

NORTH ORANGE COUNTY COMMUNITY COLLEGE DISTRICT
SECTION 27 10 00 – STRUCTURE CABLING TESTING
SAMPLE SPECIFICATION

RELATED SECTIONS:

Section 27 00 00 General Requirements
Section 27 02 00 General Communication Requirements
Section 27 05 26 Grounding and Bonding for Communications
Section 27 05 28 Pathways for Communication Systems
Section 27 05 37 Fire-stopping For Communication Systems
Section 27 11 00 Communication Equipment Room Fittings
Section 27 12 00 Communication Requirements for (RF) CATV System
Section 27 13 00 Communications Backbone Cabling
Section 27 13 23 ABF Fiber Optic Cabling
Section 27 15 00 Communications Horizontal Cabling
Section 27 16 00 Communications Connection Cords

General Test Requirements

PART I – GENERAL

1. Transmission performance of structured cabling varies with length, connecting hardware, cords and total number of connections. The installer must take care to properly install the cabling components. To ensure that the installed structured cabling solution meets or exceeds the required performance it must be 'tested' or 'certified'.
 - a. The requirements for each category of cabling (Cat5e, Cat6, or Cat6A) and optical fiber optics links are located in the ANSI/TIA-568 series standards.
 - b. Test equipment must meet the requirements set forth in the ANSI/TIA-568 series Standard for Field Test Equipment.
 - c. All Copper testers shall be Level III. All fiber testers shall meet the requirements in ANSI/TIA-568.

Field Power Meters shall meet the following:

Accuracy ± 0.2 dB
Resolution 0.01 dB
Precision ± 0.15 dB

The Field light source shall meet the following:

Accuracy ± 0.01 dB
Wavelength
850 ± 30 nm
1300 ± 50 nm
1310 ± 30 nm
1550 ± 0 nm

2. The calibration on all test equipment shall be current.
3. The software in all test equipment shall be current.
4. Manufacturers
 - a) The following manufacturer's testers are approved.

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- b) FLUKE
- c) DTX1800
- d) OptiFiber OTDR
- e) DTX-CLT CertiFiber Optical Loss Test Set
- f) IDEAL
- g) LanTEK II
- h) LANTEK 6/6A/7G
- i) FIBERTEK
- j) Or other test equipment approved by NOCCCD

5. Systems Testing and Documentation.

- a) Provide installation testing of equipment where required by manufacturer's installation instructions.
- b) Provide complete end to end testing for all copper and fiber optic systems/channels based on latest applicable standards. Document all testing and submit with final as-built submittal package.
- c) For all controls and operating equipment, submit equipment/systems to at least three complete operational sequences, in which all equipment operations are tested, observed, and verified.
- d) Prior to substantial completion and project acceptance inspection, submit test reports to indicated scope of startup and operational tests, with results of testing for each specified operation.

6. Copper Cabling System Testing

- A. General: Copper cabling shall be tested and certified after installation as follows and as required for cable manufacturer's warranty. Twisted-pair copper cable channels shall be tested for continuity as specified below, presence of ac/dc voltage, and performance. All cabling shall be tested for conformance to horizontal cable specifications as outlined herein, and shall be tested according to test set manufacturer's instructions utilizing latest firmware and software. Testing shall include all of electrical parameters as specified under Product. All cables and termination hardware shall be 100 percent tested by installation contractor for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified useable by Contractor prior to system acceptance. All cables shall be tested according to contract documents, manufacturer's warranty provisions, and best industry practices. If any of these are in conflict, Contractor shall comply with most stringent requirements. All defects in cabling system installation shall be repaired or replaced in order to ensure 100 percent useable conductors in all cables installed, at no additional cost to Owner.
- B. Continuity: Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by test unit according to manufacturers' recommended procedures, and referenced to appropriate cable identification number

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and circuit or pair number. Any faults in wiring shall be corrected and cable re-tested prior to final acceptance.

- C. Length: Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to maximum distances set forth in TIA/EIA-568-C standards and all other applicable standards specified in Appendix 1: Codes, Standards, and Informative References. Cable lengths shall be recorded, referencing cable identification number and circuit or pair number. For multi-pair cables, shortest pair length shall be recorded as length for cable.
- D. Factory testing: Every reel of cable shall be tested by cable manufacturer for all characteristics specified for cable type in this section. This testing shall be performed using a sweep test method and include frequencies specified for cable. A test report shall be available electronically, at no additional cost, for a minimum of five (5) years from the date of manufacture. The test report shall include the reel number, the date of the test, the Lot number, and test results for Return Loss (RL), Insertion Loss (Attenuation), Pair-to-Pair NEXT, and Power Sum NEXT Pair-to-Pair ELFEXT and Power Sum ELFEXT. The test report shall show the "Worst Case Margin" for the listed transmission characteristics.
- E. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from TIA/EIA-568-C standards and all other applicable standards specified in Appendix 1: Codes, Standards, and Informative References, and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
- F. Test reports: Test reports for all factory testing and field test reports for copper cabling installation shall be submitted to the Owner's Representative and manufacturer prior to commissioning voice and data system and final contract payment. Refer to Submittals in this Section.

7. Optical Fiber Cable Testing

- A. General: Optical fiber cabling shall be tested and certified after installation as described below and as required for cable manufacturer's warranty. Fiber testing shall be performed on all fibers in completed end to end system. Testing shall consist of a bi-directional end to end test in accordance with applicable standards or a bi-directional end to end test performed by EIA/TIA-455-53A and all other applicable standards. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode type glass and 1310 and 1550 nanometers for single-mode type glass. These tests shall also include continuity checking of each fiber. For spans greater than 90 meters, each tested span must test to a value less than or equal to value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each

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tested span must be less than or equal to 2.0 decibels. The insertion loss for each mated optical fiber connector pair shall not exceed 0.40 decibels.

- B. Pre-installation testing: Test all optical fiber cable for all fibers prior to installation of cable.
- C. Performance testing: Where links are combined to complete a circuit between devices, Contractor shall test each link from end to end to ensure performance of system. Only a basic link test is required. Contractor can optionally install patch cords to complete circuit and then test entire channel. The test method shall be same used for test described above. The values for calculating loss shall be those defined in applicable TIA/EIA standards in Appendix 1: Codes, Standards, and Informative References.
- D. Attenuation testing: Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. The light source shall be left in place after calibration and power meter moved to far end to take measurements.
- E. Loss budget: All fiber cabling shall be tested at both wavelengths 850 nm and 1310 nm for multimode and 1300 nm and 1550 nm for single mode.
- F. The link attenuation shall be calculated using:
 - a. The CommScope link Loss Calculator for CommScope installations
 - b. The following calculation for other installations:
Link Attenuation Allowance (dB) + Cable Attenuation (dB) + Connector loss (dB)
= Splice Insertion Loss (dB)
Where:
Cable attenuation (dB) = Cable attenuation (dB/km) X Length (km)
Connector loss (dB) = Number of Connector pairs X Allowable connector loss (dB)
Splice Insertion Loss (dB) = Number of Splices X Allowable Splice loss (dB)
- G. Link loss: A mated connector to connector interface shall be considered a single connector. Loss numbers for installed link shall be calculated by taking sum of bi-directional measurements and dividing that sum by two. All links not meeting requirements of standard shall be brought into compliance by Contractor, at no additional cost to Owner.
- H. Documentation: Following final documentation shall be submitted to the owner's representative prior to commissioning data system and final contract payment according to Submittals in this section.
- I. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from all applicable standards and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
- J. End to End Loss Data: final documentation shall be submitted to the owner's representative.

8. See **Section 27 12 00** Communication Building (RF) CATV Requirements

9. See **Section 27 13 23** ABF Fiber Optic Cabling Requirements

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10. As Installed/ As Built Diagrams: Final documentation shall be submitted to the owner's representative.
11. Test Documentation
- A. Electronic Format – One electronic copy of the Test Reports shall be provided.
 - B. Certification Test Reports shall be submitted in electronic format using the appropriate software supplied by the test equipment manufacturer. The data format should be that of the test report software (i.e. *.flw files for Fluke). The contractor shall provide any necessary software to view and evaluate the test data.
 - C. The following list is provided as a reference:
 - D.

<u>Tester</u>	<u>Test Report Software</u>
a. Fluke	LinkWare™
E. Ideal	LanTek® Reporter
 - F. Paper Format – (Architect to review with NOCCCD)
 - G. Provide test documentation in 3-ring binders within 2 weeks after completion of project testing. Binders shall be clearly marked on outside front cover and spine with words Test Results, project name, and date of completion (month and year). Major heading tabs, Horizontal and Backbone, shall divide binder. Each major heading shall be further sectioned by test type. Within horizontal and backbone sections, divide by tabs scanner test results by category, optical fiber attenuation test results, and continuity test results. Present test data within each section in sequence listed in administration records.
 - H. Provide test equipment by name, manufacturer, model number and last calibration date at the end of document. Unless manufacturer specifies more frequent calibration cycle, annual calibration cycle shall be required on all test equipment used for this installation.
 - I. Test document shall detail test method used and specific settings of equipment during test. Scanner tests shall be printed on 8 1/2 by 11 inches. Hand written test results (attenuation results and continuity results) shall be documented on a suitable test form.
 - J. When repairs and re-tests are performed, note problem found and corrective action taken, and collocate in binder both failed and passed test data.

END OF SECTION

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