PART 1  GENERAL

1.1 Scope of work

1.1.1 The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation.

1.1.2 Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of optic fiber riser infrastructure as described on the Drawings and/or required by these specifications.

1.2 Intent of the drawings and specifications

1.2.1 These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project.

1.2.2 Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of the described work, whether or not specifically called for in both.

1.2.3 Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.

1.3 Communication

1.3.1 It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements.

1.3.2 All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval.

1.3.3 No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

PART 2  PRODUCTS

2.1 Multimode Fiber Optic Riser Cable (Data)

2.1.1 General

2.1.1.1 Provide backbone cables from the BDF to each data IDF as indicated on Drawings.

2.1.1.2 The optical fiber cable construction shall consist of 50/125 \( \mu m \) laser-optimized multimode optical fibers, typically formed into groups of 6 or 12 fibers each. These groups and individual fibers shall be identifiable in accordance with ANSI/EIA/TIA-598. These groups consist of individually jacketed 900um tight buffered fiber strands around a dielectric central member with a flame-retardant outer jacket to form a protective sheath.

2.1.1.3 The function of optical fiber cables is to provide a compact, low loss, broad bandwidth transmission medium suitable for the transmission of voice, video, and high-speed data signals under adverse electrical and environmental conditions.

2.1.2 Optical Specifications

2.1.2.1 Attenuation

2.1.2.1.1 The maximum attenuation of each multimode optical fiber within a cable, when normalized to a length of 1 kilometer, shall conform with the following attenuation:

\[ \leq 3.0 \text{ dB/km} \text{ at } 850 \text{ nm} \]
2.1.2.1.2 Attenuation values and method of determining attenuation of each fiber shall be provided by cable manufacture and supplied with cable.

2.1.2.2 Bandwidth Table

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Maximum Attenuation (dB/km)</th>
<th>Transmission Capacity (MHz-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>3.0</td>
<td>1500</td>
</tr>
<tr>
<td>1300</td>
<td>1.0</td>
<td>500</td>
</tr>
</tbody>
</table>

*Note: Bandwidth values and method of determining bandwidth of each fiber shall be provided by cable manufacture and supplied with cable.*

2.1.2.3 Core Diameter: The core diameter shall be 50um.

2.1.2.4 Numerical Aperture: The numeric aperture (far-field radiation pattern) shall be .20 + .015.

2.1.3 Mechanical Specifications

2.1.3.1 The minimum tensile force over the entire length of the fiber shall be equivalent to 100kpsi (0.7 GN/m2).

2.1.4 Environmental Requirements

2.1.4.1 The cable shall be expected to operate and be stored under the following conditions:

2.1.4.1.1 Storage temperature range

- Non-plenum: -40°F to +158°F

2.1.4.1.2 Installation temperature range

- Non-plenum: +14°F to +140°F
- Plenum: +32°F to +140°F

2.1.4.1.3 Operating temperature range

- Non-plenum: -4°F to +158°F
- Plenum: +32°F to +158°F

2.1.5 Each cable shall contain 12 strands.

2.1.6 Cable shall be listed as OFNR, Type OM4 fiber.

2.1.7 Manufacturer shall be Corning Cable Systems part #012T61-31380-24.

2.1.8 Where plenum cable is required, utilize Corning Cable Systems part #012T68-31380-29 listed as OFNP.

2.2 Single-mode Fiber Optic Riser Cable (Data)

2.2.1 General

2.2.1.1 Provide backbone cables from the BDF to each data IDF as indicated on Drawings.

2.2.1.2 The optical fiber cable construction shall consist of 8/125 μm single-mode optical fibers, typically formed into groups of 6 or 12 fibers each. These groups and individual fibers shall be identifiable in accordance with ANSI/EIA/TIA-492CAAA. These groups consist of individually jacketed 900um tight buffered fiber strands around a dielectric central member with a flame-retardant outer jacket to form a protective sheath.
2.2.2.2 Optical Specifications

2.2.2.2.1 Attenuation

2.2.2.2.1.1 The maximum attenuation of each single-mode optical fiber within a cable, when normalized to a length of 1 kilometer, shall conform with the following attenuation:

- \( \leq 1 \text{ dB/km} \) @ 1310 nm
- \( \leq 0.75 \text{ dB/km} \) @ 1550 nm

2.2.2.2.1.2 Attenuation values and method of determining attenuation of each fiber shall be provided by cable manufacture and supplied with cable.

2.2.3 Mechanical Specifications

2.2.3.1 The minimum tensile force over the entire length of the fiber shall be equivalent to 35.1 kg/mm² (50 kpsi).

2.2.4 Environmental Requirements

2.2.4.1 The cable shall be expected to operate and be stored under the following conditions:

2.2.4.1.1 Storage temperature range

- Non-plenum: \(-40^\circ\text{F} \) to \(+158^\circ\text{F}\)

2.2.4.1.2 Installation temperature range

- Non-plenum: \(+14^\circ\text{F} \) to \(+140^\circ\text{F}\)
- Plenum: \(+32^\circ\text{F} \) to \(+140^\circ\text{F}\)

2.2.4.1.3 Operating temperature range:

- Non-plenum: \(-4^\circ\text{F} \) to \(+158^\circ\text{F}\)
- Plenum: \(+32^\circ\text{F} \) to \(+158^\circ\text{F}\)

2.2.5 Each cable shall contain 12 strands.

2.2.6 Cable shall be listed as OFNR.

2.2.7 Manufacturer shall be Corning Cable Systems part #012E61-31331-24.

2.2.8 Where plenum cable is required, utilize Corning Cable Systems Part #012E68-31331-29 listed as OFNP.

PART 3 EXECUTION

3.1 Telecommunications Installation

3.1.1 General

3.1.1.1 This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

3.1.1.2 The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.
3.1.1.3 The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

3.1.1.4 The Contractor shall verify space requirements and locations with a Purdue IT Infrastructure Services Representative before starting cable installations and terminations.

3.1.1.5 The Contractor shall verify the cable type and jacket rating required with a Purdue Information Technology Telecommunications Representative before starting riser cable installation.

3.1.1.6 The Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

3.2 Riser Conduits

3.2.1 Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

3.2.2 Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of Moves, Adds, and Changes.

3.2.3 All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM E814 and must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

3.3 Riser Fiber Optic Cabling

3.3.1 The fiber optic riser cabling will be terminated on either wall mountable fiber enclosures or in frame mountable fiber enclosures. Verify termination type and location with a Purdue IT Telecommunications Representative.

3.3.2 Contractor is responsible to obtain and follow installation instructions for fiber products for correct termination and wire management of cables on respective products.

3.3.3 Owner to provide future fiber patch cords connections to network equipment.

3.4 Fiber Color Codes

<table>
<thead>
<tr>
<th>Type</th>
<th>Strand</th>
<th>Color Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan – out</td>
<td>1</td>
<td>Blue</td>
</tr>
<tr>
<td>Fan – out</td>
<td>2</td>
<td>Orange</td>
</tr>
<tr>
<td>Fan – out</td>
<td>3</td>
<td>Green</td>
</tr>
<tr>
<td>Fan – out</td>
<td>4</td>
<td>Brown</td>
</tr>
<tr>
<td>Fan – out</td>
<td>5</td>
<td>Slate</td>
</tr>
<tr>
<td>Fan – out</td>
<td>6</td>
<td>White</td>
</tr>
<tr>
<td>Fan – out</td>
<td>7</td>
<td>Red</td>
</tr>
<tr>
<td>Fan – out</td>
<td>8</td>
<td>Black</td>
</tr>
<tr>
<td>Fan – out</td>
<td>9</td>
<td>Yellow</td>
</tr>
<tr>
<td>Fan – out</td>
<td>10</td>
<td>Violet</td>
</tr>
<tr>
<td>Fan – out</td>
<td>11</td>
<td>Rose</td>
</tr>
<tr>
<td>Fan – out</td>
<td>12</td>
<td>Aqua</td>
</tr>
</tbody>
</table>

*Note: Riser cables greater than 12-strand have same color code with different colored tube for each 12-strand group. Tube colors use same color scheme.*

3.5 General Cable Installation
3.5.1 Cable bends shall not be greater than that recommended by the manufacturer of the cable.

3.5.2 Care shall be taken so as not to damage cable during the installation process and that manufacturer’s pull tension specification is not exceeded.

3.5.3 Provide a minimum 8'-0" and maximum 10'-0" of slack outside the fiber enclosure. Loop at the TRs to be contained on the bottom side of the horizontal cable tray. Additional slack of (4'-6") of 900um is required within the fiber enclosures.

3.5.4 Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0" for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used.

3.5.5 Cable fill in riser conduits shall not exceed 40% cable fill.

3.5.6 New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.6 Cable Testing

3.6.1 A 100% verification by Purdue personnel of all fiber riser cable tests is required.

3.6.1.1 Contractor shall notify the Purdue Information Technology Telecommunications Representative before the start of testing.

3.6.1.2 Contractor may request Purdue personnel to accompany them in the testing of cables to ensure proper operation of the light meter. If Purdue personnel accompany the Contractor on testing, verification shall not be performed.

3.6.2 The fiber optic cables shall be tested utilizing a power meter and stabilized light source capable of testing at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode.

3.6.2.1 Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode from both directions on each fiber, actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part #, installed fiber length, building span loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode and date tested.

3.6.2.2 Testing required is 100%.

3.6.2.3 Place in a 3-ring binder, preceded by a tabbed divider and label as “fiber risers”. Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode.

3.6.3 Span Loss Benchmark Calculation

\[(D \times L) + (C \times \# \text{ connectors})\]

\[D = \text{Length}\]
\[L = \text{Loss}\]
\[C = \text{Connector loss (Max 0.75 dB)}\]
\[1 \text{ ft.} = .0003048 \text{ km}\]

The Purdue IT Infrastructure Services Department will perform 100% verification testing as part of acceptance of all fiber optic cable testing.

3.7 Equipment Installation and Cable Terminations

3.7.1 All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.
3.7.2 All fiber cables shall be installed and terminated by technicians experienced in the termination of fiber.

3.7.3 The Contractor shall employ certified system installation technicians and have at least 5 years of experience in the installation of similar and equivalent systems.

3.7.4 The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.8 As Built Information

3.8.1 Contractor shall provide as-built information with all test result information to the Purdue IT Infrastructure Services Department.

3.8.2 As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include riser labeling next to all telecom symbols.

3.8.3 If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

3.8.4 Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

3.8.5 Contractor shall submit cable records to reflect all moves, adds, and changes.

3.8.6 Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.