SECTION 13413 - OPTICAL FIBER CABLING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Product and installation requirements for the following:

1. Fiber-optic (FO) Cables.
2. Fiber-optic Connectors, Couplers, and Patch Panels.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
1. Product data for each type of product specified.
2. All testing results.
3. Standard fiber optic one-line drawings that depict fiber optic cable rounting, patch panels, bend radius and connector types.
4. Product certificates, signed by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in "Quality Assurance" Article below.

1.03 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Connected Equipment Manufacturer Certifications: Where cables specified in this Section are used to provide signal paths for systems specified in other sections of these Specifications, or for systems furnished under other contracts, obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturers.

C. UL Compliance: For cables that may be run in plenum ceilings or other air-handling spaces, provide cables tested for compliance with applicable requirements of UL Standard 910, "Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air-Handling Spaces." In addition, provide FO cables that have passed the UL VW-1 flame test.

D. EIA/TIA Compliance: Comply with applicable requirements of EIA Standards, EIA-440, -455, -458, -475, -509, –568-b.3, and 598-a pertaining to optical fiber cable and system component construction and installation. EIA/TIA-455-61, FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR.

E. Fiber Optics Experience: CONTRACTOR must be able to prove to the satisfaction of OWNER that it has significant experience in the installation of fiber-optics cable systems. Installation must include installation of fiber-optics cable, fiber termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.

F. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be black text on white background and be easily read. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each fiber-optics cable segment shall be labeled at each end with its respective identifier.

G. Fiber-Optics Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all fiber cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All fiber-optics interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.

H. Patch Cords: Patch cords shall be provided for each fiber-optic port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed fiber-optic cable. Patch cord connectors shall be matched with patch panel connector type and network fiber module connector type as required.

1.04 COMMISSIONING

A. Subsequent to hook-ups of FO system to signal sources and destination equipment, operate systems to demonstrate proper functioning. Replace malfunctioning FO cabling system items with new materials, and then retest until satisfactory performance is achieved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. FO Cables:
      a. Indoor: Corning FREEDM (OM3) gel-free loose tube (Riser rated).
      b. Indoor plenum: Corning FREEDM (OM3) gel-free loose tube (plenum rated).
      c. Outdoor aerial or duct: Corning Altos (OM3) with Fast Access Technology.
      d. Outdoor direct buried: Corning Altos lite (OM3) gel-free, single armored cable.
   2. FO Connectors and Couplers:
      a. AMP Netcon.
      b. AT&T Network Systems.
      c. Corning.
      d. ITT Corp.
      e. Thomas and Betts Corp.
   3. FO Patch Panels:
      a. Panduit.
      b. Volition.
      c. Corning
   4. FO Patch Cables:
      a. Belden
      b. Black Box
      c. Panduit

d. Tripp Lite
e. Proline

2.02 OPTICAL FIBER CABLING SYSTEMS

A. Fabricate system using manufacturer's standard materials as indicated by published product information and in sizes, types, and performance characteristics as indicated.

B. FO Cables: Factory fabricated, single channel, all dielectric, low loss glass type, fiber-optic multimode graded-index cables with the following operational and construction features:
   1. Multi-mode Fibers:
      a. Cable Type shall be Corning FREEDM One Indoor/Outdoor Tight-Buffered Cable (or equal).
      b. Fiber type: OM3 or better.
      c. Number of Fibers: 12 minimum or as listed on Drawings.
      d. Core Diameter: 50 microns or as listed on Drawings.
      e. Cladding Diameter: 125 microns or as listed on Drawings.
      f. Subunit Size: 2.0 mm or as listed on Drawings.
      g. Maximum Attenuation: Less than or equal 3.0 dB/Km (850), 1.5 dB/Km (1300 nm).
      h. Minimum Bandwidth: Greater than 1000 MHz-km.
      i. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
      j. Operating Temperature Range: -20 to +70 degrees C.
   2. Single-mode Fibers:
      a. Cable Type shall be Corning FREEDM One Indoor/Outdoor Tight-Buffered Cable (or equal).
      b. Fiber type: OM3 or better.
      c. Number of Fibers: 12 minimum or as listed on Drawings.
      d. Cladding Diameter: 125 microns or as listed on Drawings.
      e. Subunit Size: 2.0 mm or as listed on Drawings.
      f. Maximum Attenuation: Less than or equal 0.4 dB/Km (1310nm), 0.3 dB/Km (1550nm).
      g. Minimum Bandwidth: Greater than 1000 MHz-km.
      h. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
      i. Operating Temperature range: -20 to +70 degrees C.

C. FO Patch Cables:
   1. OM3/OM4 Rated.
   2. OFNR, OFNP, and LSZH jackets.
   3. Connector styles: ST, SC, LC, and MT-RJ as required.
   4. LockPORT boots.
   5. Cable length as required.

D. Water blocking shall not include gel type fiber products.
E. FO Connectors: Stainless steel, fiber-optic cable connectors, capable of terminating FO glass cables with diameters from 8 through 1,000 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms. Select ST or SC style connectors as required or shown on Drawings. Connectors shall have an insertion loss of 0.5dB or better.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions with the Installer present for compliance with requirements, and other conditions affecting the performance of optical fiber cabling system. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION

A. Install fiber-optic cables and associated equipment and devices in accordance with industry standards and manufacturer's written instructions.

B. Install fiber-optic cable without damage to fibers, cladding, or jacket. Ensure that media manufacturer's recommended pulling tensions are not exceeded. Do not, at any time, bend cables to smaller radii than minimums recommended by manufacturer.

C. Install FO cables simultaneously where more than one cable is being installed in same raceway. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.

D. No splices are allowed, except at indicated splice points.

3.03 GROUNDING

Provide grounding connections for other system components as required by manufacturer's written instructions.

3.04 INSTALLATION/APPLICATIONS

A. CONTRACTOR shall follow all fiber optic cable manufuctures recommended installation requirements and handling guidelines including but not limited to the following:
   1. Install optical fiber cabling for project applications as detailed on drawings.
   2. Never kink fiber cable.
   3. Never exceed recommended bend radiuses, during or after installation.
   4. Do not exceed recommended tensile loads. If you are ever concerned that you may be exceeding listed cable values or are not certain what they are, contact the manufacturer.
   5. Do not crush fiber cable; avoid impacts to it.
   6. Optical-fiber cable should not rest against sharp edges, and must be swept around corners.
   7. Monitor tensile loading during pulls, and avoid pulling long lengths in one direction.
   8. Plan to install extra cable protection in high-risk areas.
   9. Do not exceed maximum vertical rise.
   10. Secure cables in all installations. Do not let them run free over ceilings or under floors.
   11. Plan all cable routes before beginning, ensuring the cable will not be unnecessarily exposed to hazards.
   12. Comply with all regulatory requirements and fire codes.

3.05 FIELD QUALITY CONTROL

A. Testing: Testing shall be done by CONTRACTOR with at least 5 years of experience in testing fiber-optic cabling systems. CONTRACTOR shall terminate and test each fiber strand. **OWNER reserves the right to have representation present during all or a portion of the testing process. CONTRACTOR must notify OWNER 5 days prior to commencement of testing**. If OWNER elects to be present during testing, test results will only be acceptable when conducted in the presence of OWNER. Any fiber-optic cable left non-terminated at the discretion of OWNER, shall be tested using an adequate light source to determine that all installed strands are not damaged.

B. Fiber-Optics Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses using power meter and light source. Testing shall also include Optical Time Domain Reflectometer (OTDR) at both 850 and 1,300 nanometers for all installed fiber strands.
   1. Recommended Test Equipment:
      a. Multimode: Siecor OM-100F and OS-100D or equivalent power meter and light source.
      b. Multimode: Siecor OTDRPlus with appropriate modules for testing.
   2. Tests:
      a. Multi-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
      b. Single-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
   3. Test Criteria: Rusults shall adhere to industry standard acceptable ranges, total signal loss of less than 5 dB through entire fiber path, including cable, couplers and jumpers.

C. Documentation (Fiber Optic): CONTRACTOR shall provide documentation to include test results and as-built Drawings. Fiber Test Results: The results of the fiber testing shall be entered into the form "Fiber Attenuation Tests Results." Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.
   1. Each cable installed shall undergo complete testing in accordance with TIA/EIA TSB-67 to guarantee performance to this standard.
   2. All required documentation shall be submitted to OWNER/ENGINEER within 30 days of final testing.
   3. Test Criteria: Pass rate to conform to latest TIA/EIA Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.

D. Acceptance: Acceptance of the Data Communications System, by OWNER, shall be based on the results of testing, functionality, and the receipt of documentation.

3.06 CLEANING

A. Clean optical fiber cabling and components of dirt and construction debris upon completion of installation.

END OF SECTION