

# **Intelligent Transportation Systems Construction Engineering and Inspection Training, for Road Weather Information System**

## **Module 4 Testing**

### **Welcome**

Welcome to the Intelligent Transportation Systems Construction Engineering and Inspection Training, for Road Weather Information System, Module 4 Testing. This training contains audio, so please adjust your speakers accordingly. This CBT contains interactive elements. An alternate version is available on the resources page. The Knowledge Check questions allow you two chances to try and answer the question correctly. To begin, select the start button or press Shift + N on your keyboard.

### **Types of Tests**

The Construction Engineering and Inspection (or CEI) personnel will be required to oversee the following tests: Field Acceptance Test, Subsystem Test, System Test, and the 30 Day Acceptance Test. These four tests are equivalent to the environmental sensor-to-RPU test, remote-to-central communication test, and the systems operational test described in Developmental Specification Section 688-3 Testing. It is also important that the CEI review the contract documents because the types of tests could vary for each project.

Typically, for the RWIS system, a Factory Acceptance Test is not required. The FDOT Traffic Engineering Research Lab, or TERL, has performed verification testing of an RWIS unit against FDOT Developmental Specification 688. The model that was tested is listed on the FDOT Innovative Products List.

The Field Acceptance Test plan, Subsystem Test Plan, System Test Plan, and the 30 Day Acceptance Test Plan will be developed by the Contractor. The plans will be approved by the Engineer of Record (or EOR) and the Department prior to testing.

### **Test Plans**

The RWIS subsystem will be tested to ensure that the installed products meet all of the contractual requirements.

A test plan will be provided for each of the following tests: Field Acceptance Test, Subsystem Test, System Test and 30 Day Acceptance Test. The test plans must be submitted for Department approval in advance of any testing. The plans will be reviewed by the CEI personnel, District Network Administrator, and the District Regional Transportation Management Center (or RTMC) Manager. The Contract will specify when the test plans are to be submitted for review and approval.

The format of the test plan will be a step-by-step procedure. All calibrated tools and equipment required for testing will be supplied by the Contractor. Each test step will yield an actual result. The Inspector will compare the actual result with the expected result.

If the device does not exhibit the expected test results from any test step, then the device will be determined as having failed the test. A Test Discrepancy Report will be generated and submitted to the Inspector. The Contractor will either resolve the issue or replace the device in kind. If the original device is replaced with a new device, then the complete test must be repeated on the replaced device.

If the device exhibits the expected result in each step, then it is considered to have passed the associated test. The Department or the Department representative witnessing each test will sign the test procedure.

The Contractor or his representative will perform the actual testing with the CEI personnel on hand as an observer.

The approved test plans and procedures will show the individual test steps and the expected outcome of each step. If each test step has been performed successfully, then the tester and the CEI personnel will sign off that the test has been properly performed.

The CEI personnel should note the firmware version being tested and verify that it is the same as that listed in the project submittal.

The CEI personnel should verify that the test equipment matches the test plan and that the calibration certificate has been submitted.

The serial number of the sensors should be documented on the test procedure.

### **Types of Testing – Field Acceptance**

The Field Acceptance Test, also referred to as the Stand Alone Test, is a test that is performed in the field by the Contractor and witnessed by the Department or Department representative (the CEI personnel). Check the Contract to see how many days in advance the Contractor should be notifying the Department prior to performing the test.

During the Field Acceptance Test, individual components of a Road Weather Information System are tested to ensure that they operate correctly. Each component is tested independently without other system components.

On-site field acceptance tests verify that the device is correctly installed, functioning and configured. This test includes the inspection of workmanship, cable management, proper labelling of panels and cables, mounting of sensors on the infrastructure as well as components inside the cabinet.

Usually, the vendor's software is used for this local testing, which requires use of a laptop connected either directly to the device or connected through the Managed Field Ethernet Switch (or MFES).

The sensors are tested in accordance with FDOT approved test plans and specifications to show that they are installed properly.

Developmental Specifications Section 688-3 requires several documents to be submitted. In addition, several performance steps are required.

1. Sensor Calibration Certificates must be submitted by the Manufacturer. Check the date to see if the calibration certificate is valid.
2. The wind sensor requires alignment to the northerly direction. The installer of the sensor shall show the compass measurements to the inspector.
3. Manufacturer must submit calibration and tuning procedures. Sensors delivered to the job site are initially calibrated; however, minor tuning exercises will be conducted by the installer on the project site.
4. The installer should provide proper instrumentation and tools to measure the weather parameters. Compare the sensor data with the physical measurements.

There are several things you will need before you go to the jobsite.

First, bring a copy of the inspection checklist.

Second, you will need to know what IP address the device should be set to.

Also, you will need to know the administrator user name and password.

Bring a smartphone so you can access the NOAA website for the latest weather conditions.

The CEI personnel's role is to ensure that the Contractor, Integrator, or Tester has all the necessary equipment to conduct the test completely, as required by the test plan.

### **Types of Testing – Subsystem**

**Subsystem Testing:** The RWIS subsystem test is only conducted if it is required by the contract. The test is performed after the successful completion of the Field Acceptance Test and is performed on all new RWIS stations within the project.

The Subsystem test involves the testing of all RWIS sensors that have been installed and integrated into the District's network. Subsystem tests verify connectivity of the RWIS sensors to the RTMC. Usually this test is done from the RTMC using the vendor control software.

It can also be performed from an Intelligent Transportation Systems Hub shelter, using a laptop connected to the Layer 3 Switch. As a result, it is imperative to coordinate with the District Network Administrator and RTMC Manager prior to starting the Subsystem test. The software used and location where the RWIS subsystem test is performed should be mentioned in the test plans.

The data captured by the sensors will now be sent to the RTMC. The inspector should verify that all sensor data can be accessed at the RTMC. The data accuracy can be analyzed by comparing it to a weather website.

### **Types of Testing – System**

**System Testing:** A System Test is typically required by the contract. System testing is performed on the entire system in the context of the contract and any governing standards. The testing process is concerned with finding errors that result from unanticipated interactions between subsystems and its components. This test is performed from the RTMC using the SunGuide software. System Tests verify the integration of the RWIS with the SunGuide software and the database servers. Since the System Test involves implementing a new system onto the existing network, it is important to coordinate with the District Network Administrator and the RTMC Manager when performing this test.

The System Test is performed after the successful completion of Subsystem Testing on all subsystems within the project.

From the RTMC using SunGuide® software, the RWIS unit can be accessed. From the Overview page, ensure that the various weather parameters are shown. In this example, note that none of the RWIS sites were operational, therefore the various sensors at the bottom showed Not Applicable.

As shown in the lower window of the Overview page, the key weather measurements are:

Temperature in Fahrenheit

Relative Humidity in percentage

Precipitation type

Precipitation Rate in inches per hour

Wind in miles per hour and direction

Air Pressure in inches of Mercury

Visibility in miles

And finally, the time at which the measurements were polled.

The data that is displayed on the SunGuide RWIS Overview page can be cross checked with the NOAA website. Typically, as shown in this example, the data is acquired from the nearest airport.

### **Types of Testing – 30 Day Acceptance**

According to the FDOT Standard Specifications for Road and Bridge Construction, the 30 Day Acceptance Test only applies to the Dynamic Message Signs. However, typically, the contract documents would require that the 30 Day Acceptance Test be conducted for all of the subsystems, not just the DMS subsystem. Contract language may refer to the 30 Day Acceptance Test as a burn-in period.

The **30 Day Acceptance Test** commences after the System Test has been successfully completed. If any equipment on the subsystem fails to operate during the 30 day period, testing of the entire system will be restarted. The Engineer may select to pause and extend the 30 day test period by the number of days lost by failure and repair time in lieu of restarting the full 30 day test. The Engineer will submit to the Contractor a letter of approval and completion stating the first and last day of the 30 day test period.

The 30 Day Acceptance Test creates an environment whereby the system's operational environment is simulated during the testing. Operational testing consists of a set of steps that RTMC operators perform during their day to day operations. During this 30 Day test period, it is important to prevent access to the RWIS facility to minimize any disruptions to the performance of the equipment being tested.

### **Final Acceptance**

The CEI personnel will perform an inspection for final acceptance of device installations as part of all work under the Contract in accordance with FDOT Standard Specifications Section 5-11. The inspection will be performed only after satisfactory completion of the 30 Day Acceptance Test.

All punch list items must be completed by the Contractor or Design-Build Firm prior to the final construction inspection. When, upon completion of the final construction inspection of the entire project, the Engineer determines that the Contractor has satisfactorily completed the work, the Engineer will submit written notice of final acceptance to the Contractor.

The Contractor will transfer warranties and guarantees on all equipment to the Department in accordance with FDOT Standard Specifications Section 608.

All documents, firmware and software and spare parts must be furnished to the Department by the Contractor or Design-Build Firm. Documents such as User Manual, Operation Manual, Troubleshooting and Service Manual Assembly and Installation Instructions, Training Materials, Equipment Warranty, FDOT ITS Inspection Checklist, Firmware and Software Licenses, Test Results, Field Inventory List, ITS Facilities Management data, Spare Parts list, IP Address List and any As-Builts drawings should be provided to the Department.

## **Partial Acceptance**

The Engineer may also perform an inspection for partial acceptance under the Contract in accordance with FDOT Standard Specifications Section 5-10 of a device installation upon its completion in accordance with the Contract Documents.

Partial Acceptance occurs when only one system such as the RWIS is tested and approved.

Prior to performing an inspection for partial acceptance, the Engineer will require the satisfactory completion of the 30-Day Acceptance Test of completed installations in accordance with the requirements of FDOT Standard Specifications Section 611-4. The Engineer will perform an inspection for partial acceptance in accordance with FDOT Standard Specifications Section 5-10 in company with a Contractor's representative and, when applicable, a representative of the agency designated to accept maintenance responsibility.

## **Document Review – Post Construction**

All of the inspection aspects covered here are also in the newly developed FDOT Field Acceptance Test Procedures, developed by the State Traffic Engineering and Operations Office.

Prior to final acceptance, the Contractor will submit the following documentary items obtained from the manufacturer:

1. Operations and Maintenance Manual
2. Troubleshooting and Service Manual
3. Assembly and installation instructions
4. Pictorial layout of components and schematics for circuit boards
5. Parts list
6. Diagram of the field installation wiring
7. Warranty information

Look through the data, make sure that two copies of the operation manual, trouble shooting and service manual, and the assembly and installation instructions are provided. Some manufacturers combine part or all of these documents, so you may not actually see all three, but make sure that if not provided separately, they are, at minimum, components of a larger, comprehensive manual.

Make sure that the manuals for the RWIS sensors, SPDs, Cables, and the Power Supply are submitted.

The Contract and the project governing standards may require the Contractor to provide training on the RWIS. The Contractor will supply the training material, which is typically the User's Manual.

Ensure that the RWIS has a manufacturer's warranty covering defects for a minimum of one year from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608. Ensure that the calibration certification period for the sensors lie beyond the warranty date.

The Contractor may also purchase an extended warranty to warrant the product for a longer duration, if required by the Contract.

Check the project specifications for additional warranty requirements.

Make sure information on warranty return service is provided.

Make sure the owner is named by the warranty provider.

Make sure there is a Warranty for all components including: Sensors, Remote Processing Unit, Surge Protection Device.

Surge Protective Devices should have a 10 year warranty.

### **Resources and Documentation**

Please see the following resources for further information.

The Statewide Construction Quality Assurance and Quality Control Inspection Guide List is a multi-sectioned document that references the FDOT Standard Plans Index and Standard Specifications.

ITSFM is a statewide database that tracks the inventory of the ITS devices. The information contained in this database include the make, model, serial number, manufacture date, firmware, MAC address, IP address, geographical location, and install date.

### **Thanks for Attending**

This concludes the Intelligent Transportation Systems Construction Engineering and Inspection Training, for the Road Weather Information System. For more information about Construction Engineering and Inspection Training, please contact the State Traffic Engineering and Operations Office, Transportation Systems Management and Operations Section. To print your certificate, please select the "Print Certificate" button or press Shift + P on your keyboard. Thank you for your time and attention.

## Knowledge Check

1. Which of the high-level ITS Project High Level Phases listed below typically happens first?
  - a. Testing & Burn-In Period
  - b. Field Acceptance Test
  - c. **Design & Testing**
  - d. Construction & Testing
  
2. Determine whether the following statement is TRUE or FALSE. "A test plan is required for each and every test to be conducted for an RWIS unit installation"
  - a. **true**
  - b. false
  
3. Determine whether the following statement is TRUE or FALSE. "The Final Acceptance Test for an RWIS installation occurs after the RWIS unit Burn-In Period"
  - a. **true**
  - b. false
  
4. The first verification of SunGuide® software integration between the RWIS unit and database servers occurs during the:
  - a. Field Acceptance Test
  - b. Sub-system Tests
  - c. **System Test**
  - d. Final Acceptance Test
  
5. Which of the following is NOT true regarding the Final Acceptance Test?
  - a. The Final Acceptance Test is the final test conducted before the RWIS unit is accepted by the FDOT.
  - b. **Only a majority (greater than 50 percent) of project punch list items must be completed before the Final Acceptance Test.**  
Acceptance Test is conducted.
  - c. All documents, firmware and software and spare parts must be furnished prior to the Final Acceptance Test.
  - d. The Burn-In Period has been performed prior to the Final Acceptance Test.