

FIBER OPTIC ACCEPTANCE TESTING

****From Hartford-Sharon FITS(503)**

- xx. DESCRIPTION. This work shall consist of performing fiber optic acceptance testing as specified herein and as directed by the Engineer.
- xx. GENERAL REQUIREMENTS. Upon delivery of the cable to the project site, the Contractor shall conduct fiber loss tests on the entire length of cable in the presence of the Engineer. These tests shall be conducted at both 1310nm and 1550nm light wavelengths via an Optical Time Domain Reflectometer (OTDR). The use of mechanical splices is permitted during on-reel acceptance testing. The use of a launch box is not required, but the OTDR launch cord must be a minimum 100 ft. Bidirectional testing is not required for the on-reel acceptance testing. The Contractor shall provide the Engineer with for (4) certified copies of the loss test results for comparison with the test made on the cable prior to delivery. All tests will be recorded on USB flash drive and submitted to VTrans for approval.
- xx. CONSTRUCTION REQUIREMENTS. Prior to shipping, the manufacturer of the cable shall conduct fiber loss tests on the entire length of cable to be delivered for this project. These tests shall be conducted at both 1310nm and 1550nm light wavelengths. Four (4) manufacturer certified copies of the fiber loss tests shall be delivered with the cable for review by the Engineer.

Each reel shall contain an identification tag or "Birth Certificate" with the following minimum information:

- (a) Date of Manufacture.
- (b) Manufacturer's Cable Code.
- (c) Fiber Count.
- (d) Length of Cable.
- (e) Beginning and End Length Markings.
- (f) Both ends of the cable shall be accessible to provide access for testing.
- (g) The cable ends shall be securely fastened and shall not protrude beyond any portion of the reel in an unprotected manner to prevent the cable from becoming loose in transport.
- (h) Cables ends shall be sealed to prevent the escape of the water blocking material and entry of moisture during shipping, handling, storage, and installation.

The OTDR used for testing shall meet the following requirements:

- (a) The OTDR used shall include a Flash Drive USB for storage of all Fiber Optic Cable signatures. Signatures of all cables tested shall be stored on a USB drive and supplied by the Contractor. The Contractor shall supply OTDR emulation software manufactured

by the OTDR manufacturer which is capable of reading the stored signatures from the disk(s) and performing all measurement and analysis on the stored signatures as if the OTDR were connected live to the Fiber Optic Cable. The analysis shall include, but not be limited to, readout of fiber loss per unit length, splice loss measurement (amount of loss and distance from OTDR), connector loss measurement (amount of loss and distance from OTDR), total Fiber Optic Cable length, generation of event tables, as well as identification and measurement of any other reflective events or faults.

- (b) The OTDR shall be located at one end of the Fiber Optic Cable Reel during the testing.
- (c) The pulse width setting of the OTDR shall be set to the lowest possible setting while allowing the full length of Fiber Optic Cable to be measured for faults or reflective events.
- (d) The Contractor shall document the OTDR readings by supplying hard copies of the OTDR signatures for all Fiber Optic Cables. The Contractor shall also supply hard copy of the reflective event table for all optical fibers which shall be directly printed out from the OTDR.

The personnel involved and responsible for the testing of the cable shall meet the following minimum requirements:

- (a) Provide documentation that the OTDR test equipment has been calibrated within one year of the test date, for review by the Engineer.
- (b) Documented proof of three (3) years experience with the installation of single-mode Fiber Optic Cable, including splicing, termination, and testing.
- (c) The installation experience should be applicable to the work required for this project and shall include projects of similar or larger scope, providing mid-span access points and fusion splicing in field conditions.
- (d) The Contractor shall provide the names and phone numbers of references to the Engineer.
- (e) At least thirty (30) days prior to the installation of the Fiber Optic Cable, the Contractor shall submit to the Engineer documentation outlining the information above.
- (f) The Contractor shall provide the Engineer with four (4) copies of the cable manufacturer's recommendations and requirements, listed below, for each Fiber Optic Cable type and size:
 - (1) A list of the cable manufacturer's approved pulling lubricants for use on the cable. No other lubricants will be permitted.
 - (2) The maximum pulling tensions of the cable, which shall specify both pulling from the cable's strength member(s) and for pulling from the outer jacket.

1/26/2011

- (3) The minimum bending radius of the cable, which shall specify a radius for both the installation and for long-term installation.

The Contractor is responsible for following the test procedures as documented below:

- (a) Remove the reel "Birth Certificate" or identification tag for submission to VTrans.
- (b) Record the reel identification or serial number.
- (c) Check the reel for any physical damage, such as broken wood, spool holes, dents, scratches, etc. All anomalies shall be documented and submitted to VTrans and the Engineer. Any anomalies deemed to compromise the integrity of the fiber will result in the reel being rejected from installation.
- (d) Access either the internal reel end or the external reel end.
- (e) Remove the cable sheath or jacket to expose a minimum of 8' buffer tubes.
- (f) Clean and remove all internal wraps, protective yarns, or tapes.
- (g) Remove a 5' minimum on fiber optic buffer tube cover, to expose the bare fibers.
- (h) Clean and completely remove all internal gels and water blocking agents from bare fibers.
- (i) Test buffer tubes in consecutive order in accordance with the /EIA -598-A, "Optical Cable Color Coding".
- (j) Setup the OTDR to test the individual fiber strands, with the same settings as tested by the manufacturer, including but not limited to the specific test wavelengths, pulse width, acquisition time, Index of Refraction (IR), cable span, and event thresholds.
- (k) Strip the outer protective coating from the bare exposed fiber. Test fibers in consecutive order in accordance with the TIA/EIA - 598-A, "Optical Cable Color Coding."
- (l) Clean exposed bare fiber and cleave end.
- (m) Place the cleaned fiber in an approved mechanical splice adapter. Mechanical adapters shall be the 3M FIBERLOK or an approved equal.
- (n) Test the fiber at 1310 nm for a minimum of 15 seconds.
- (o) Analyze the tested fiber for anomalies and verify the fiber characteristics, such as length and signal loss, versus the manufacturer test results.

1/26/2011

- (p) Record the test data. Label the fiber trace with the reel number and associated fiber number. The approved convention for recording fiber test results is as follows:

XXXXYYY-mm/dd/yyyy where XXXX denotes the reel number, YYY denotes the fiber number, and mm/dd/yyyy denotes the test date. It is required for each fiber strand tested that the documented information includes a trace image, detailed OTDR settings per trace, and any associated event tables.

- (q) Save all test report files to an individual file. All test result files are to be stored on a flash drive and submitted to VTrans and the Engineer for approval.
- (r) Repeat the requirements of parts (k) through (p) at the wavelength of 1550nm for all fibers.
- (s) Once all fibers have been tested, cut the fibers and buffer tubes at the location where the sheath has been removed. Cable end shall be sealed or capped and secured to the fiber reel.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Fiber Optic Acceptance Testing) will be the number of reels inspected in the complete and accepted work, not to exceed a quantity of 8 reels as specified in the Plans.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Fiber Optic Acceptance Testing) will be paid for at the Contract unit price per each. Payment will be full compensation for performing the work specified and for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.620 Special Provision (Fiber Optic Acceptance Testing)	Each