

SECTION 16782 – MULTIMODE FIBER OPTIC CABLE SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing and installing a fiber optic conduit system including fiber optic cable (FOC), conduit, pullboxes, splices, terminations and testing.
- B. The Work includes splicing and testing individual fiber cables installed under this CONTRACT, and testing a completed DCS-fiber link as shown on the plans
- C. Specific requirements are shown in the Specifications, Plans and/or in Appendix A.

1.2 RELATED REQUIREMENTS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 01300 - CONTRACTOR Submittals
 - 2. Section 01530 - Protection of Existing Facilities
 - 3. Section 01700 - Project Closeout

1.3 CONTRACTORS SUBMITTALS

- A. **General:** Shop Drawings shall be submitted in conformance with the requirements of Section 01300 - Contractor Submittals, Section 17100 - Process Control and Instrumentation Systems
- B. **System Drawings:** The following information shall be submitted:
 - 1. Communications system block diagram. Include cable routing, cable identification, and locations of pull boxes, splices, and patch panels.
 - 2. Details of connector installations and dimensions.
 - 3. Details of cable installation, cable entrance into and terminations inside enclosures.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Current Technology:** All data communication equipment and materials shall be the most recent field-proven models currently available from their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.
- B. **Transmission Media:** All transmission media, including connectors, patch panels, shall include a manufacturer 10-year extended product warranty. Manufacturers shall be Lucent Technologies, Corning or equal.

- C. **Environmental Requirements:** Equipment to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of 0 degrees C to 50 degrees C (32 degrees F to 122 degrees F) and 10 percent to 95 percent relative humidity, non-condensing. Fiber optic cables to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of minus 40 degrees C to 70 degrees C (minus 40 degrees F to 158 degrees F). Under this requirement, fiber cables shall be rated higher than electronics and other equipment to ensure the use of quality performing fibers with minimal performance variation due to temperature fluctuation.

2.2 FIBER-OPTIC CABLE

- A. The fiber-optic cable shall contain twelve optical fibers. Cable fibers shall not be twisted but shall lay parallel to each other within the cable. The cable shall be jacketed with a PVC sheathing material. Aramid yarn strength members shall cover the fibers and fill the remaining cable space, without a central strength member and with no metallic elements, to preserve the intrinsic strength of the glass. Cables may not contain ripcords that may potentially damage fibers. All cables shall be from the same manufacturer, of the same cable type, and of the same size. Each fiber shall be continuous with no factory splices.
- B. Multi-mode, all-dielectric, tight-buffer cable with 12 optical glass fibers encased in primary polymer buffer.
- C. Indoor/outdoor distribution cable, riser-rated.
- D. 62.5 microns core diameter.
- E. 125 microns cladding diameter.
- F. Primary buffer encased in a secondary hard elastomeric polymer buffer.
- G. Flame-retardant, fungus-resistant PVC jacket with dielectric strength members and ripcord.
- H. UL-listed riser-rated OFNR, meeting NEC sections 770-519(b) and 770-53(b) for use in vertical runs in building riser shafts.
- I. Maximum attenuation (dB/kM): 3.5 at 850 nm, 1.0 at 1300 nm.
- J. Maximum short-term tensile load rating of 1400 n. (315 lbs).
- K. Maximum bend radius during installation = 20 times outside diameter.
- L. Minimum bend radius during installation = 10 times outside diameter.
- M. Minimum crush resistance: 1800 N/cm.
- N. Maximum optical attenuation after installation: 4.5 dB/kM at 850 and 1.5 dB/kM at 1300 nm.
- O. Type: Corning Cable Systems MIC Riser cables.

2.3 FIBER OPTIC TERMINATION PATCH PANELS

- A. A patch panel shall be provided at each cabinet that requires fiber-optic cable connections. All fiber sub-cables within the cable shall be terminated with straight tip (ST) compatible connectors. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected. Patch panels shall be designed for either rack mounting on a

standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain ST type bayonet couplings. All unused couplings shall have protective dust covers. All panels shall be furnished with locking doors. Factory-terminated, tight-buffered, agamid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0 mm O.D., shall connect the optical cable terminations to the patch panel couplings. Panels shall be equal to the following panels manufactured by Siecore:

Mounting	Fiber Capacity	Model Number
Rack	48	C.H.-02U
Rack	72	C.H.-03U
Wall	48	AC-048L with lock
Wall	72	AC-072L with lock

The patch panel shall be equipped with a suitable means for routing and securing of cables and shall provide a suitable means of protection for the mounted fiber connectors, to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four (4) inches at all times to ensure optical and mechanical integrity of the optical fibers.

B. Optical Connectors

1. All connectors shall be field-install able and perfectly matched to the cable used. The connectors shall provide tight fitting termination to the cladding and buffer coating. Epoxy-based or "hot melt" adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face. No dry-termination or "quick crimp" connectors are allowed.
2. After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100-power to check for cracks or pits in the end face of the fiber. If any irregularities found cannot be removed by further polishing, the entire process must be redone by cutting off and disposing the connector body.
3. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EA.-455-34. No index-matching gel is to be used, dry interfaces only. Connectors must be capable of mounting on either 0.9 mm buffered fiber or 3.0 mm cordage.
4. Each connector shall be of the industry standard ST type compatible, designed for and shall meet or exceed the applicable provisions of EA.-455-5, 455-2A, and 455-34, and shall be capable of 100 repeated matings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a keyway design and shall have a zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials, such as nickel plated zinc, designed to operate in humid environments without degradation of surface finishes.

2.4 FIBER-OPTIC CONNECTORS

- A. Fiber-optic connectors shall be the ST type, bayonet style, and field installable, self-aligning and centering. Fiber-optic connectors shall match the fiber core and cladding diameters. The connector coupler shall be nickel plated, and the alignment ferrule shall be ceramic. The

connector shall have a short boot for strain relief. Fiber-optic equipment and cable shall use the same type connectors for correct mating. Connector insertion loss shall not exceed 0.3dB. Connectors must be capable of mounting on either 0.9 mm buffered fiber or 3.0 mm cordage. The connector shall be Lucent Technologies Series ST II, or equal.

2.5 FIBER PATCH CORDS

- A. Fiber patch cords shall consist of buffered, graded-index fiber with a 62.5 μm core and a 125 μm cladding consistent with all fiber properties required under Paragraph 2.2.B. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC. Duplex fiber jumpers/patch cords with a factory installed connectors and a tension rating of 888 N (200-pound) on the cordage shall be provided. Cable retention shall be 220 N (50-pound) minimum, and connection repeatability shall yield 0.20 dB maximum change per 100 reconnects with ST connectors attached. Factory produced patch cords shall be of cordage sized at 3.0 mm and utilize ST connectors that provide a pull-proof non-optical disconnect feature. The patch cords shall be Lucent Technologies Series FL2EP-EP, or equal.

2.6 SPARE PARTS AND TOOLS

- A. Furnish to the CONSTRUCTION MANAGER all necessary tools and spare parts of components required to maintain the system. Prior to final acceptance of work, provide a spare parts listing of all necessary spare parts and quantities for review by the CONSTRUCTION MANAGER. Tools shall include equipment needed to make fiber connectors or fiber optic cable. The spare parts shall include the following minimum requirements:

MINIMUM SPARE PARTS LIST

No.	Part Description	Quantity
1	Fiber-Optic Cable	200 Feet
2	Fiber-Optic Connectors	24 each
3	Fiber-Optic Splices	24 each
4	Fiber-Optic Patch Cords	24 each
5	Fiber-Optic Splice Closure (Trays & Encapsulant)	2 each

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution requirements of Section 13300 - Process Control and Instrumentation Systems apply to the Work of this Section.
- B. All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as indicated. Conduits shall be used for installation of fiber-optic cables. Each fiber-optic cable entering a cabinet shall be terminated at a patch panel. All fibers in the cable shall be terminated. Interfacing between a fiber-optic cable and a fiber-optic communications module shall be through a patch panel.

- C. A short cable slack of 10 feet minimum for repair shall be provided for all Fiber-Optic Cable Segments (FOCS) longer than 100 feet.
- D. All necessary interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided. Verify the complete operation of the data transmission system in conjunction with field testing associated with systems supported by the fiber-optic data transmission system. Prior to formal acceptance testing, field tests shall include a power attenuation test and a gain margin test. These tests shall be performed on each link and repeated from the opposite end of each link.
 - 1. Power Attenuation Test: Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The CONSTRUCTION MANAGER shall be notified of the problem and what procedures the CONTRACTOR proposes to eliminate the problem. Prepare a report documenting the results of the test. The report shall be submitted to the CONSTRUCTION MANAGER.
 - 2. Gain Margin Test: Test and verify that each circuit has a gain margin which exceeds the circuit loss by at least 6 dB.

3.2 TRAINING

A. Fiber Optic Cable Maintenance:

- 1. Content:
 - a. Description of Fiber Optic Data Network System.
 - b. Handling fiber optic cable.
 - c. Use and trouble shooting cables and patch panels.
 - d. Installing fiber connectors.
 - e. Training session length: 8 hours.
 - f. Number of training sessions: One.
 - g. Location: Project jobsite.

** END OF SECTION **