

## SECTION 27-08-23 TESTING OF FIBER OPTIC CABLES

### PART 1 – GENERAL

#### 1.01 DESCRIPTION

- A. The work covered by this section of the Specifications includes all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work of this section shall include, but is not limited to, the following:
  - 1. Cable testing for fiber optic cables.
  - 2. Providing testing results in accordance with the strictest manufacturer written recommendations.

#### 1.02 QUALITY ASSURANCE

- A. Refer to Section 27-00-00 for general details.

#### 1.03 CODES, STANDARDS AND GUIDELINES

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations in Section 27-00-00
- B. The Cal Poly ITS Telecomm group, Telecommunications Standards Document and the Labeling, Design and Syntax Standards in Appendix B.

#### 1.04 SUBMITTALS

- A. Refer to Section 27-00-00 for general details.
- B. Shop Drawings:
  - 1. None Required
- C. Submit Manufacturer's Cut Sheets for the following:
  - 1. Any products not specifically listed in the PRODUCTS section shall require a submittal of the manufacturer's cut sheets and approval by the Cal Poly ITS Telecomm group.
- D. Submit a list of test equipment to be used along with most recent calibration information.
- E. Prior to starting, a sample of test data shall be provided to the Cal Poly ITS Telecomm group representative that is indicative of the reports that shall be submitted upon completion of project testing for approval.
- F. Provide the identity and qualifications of Contractor's personnel who will perform the testing. Submit documentation for all test personnel verifying qualified operator training on the proposed test equipment.
- G. Submit a proposed schedule for performing testing at least 2 weeks prior to the start of each test.

### 1.05 IDENTIFICATION

- A. Refer to Section 27-05-53 for general details.

### 1.06 DEFINITIONS

- A. N/A

### 1.07 WARRANTY

- A. Refer to Section 27-00-00 for general details.

## PART 2 – PRODUCTS

### 2.01 OPTICAL TIME DOMAIN REFLECTOMETER (OTDR)

- A. The personnel performing field testing shall provide results that meet the requirements of tests specified in ANSI/TIA/EIA-455, inclusive of all subsections.
- B. Make and model of test equipment requires approval of the Cal Poly ITS Telecomm group. The Cal Poly ITS Telecomm group currently has licensed copies of Agilent Technologies Traceviewer III and Fluke Linkware. If other manufacturer's test equipment is used the contractor shall deliver to the ITS Telecomm group a licensed copy of the necessary software to read and manipulate the test data as part of the contract. The software shall remain the property of the ITS Telecomm group.
- C. Included in the test results submitted shall also be OTDR traces and power loss sum information for each fiber optic core.

### 2.02 OPTICAL POWER MEASUREMENT EQUIPMENT

- A. Fluke Networks Linkware
  - 1. SimpliFiber
  - 2. OMNIScanner w/ Fiber Test Adapters or Cal Poly ITS Telecomm group approved equal.

### 2.03 OPTICAL FIBER INSPECTION SCOPE

- A. Fluke Networks
  - 1. Fiber Inspector Pro
- B. Other Inspection Scopes, if used, shall be Approved in advance by the Cal Poly ITS Telecomm group.

## PART 3 – EXECUTION

### 3.01 GENERAL

- A. The Contractor shall test, as described below, all fiber optic cables installed under these specifications.
- B. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
- C. Where post-manufacturer test data has been provided by the manufacturer on the reel or shipping carton: submit copies to the Cal Poly ITS Telecomm group representative prior to installing cables.
- D. Test fully completed systems only. Piecemeal testing is not acceptable.

- E. Testing shall not be performed until after all hardware is installed and attached, and all labeling and identification has been completed. Using any other methodology shall render the test data not acceptable.
- F. Any cable that does not pass all required testing shall be removed or replaced, and retested.
- G. Remove and replace any defective cables from pathways system. Do not abandon cables in place.
- H. The Cal Poly ITS Telecomm group representative reserves the right to observe all portions of the testing process.
- I. The Cal Poly ITS Telecomm group further reserves the right to conduct "Proof of performance testing", using Contractor equipment and labor, by random re-testing of up to ten percent (10%) of the cable plant, to confirm documented test results. Multiple failures shall cause the percentage of the cable plant to be tested to increase.
- J. Perform all tests as required by the manufacturer in support of the structured cabling system warranty.

### 3.02 QUANTITIES

- A. N/A

### 3.03 INSTALLATION

- A. N/A

### 3.04 GROUNDING & BONDING

- A. N/A

### 3.05 TESTING

- A. All test results shall be defined as acceptable / unacceptable by the requirements of ANSI/TIA/EIA-526, inclusive of all subsections.
- B. Fiber Optic Cables – General Requirements
  - 1. Index matching fluids or gels shall not be used.
  - 2. Strands whose measured attenuation fall outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. Faults related to affixing the connector shall be corrected, and the fiber re-tested as described above, until acceptable attenuation measurements are recorded. If acceptable attenuation cannot be achieved, than the fiber shall be replaced in its entirety.
- C. Optical Time Domain Reflectometer Testing
  - 1. All OTDR testing procedures and field test instruments shall comply with applicable requirements of: EIA/TIA 455-78 and EIA/TIA 455-133.
  - 2. OTDR test jumpers must meet the criteria for reference jumpers specified in EIA/TIA-455-171.
  - 3. A 1,000 foot launch cable shall be installed between the OTDR and the first link connection.
  - 4. A 1,000 foot receive cable shall be installed after the last link connection.
  - 5. All cables shall be OTDR tested at 1310 nm and 1550 nm for Single-mode operating wavelength anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

6. All cables shall be OTDR tested at 850 nm and 1300 nm for Multi-mode operating wavelength anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
  7. All fiber links shall be tested in both directions.
  8. Optical Return Loss (ORL) for each link shall be measured and documented.
  9. Fiber Length shall be measured and documented.
  10. Perform a high resolution OTDR test with tracing printouts noting each optical fiber and buffer tube color designation.
- D. Optical Power Loss Testing
1. All fiber optic cables are to be tested via the One-Jumper Reference Method, formerly Method B.
  2. Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 850nm and 1300nm for multi-mode fiber or at 1310nm and 1550nm for single mode fiber.
- E. Other Tests
1. After installation of connectors, visually inspect each fiber end-face at 200x magnification for multi-mode fiber and 400x magnification for single mode fiber. Replace fibers with visible defects and/or striations in the core area.

### 3.06 ACCEPTANCE

- A. All test results and corrective procedures shall be documented and submitted, in the manufacturer's approved software format, to the Cal Poly ITS Telecomm group representative (with software and license if necessary) within five (5) working days of test completion. Test results submitted in the PDF format shall not be acceptable.
- B. Each test report shall contain the following general information:
1. Date of Preparation
  2. Date of Test
  3. Project Name (shall be: Start Building # / End Building #, with the same name used at both ends)
  4. Contractor's Name
  5. Media Type (MM / SM)
  6. Make, Model and Serial Number of test equipment used
  7. Date of Last Calibration
  8. Names of Test Crew.
- C. Submit the following information regarding the optical fiber cable testing:
1. Cable Number (use Cal Poly Labeling, Design & Syntax Standard methodology in Appendix B)
  2. Fiber Count
  3. Individual Fiber Numbers
  4. Connector Types
  5. Number of Connectors / Patches
  6. Calculated Maximum Link Loss

7. Length of Run
  8. Results of Each Test for Each Fiber
  9. Measured Link Loss for Each Fiber.
- D. Test result shall be recorded per cable and identical copies placed on three removable media devices (CD or DVD) for delivery to the Cal Poly ITS Telecomm group representative (along with software and license if necessary). The PDF format shall be unacceptable. (Software will not be returned)
- E. Once the testing has been completed and the Cal Poly ITS Telecomm group representative is satisfied that all work is in accordance with the Contract Documents, the ITS Telecomm group representative shall notify the Contractor and/or Cal Poly Project Manager in writing or via email.

### **3.07 RECORD (AS-BUILT) DRAWINGS**

- A. None Required

END OF SECTION

DOCUMENT VERSION CONTROL

REVISION	DATE	AUTHOR	REASON
1	02/20/2014	R. VOLK	INITIAL DOCUMENT DEVELOPMENT
	02/20/2014	DW & MH	PRIMARY REVIEW COMPLETE