or MP Husky.

- a. GS Metals
- 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.
- E. 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:

CWU typically prefers welded-wire cable tray for most projects, especially where the cable tray will be installed out of sight. If solid cable tray materials are required for a project, the Designer shall specify suitable product lines below.

- a. For GS Metals: Flextray Series
- b. For Cablofil, Inc.: EZ Tray CF54/xxx Series

2.2 MATERIALS AND FINISH

If solid cable tray materials are required for a project, the Designer shall specify suitable materials below.

- A. Welded wire: Cable tray shall be constructed of welded wire mesh (high strength steel wires) with a continuous safety edge wire lip. Cable tray shall be complete with all tray 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: 2 inches.
 4. Mesh: 2 x 4 inches.
 5. Fittings: Fittings shall be field fabricated from straight sections using manufacturer-approved tools and in accordance with manufacturer's instructions.
- B. Grounding/bonding: In accordance with ANSI/NFPA 70 Section 318-7, cable tray shall be complete with bolted splicing hardware for grounding/bonding throughout the entire cable tray system.

Review and edit the following products/part numbers as applicable to this project. If firestopping material is specified in another section, the Designer shall ensure that that section is listed in Part 1 - General above as a related section, and delete this paragraph in its entirety.

2.3 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.

Review and edit the following products/part numbers as applicable to this project.

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, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
 1. Hand-carried label maker: Brady: ID Pro Plus (or approved equal).
 2. Labels: Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
 3. Label Clips: Cablofil, Inc. (regardless of cable tray manufacturer)

3 PART 3 - EXECUTION

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 it is desirable to use other products, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

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 (NEC) 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 -- REFERENCES 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. 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.
- F. Install the cable tray system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.
- G. Remove surplus material and debris from the job site and dispose of legally.

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

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 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. Cable tray elevation changes shall be gradual.
- B. Slots/sleeves: Provide slots/sleeves where required and where shown on the Contract Documents. Provide roto-hammering, core drilling and saw cutting where required for installation. Seal and firestop (firestop only if fire rated barrier) between slot/sleeve and cable tray.
- C. 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.
- D. Cable Tray Clearance Requirements:
1. Clearance requirements for cable tray accessibility:
 - a. Maintain a clearance of 6" between top of cable tray and ceiling structure or other equipment or raceway.
 - b. Maintain a clearance of 8" between at least one side of cable tray and nearby objects.
 - c. Maintain a clearance of 6" 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" or more from fluorescent lighting.
 - b. Maintain a clearance of 12" or more from conduit and cables used for electrical power distribution.
 - c. Maintain a clearance of 48" 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.
- E. Cable 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 called out on the Contract Documents.

- F. Cable tray supports shall be provided where shown on the Contract Documents. Where not shown on the Contract Documents, supports shall be provided according to the manufacturer's recommendations.
 - 1. 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.
 - 2. Where cable trays abut walls, provide wall-mounted supports.
 - 3. Do not attach cable tray supports to ceiling support system or other mechanical support systems.
- G. Load span criteria: Install tray supports in accordance with the load criteria of L/240, and as shown on the Contract Documents.
- H. Cable tray shall be installed free of burrs, sharp edges, or projections which may damage cable insulation.
- I. Wire-type cable tray shall be cut with a manufacturer-approved cutter with "offset cutting blade" jaws and a minimum 24 inch handle.
 - 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.
- J. Supports: Trays shall be supported at 6 foot intervals as shown on the Contract Documents, or more frequently if required by the manufacturer.
- 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.
- 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. Grounding/Bonding: 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 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.
- B. Bond metallic raceway (including cable tray) together and to the nearest TGB (as provided under Division 16 Section — "Grounding and Bonding for Telecommunications"). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

- C. Cable tray bonding splices: Provide cable tray splices according to manufacturer requirements to create a continuous bonding conductor throughout the entire cable tray.
- D. Bonding conductors:
 - 1. Bond distribution conduits 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 FIRESTOPPING

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. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
- B. Maintain the fire rating of all penetrated fire barriers. Fire stop and seal all 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 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 reusable/re-enterable.

List additional Firestopping product installation requirements above as applicable to this project.

3.6 CLEANING AND PROTECTION

- A. 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.
- 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.

3.7 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.

3.8 LABELING AND ADMINISTRATION

- A. Provide the following two labels, alternating one label every 10 feet, along the entire length of the cable tray:
 - 1. Label #1: Label shall read "TELECOMMUNICATIONS / LOW VOLTAGE CABLING ONLY".
 - 2. Label #2: Label shall read "WARNING! CABLE TRAY SERVES AS A TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT DISCONNECT!"

END OF SECTION

SECTION 16453 – GROUNDING AND BONDING FOR TELECOMMUNICATIONS

SECTION 16453 — GROUNDING AND BONDING FOR TELECOMMUNICATIONS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University 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 CWU 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.

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Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this Guide Specification 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 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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

- 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.

1.2 SUMMARY

- A. Provide all materials and labor for the installation of a grounding and bonding system for communications infrastructure. This section includes requirements for providing a permanent grounding and bonding infrastructure for communications circuits, raceways, and cable tray. These requirements are in addition to any that may exist in Section 16 – "Grounding."

- B. Related Sections

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 16 Section — "Basic Electrical Materials and Methods"
2. Division 16 Section — "Raceway and Boxes for Communications Circuits"
3. Division 16 Section — "Inside Plant Communications Circuits"
4. Division 16 Section — "Outside Plant Communications Circuits"

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

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.

- D. 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, CWU 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.

- E. Provide Unit Prices for:

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. For example, unit prices may be requested for grounding busbars, grounding conductors, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Designer shall verify with the CWU Project Manager and/or the CWU IT Specialist 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 these specifications.

1. General:

- a. National Electrical Code (NEC)
- b. National Electrical Safety Code (NESC)
- c. Washington Industrial Safety and Health Act (WISHA)
- d. Occupational Safety and Health Act (OSHA)

2. Communications:

- a. TIA/EIA - 568: *Commercial Building Telecommunications Cabling Standard*
- b. TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
- c. TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
- d. TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
- e. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*

- f. BICSI: *BICSI Telecommunications Cabling Installation Manual*
- g. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*
- h. BICSI: *BICSI Customer-Owned Outside Plant Design Manual (CO-OSP)*

1.4 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. "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.
- B. "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.
- C. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.

1.5 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 16740 - Inside Plant Communications Circuits and 16741 - Outside Plant Communications Circuits.
- 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.

1.6 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 CWU through the Alternative Design Request (ADR) 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. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.
1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
 2. For those items noted as allowing “or equal,” and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.
 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.
- B. 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 this section shall be included in the O&M Manual for Communications and statements should be included in each section directing the Contractor to provide applicable information in the O&M Manual for Communications. The requirement that the Contractor provide an O&M Manual for Communications should be stated in Inside Plant Communications Circuits or in Outside Plant Communications Circuits.

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.
2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.

- b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
- c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. CWU 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 CWU 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.

1.8 CONTRACTOR 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 CWU 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. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.
 - 1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.
 - 2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

2 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.

The following paragraphs include products that do not indicate that they allow “or equal” substitutions. If the Designer wishes to use other products, a request to consider an alternative product shall be submitted in writing to the CWU ITS Infrastructure Specialist. This request shall follow the format and procedures of the Alternative Design Request identified in the TDDG, and include detailed literature from the manufacturer of the alternative product. If the alternative product is approved, the Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that products required by the design are specified with equal or greater detail to the following paragraphs. 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 MATERIALS

A. Grounding/Bonding:

1. Telecommunications Main Grounding Bus Bar (TMGB):
 - a. Large (20" x 4" x ¼"), Pre-drilled: CPI 10622-020
 - b. Small (10" x 4" x ¼"), Pre-drilled: CPI 10622-010
2. Telecommunications Grounding Bus Bar (TGB):
 - a. Large (20" x 4" x ¼"), Pre-drilled: CPI 10622-020
 - b. Small (10" x 4" x ¼"), Pre-drilled: CPI 10622-010
3. Telecommunications Bonding Backbone: #6 AWG insulated (green in color) copper conductor.
4. Grounding Conductor: #6 AWG insulated (green in color) copper conductor.

Review and edit the following products/part numbers as applicable to this project. If firestopping material is specified in another section, the Designer shall ensure that that section is listed in Part 1 - General above as a related section, and delete this paragraph in its entirety.

- B. 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.

Review and edit the following products/part numbers as applicable to this project.

- C. 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. Hand-carried label maker:
 - a. Brady: ID Pro Plus (or approved equal).
2. Labels:
 - a. Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

3 PART 3 - EXECUTION

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 it is desirable to use other products, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

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 -- REFERENCES 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. 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.
- F. 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 and other references listed in Part 1 — References, above.
- G. Remove surplus material and debris from the job site and dispose of legally.

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.
- B. Ground/Bonding:
 - 1. 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.

2. TGB: Provide TGB as shown on the Contract Documents and as required. Directly bond each TGB to its associated TBB 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.
3. 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).
 - a. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.

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.

C. Firestopping

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.

1. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
2. Maintain the fire rating of all penetrated fire barriers. Fire stop and seal all penetrations made during construction.
 - a. Provide firestopping material for through and membrane penetrations of fire-rated barriers.
 - b. Install firestops in strict accordance with manufacturer's detailed installation procedures.
 - c. 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.
 - d. 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.
 - e. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

List additional Firestopping product installation requirements above as applicable to this project.

D. Labels:

1. Label TMGB(s) with "TMGB"
2. Label TGB(s) with "TGB".
3. Label TBB(s) and bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

END OF SECTION

SECTION 16740 – INSIDE PLANT COMMUNICATIONS CIRCUITS

SECTION 16740 — INSIDE PLANT COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 – GENERAL

This Telecommunications Construction Guide Specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University 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 CWU 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), or shall create a new specification section based on the "intent" of this section, or cut and paste content from this section into another existing specification section.

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this Guide Specification 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 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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

- 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.

1.2 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).
- B. Related sections include but are not necessarily limited to the following:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

1. Division 7 Section — "Firestopping"
2. Division 10 Section — "Cutting and Patching"
3. Division 16 Section — "Basic Electrical Materials and Methods"
4. Division 16 Section — "Raceway and Boxes for Communications Circuits"
5. Division 16 Section — "Grounding for Communications Circuits and Raceway"

6. Division 16 Section — "Outside Plant Communications Circuits"

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

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.

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

A. Include this paragraph only if products will be installed under this section but furnished under other sections, by others or by the Owner. For example, CWU 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.

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

1. Paint for Backboards
2. Grounding Conductor

E. Provide Unit Prices for:

Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure and pay for the quantity. For example, unit prices may be requested for duplex outlets, quadruplex outlets, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

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 applicable portions of the following specifications, standards, codes into this specification section.

1. General:
 - a. National Electrical Code (NEC)
 - b. National Electrical Safety Code (NESC)
 - c. Washington Industrial Safety and Health Act (WISHA)
 - d. Occupational Safety and Health Act (OSHA)
2. Communications:

- a. ANSI/TIA/EIA - 455: *Fiber Optic Test Standards*
- b. ANSI/TIA/EIA - 526: *Optical Fiber Systems Test Procedures*
- c. ANSI/TIA/EIA - 568-B: *Commercial Building Telecommunications Cabling Standard*
- d. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
- e. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
- f. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
- g. ANSI/TIA/EIA -TSB67: *Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems*
- h. ANSI/TIA/EIA -TSB75: *Additional Horizontal Cabling Practices for Open Offices*
- i. NECA/FOA 301-1997: *Standard for Installing and Testing Fiber Optic Cables*
- j. NECA/BICSI 568-2001: *Standard for Installing Commercial Building Telecommunications Systems*
- k. IEEE 802.3 (series): *Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit Ethernet Standard*
- l. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*
- m. BICSI: *BICSI Telecommunications Cabling Installation Manual*
- n. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*

1.4 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 operational or ready for the intended operation".

- A. "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 3, Category 5E, Category 6, 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.

- B. "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.
- C. "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.
- D. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.
- E. "UTP" shall mean *Unshielded Twisted Pair* cable.

1.5 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.

1.6 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 CWU 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.
 - a. 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. 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) AMP NetConnect Design & Installation Contractor (for copper).
 - 2) Corning EWP Certified Installer Program (for fiber).
 - 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 also that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.
- Include the following paragraph (or one similar) only if the project is to be Public-Bid.
- 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 three 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, and addresses

Include the following paragraph (or one similar) only if the project is to be constructed under the State of Washington Department of Information Services (DIS) Master Contract. Use of the DIS contract shall be discussed with the CWU project manager prior to the completion of Design Development. Pre-qualified Contractors from the DIS list shall be recommended by the Designer and approved by the CWU project manager.

- e. Documentation demonstrating that the Contractor has a current Master Contract with the State of Washington Department of Information Services (DIS) per the requirements in Section 01010, and shall be on the CWU pre-qualified DIS contractor list shown in Section 01010.
2. Submit a cable routing and grouping plan as follows:
 - a. Where the cable routing and grouping is to be provided as shown on the Contract Documents, do not provide a cable routing and grouping plan. Submit written documentation stating that the cable routing and grouping will be provided as shown on the Contract Documents, that the Contractor has reviewed the routing and grouping on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts with other building utility infrastructure, and that the routing and grouping meets applicable codes, regulations and standards.
 - b. Where changes in cable routing and grouping are proposed, submit complete floor plan(s) and/or detail drawing(s) showing the proposed routing, raceway sizes and locations, and cabling in a manner equal to that of the Contract Documents. Ensure that any cabling changes are coordinated with comparable accommodating changes to the raceway routing and grouping. Specifically note each location where the proposed routing and grouping is different from the Contract Documents. Submit written documentation detailing the reason for each change request. Each change request must be approved in writing by the Designer prior to proceeding with the change.
 3. Submit wall field termination block and wire management elevations as follows:
 - a. Where wall field termination blocks and wire management are to be provided as shown on the Contract Documents, do not submit elevations. Submit written documentation stating that the wall field termination blocks and wire management will be provided as shown on the Contract Documents, that the Contractor has reviewed the elevations on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the elevations meet applicable codes, regulations and standards.
 - b. Where changes to the wall field termination blocks and wire management are proposed, submit wall field termination block and wire management elevations along with written documentation detailing the reason for the change. The change request must be approved in writing by the Designer prior to proceeding with the change.
 4. 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).

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. Raceway and Boxes 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. The requirement that the Contractor provide an O&M Manual for Communications should be stated in this section or in Section 16741 - Outside Plant Communications Circuits.

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 Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of changes to Contract Documents such as drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
- b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
- c. Keep Record Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

1.7 QUALITY ASSURANCE

The following are CWU requirements for Telecommunications Contractors and Telecommunications Contractor Employees. Review these requirements with the CWU Project Manager and include as applicable to this project.

For projects that are not being quoted by Contractors on the WA State DIS Master Contract list, consider establishing a deadline prior to the bid date for Contractors to have submitted prequalification documentation demonstrating that they meet the qualification requirements. Also, consider publishing the list of prequalified Contractors as an addendum prior to the bid deadline.

A. Contractor Qualifications:

1. Contractor shall be trained and certified by the Manufacturers to install, test, and maintain the SCS and be certified by the SCS Manufacturers to provide the SCS Manufacturers' Warranties (see PART 1 - WARRANTY).

- a. AMP NetConnect Design & Installation Contractor (for copper).
 - b. Corning EWP Certified Installer Program (for fiber).
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:
 - 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'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.
4. 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.

Include the following paragraph (or one similar) only if the project is to be Public-Bid.
5. 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 three years.

Include the following paragraph (or one similar) only if the project is to be constructed under the State of Washington Department of Information Services (DIS) Master Contract. Use of the DIS contract shall be discussed with the CWU project manager prior to the completion of Design Development. Pre-qualified Contractors from the DIS list shall be recommended by the Designer and approved by the CWU project manager.
6. Contractor shall have a current Master Contract with the State of Washington Department of Information Services (DIS).

1.8 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. CWU 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 CWU 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.

1.9 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 CWU 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 two-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. 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. AMP 25-year System Warranty.
 - 1) Provide a copy of the warranty registration document to the Owner at the time of submittal to AMP.
 - 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.

2 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.

CWU has standardized on AMP and Corning products for all new Structured Cabling Systems in CWU facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. “Or-Equal” substitutions for AMP and Corning products are not permitted.

Some of the following paragraphs include ancillary products (such as racks, cable supports, etc.) manufactured by companies other than AMP and Corning, but do not indicate that they allow “or equal” substitutions. If the Designer wishes to use other products in lieu of non-AMP/Corning ancillary products, a request to consider an alternative product shall be submitted in writing to the CWU project manager. If the alternative product is approved, the Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. 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”, equivalent items are not acceptable. Provide items as specified.
- B. 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.
- C. 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 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:

Review and edit the list of manufacturers below as applicable to the project.

- a. AMP, for copper-related products
 - 1) AMP fiber optic cabling products are not acceptable.
 - b. Corning, for fiber optic-related products
- 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.
1. The SCS Product Line shall be the following, per manufacturer. Substitution is not acceptable:

CWU has standardized on using Category 6 cabling for new construction and for projects where the existing telecommunications cabling is substantially replaced. Category 6 cabling is also used for projects where new cable is added to systems where Category 6 cabling is already in use. CWU has standardized on using Category 5E cabling for projects where new cable is added to systems where Category 5E cabling is already in use. The Designer shall verify with the CWU project manager whether Category 5E or Category 6 cabling will be used on each project, and edit this section to reflect the appropriate cable type. Please note that references to Category 6 occur in many places throughout this section.

If Category 5E cabling is to be used on this project, replace the reference to Category 6 (below) with the following text:
“For Category 5E Copper Distribution: AMP NETCONNECT, Category 5E”

- a. For Category 6 Copper Distribution: AMP Category 6, SL Series Solution
 - b. For Fiber Distribution: Corning LANscape Horizontal Solutions
- E. 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. Wall-mount Racks and Cabinets:
 - a. Chatsworth Products, Inc. (CPI)
 - b. B-Line
- F. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

2.2 PATHWAYS AND CABLE SUPPORTS

Review and edit the following products/part numbers as applicable to this project.

- A. Installation and materials for the raceway and boxes for the SCS shall be as specified under Division 16 Section — “Raceways and Boxes for Communications Circuits” except where noted below.
- B. Surface Raceway: UL listed under Section 5 with fittings including (but not limited to) mounting clips and

straps, couplings, internal and external elbows, cover clips, bushings, end fittings, outlet boxes and other incidental and miscellaneous hardware required for a complete Surface Raceway system.

1. Surface Plastic Raceway (SPR):
 - a. Wiremold 2800/2900/5400 w/Category 5 fittings
 - b. Panduit Surface Plastic Raceway w/Category 5 fittings
2. Surface Metal Raceway (SMR): Wiremold w/Category 5 fittings
3. Sleeves: EMT conduit, with insulated throat bushings for each end.

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.

4. Backboards: $\frac{3}{4}$ inch A-C non-fire-retardant plywood backboards, void free, 2440-mm (8-ft) high unless otherwise noted.
 5. D-Rings:
 - a. Metallic: CPI 10941, 10942, 10943
- C. Cable Supports (J-Hooks, Straps): Complete with incidental materials and assemblies required for mounting.
1. CADDY CableCat Wide Base Cable Supports (J-Hooks):
 - a. CAT12 (up to 16 4-pair/2-strand UTP/fiber cables)
 - b. CAT21 (up to 50 4-pair/2-strand UTP/fiber cables)
 - c. CAT32 (up to 80 4-pair/2-strand UTP/fiber cables)
 2. CADDY CableCat Adjustable Cable Supports (Straps):
 - a. CAT425 (up to 425 4-pair/2-strand UTP/fiber cables)
- D. 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. Gray
 2. Ladder rack:
 - a. For CPI: Universal Cable Runway 10250-xxx
 3. Horizontal radius bends:
 - a. For CPI: Cable Runway E-Bend 10822-xxx

4. Cable Retaining Posts:
 - a. For CPI: 10596-108
5. Radius Drops:
 - a. For CPI: 1210x-xxx
6. Ladder rack/cable runway Grounding kits:
 - a. For CPI: 12061-001

Verify the size of innerduct required for the project and modify paragraph below accordingly.

- E. Innerduct: 1 ¼" Outside Diameter, bright orange in color.
- F. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

List additional raceway products above as applicable to this project.

2.3 FIRESTOPPING

Review and edit the following products/part numbers as applicable to this project. If firestopping material is specified in another section, the Designer shall ensure that that section is listed in Part 1 - General above as a related section, and delete this paragraph in its entirety.

- 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. (or approved equal).

List additional firestopping products above as applicable to this project.

2.4 EQUIPMENT RACKS/ENCLOSURES

Review and edit the following products/part numbers as applicable to this project.

- A. Unless otherwise indicated, equipment racks/enclosures and incidental equipment color shall be:
 1. Clear aluminum
- 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 with universal alternating-hole pattern, complete with top angles, self-supporting bases, and mounting holes on both sides of the rails.
 1. Racks:
 - a. For CPI: Standard Rack 55053-503
 2. Guard rail: 7" deep:
 - a. For CPI: 40056-519
 3. Wide (6 inches) cable channels for vertical cable management:

- a. For CPI:
 - 1) Double-sided: 11729-503
 - 2) Single-sided: 11374-503
- D. Free Standing Equipment Frames (double rails): EIA-standard 7-foot high x 19-inch wide equipment frames with universal alternating-hole pattern and with rails in front and back (4 posts), complete with top angles, self-supporting bases, and top and bottom extension pans.
 - 1. Frames:
 - a. For CPI: 50130-x03
 - The Designer shall take care to coordinate the locations of floor-mounted power outlets with the space between the base plates of adjoining double-rail racks to avoid superimposing the base plates over the power outlets.
 - 2. Guard rail: 7 inches deep:
 - a. For CPI: 40056-x19
 - 3. Wide (6 inches) cable channels for vertical cable management:
 - a. For CPI:
 - 1) Double-sided: 11729-503
 - 2) Single-sided: 11374-503
- E. Wall-mount Swing Gate Equipment Racks: EIA-standard 19-inch wide, 35 inches high (20U), hinged, wall-mount swing gate racks with universal alternating-hole pattern.
 - 1. Swing gate racks:
 - a. For CPI:
 - 1) 12 inches deep: CPI 11347-519
 - 2) 18 inches deep: CPI 11348-519
 - b. For B-Line:
 - 1) 12 inches deep: CPI 11347-519
 - 2) 18 inches deep: CPI 11348-519
 - 2. Jumper rings/loops for vertical cable management:
 - a. For CPI: 1307 (or approved equal)
- F. Wall-mount Rack Enclosures/Cabinets: EIA-standard 19-inch wide (interior rack dimension), dual locking hinge (for front and back access), wall-mount rack enclosures/cabinets with universal alternating hole pattern. Complete with fan/filter kit for cooling, with mounting holes on both sides of the rails, and a metallic, lockable door.
 - 1. For CPI:
 - a. 41 inches high (20U), 14 inches deep: 11680-719

- b. 41 inches high (20U), 24 inches deep: 11685-719
 2. For B-Line:
 - a. 36 inches high (16U), 20 inches deep: E2-WM-2H-362420-xx-PD-BL
 - b. 36 inches high (16U), 24 inches deep: E2-WM-2H-362424-xx-PD-BL
 3. Or approved equal.
- G. Hinged Wall-mount Brackets: EIA-standard 19 inch wide, 4 inches deep, hinged, wall-mount brackets:
 1. For CPI:
 - a. 3.50 inches (2U) high: 11521-704 (black)
 - b. 5.25 inches (3U) high: 11522-704 (black)
 - c. 7.00 inches (4U) high: 11523-704 (black)
 - d. 8.75 inches (5U) high: 11524-704 (black)
 - e. 10.5 inches (6U) high: 11525-704 (black)
 2. For B-Line:
 - a. 3.50 inches (2U) high: SB-750-19-6-02-FLTBLK
 - b. 5.25 inches (3U) high: SB-750-19-6-03-FLTBLK
 - c. 7.00 inches (4U) high: SB-750-19-6-04-FLTBLK
 - d. 10.5 inches (6U) high: SB-750-19-6-06-FLTBLK
 3. Or approved equal.
- H. Flush Mounted Wall Brackets: EIA standard universal 19 inch wide, 2U, flush wall mount brackets:

Please note that the weight limit for the following CPI flush-mounted wall bracket is 75 pounds. For larger loads, select and specify an appropriate bracket.

 1. For CPI: 11583-x19
- I. Single sided low profile equipment shelf:
 1. For CPI: 40074-500
- J. Lockable storage drawer:
 1. For CPI: 11505-519
- K. 120 VAC / 15 Ampere power strip:
 1. For Free Standing Equipment racks: Complete strip (72" in length) with mounting hardware to mount to back of cable management channel and/or standoff brackets to mount to back of rack:
 - a. For CPI: 12x70-701 (or approved equal)
 2. For wall-mounted equipment racks/enclosures/bracket (sets): Rack-mountable, surge protecting, with On/Off switch:

- a. For Homaco: PS-19-15A-xxx (or approved equal)

Coordinate with CWU personnel to determine if shelves, drawers or other rack accessories are desired/required.

- L. Grounding kit and #6 AWG insulated copper conductor grounded to the nearest TGB.
 - 1. For CPI: CPI grounding kit
 - 2. For B-Line: B-Line grounding kit
- M. Incidental materials required for proper construction, mounting and securing.

List additional Equipment Racks/Enclosure products above as applicable to this project.

2.5 GROUNDING AND BONDING

Review and edit the following section number or name as applicable to this project.

- A. As specified under Division 16 Section – “Grounding and Bonding for Telecommunications.”

List additional Grounding and Bonding products above as applicable to this project.

2.6 PATCH PANELS

Review and edit the following products/part numbers as applicable to this project.

- A. 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. For Outside Plant Distribution:
 - a. For Corning:
 - 1) Rack mounted patch panels:
 - a) Corning CCH-01U (1U, 12/24 port) (black)
 - b) Corning CCH-02U (2U, 24/48 port) (black)
 - c) Corning CCH-03U (3U, 36/72 port) (black)
 - d) Corning CCH-04U (4U, 72/144 port) (black)
 - 2) Wall-mounted patch panels:
 - a) Corning WCH-02P (12/24 port) (black)
 - b) Corning WCH-04P (24/48 port) (black)
 - c) Corning WCH-06P (36/72 port) (black)
 - d) Corning WCH-08P (48/96 port) (black)
 - e) Corning WCH-12P (72/144 port) (black)
 - 3) Connector Panels:
 - a) Multimode: Corning high density (12-strand/6-connector) duplex SC, CCH-CP12-57

- b) Singlemode: Corning high density (6-strand/6-connector) duplex SC, CCH-CP12-59
2. For Inside Plant Backbone Distribution:
- a. For Corning:
 - 1) Rack mounted patch panels:
 - a) Corning CCH-01U (1U, 12/24 port) (black)
 - b) Corning CCH-02U (2U, 24/48 port) (black)
 - c) Corning CCH-03U (3U, 36/72 port) (black)
 - d) Corning CCH-04U (4U, 72/144 port) (black)
 - 2) Wall-mounted patch panels:
 - a) Corning WCH-02P (12/24 port) (black)
 - b) Corning WCH-04P (24/48 port) (black)
 - c) Corning WCH-06P (36/72 port) (black)
 - d) Corning WCH-08P (48/96 port) (black)
 - e) Corning WCH-12P (72/144 port) (black)
 - 3) Connector Panels:
 - a) Multimode: Corning high density (12-strand/6-connector) duplex SC, CCH-CP12-57
 - b) Singlemode: Corning high density (12-strand/6-connector) duplex SC, CCH-CP12-59
3. For Horizontal Distribution:
- a. For Corning:
 - 1) Patch Panel: Corning CCH-01U (1U, 24 port) (black)
 - 2) Connector Panels: Corning CCH-CP24-97 MT-RJ (24 fiber strands/12 connectors)
- B. Horizontal Wire Management: Horizontal wire management shall be, regardless of rack/distribution equipment manufacturer:
- 1. Panduit WMPH2 (3.5 inch)

List additional Patch Panel products above as applicable to this project.

2.7 CONNECTORS

Review and edit the following products/part numbers as applicable to this project.

- 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.

If Category 5E cabling is to be used on this project, replace the reference to Category 6 (below) with the following text:
 "...Category 5E..."

1. Horizontal Distribution: Shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801, and shall be part of the UL LAN Certification and Follow-up Program:

- a. For AMP:

If Category 5E cabling is to be used on this project, replace the two Category 6 part numbers below with the following CAT5E-specific text:

- 1) AMP NETCONNECT 406372-6 (Blue)
- 2) AMP NETCONNECT 406372-2 (Black)

- 1) AMP NETCONNECT 1375055-6 (Blue)

- 2) AMP NETCONNECT 1375055-2 (Black)

- B. Fiber Connectors: Complete with fiber optic receptacle adapters where required for mounting.

1. For Horizontal Distribution:

- a. For Multimode: MT-RJ, for 62.5/125 μm multimode fiber, epoxyless with a zirconia ceramic ferrule, beige:

- 1) For Corning: MT-RJ 92-001-97-P-E

2. For Backbone Distribution:

- a. For Multimode: Duplex SC, for 62.5/125 μm multimode fiber, epoxyless with a zirconia ceramic ferrule:

- 1) For Corning: Unicam 95-000-41 with SC Duplex Clip (95-400-03-BP)

- b. For Singlemode: Duplex SC, singlemode fiber with Ultra PC Polish and rotating cam:

- 1) For Corning: Unicam 95-200-42 with SC Duplex Clip (95-400-03-BP)

List additional Connector products above as applicable to this project.

2.8 COPPER TERMINATION BLOCKS

If Category 5E cabling is to be used on this project, replace the reference to Category 6 (below) with the following text:
 "...Category 5E..."

Review and edit the following products/part numbers as applicable to this project.

- A. Copper Termination Blocks: UL listed and exceed ANSI/TIA/EIA 568-B Category 6 specifications for performance. Include connecting blocks, designation strips, and labels for each 25-pair strip. Label colors per ANSI/TIA/EIA standards. Termination blocks shall be manufactured by the selected SCS Manufacturer:

1. For Backbone Cable:

- a. For AMP

If Category 5E cabling is to be used on this project, replace the two Category 6 part numbers below with the following text:

- 1) Blocks: 110Connect XC 100-Pair without legs (558840-1)
 2) IDC Connecting Blocks (5-pair markings): 558402-1

- 1) Blocks: 610XC 100-Pair without legs (1479251-1)
 2) IDC Connecting Blocks (5-pair markings): 1479246-1
 3) Designation Strips: 558417-1
 4) Labels (white): 1116037-1

2. For Horizontal Cable:

a. For AMP:

If Category 5E cabling is to be used on this project, replace the two Category 6 part numbers below with the following CAT5E-specific text:

- 1) Blocks: 110Connect XC 100-Pair without legs (558840-1)
 2) IDC Connecting Blocks (4-pair markings): 558401-1

- 1) Blocks: 610XC 100-Pair without legs (1479251-1)
 2) IDC Connecting Blocks (4-pair markings): 1479245-1
 3) Designation strips: 558417-1
 4) Labels (blue): 1116034-1

B. Copper Termination Blocks Cable Management: Vertical and horizontal cable management for jumper/patch cables between termination blocks shall consist of a single unit with separate horizontal and vertical pathways and shall be capable of mounting 110Connect wiring blocks. Cable management shall be:

1. For AMP:

Note: CWU does not accept the 110D-1800W due to the reduced horizontal patch cord/jumper cable management that it offers.

a. HOMACO 110D-900W

List additional Copper Termination Block products above as applicable to this project.

2.9 STATIONS

Review and edit the following products/part numbers as applicable to this project.

A. Faceplates: Complete with port identification labels and blank inserts/fillers for covering unused connector openings:

1. Stations to be used for wall-mount telephones: Brushed stainless steel with stainless steel mounting lugs suitable for supporting wall-mount telephones:

a. SUTTLE SE-630AD4, 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 brushed stainless steel and shall be equipped with Decora style cutouts.

a. Faceplates shall be: Hubble, SEMTRON, or approved equal

b. Decorator Mounting Straps shall be: 3-port modular jack adapter, complete with blank

module inserts for all unused modular jack locations. Adapter shall be:

- 1) For AMP: 3-port Decorator Mounting Strap Adapter 1116616-2 (Black)

B. Faceplate Mounting Brackets: Suitable for mounting faceplates over wall cutouts (i.e. flush-mount faceplates with no in-wall outlet box).

1. For CADDY:

- a. Single gang faceplates: CADDY MP1P
- b. Double gang faceplates: CADDY MPAL2

C. Surface Device Boxes: Surface mount device boxes shall be:

1. Wiremold
2. Panduit

List additional Station products above as applicable to this project.

2.10 CABLE

Review and edit the following products/part numbers as applicable to this project.

A. General: Cables shall be manufactured by the selected SCS Manufacturer.

B. Copper Cable:

1. For Horizontal Distribution: 4-pair, UTP, 24 AWG, with solid copper conductors and shall be part of the UL LAN Certification and Follow-up Program.

If Category 5E cabling is to be used on this project, replace the two references to Category 6 (below) with the following text:
 "...Category 5E..."

- a. Category 6: Shall exceed Category 6 transmission requirements as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:

- 1) For AMP:

If Category 5E cabling is to be used on this project, replace the two Category 6 part numbers below with the following CAT5E-specific text:

- a) Plenum: 57825
- b) Non-plenum: 57826

- a) Plenum: 219567

- b) Non-plenum: 219560

2. For Backbone Distribution:

- a. Copper backbone cable shall be non-shielded 24-AWG solid copper conductors insulated with color coded PVC, shall be UL Verified to TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured the selected SCS Manufacturer:

- 1) AMP (or approved equal)

- b. For Termination Block Connections (back-side): Unshielded, non-plenum multi-pair copper cable.

- c. Multi-pair Copper Cable: 24-AWG, solid copper conductor, and insulated with color coded PVC, UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by the selected SCS Manufacturer:

- 1) AMP (or approved equal)

C. Fiber Cable:

1. For Horizontal Distribution:

- a. For Multimode: Multimode, graded index, tight-buffered, 2-strand fiber optic cable.

- 1) For 62.5/125 μm : Maximum attenuation of 3.5 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and minimum cable bandwidth of 200 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm. Cable shall be manufactured by the selected SCS Manufacturer:

- a) For Corning:

- i. OFNP (Plenum): Corning MIC2 002K88-B1130-49

- ii. OFNR (Riser): Corning MIC2 002K81-B1130-44

2. For Backbone Distribution:

- a. For Multimode: Graded index, tight-buffered cable.

- 1) For 62.5/125 μm : Extended/high grade with a maximum attenuation of 3.5 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and a minimum cable bandwidth of 200 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm. Cable shall be manufactured by the selected SCS Manufacturer:

- a) For Corning: Corning MIC and Unitized MIC

- b. For Singlemode: 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:

- 1) For Corning: Corning MIC and Unitized MIC

- c. For 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:

- 1) For Corning: Corning MIC and Unitized MIC

List additional Cable products above as applicable to this project.

2.11 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

Review and edit the following products/part numbers as applicable to this project.

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

- 1. SIEMON VCM-xxxx-xxx
- 2. AMP 5/8" wide: 1375255-X
- 3. Or approved equal

Patch cables will generally be furnished by the Contractor and delivered to CWU IT personnel at the facility for installation. CWU personnel shall determine lengths of patch cables and colors.

- B. Copper Patch Cables: Pre-manufactured (factory-terminated), stranded unshielded twisted pair (UTP), with 8-pin modular plugs and/or termination block-style patch plugs. Patch cables shall be manufactured by the selected SCS Manufacturer.

1. For Horizontal Distribution:

If Category 5E cabling is to be used on this project, replace the two references to Category 6 (below) with the following text:
“...Category 5E...”

- a. Category 6: Shall exceed Category 6 transmission as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801. Modular plugs shall be complete with snagless boots.

If Category 5E cabling is to be used on this project, replace the Category 6 part number below with the following CAT5E-specific text:

1) Modular-to-modular plugs (8-pin to 8-pin): AMP 1-219245-x

1) Modular-to-modular plugs (8-pin to 8-pin): AMP 219884-x

- C. Fiber Patch Cables: Pre-manufactured (factory-terminated) with a UL rating of OFNR. Fiber patch cables shall be manufactured by the selected SCS Manufacturer.

1. For Backbone Distribution:

- a. For Multimode: 62.5/125 μ m, duplex, ceramic:

- 1) For SC-to-SC: Corning 57-57-02K5141-xxx-x
2) For SC-to-MTRJ: Corning 57-97-02KJ140-xxx-x

- b. For Singlemode, UltraPC polished, ceramic:

- 1) For SC-to-SC: 72-72-02R5131-xxx-x

- D. Copper Jumper Wire: Category 5 (for cross connects):

1. For AMP: AMP or NORCOM/CDT 22208253 (white/blue)

List additional Cable products above as applicable to this project.

2.12 LABELING AND ADMINISTRATION

Review and edit the following products/part numbers as applicable to this project.

- 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. For Station Cable:

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

- b. For Backbone Cable:

- 1) Panduit Marker Tie (or approved equal)

- B. Hand-carried label maker:
 - 1. Brady: ID Pro Plus (or approved equal).

List additional Labeling products above as applicable to this project.

3 PART 3 - EXECUTION

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.

CWU has standardized on AMP products for all new copper-based Structured Cabling Systems and Corning products for all new fiber optic Structured Cabling Systems in CWU facilities. Installation requirements shall be specified accordingly.

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 written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Designer shall ensure that products required by the design are specified in Part 2 with corresponding installation requirements specified in Part 3.

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 -- REFERENCES 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. 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.
- F. Remove surplus material and debris from the job site and dispose of legally.

3.2 DEMOLITION

Review any demolition requirements for this project with the CWU 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.

1. Remove all materials demolished by the Contractor from the site and dispose of properly and legally.
- B. When demolishing existing surface plastic/metal raceway, patch and/or paint wall to match existing undisturbed wall finish after raceway is removed.

3.3 RACEWAY

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. Surface Raceway: Provide for all surface mounted stations as shown in the Contract Documents.
 1. Size surface raceway according to the quantity of cable to be routed through it according to ANSI/TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion. Size fittings/bends to accommodate Category 5/6 and fiber optic bend radii as specified in ANSI/TIA/EIA 569.
 2. Match surface raceway finish as close as possible to the finish of the wall it is to be mounted on but do not paint surface raceway. Surface raceway shall be:
 - a. Installed per Article 352 of the NEC. Surface raceway shall be installed as mechanically and electrically continuous and bonded in accordance with NEC and ANSI/TIA/EIA 607 codes and standards.
 - b. Installed according to ANSI/TIA/EIA standards for fiber optic and Category 5/6 bend radii. Bend points shall have a minimum two inch radius control.
 - c. Securely supported using screws or other anchor-type devices (tape or glue is not an acceptable support medium) at intervals not exceeding 5 feet and with no less than two supports per straight raceway section. Surface raceway shall be supported in accordance with the manufacturer's installation requirements.
 - d. Completely installed including insulating bushings and inserts where required by manufacturer's installation requirements.
 - e. Installed parallel and perpendicular to surfaces or exposed structural members, and following surface contours where possible.
 - f. Close any unused raceway openings.

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.

- B. Backboards: Provide backboards as shown on Contract Documents. Backboards shall be capable of supporting attached equipment, and painted with a minimum of two coats (over primer) of fire retardant, non-conductive paint, and one coat of white colored semi gloss top coat paint. Mount A-C plywood backboards with the "A" side exposed.
- C. Sleeves: Provide sleeves where required for cable pass-thru through building structures and/or fire rated barriers. Provide roto-hammering or core drilling where required for sleeve installation. Seal (and if a fire rated barrier, firestop) between sleeve and building structure and/or barrier. Size sleeves:
 1. As noted in the Contract Documents.
 2. Where not noted, size sleeves a minimum of 2 inches in diameter or by the type and quantity of cable

to be routed through the sleeve per ANSI/TIA/EIA 569 cable capacity standards plus an additional 100% for future expansion - whichever is greater.

- D. D-Rings: Provide D-Rings as necessary to route exposed 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. Mount D-rings used for raceway in open access environments at 4 foot intervals unless otherwise specified 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.
- E. Cable Supports (J-Hooks, Straps): Provide cable supports for routing cable in non-exposed open access environments as shown in the Contract Documents. Cable supports may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. Mount cable supports at 4 foot intervals unless otherwise specified in the Contract Documents. Do not use cable supports for more cables than they were designed to support. Provide multiple cable supports where the total cable count exceeds the maximum cable count for which the support was designed. Size according to the type and quantity of cable to be routed through the ring per ANSI/TIA/EIA 569 cable capacity standards, plus an additional 50% for future expansion.
- F. Ladder Rack: Install ladder rack per manufacturer's instructions with flat (rung) side up. Provide ladder rack to affix tops of racks to walls, to route cable from walls to racks within telecommunications rooms, and in locations shown in the Contract Documents. Size and install as shown in the Contract Documents. Cut ends of ladder rack square. Ream cut ends to remove burrs and sharp edges. Cap cut ends with manufacturer's recommended caps. Mount retaining posts as required. Provide Cable Radius Drops wherever cable is to drop from one section of ladder rack to another lower section of ladder rack or onto racks or cabinets.. Provide 90-degree horizontal radius bends for each 90-degree change in direction of ladder rack angle. Provide Cable Retaining Posts for all sides of ladder rack within a telecommunications room not directly adjacent to a wall. Affix posts at 2 foot centers and at corners and/or junctions. Provide Cable Runway Grounding kits across ladder rack splices and where ladder racks end at or are connected to racks/cabinets.
- G. Innerduct: Provide bright orange innerduct as pathway for backbone fiber optic cables (backbone only – not station cables), from backbone fiber patch panels to conduit or plenum entrances, and as shown in the Contract Documents. Innerduct installed in plenum rated environments shall be plenum rated.
- H. Pull Strings: Provide a pull string in existing conduits that are to remain vacant after existing cable is demolished and in existing and new conduits that have new cable installed under this project.

I. List additional Raceway product installation requirements above as applicable to this project.

3.4 FIRESTOPPING

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. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
- B. 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.

List additional Firestopping product installation requirements above as applicable to this project.

3.5 EQUIPMENT RACKS/ENCLOSURES

See the CWU Telecommunications Distribution Design Guide for information on required drawing content, including telecommunications room Plan Views discussed below. Verify with CWU facility IT personnel 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. For 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. Coordinate with Owner to identify desired location for shelf. Provide shelf, installed per Owner's direction.
 2. Coordinate with Owner to identify desired location for lockable storage drawer. Provide drawer, installed per Owner's direction.
- D. Free Standing Equipment Frames (Double Rails):
 1. Coordinate with Owner to identify desired location for shelf. Provide shelf, installed per Owner's direction.
 2. Coordinate with Owner to identify desired location for lockable storage drawer. Provide drawer, installed per Owner's direction.
- E. Wall Mount Swing Gate Equipment Racks: Provide racks, sized and located as shown on the Contract Documents.
 1. Provide Jumper rings/loops mounted at 8" intervals along each vertical rack rail.
 2. Mount Wall-Mounted racks on unistrut rails in order to provide the 24" deep wall-mount rack with a

minimum 26" depth.

3. If horizontal cabling is intended to be terminated in rack, provide two (2) cable support bars per rack to be used to provide additional cable support and routing control in the rear of the rack.
- F. Wall-Mount Rack Enclosures/Cabinets: Provide in sizes and locations as shown on the Contract Documents.
- G. Hinged Wall-Mounted Brackets: Provide in sizes and locations as shown on the Contract Documents.
- H. Flush Mounted Wall Brackets: Provide in sizes and locations as shown on the Contract Documents.

List additional Equipment Rack/Enclosure product installation requirements above as applicable to this project.

3.6 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.

- 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 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.

Verify and edit referenced section titles.

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 Division 16 Section — “Grounding for Communications Circuits and Raceway”).
 - 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.

List additional Grounding and Bonding product installation requirements above as applicable to this project.

3.7 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: Size and install rack-mountable patch panels as shown on the Contract Documents. Use fiber patch panels to terminate multimode and/or singlemode fiber backbone cables.

CWU generally requires two 3.5 inch horizontal wire managers for each workstation patch panel or hub with more than 24 ports; provide one 3.5 inch horizontal wire manager for every two workstation patch panels or hubs with less than 24 ports.

2. Horizontal Wire Management: Provide horizontal wire management as shown on the Drawings.

Additional Patch Panel product installation requirements shall be added to the above list as applicable to this project.

3.8 CONNECTORS

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 Connectors (modular jacks):

1. For Horizontal Distribution:
 - a. Provide connectors and install using T568A wiring pattern.
 - b. Mount connectors at 90-degrees (i.e. straight, not angled)

10 spare connectors of each color is typical.

- c. Provide XXXX blue connectors and XXXX black connectors to Owner for spares.

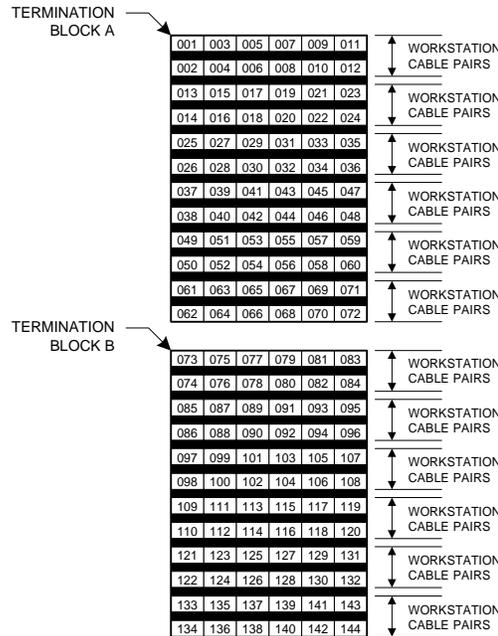
Additional Connector product installation requirements shall be added to the above list as applicable to this project.

3.9 COPPER TERMINATION BLOCKS

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 vertical and horizontal cable management for jumper/patch cables between termination blocks. Provide termination blocks and (jumper troughs) with or without legs based on the following mounting conditions:
 1. Mounting on Backboards: Provide termination blocks, jumper troughs, and distribution rings with legs and as shown on the Contract Documents. Use jumper troughs above and below each termination block in a column. Use a distribution ring backboard in place of jumper troughs in the vertical middle of each column of 600 pair or more.
 2. Mounting on Racks: Provide termination blocks and jumper troughs without legs. Use rack mount brackets to mount termination blocks on EIA standard 19" floor and wall-mount racks.
- B. Provide one horizontal cable termination block with connecting blocks, designation strips, and labels, to Owner for spare.
- C. Provide one backbone cable termination block with connecting blocks, designation strips, and labels, to Owner for spare.
- D. Route cable horizontally along base of backboard until it reaches the termination block column on which it is to terminate and then route vertically to the termination block.
- E. Install termination block wall field according to the elevations shown in the Drawings and as shown below.
 1. Punch down workstation cable in the same manner as it is terminated at the workstation communications outlet (i.e. one cable on top, one cable on bottom, not side-to-side). See elevation at the end of this Section for a detail showing workstation cable punchdowns.
 - a. Designate two termination strips for a row of workstation outlets. The top strip will be used to punch down the top cable from the workstation outlet (blue jack — voice). The bottom strip will be used to punch down the bottom cable from the workstation outlet (black jack — data).

- b. For workstation outlets with only one cable, the cable shall be punched down either on the top or the bottom termination strip (depending upon whether the outlet will be used for voice or data as shown on the Drawings) and the corresponding termination location on the other strip shall be left blank.
- c. If questions arise regarding the proper sequence for punching down cable, the Contractor shall obtain clarification from the Engineer prior to punching down cable. The Contractor shall be responsible, at no additional expense to the Owner, for re-terminating and re-installing (if necessary) all cable not punched down in the proper sequence.
- d. Columns shall be defined by floor of originating workstation cable. No two floors shall terminate in the same termination block column.



ELEVATION - EV2
TYPICAL WORKSTATION CABLE PUNCHDOWN SEQUENCE
(FOR TWO STACKED TERMINATION BLOCKS)

NOT TO SCALE

- F. Install termination block punch downs for riser cable as follows:
 - 1. Punch down riser cable sequentially across the termination strips.
- G. Punch down cable using only the selected SCS Manufacturer approved impact tool.

List additional Copper Termination Block product installation requirements above as applicable to this project.

3.10 STATIONS

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. Faceplates: Provide faceplates for stations in the locations and gang counts shown on the Contract Documents. Faceplates shall completely conceal outlet boxes, reducer plates, etc. Faceplates shall provide a snug and sure fit for connectors – loose connectors are not acceptable.

1. Flush-mount connectors on faceplates.

Delete the following paragraph if horizontal fiber is part of this project.

- a. Unless otherwise noted in the Contract Documents, mount voice connector in top port location (blue jack), middle port location shall be blank, mount data connector in bottom port location (black jack).

Delete the following paragraph if horizontal fiber is not part of this project.

- b. Unless otherwise noted in the Contract Documents, mount voice connector in top port location (blue jack), mount data connector in middle port location (black jack), mount MT-RJ fiber connector in bottom port location.

- B. Faceplate Mounting Brackets: Provide faceplate mounting brackets as required and as shown for flush mounted communications outlets.

- C. Surface Device Boxes: Provide surface mount device boxes as required and as shown for surface mounted communications outlets.

List additional Station product installation requirements above as applicable to this project.

3.11 CABLE

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. 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, non-plenum rated otherwise. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.
1. For 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. For Intra-building Backbone Distribution: Provide intra-building backbone cable in types, sizes, and quantities as shown on the Contract Documents. Install intra-building 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.
 3. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
 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. 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.
 5. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
 6. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
 7. 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 SCS manufacturer's installation recommendations. Do not over-tighten tie wraps or cause cross-sectional deformation of cabling.
 8. 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. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Support cables so as not to create a load on the equipment upon which the cables are terminated. Tie-wrap similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.
 - d. See COPPER TERMINATION BLOCKS above for details on routing copper cabling to termination blocks.
 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 tie-wraps or velcro straps.
 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. For horizontal distribution: 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.

If Category 5E cabling is to be used on this project, replace the two references to Category 6 (below) with the following CAT5E-specific text:
"...Category 5E..."

- a. For workstation outlets with both Category 6 and coaxial cable for TV Distribution, terminate Category 6 cabling after coaxial cable has been installed and terminated.
 - 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
2. For intrabuilding backbone distribution: 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 termination blocks to entrance protectors, telephone systems, and voice grade active electronics.
 - b. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Division 16 Section — "Grounding and Bonding for Telecommunications").
- C. Fiber Cable: Terminate all fiber strands within a fiber cable. The installation of "dark fiber" is not acceptable.
1. For Intrabuilding Backbone Distribution:
 - a. 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.
 - 1) Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.
 - 2) Demonstrate that the test results are in harmony with the factory test results as shipped with the reel.
 - b. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Division 16 Section — "Grounding for Communications Circuits and Raceway").
 - c. Provide a service loop long enough in the ER/TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 10 feet at each end.
 - d. The service slack stored inside the fiber patch panel cabinets shall be a minimum of 3 m (10 ft).

List additional Cable product installation requirements above as applicable to this project.

3.12 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

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.

Patch cables will generally be furnished by the Contractor and delivered to CWU IT personnel at the facility for installation. Include specific requirements for patch cables on the project, including quantity, color and length. CWU personnel shall determine lengths of patch cables and colors.

- A. Furnish copper patch cables for modular copper cross-connects. Deliver patch cables to Owner in the sizes, colors and quantities below:
1. For Telecommunications Rooms:
 - a. Length (e.g. 10m) - (Qty) (White)
 - b. Length (e.g. 1m) - (Qty) (White)
 2. For Workstations:
 - a. Length (e.g. 3m) - (Qty) (White)
 - b. Length (e.g. 1m) - (Qty) (White)
- B. Furnish fiber patch cables for fiber cross connects. Deliver patch cables to Owner in the lengths and quantities below:
1. For Multimode:
 - a. Length (e.g. 3m) - (Qty), Type: (Duplex SC-to-SC, Duplex SC-to-MTRJ)
 - b. Length (e.g. 1m) - (Qty), Type: (Duplex SC-to-SC, Duplex SC-to-MTRJ)
 2. For Singlemode:
 - a. Length (e.g. 3m) - (Qty), Type: (Duplex SC-to-SC)
 - b. Length (e.g. 1m) - (Qty), Type: (Duplex SC-to-SC)
- C. Furnish one (1) spool of Category 5 jumper wire for each telecommunications room for cross connects and deliver unopened to Owner.
- D. Furnish hook-and-loop cable managers for managing patch cords in the telecommunications rooms. Provide in colors, sizes and quantities as indicated below. Cable managers shall be the same color as the patch cable type that they manage.

Include specific requirements for cable managers on the project, including quantity, color and size. Review and edit the information below as required for this project.

1. Furnish four (4) cable managers each 6 inches in length for each telecommunications room with fiber connectivity
2. Furnish one roll of 50 cable managers each 6 inches in length for use in Main Equipment Room.

List additional Patch Cable/Cross Connect requirements above as applicable to this project.

3.13 LABELING AND ADMINISTRATION

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. General: Labeling and administration shall comply with ANSI/TIA/EIA 606 and standard industry practices.
- B. 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. 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.
- C. Telecommunications Rooms: Affix a permanent label to the door of each telecommunications room. Where telecommunications room names are required in other labels, use the telecommunication room name shown on the Contract Documents.
- D. Racks: Label racks as shown on the Contract Documents. Affix label centered across top cross-member of rack.
- E. Grounding/Bonding Conductors: Label bonding conductors; "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"
- F. Cables:
1. Label Location: Affix at each end of the cable.
 2. Station Cables: Label station cables with the same label as the station connector (see STATION CONNECTORS (PORTS) below) that terminates the cable at the station location. 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.
 3. Copper Backbone Cables: Label intrabuilding copper backbone cables in the form "C (TR to TR), ###-PR, CAT##, ###-FT " where "C" stands for media type ("C" for "administrative copper" media), "(TR to TR)" is the origination and destination telecommunications rooms between which the cable routes, "###-PR" is the pair count, "CAT##" is the cable type (i.e. CAT3 or CAT5E), and ###-FT is the cut length.
 - a. Example: If a copper backbone cable running between telecommunications rooms "1A" and "4A" were a 150-FT long, 100-PR, CAT3 cable, then the label for the cable would read "C (1A to 4A), 100-PR, CAT3, 150-FT"
 4. Fiber Backbone Cables: Label intrabuilding fiber backbone cables in the form "F (TR to TR), ###-ST, type, ###-FT " where "F" stands fiber, "(TR to TR)" is the origination and destination telecommunications rooms between which the cable routes, "###-ST" is the strand count, "type" is the fiber type (i.e. SM, 62.5MM, etc), and ###-FT is the cut length.

- a. Example: If a 12-strand, 62.5/125 m fiber backbone cable running between telecommunications rooms "1A" and "2A" were 75-FT long, then the label for the cable would read "F (1A to 2A), 12-ST, 62.5MM, 75-FT"
5. Provide labels at each end of each cable within 24" of telecommunications room entrance and again within 24" of termination point.

G. Termination Blocks:

1. General:

- a. Label termination block ports/pairs sequentially beginning on the first row of each termination block column. Begin with "001" for the first port/pair.
 - b. Label termination strip pairs sequentially (left to right).
2. For Horizontal Distribution: Label termination blocks used for horizontal distribution with a single label affixed above the entire termination block column indicating the floor number on which the outlets are located, whose cable terminates on that column. For example: A termination block column terminating workstation cables from the second floor would have the label "2nd Floor."
 - a. Termination strip pairs shall be of the form "####" where "####" denotes the sequential cable number terminated (see Cables, above).
 - 1) Example: Two termination strips are used to terminate 6 single gang two jack outlets with sequential cable numbers "001" to "012." The top termination strip pairs would be labeled "001, 003, 005, 007, 009, 011" and the bottom termination strip would be labeled "002, 004, 006, 008, 009, 012."
 3. For Backbone Distribution: Label termination blocks used for backbone distribution with a single label affixed above the entire termination block wall field which reads "Backbone". Additionally, label each termination block column within the termination block wall field as follows:
 - a. Label columns in the form "TR", where "TR" is the telecommunications room where the backbone cable originates (see TELECOMMUNICATIONS ROOMS above). Use a new column for each telecommunications room. Do not intermix cables from multiple telecommunications rooms in a single termination block column.
 - 1) Example: If a termination block column on the fourth floor terminates backbone cabling from the first floor telecommunications room, then the column on the fourth floor would have the label "1A" and the termination block column on the first floor would have the label "4A."
 - b. Termination strip pairs shall be of the form "####" where "####" denotes the sequential cable number terminated.
 - 1) Example: A termination strip is used to terminate a 12-pair backbone cable. The termination strip would be labeled "001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 012," corresponding to the backbone cable pair numbers.

H. Patch Panels:

1. For Horizontal Distribution:

- a. General: Label patch panels as shown on the Contract Documents.

- b. Ports: Ports are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48). For ports which are not pre-labeled, label port in the form “##” where “##” is the sequential port number within the panel. Each patch panel shall start at port number “01”.
 - 1) For example: The ports on a patch panel terminating horizontal fiber optic cabling in duplex SC ports would be labeled starting with “01” for the first duplex port (one label per pair of fiber strands) and continue sequentially through the remainder of the duplex ports.

I. Station Connectors (Ports):

1. Connected to Termination Blocks in the Telecommunications Room:

Refer to the Telecommunications Distribution Design Guide for information on the Port Designation labels shown on the Contract Documents.

- a. Label connectors in the form “FTR-###” where “F” is the floor of the communications outlet where the horizontal cable terminates, “TR” is the telecommunications room where the cable terminates (see TELECOMMUNICATIONS ROOMS above), and “###” is the sequential cable number for that telecommunications room. Cross reference connector labels with the Port Designation label on the Contract Documents.
 - 1) Example: If an outlet on the third floor has a faceplate with two copper cables (sequentially numbered 5 and 6) terminated in the second telecommunications room on the fourth floor, then the connectors would have the labels “34B-005” and “34B-006” respectively.

- J. Conduits: Label each conduit end (existing or new) in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room identifier, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.). Indicate conduit length on the label.
- K. Pull Strings: Label each pull string in a clear manner by designating the location of the other end of the pull string (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.).

List additional Labeling requirements above as applicable to this project.

3.14 TESTING

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 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 form (on diskette 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. Copper:

If Category 5E cabling is to be used on this project, replace the reference to Category 6 (below) with the following text:
“...Category 5E...”

- a. For Horizontal Distribution: Test all pairs of each copper station cable, for conformance to ANSI/TIA/EIA 568-B Category 6, and ANSI/TIA/EIA 568-B standards. 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, shorts, polarity, near-end cross talk (NEXT), far-end cross talk (FEXT), attenuation, installed length, transposition (wire map), mutual capacitance, characteristic impedance, resistance, ACR, and presence of AC voltage. Use the Power Sum method to test NEXT and FEXT. Test each cable in both directions.

If Category 5E cabling is to be used on this project, replace the reference to Category 6 (below) with the following CAT5E-specific text:
“...Category 5E...”

- 2) 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 ANSI/TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system and equipped with the current "AMP Category 6 test adapters".

If Category 5E cabling is to be used on this project, replace the reference to CAT-6 (below) with the following CAT5E-specific text:
“...CAT-5E...”

- a) Testing Device: Fluke DSP-4000 with latest software and hardware releases for AMP CAT-6 horizontal distribution cables, or approved equal.

If Category 5E cabling is to be used on this project, delete the following paragraph in its entirety.

- 3) In addition to the above, perform tests both recommended and mandated by AMP. Tests shall confirm/guarantee compliance to AMP Ethernet Category 6 1000B-T (1000 Mb/s IEEE 802.3ab) and 1000B-TX (1000 Mb/s ANSI/TIA/EIA-854) applications based on the data contained in the AMP Performance Specifications, Volume 1, May 2001 or latest edition.
- b. For Intra-building Backbone Distribution: Test all cable pairs for length, shorts, opens, continuity, polarity reversals, transposition (wire map), and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.
 - 1) Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.
 - 2) Test entire channel, from termination block to termination block.
 - 3) 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.
 - a) 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) For Horizontal Distribution:
 - a) Max Loss = 2.0db (per ANSI/TIA/EIA 568-B)
 - 2) For 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.
 - 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) For Multimode Cable: Test at both 850 and 1300nm.
 - c. For Singlemode Cable: Test at both 1310 and 1550nm.
 - d. 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 802.3z (1000Base-X 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 802.3z 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, and retest the cable or connection materials at no additional expense to the Owner. Provide new test results to the Owner and Designer in the same manner as above.
1. In addition to the above, if it is determined that the cable is at fault, 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.
 - 4) Provide test results to the Owner and Designer for approval by the Owner and Designer.
- 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.
 - 3) Provide test results to the Owner and Designer for approval by the Owner and Designer.
- 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.

List additional Testing requirements above as applicable to this project.

3.15 FOLLOW UP

Review any contractor follow-up requirements with the CWU project manager and clearly state these requirements in the following paragraph(s).

- A. For the first four weeks that the system is in full operation, provide technical assistance for trouble shooting, training, and problem solving by phone and (within 24 hours of notice) on site. Provide up to 40 hours of assistance (in addition to any warranty-related work), including phone, travel, and on site time during this period.

END OF SECTION

SECTION 16741 – OUTSIDE PLANT COMMUNICATIONS CIRCUITS

SECTION 16741 — OUTSIDE PLANT COMMUNICATIONS CIRCUITS

1 PART 1 - GENERAL

PART 1 - GENERAL

This specification section has references, products, procedures, processes, and work descriptions/summaries that are common to many Central Washington University telecommunications 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 CWU 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 Engineer/Designer may edit this section (adding and/or removing content where required), but shall not create a new specification section based on the "intent" of the TCGS, or cut and paste content from the TCGS sections into other existing specification sections.

Text in shaded boxes (such as this text) is included to aid the Engineer/Designer in understanding areas of this Guide Specification that may require modification for a particular project. Although this text is generally written in declarative form, the Engineer/Designer shall consider it guidance only. The Engineer/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 RELATED DOCUMENTS

Review and edit the following paragraph to ensure appropriate references are included.

- 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.

1.2 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).
- B. Related sections include but are not necessarily limited to the following:

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate. Include sections that furnish products which are installed under this section (coordinate with paragraphs below). This paragraph should be used sparingly to avoid assuming the contractor's responsibility for coordinating work.

- 1. Division 16 Section — "Basic Electrical Materials and Methods"
- 2. Division 16 Section — "Outside Plant Communications Site Work"
- 3. Division 16 Section — "Raceway and Boxes for Communications Circuits"

4. Division 16 Section — "Grounding and Bonding for Telecommunications"
5. Division 16 Section — "Inside Plant Communications Circuits"

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

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.

D. 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, CWU 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
2. Firestopping

E. Provide Unit Prices for:

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. For example, unit prices may be requested for cable, patch panels, etc. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

1.3 REFERENCES

Review and edit the following list of references. Check for completeness, currency and applicability to this project. The Engineer/Designer shall verify with the CWU FP&C PM and/or the CWU ITS Infrastructure Specialist 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. National Electrical Code (NEC)
 - b. National Electrical Safety Code (NESC)
 - c. Washington Industrial Safety and Health Act (WISHA)
 - d. Occupational Safety and Health Act (OSHA)
2. Communications:

- a. ANSI/TIA/EIA - 455: *Fiber Optic Test Standards*
- b. ANSI/TIA/EIA - 526: *Optical Fiber Systems Test Procedures*
- c. ANSI/TIA/EIA - 568-B: *Commercial Building Telecommunications Cabling Standard*
- d. ANSI/TIA/EIA - 569: *Commercial Building Standard for Telecommunication Pathways and Spaces*
- e. ANSI/TIA/EIA - 606: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
- f. ANSI/TIA/EIA - 607: *Commercial Building Grounding and Bonding Requirements for Telecommunications*
- g. ANSI/TIA/EIA - 758: *Customer-Owned Outside Plant Telecommunications Cabling Standard*
- h. IEEE 802.3 (series): *Local Area Network Ethernet Standard*, including the IEEE 802.3z *Gigabit Ethernet Standard*
- i. ISO/IEC IS 11801: *Generic Cabling for Customer Premises*
- j. BICSI: *BICSI Telecommunications Cabling Installation Manual*
- k. BICSI: *BICSI Telecommunications Distribution Methods Manual (TDMM)*
- l. BICSI: *BICSI Customer-Owned Outside Plant Design Manual*

1.4 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* or *Handholes* used for the routing of communications cables.

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

1.5 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 (OSP-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 OSP-SCS.

1.6 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 Engineer/Designer prior to start of construction. The Engineer/Designer shall obtain approval from CWU through the Alternative Design Request (ADR) process prior to approving a Contractor-submitted deviation.

If the deviation is not approved by the Engineer/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. Provide product data submittals for all products at the same time.
 - 1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.
 - 2. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

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.
- B. Quality Assurance/Control Submittals: Provide submittal information for review as follows:
1. Submit a cable routing and grouping plan as follows:
 - a. Where the cable routing and grouping is to be provided as shown on the Contract Documents, do not provide a cable routing and grouping plan. Submit written documentation stating that the cable routing and grouping will be provided as shown on the Contract Documents, that the Contractor has reviewed the routing and grouping on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the routing and grouping meets applicable codes, regulations and standards.
 - b. Where changes in cable routing and grouping are proposed, submit complete floor plan(s) and/or detail drawing(s) showing the proposed routing, raceway sizes and locations, and cabling in a manner equal to that of the Contract Documents. Ensure that any cabling changes are coordinated with comparable accommodating changes to the raceway routing and grouping. Specifically note each location where the proposed routing and grouping is different from the Contract Documents. Submit written documentation detailing the reason for each change request. Each change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.
 2. Submit wall field termination block and wire management elevations as follows:
 - a. Where wall field termination blocks and wire management are to be provided as shown on the Contract Documents, do not submit elevations. Submit written documentation stating that the wall field termination blocks and wire management will be provided as shown on the Contract Documents, that the Contractor has reviewed the elevations on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the elevations meet applicable codes, regulations and standards.
 - b. Where changes to the wall field termination blocks and wire management are proposed, or where elevations have not been included on the Contract Documents, submit wall field termination block and wire management elevations along with written documentation detailing the reason for the change. The change request must be approved in writing by the Engineer/Designer prior to proceeding with the change.
 3. 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).
 4. Submit a list of the personnel who will be assigned to the project, the type of work they will be performing per QUALITY ASSURANCE below, and copies of the manufacturer’s training certification for each. If personnel changes are made during the project, submit the above information for any new personnel prior to them beginning work on the project.
- 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. Raceway and Boxes 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. The requirement that the Contractor provide an O&M Manual for Communications should be stated in this section or in Inside Plant Communications Circuits.

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 Engineer/Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.
2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.

Portions of the text below may be contained in other Sections (e.g. 16010 (or equivalent) - General Electrical). Coordinate text for accuracy and content.

- a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
- b. Keep Record Drawings at the job site and make available to the Owner and Engineer/Designer at any time.
- c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).
- d. Show identifiers for major infrastructure components on Record Drawings.

Refer to the CWU Telecommunications Distribution Design Guide for format and content of the cable records described below.

- e. Provide a table/schedule showing the following information for each cable link in the project on the Record Drawings. Base the table/schedule on the schedule provided by the Engineer/Designer in the Project Manual. Items 1 through 6 and item 8 have already been completed by the Engineer/Designer and are included in the table/schedule. Complete items 7 and 9. Include the following items in the table/schedule:
 - 1) End locations of cable (telecommunications room)
 - 2) Link Type (campus, riser, horizontal)

- 3) Media type (fiber, Cat 5, Cat 3, etc.)
- 4) Proposed usage (voice, data, lighting control, etc.)
- 5) Cable Identifier
- 6) As-designed maximum link length
- 7) Actual measured link length (from test results)
- 8) For fiber optic cabling, as-designed maximum link attenuation at design frequency (indicating frequency used for design calculations) including as-designed maximum splice loss and as-designed maximum connector loss
- 9) For fiber optic cabling, actual measured link attenuation as tested with test frequency (from test results)
- 10) For copper cabling, actual measured headroom (from test results)

1.7 QUALITY ASSURANCE

The following are CWU requirements for Telecommunications Contractors and Telecommunications Contractor Employees. Review these requirements with the CWU ITS Infrastructure Specialist and include as applicable to this project.

For projects that are not being quoted by Contractors on the WA State DIS Master Contract list, consider establishing a deadline prior to the bid date for Contractors to have submitted prequalification documentation demonstrating that they meet the qualification requirements. Also, consider publishing the list of prequalified Contractors as an addendum prior to the bid deadline.

- A. Contractor Qualifications: Prior to bidding the project, submit:
1. Documentation from the OSP-SCS manufacturer demonstrating that the Contractor is trained and certified by the Manufacturer to install, test, and maintain the SCS and is certified by the OSP-SCS Manufacturer to provide the OSP-SCS Manufacturer's Warranty (see PART 1 - WARRANTY).
 - a. AMP NetConnect Design & Installation Contractor (for copper).
 - b. Corning EWP Certified Installer Program (for fiber).
 2. Documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below.
 3. 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 RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). The document shall also declare that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.
 4. 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 three years. Detail the following for each project:
 - a. Project name and location

- b. Construction cost
- c. A brief description of the project, the components involved, and the OSP-SCS manufacturer used on the project.
- d. Number of station drops
- e. Customer contact names, phone numbers, and addresses

Include the following paragraph (or one similar) only if the project is to be constructed under the State of Washington Department of Information Services (DIS) Master Contract. Use of the DIS contract shall be discussed with the CWU project manager prior to the completion of Design Development. Pre-qualified Contractors from the DIS list shall be recommended by the Engineer/Designer and approved by the CWU project manager. Review and edit the section numbers and titles below and coordinate content as applicable to this project.

- 5. Documentation demonstrating that the Contractor has a current Master Contract with the State of Washington Department of Information Services (DIS) per the requirements in Section 01010, and shall be on the CWU pre-qualified DIS contractor list shown in Section 01010.
- B. Contractor's employees directly involved with the supervision, installation, testing, and certification of the SCS shall be trained and certified by the selected SCS' manufacturer. Training and certifications by employee type are required as shown below:
 - 1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation and testing.
 - 2. Test Technicians: All (100%) shall be trained/certified for installation and testing.
 - 3. Installation Technicians: All (100%) shall be trained/certified for installation.
 - 4. 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.
- C. 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:
 - 1. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation.
 - 2. Firestopping Technician: All (100%) shall be trained/certified for installation.

1.8 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. CWU 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 CWU 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.

1.9 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 Engineer/Designer is required to have a thorough understanding of the manufacturer warranties applicable on this project. The Engineer/Designer shall consider, account for, and advise CWU 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 two-year service warranty against defects in materials and workmanship.
 - a. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.
 - 1) The Contractor Warranty period shall commence upon Owner acceptance of the work.
- B. OSP-SCS Manufacturer Warranty:
1. Provide a OSP-SCS Manufacturer extended product, performance, application, and labor warranty that shall warrant all passive components used in the OSP-SCS. Additionally, this warranty shall cover components not manufactured by the OSP-SCS Manufacturer, but approved by the OSP-SCS Manufacturer for use in the OSP-SCS (i.e. "Approved Alternative Products"). The OSP-SCS Manufacturer warranty 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 OSP-SCS Manufacturer Warranty shall be provided by the selected OSP-SCS Manufacturer and shall be:
 - a. AMP 25-year System Warranty
 - 1) Provide a copy of the warranty registration document to the Owner at the time of submittal to AMP.
 - 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 OSP-SCS Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the manufacturer. The Warranty Certificate shall be issued no later than three months after Owner acceptance of the work.

2 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.

CWU has standardized on AMP and Corning products for all new Structured Cabling Systems in CWU facilities. Products shall be specified accordingly. The Engineer/Designer shall ensure that the latest part numbers are used for specified products. “Or-Equal” substitutions for AMP and Corning products are not permitted.

Some of the following paragraphs include ancillary products manufactured by companies other than AMP and Corning products, but do not indicate that they allow “or equal” substitutions. If the Engineer/Designer wishes to use other products, a request to consider an alternative product shall be submitted in writing to the CWU ITS Infrastructure Specialist. If the alternative product is approved, the Engineer/Designer shall ensure that the specification is written with equal or greater detail to the following paragraphs.

The products listed throughout PART 2 – Products below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified with equal or greater detail to the following paragraphs. The Engineer/Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

- A. Unless otherwise noted, provide items as specified. “Or equal” or equivalent items are not acceptable.
- B. Physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths and condition of conduit and/or pathway (including maintenance holes and handholes) to be used for routing backbone cabling. Pre-cut materials of insufficient length are the sole responsibility of the Contractor.
- C. OSP-SCS components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers unless the manufacturer of the OSP-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 OSP-SCS Manufacturer Warranty (see PART 1 - WARRANTY).
- D. Bid only one OSP-SCS Manufacturer and only bid a manufacturer for which the Contractor is certified. The OSP-SCS Manufacturer shall be the following. Substitution is not acceptable:
 1. AMP (for copper cabling)
 2. Corning (for fiber optic cabling)
- E. For a given manufacturer, all components shall be part of a single OSP-SCS product line – components shall not be intermixed between a manufacturer’s OSP-SCS product lines. The OSP-SCS product line 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.

- F. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

2.2 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 Division 16 Section – “Outside Plant Communications Site Work”, Division 16 Section – “Raceway and Boxes for Communications Circuits” and Division 16 Section – “Inside Plant Communications Circuits” except where noted below.

1. Innerduct:

- a. Outside Plant: Corrugated, bright orange, and rated for outdoor duct installation.

- 1) 1” Diameter
- 2) 1-1/2” Diameter

- b. Intrabuilding: Corrugated, bright orange, and rated for indoor installation.

- 1) 1” Diameter - non-plenum rated
- 2) 1-1/4” Diameter - non-plenum rated
- 3) 1” Diameter - plenum rated
- 4) 1-1/4” Diameter - plenum rated

2.3 FIRESTOPPING

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

- A. As specified in Division 16 Section – “Inside Plant Communications Circuits.”

2.4 EQUIPMENT RACKS/ENCLOSURES

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

- A. As specified in Division 16 Section – “Inside Plant Communications Circuits.”

2.5 TERMINATION EQUIPMENT

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

- A. Voice Backbone Copper Building Entrance Terminals (BETs). 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. BETs and protectors shall be manufactured by the following manufacturers:

1. For Siecior:

- a. 810 Series with MOXS Connectors

- 1) Less than or equal to 25-pair to be terminated: A0350252
- 2) 25-pair to 50-pair to be terminated: A0350254

3) 50-pair to 100-pair to be terminated: A0350256

b. Solid state over-voltage protectors with sneak current protection. Protectors shall be:

The Designer shall verify whether CWU prefers the "standard" (black) vs. "special" (red) protectors on a project by project basis.

1) Black: A0353716

2) Red: A0353717

2. For Circa Enterprises, Inc.:

a. 1880ECA1 Series

1) Less than or equal to 25-pair to be terminated: 1880ECA1-25G

2) 26-pair to 50-pair to be terminated: 1880ECA1-50G

3) 51-pair to 100-pair to be terminated: 1880ECA1-100G

4) 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) Non-Balanced: C4B1S (PTC)

3. Porta Systems Corp:

a. 10-pair — Porta Systems 504PX2-10GT, complete with over-voltage protectors

b. 25-pair — Porta Systems 581P2-25GT, complete with over-voltage protectors

CWU does not generally allow the use of OSP rated cable in the horizontal data environment. If a design solution (approved by CWU) requires the use of OSP rated Category 5e/6, then include the following paragraph. An alternative CWU-approved OSP CAT-5e/6 cable should be specified (Note that AMP does not provide such a cable – see Commscope). OSP-rated Category 5e/6 cabling for this application is specified in the Inside Plant Communications Circuits section.

B. OSP Copper Data Station Entrance Protectors. Protectors shall be:

1. Commscope: Category 5 OSP Protector (or approved CAT-5e/6 alternative)

C. Copper Splice Closures: Closures shall be re-enterable without the destruction of the housing. Closures shall be complete with all incidental and/or required hardware including, but not limited to, cans, end caps, grommet kits, covers, splice connectors, and grounding/bonding hardware. Closures shall not require special tooling for entry and sealing of the closure.

1. Outdoor: Splice closure shall have a stainless steel shell and shall be watertight sealable.

a. Closures shall be, regardless of the selected OSP-CCS Manufacturer:

1) Preformed Line Products: PREFORMED Splice Closure

A properly installed splice closure should be watertight without encapsulant. However, in an abnormally harsh environment, it may be beneficial to use an encapsulant. The following paragraph should be deleted if no encapsulant is required.

- b. Encapsulation: Waterblocking compound per manufacturer's recommendation.
- 2. Indoor:
 - a. Closures shall be, regardless of the selected OSP-CCS Manufacturer:
 - 1) 3M: K&B Riser Closure
- 3. Connectors: Shall be RUS Listed. Connectors shall be, regardless of the selected OSP-CCS Manufacturer:
 - a. Straight Only: 3M MS² 4000 Series Splicing Modules
 - b. Straight or Bridge: 3M MS² 4005 Series Pluggable/Bridge Splicing Modules
- D. Fiber Splice Closures: Shall be outdoor rated and re-enterable without the destruction of the housing. Closures shall not require special tooling for entry and sealing of the closure. Closures shall be complete with all incidental and/or required hardware including, but not limited to end caps, grommet kits, splice trays, and grounding/bonding hardware. Closures shall be either butt or in-line depending upon the application. Closures shall be manufactured by the selected OSP-CCS Manufacturer and shall be:

Note that Fiber Patch Panels and Fiber Patch Cords are specified in section 16740 Inside Plant Communications Circuits.

- 1. For Corning:
 - a. Splice Closure Family (SCF): Advanced Splice Closures, with splice trays
 - b. Encapsulation: Waterblocking compound per manufacturer's recommendation.
- 2. Fiber Connectors:
 - a. For Multimode: Fiber connectors shall be SC, duplex, for 62.5 /125 μ m multimode fiber. The connectors shall be epoxyless with a zirconia ceramic ferrule. The connectors shall be:
 - a) For Corning: Unicam 95-000-41
 - b. For Singlemode: Fiber connectors shall be SC, simplex, for singlemode fiber. The connectors shall utilize a one-piece design with a ceramic ferrule. The SC connectors shall be:
 - a) For Corning: Unicam 95-200-4x

A properly installed splice closure should be watertight without encapsulant. However, in an abnormally harsh environment, it may be beneficial to use an encapsulant. The following paragraph should be deleted if no encapsulant is required.

2.6 CABLE

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

- A. Outdoor Cable: Rated for outdoor use, duct installation, and/or direct burial installation as dictated by the application.

1. 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. Multimode: All-dielectric, multimode graded index, 62.5/125 multimode, with a maximum attenuation of 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm and bandwidth of 200 MHz/km at 850 nm and 500 MHz/km at 1300 nm.
 - 1) For Corning LANscape:
 - a) Outdoor rated: ALTOS
 - b) Indoor/Outdoor rated: FREEDM
 - b. Singlemode: All-dielectric with a maximum attenuation of 0.4 dB/km at 1300 nm and 0.3 dB/km at 1550 nm.
 - 1) For Corning LANscape:
 - a) Outdoor rated: ALTOS
 - b) Indoor/Outdoor rated: FREEDM
 - c. Hybrid/Composite: Conform to the Multimode and singlemode characteristics above.
 - 1) For Corning LANscape:
 - a) Outdoor rated: ALTOS
 - b) Indoor/Outdoor rated: FREEDM
2. Copper Cable:
 - a. For 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) General Cable:
 - a) Filled Foam Skin QUALPETH Cable, Spec. 2007
 - b. For Termination Block Connections (back-side): Unshielded, non-plenum multi-pair copper cable, 24-AWG, solid copper conductor, insulated with color coded PVC. UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by the selected OSP-SCS Manufacturer:
 - 1) For AMP: Category 3 UTP Cable 57242-x

2.7 GROUNDING AND BONDING

Review and edit the following section number or name as applicable to this project.

- A. As specified under Division 16 Section – "Grounding and Bonding for Telecommunications."

2.8 LABELING AND ADMINISTRATION

Review and edit the following products/part numbers as applicable to this project.

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) Panduit Marker Tie (or approved equal)
2. Hand-carried label maker:
 - a. Brady: ID Pro Plus (or approved equal).

3 PART 3 - EXECUTION

PART 3 - EXECUTION

3.1 GENERAL

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.

CWU has standardized on AMP and Corning products for all new Structured Cabling Systems in CWU facilities. Installation requirements shall be specified accordingly.

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

The products listed throughout PART 2 – Products and the installation requirements below are not all-inclusive for any given project. The Engineer/Designer shall ensure that products required by their design are specified in Part 2 with corresponding installation requirements specified in Part 3.

- 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 (NEC) 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 -- REFERENCES 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. 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.
- F. 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.
- G. Remove surplus material and debris from the job site and dispose of legally.

3.2 DEMOLITION

The Engineer/Designer shall coordinate with local CWU authorities to determine whether CWU wishes to retain certain demolished material or wishes to have it hauled away. Review any demolition requirements for this project with the CWU 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 ¼ 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

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 and install as specified under Division 16 Section – “Outside Plant Communications Site Work”, Division 16 Section – Raceway and Boxes for Communications Circuits and Division 16 Section – “Inside Plant Communications Circuits” except where noted below:
- B. Outside Plant Innerduct:
 - 1. Provide in quantities, sizes and locations as shown on the Contract Documents. Where not shown on the Contract Documents, do not provide innerduct.
 - 2. Provide sufficient innerduct slack to allow for innerduct shrinkage after stretching during installation.
 - 3. Avoid excessive pulling tension. Replace corrugated innerduct showing evidence of excessive pulling tension at no cost to the Owner.
 - 4. Rack and secure innerduct inside maintenance holes and handholes. If existing maintenance holes and handholes have insufficient racking to support new cabling, provide racking.

5. Cap innerduct immediately after placement in order to prevent debris from entering. Uncap only when cable is to be installed.

C. Inside Plant Innerduct

1. As shown on the Contract Documents, provide innerduct for outside plant fiber optic cables from termination points within buildings to outside conduit entrances and in the sizes and locations. Where not shown on the Contract Documents, do not provide innerduct.
2. Provide plenum-rated innerduct within plenum rated spaces.

List additional Raceway product installation requirements above as applicable to this project.

3.4 FIRESTOPPING

Review and edit the list of sections below for relevance to this project and include only those that are directly related to this section. Ensure that the referenced sections are included in the project manual and that titles are accurate.

- A. Provide as specified in Division 16 Section – “Inside Plant Communications Circuits.”

List additional firestop product installation requirements above as applicable to this project.

3.5 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 Terminals: Provide BETs in types, sizes and quantities as shown on the Contract Documents and as required for protection of building-to-building copper circuits. Provide BETs in sufficient quantity to protect each pair of each cable plus an additional 10% for future use. Install BETs per manufacturer’s instructions. Route outside plant copper cables through a BET.
1. Connect each BET’s protector ground lug to the nearest TGB with a #6 AWG copper grounding conductor.
- B. OSP Copper Data Station Entrance Protectors: Provide Protectors in quantities as shown on the Contract Documents and as required for protection of OSP copper data circuits. Install Protectors per manufacturer’s instructions. Route outside plant copper cables through a Protector.
1. Connect each Protector’s ground lug to the nearest TGB with a #10 AWG copper grounding conductor.

List additional termination equipment product installation requirements above as applicable to this project.

3.6 SPLICE CLOSURES

The Designer shall enter a value for “XXX” below for each specific project.

- A. OSP Copper Splice Closures: Provide copper splice closures in sizes and quantities as shown on the Contract Documents with suitable connectors. Do not install splice closures where not shown on the Contract Documents. Install closures per manufacturer’s instructions. Closures shall be sized to accommodate the quantity of pairs to be spliced with spare capacity to support a minimum of XXX additional splices in the future. Closures shall be outdoor or indoor rated (depending upon the use).
1. Splice closures located in maintenance holes shall be supported on racks (at both ends) and shall be located to avoid blocking duct access. Splice closures shall not be installed in handholes.

2. Prior to sealing closure, electrically test each cable pair for opens, shorts, crosses and grounds.
3. Cable shields/sheaths shall be connected together at all splices and termination points to assure a continuous metallic shield, and shall also be connected to the grounding conductor if located in a maintenance hole. Electrically test the shield/sheath continuity. Connect each closure’s ground lug to the nearest TGB with a #10 AWG copper grounding conductor.
4. Closures shall be properly sealed and demonstrated watertight without encapsulant. Test seals after closure by pressurizing the closure and checking seals for leaks.
5. Provide encapsulated closures in the locations shown on the Drawings, or if upon visual inspection during construction it appears that the location for closure installation is or is likely to be subject to prolonged immersion in water.
6. Provide connector tool to Owner after construction.

The Designer shall enter a value for “XXX” below for each specific project.

- B. OSP Fiber Splice Closures: Provide fiber splice closures in sizes and quantities as shown on the Contract Documents. Do not install splice closures where not shown on the Contract Documents. Install closures per manufacturer’s instructions. Closures shall be sized to accommodate the quantity of pairs to be spliced with spare capacity to support a minimum of XXX additional splices in the future. Closures shall be outdoor or indoor rated (depending upon the use). Closures shall be either butt or in-line depending upon the application.
1. Splice closures located in maintenance holes shall be supported on racks (at both ends) and shall be located to avoid blocking duct access. Splice closures shall not be installed in handholes.
 2. Connect each closure’s ground lug to the nearest TGB with a #10 AWG copper grounding conductor.
 3. Fiber splices shall be fusion splices. Provide splice trays designed to mount within the closure to manage each splice. Protect each bare/stripped optical fiber strand with heat shrink or silicon adhesive to prevent exposure to moisture.
 4. Closures shall be properly sealed and demonstrated watertight without encapsulant. Test seals after closure by pressurizing the closure and checking seals for leaks.
 5. Provide encapsulated closures in the locations shown on the Drawings, or if upon visual inspection during construction it appears that the location for closure installation is or is likely to be subject to prolonged immersion in water.

List additional splice closure product installation requirements above as applicable to this project.

3.7 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.

- A. All 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 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.

Verify and edit referenced section titles.

- B. Bond non-current carrying metal telecommunications equipment and materials to the nearest TGB (if within a building – as specified under Division 16 Section - “Grounding for Communications Circuits and Raceway”) or the nearest grounding conductor if in the outside plant.
 - 1. Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

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

3.8 CABLE

- A. For each conduit in which innerduct or cable is to be installed:
 - 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.

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

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.

- 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. Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.
- 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.
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, select the same duct at both sides of maintenance holes or handholes unless specifically noted on the Contract Documents. 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.
9. 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. Route cables in maintenance holes and handholes to avoid blocking duct access.
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 ER/TR 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. Cable at the backboards:
 - a. Lay and dress cables to allow future cabling to enter raceway (conduit or otherwise) without obstruction by maintaining a working distance from these openings.
 - b. Route cable as close as possible to the ceiling, floor or other corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
 - c. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Support cables so as not to create a load on the equipment upon which the cables are terminated. Tie-wrap together similarly routed and similar cables and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.

17. 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.
18. Building Entrances: Seal conduits (both in-use and spare) that enter the building from the outside plant to prevent intrusion of water, gases, and rodents.

C. Copper Cable:

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.

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. Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
4. For shielded cable, bond the shield at both ends to the ground lug on the Building Entrance Protector.
5. Copper splices are not acceptable.

D. Fiber Cable:

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.

1. Provide fiber optic cable in quantities, strand counts, and types (singlemode, multimode, or composite multimode/singlemode (hybrid)), as shown on the Contract Documents. Provide cable with fan-out kits for both ends.
2. Test fiber optic 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. Terminate all fiber strands within a fiber cable. The installation of “dark fiber” is not acceptable.
4. For shielded cable, bond the shield at both ends to the TGB.
5. Fiber splices are not acceptable.

List additional cable product installation requirements above as applicable to this project.

3.9 LABELING AND ADMINISTRATION

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. General: Labeling and administration shall comply with TIA/EIA 606 and standard industry practices.
- B. 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.
- C. Termination Equipment:
1. Copper Building Entrance Protectors:
 - a. Label each BEP on the outside with a minimum of ½ inch high lettering that clearly indicates the building at the opposite end of the cable. Label each BEP on the inside with details for each cable terminating in the panel: the cable identifier, the cable pair-count and the building at the opposite end of the cable.
 - 1) Example: A BEP used to terminate a 100-PR cable identified as "C12" from the Computer Center would have the following label on the outside of the BEP: "Computer Center". Another label would be located inside the BEP and would read "C12, 100-PR, Computer Center."
 2. Fiber Patch Panels:
 - a. Outside the panel: Label fiber patch panels on the outside with a minimum of ½ inch high lettering that clearly indicates the building at the opposite end of each cable. In addition, label patch panels with a patch panel designation label as follows:
 - 1) General: Label patch panels sequentially within a given closet. Labels shall be of the form "R#-FPP#" where "R" stands for "Rack", "#" is the sequential rack number

within a given closet, "FPP" stands for "Fiber Patch Panel" and "#" is the sequential fiber patch panel number within that rack.

- a) Example: The second campus fiber patch panel within Rack 1 would have the label "R1-FPP2".
- b. Inside the Panel:
 - 1) General: Label patch panels with a single label which details the following information for cables terminating in the panel: The cable identifier, the building at the opposite end of the cable, the telecommunications room at the opposite end of the cable, the fiber type (62.5/125µm multimode, 50/125µm multimode, singlemode, composite) and the strand counts.
 - 2) Connector Panels: Label each connector panel with the cable identifier ("F#") of the fiber cable terminating in that connector panel.
 - a) Example: Connector panel "B" terminates the first twelve strands of campus backbone fiber cable "F4". The label would be "F4."
 - b) Example: Connector panel "C" terminates the second twelve strands of campus backbone fiber cable "F4". The label would be "F4."
 - 3) Ports: Label each duplex port with the tube and strand color/number nomenclature in the form of "tube:strand/strand".
 - a) Example: The duplex port terminating the rose-colored strand and the aqua-colored strand in the blue tube within fiber F22, would be labeled "blue:rose/aqua."
- D. Grounding/Bonding Conductors: Label bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"
- E. Cable:
 1. Copper Cables: Labels shall include the cable identifier in the form of "C#" where "C" is the cable media type (copper) and "#" is the sequential cable number for that cable type (as assigned on the Contract Documents), the origination and destination building names and telecommunications room identifiers, the pair count and cut length.
 - a. Example: A 350 foot long, 100-PR campus copper backbone cable identified on the Contract Documents as "C2", terminating in telecommunications room "1A" within the Computer Center and in telecommunications room "2A" within Kamola Hall, would be labeled with the following information: "C2", 100-PR, 350-FT, Computer Center - "1A", Kamola Hall - "2A".
 2. Fiber Cables: Labels shall include the cable identifier in the form of "F#" where "F" indicates "fiber" media, and "#" is the sequential cable number for that cable type (as assigned on the Contract Documents), the origination and destination building names and telecommunications room identifiers, the fiber type(s), strand count(s), and cut length.
 - a. Example: A 250 foot long, 12-strand, 62.5/125µm campus fiber backbone cable identified on the Contract Documents as "F4", terminating in telecommunications room "1A" within Barto Hall and in telecommunications room "2A" within Beck Hall, would be labeled with the following information: "F4", 12-ST, 62.5/125µm, 250-FT, Barto Hall - "1A", Beck Hall - "2A".
 3. Provide labels at each end of each cable within 24" of building entrance and again within 24" of termination point. Provide labels in each maintenance hole and handhole through which a cable

passes. Label each cable immediately as it enters a maintenance hole or handhole and again just prior to exiting the maintenance hole or handhole. Where cabling is routed unexposed via innerduct through maintenance holes or handholes, provide labels on exterior of innerduct indicating contents of innerduct.

List additional label product installation requirements above as applicable to this project.

3.10 PATCH CABLES

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. Installation shall be as specified in Division 16 Section – “Inside Plant Communications Circuits.”

List additional patch cable product installation requirements above as applicable to this project.

3.11 TESTING

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 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 form (on diskette 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, continuity, polarity reversals, transposition (wire map), 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, 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 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) For 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).
- b. 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).
 - 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) For Multimode Cable: Test at both 850 and 1300nm.
 - b) For Singlemode Cable: Test at both 1310 and 1550nm.
 - c. 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 Engineer/Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials, and retest the cable or connection materials at no additional expense to the Owner. Provide new test results to the Owner and Engineer/Designer in the same manner as above.
 1. In addition to the above, if it is determined that the cable is at fault, 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 Engineer/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.

- 4) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.
- 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.
 - 3) Provide test results to the Owner and Engineer/Designer for approval by the Owner and Engineer/Designer.
- 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.

List additional testing requirements above as applicable to this project.

3.12 FOLLOW UP

Review any contractor follow-up requirements with the CWU project manager and clearly state these requirements in the following paragraph(s).

- A. For the first four weeks that the system is in full operation, provide technical assistance for trouble shooting, training, and problem solving by phone and (within 24 hours of notice) on site. Provide up to 40 hours of assistance (in addition to any warranty-related work), including phone, travel, and on site time during this period.

END OF SECTION