

**CENTRAL
FLORIDA
EXPRESSWAY
AUTHORITY**

**CFX ITS Inspection Reference & Training
Manual**

**Chapter 10
ITS Testing**

10.0 Overview of ITS Testing

Prior to a project reaching Substantial Completion, CFX requires testing of all newly installed and/or relocated ITS components, equipment, and devices as required by Section 611A of CFX's Technical Specifications. Due to the technology components within all ITS projects, testing is a critical part of the project. The components installed on the project must not only work on their own (stand-alone testing) but must work as part of the overall system (system testing) and must be installed to meet Specifications. Testing of ITS devices is vital to ensuring these items have been properly installed, configured, and are functioning as intended. Testing is performed in coordination with CFX Consultant staff who are familiar with all components of the CFX ITS Network and the testing requirements. These Consultant staff members provide a benefit to CEI staff who may not be as familiar with the CFX ITS Network, while also providing an additional means of verifying that CFX is getting a complete and functional product. Inspection by CFX or its representatives does not relieve the Contractor of their obligation to comply with the requirements of the Plans and Technical Specifications. Any equipment or labor that is found to be defective or unsuitable prior to Final Acceptance must be repaired or replaced at the Contractor's expense.

Once testing has been completed, the functionality and performance of the newly installed ITS system(s) will be monitored during a burn-in period. The burn-in period is a contractually designated timeframe with a duration of 90 days, that occurs between the successful completion of the System Acceptance Test and Final Acceptance during which the newly installed ITS system(s) are monitored and must meet certain performance requirements as a prerequisite to acceptance of the work. In this Chapter we will take an in depth look at the various ITS testing techniques and requirements that CFX employs for not only the individual components of their ITS infrastructure and devices, but also for the system as a whole.

ITS testing requires testing of all components that make up the ITS system. CFX Specification 611A states that Acceptance procedures may include Factory Tests, Stand-Alone Tests, System Tests, 90-day Burn-In, and Final Acceptance. For the purposes of this training, the ITS system will be separated into three categories: infrastructure, ancillary equipment, and ITS devices.

10.0.1 Infrastructure – Items such as conduit, conductor, pull boxes, and fiber optic cable whose primary purpose is to provide each ITS device location with power and a means of communicating information across CFX's FON.

10.0.2 Ancillary Equipment – Hardware such as media converters, patch panels, terminal servers, surge suppressors/protectors, and network switches that work with their respective ITS device to create a fully functioning system.

10.0.3 ITS Devices – ITS devices such as TMSs, DCSs, DMSs, CCTVs and the WWD system are the in-field devices that collect, monitor and transmit pertinent data to both the traveling public and the District 5 RTMC's staff. This data is not only used to notify the public of delays and safety concerns but is also leveraged for incident response, traffic modeling and future planning.

10.1 ITS TESTING REQUIREMENTS

There are multiple phases of required testing which are needed to successfully integrate a newly installed ITS device into CFX's ITS infrastructure. This Section outlines the standard testing procedures that CFX requires to integrate ITS devices on their construction projects.

10.1.1 Infrastructure Testing –

10.1.1-1 Conduit Proofing – The proof test method requires blowing a proofing dart through the conduit in both directions to confirm an airtight seal and no damage is present within the spare conduit. Technical Specification 631-3.1 requires an initial proofing test for all existing spare

conduits and a final proofing test for all spare conduits, whether installed by the contractor or not. The initial proofing test of the spare HDPE conduit system must be completed within fifteen days of the Notice To Proceed and includes the conduit system to the nearest manhole beyond the construction limits. The Contractor shall submit a written report to CFX documenting the results of the conduit proofing within 5 days of the completion of the proofing test. If any damage is found before construction, CFX will repair the damage and if necessary, retest the conduit with the Contractor present. Once it is verified that there is no damage present, the Contractor will be responsible for the conduit system throughout the remaining duration of the project.

The final proofing test requires that all spare conduits within the project limits be tested within 5 days of the semi-final inspection. The Contractor must submit a written report documenting the results of the proofing within five (5) days of completing the test and must repair any issues at no cost to CFX. Any repaired conduits must be re-proofed to confirm the problem was adequately addressed.

All conduit proofing performed by the Contractor must be coordinated with the CEI to allow for CFX and/or their representative to be present at the time of testing.

10.1.1-2 Grounding – Technical Specification 620A-2.1 requires grounding arrays for all ITS devices which must meet a grounding resistance of 5 ohms or less as measured from the main ground rod of the array, which is located in the designated grounding pull box. The grounding electrode conductor shall be enclosed in galvanized rigid metal conduit. The power service ground shall be separate from the ITS cabinet and pole ground array.

Grounding testing must be done using a 3-point earth ground megger to test the assembly. As shown in Figure 10.1 below, the 3-point earth ground megger device has three leads, one of which is connected to the grounding electrode and the other two connect to metal stakes offset from the grounding electrode in a straight line. This testing method provides a more accurate reading of resistance when compared to a clamp-on unit.

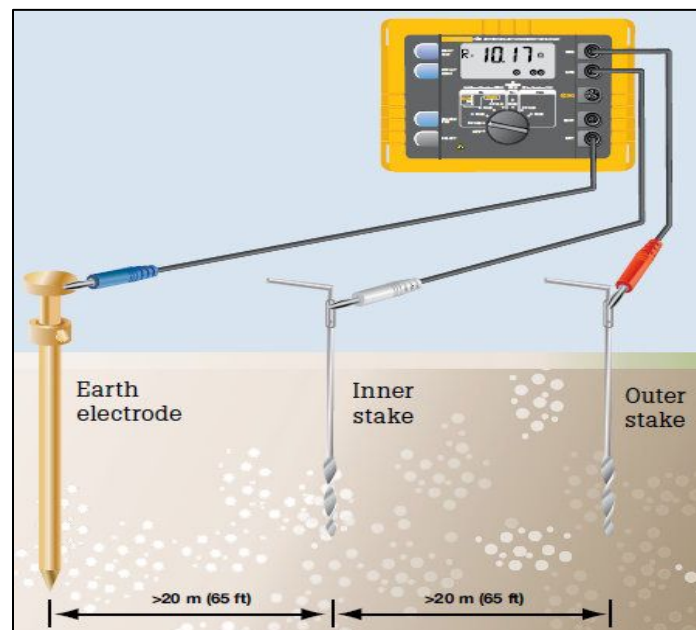


Figure 10.1: 3-Point Earth Ground Megger

10.1.1-3 Fiber Optic Cable – The contractor is to provide factory OTDR reel test for all new cables, verifying that the cable meets project specifications. The contractor is also required to provide an OTDR reel test, which is performed again in the field prior to installation. These two tests are to be compared for variances caused by damage in shipping or transport to the field. A separate report is to be provided per cable size and for each reel. This report certifies that the fiber optic cable is in good working condition before installation. Additionally, Technical Specification 633-3 requires the Contractor to perform bi-directional end-to-end OTDR tests at 1310nm and 1550nm on every installed single mode fiber optic cable. A launch cable with a length of at least 500 feet must be used for all OTDR testing. The results of the bi-directional OTDR will be compared to the Contractor’s calculated estimate of the total attenuation loss expected for each completed link which represents the acceptance benchmark for each fiber. Splice losses must not exceed 0.08 dB and each OTDR event shall not exceed 0.10 dB, measured at 1310nm. The Contractor must submit the final passing results of the tests for all links including any additional fibers they install.

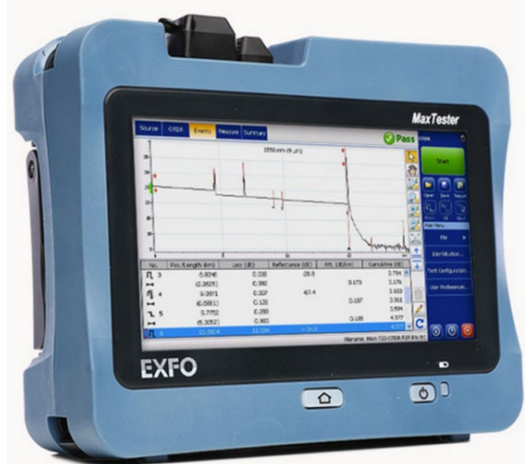


Figure 10.2: EXFO Brand OTDR with OTDR trace shown

10.1.1-4 Locate Management System – The Contractor must test the LMS within 15 days of NTP and then once again within 10 days of Final Project Acceptance. This is to ensure that the LMS system is functional and has not been damaged due to construction activities. For these tests, the Contractor must schedule and coordinate activities with the CEI Engineer prior to documenting the voltage and current ratings of the LMS within their project area. The Contractor must submit a report documenting the voltage and current ratings of the before construction and after construction readings within 5 days following the LMS testing for Final Project Acceptance. The readings for the after-construction condition must be within 10% of the original condition readings, or the Contractor shall be responsible for all costs associated with locating and repairing damage to the tone wire in their project area. After repairs have been completed, new readings must be documented, and the report must be resubmitted.



Figure 10.3: LMS Transmitter

10.1.2 Ancillary Equipment and ITS Device Testing –

10.1.2-1 Pre-Installation Testing – Pre-Installation testing is required for all DMSs prior to delivery to the project site for installation. Once the signs are received by the Contractor, each sign will need to go through a thorough Pre-Installation Test procedure at the Contractor’s yard. The purpose of the Pre-Installation Test is to ensure that the sign was not damaged during the shipping process, the sign functions as required, all wiring and communication is correctly assembled, and the sign is capable of displaying a variety of test messages via communication with a laptop.

10.1.2-2 Stand-Alone Testing – Before connecting any ITS devices or equipment to CFX’s FON, stand-alone testing must be performed to verify their functionality and that no damage occurred prior or during installation. CFX has developed a standardized stand-alone test plan, shown below as Figure 10.4, which is provided at the end of this Chapter. This document includes standardized testing for all ITS devices and associated equipment Installed on CFX roadways. This document will be provided to the Contractor at the pre-construction conference along with any equipment configuration information. This will provide the Contractor with the data needed to determine how they should be configuring the equipment as it is installed and what must be tested during stand-alone testing. You will notice, DMSs are not included in this document. Contractors must obtain DMS stand-alone tests from the DMS manufacturer and submit them to CFX for review and approval. The Contractor, CEI, and CFX’s representative (if desired) must be present during stand-alone testing and a test form must be completed and signed for every equipment/device location.

1. Device Testing

These individual sections address most devices installed as a portion of this project and provide the required standalone test procedures to satisfy the contract requirements. These standalone test procedures address the testing and functionality of the each individual device prior to integration into the existing CFX ITS network. These forms shall be filled out completely and neatly and signed by the technician performing the test and by the CFX representative(s) observing the test. An electronic and hard copy of these completed and signed forms shall be turned over to the CEI after the standalone testing has been completed.

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Figure 10.4: CFX Standardized Stand-Alone Test Plans

10.1.2-3 System Testing – Once all stand-alone testing items have been completed, a system test must be conducted which will test the functionality of each ITS device(s) and assembly at each device location. The system test is performed remotely from CFX’s ITS Control Room with the exception of wrong way driving installations. Wrong way driving installations require on-site testing involving shutting down the ramp and physically driving vehicles in the opposite direction to verify the equipment is properly detecting wrong way drivers as pictured in Figure 10.5 below.

The CEI must contact the ITS/Electrical Project Manager, to conduct system testing. For this testing, CFX’s General Engineering Consultant (GEC) will monitor the network to ensure the network is stable once the new devices begin coming online. They will also remotely log into each device and verify the configuration and functionality. Any issues noted during this testing, must be corrected by the Contractor. The ITS/Electrical Project Manager will then coordinate with CFX’s GEC to have the devices integrated into SunGuide. Once this is completed, the final system testing will be performed remotely from the CFX ITS Control Room.

The Contractor must notify the ITS/Electrical Project Manager and CFX 14 days prior to their intent to perform System Testing. Contact information is provided below.

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407-947-2250

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Figure 10.5: Wrong Way Driving Installation Testing

Though these are the typical ITS testing procedures for CFX ITS construction, it is important that the construction team verify the specific requirements in their contract. All required ITS testing should be listed on the Contractor’s CPM schedule as it is a pre-requisite for both Substantial Completion and Final Acceptance, and it is vital that both the Contractor and CEI are aware of and meet these requirements.