

STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
KANSAS	87 N-0684-01	2019	95	109

### 20.3.2 CCTV VIDEO CAMERA THROUGHPUT TEST

Ensure that this test demonstrates that video data from the CCTV camera can be manually selected on the IP network switch and be displayed on a workstation monitor at a KDOT designated facility.

### 20.3.3 CCTV STAND-ALONE TEST

Following the installation, conduct an approved stand-alone test for each CCTV to verify that the units operate as specified. If a unit fails to pass the stand-alone test, correct or replace the unit, and repeat the test until proven successful.

For each unit of equipment, conduct approved stand-alone tests that exercise all stand-alone functional operations of the equipment including the following: control of focus, iris, and power on/off; range of pan, tilt, zoom and digital zoom; presence and quality of video signal; camera ID and preset text generation; and pan and tilt limit stops are set to the Engineer's specification.

Stand-alone test the CCTV camera assembly for no-less-than 24 hours as a complete unit to include the CCTV camera, all cabling, all surge suppression, video encoder and/or IP network switch (if applicable) as required per project plans and specifications. This testing will require that each CCTV location be connected to a laptop to exercise the CCTV camera functionality.

### 20.3.4 CCTV SUBSYSTEM TEST

Verify the video transmission quality; response to all central software commands identified under functional requirements; horizontal and vertical resolution; and verify the video transmission quality to the KDOT designated facility. Conduct the subsystem test in the following order: Test with vendor software at site, test with KDOT ATMS software, verify video transmission at site, and verify video transmission at KDOT designated facility. Test video for smooth frame transmission, good color, and overall image quality. Ensure no video locking.

### 20.3.5 CCTV TEST PERIOD AND FINAL ACCEPTANCE

The test period for each CCTV will be 60 days, to commence when all work has been completed, materials have been furnished and completely installed, and copies of the CCTV test results have been received and accepted by the Engineer. Final system acceptance for each CCTV camera will be defined as when the CCTV camera assembly has been operated continuously and successfully for 60 calendar days with no more than 2 calendar days downtime due to mechanical, electrical, and/or other malfunctions.

### 20.4 DYNAMIC MESSAGE SIGN TEST

Perform the DMS test to evaluate the functionality of the installed DMS signs as well as the communication links between the controller and the KDOT central software. Use vendor software and KDOT's current NTCIP-compliant central software for this test. This testing will require that each DMS location be connected to a laptop to exercise DMS functionality. Contact and coordinate with the DMS manufacturer to power up the unit and perform sign commissioning. Provide all equipment required to complete testing.

#### 20.4.1 DMS STAND-ALONE TEST

Following the installation, including power connectivity, conduct an approved stand-alone test for each DMS assembly to verify that the unit operates as specified. Complete the stand-alone test for each DMS within two weeks following the installation of the DMS case, cabinet, power, and communication links. If a unit fails to pass the stand-alone test, correct or replace, and repeat the test until proven successful.

Perform the stand-alone test for the DMS system using both the controller front display panel and a laptop. Provide the laptop. The DMS manufacturer shall provide the vendor software for the test.

#### 20.4.2 DMS COMMISSIONING

Manufacturer shall perform on-site DMS commissioning including communication testing with KDOT central software. DMS commissioning includes the following items: DMS system is installed correctly, DMS system is functioning correctly, DMS is ready for normal operations without the need for an additional site visit, record of all tests and setup tests performed. Manufacturer shall provide procedures. DMS commissioning shall include the following tests in this order: test with vendor software at site, test with KDOT central software, verify transmission at site, verify transmission at KDOT facility.

#### 20.4.3 DMS TEST PERIOD AND FINAL ACCEPTANCE

Test each DMS for a 60-day test period, to commence when all work has been completed, materials have been furnished and completely installed, and copies of the DMS stand-alone and commissioning test results have been received and accepted by the Engineer. Final system acceptance for each DMS will be defined as when the DMS assembly has been operated continuously and successfully for 60 calendar days with no more than 2 calendar days down time due to mechanical, electrical, and/or other malfunctions.

### 20.5 VEHICLE DETECTOR TEST

Test each radar vehicle detector to confirm the accuracy of the data reported to the KDOT designated facility staff.

#### 20.5.1 VOLUME

Use human observers to count the vehicles in each lane during a 15 minute interval. The total for each lane shall be compared with the lane total for the same period reported by the central computer. The totals from the computer and from the observers must not differ by more than 10 percent for every lane.

#### 20.5.2 SPEED

Conduct this test one lane at a time. Use a trained, experienced operator with a LIDAR gun to measure the speeds of individual vehicles, excluding large trucks, in the lane. Measure as many vehicles as possible in a 10 minute period and the results averaged. Calculate a weighted average speed for the same period based on data from the central computer. Weight the speed for each reporting period by the number of vehicles in that reporting period. The speeds from the computer must be within fifteen percent of the observed speed for every lane. If vehicles in the closest lane interfere with speed measurements in other lanes, provide a means of elevating the observer enough to provide a clear line of sight to the vehicles being observed.

#### 20.5.3 VEHICLE DETECTOR TEST PERIOD AND FINAL ACCEPTANCE

Test each Vehicle Detector for a 60-day test period, to commence when all work has been completed, materials have been furnished and completely installed, and copies of the test results have been received and accepted by the Engineer. Final system acceptance for each Vehicle Detector will be defined as when the detector has been operated continuously and successfully for 60 calendar days with no more than 2 calendar days downtime due to mechanical, electrical, and/or other malfunctions.

#### 20.6 WIRELESS DATA COMMUNICATIONS LINK TEST

Prior to testing an installed link, calculate expected signal strengths for each link and expected throughput. Include the following in the test plans installation documentation for each site: Transmit power setting, antenna type and gain, antenna azimuth, transmit frequencies (or channel/band for broadband equipment), antenna height, and minimum receive power for the applicable modulation scheme/throughput as provided by the manufacturer. Include in the test reports: signal quality, modulation scheme selected (or selected by device if automatic), link throughput for TCP and UDP protocols using a tool such as Iperf over a period of no less than 60 seconds and packet loss over a period of no less than 60 seconds. Include in the test report comparisons of observed and expected throughput for each link. Provide test results to the Engineer.

#### 20.7 FIBER OPTIC CABLE INSTALLATION TEST

Provide sample OTDR test results to the Engineer for approval before testing begins. As indicated on the form, the actual link loss must be less than the calculated maximum for each fiber and no unexplained events shall exist. If any fiber fails to satisfy the specified performance requirements in the 1310 nm or 1550 nm wavelength tests, determine the cause and correct the failure to the satisfaction of the Engineer. Provide electronic copies of all test results to the Engineer. Provide test results with a summary table indicating fiber data, calculated losses, 1310 nm results, 1550 nm results, and fiber identification.

Testing must meet the loss budget as shown below:

Allowed Loss Per	
Kilometer (km)	0.35 dB
Splice (Average)	0.05 dB
Connector (Average)	0.2 dB

A maximum loss of 0.3dB is allowed for any single splice  
A maximum loss of 0.5dB is allowed for any single connector

A loss budget calculation spreadsheet may be provided by the Engineer.

After all splices and terminations have been completed, test each fiber, including spares, with a power meter/stable laser source and OTDR between termination points. Test fiber optic cables bi-directionally. Provide launch cable when testing.

Conduct power meter tests for each fiber to demonstrate connectivity and attenuation from origin to destination. Model this test after FOTP-171 insertion loss. Demonstrate that the attenuation for each fiber path including connectors, and splices as a whole, comply with the loss budgets required by these documents and the optical equipment being installed. Submit a test result summary sheet showing calculated attenuation, splice and connector losses and tested loss for each fiber to the Engineer for review and approval. Test between termination and ITS Cabinets as designated by the Engineer.

In addition to the above, conduct bidirectional OTDR and power meter tests end to end. End to end is defined as KDOT designated facility to field device. This includes tests for each fiber from the designated KDOT facility to the field device.

Conduct the tests at test wavelengths of 1310 nm and 1550 nm. Prior to testing, provide the Engineer with an example test sheet for approval that includes OTDR and power meter test data as well as physical characteristics of the fiber optic cable and the cable run. Provide OTDR trace results in a graphical form acceptable to the Engineer.

Coordinate with CenturyLink, if necessary, to verify testing and confirm results. If problems are identified caused by CenturyLink coordination or backbone splicing that require additional site visits, Contractor shall document and notify KDOT. Additional expenses from extra site visits to establish and test connectivity as a result of CenturyLink coordination or backbone splicing shall be approved by KDOT in advance.

### 20.8 DOCUMENTATION TECHNICAL REFERENCE MANUAL (TRM)

Contractor shall coordinate with Engineer to locate and compile all vendor-supplied component information required by these Specifications into a Technical Reference Manual (TRM). The TRM shall be submitted on a flash drive and/or downloadable files. Submit a draft version of the TRM with all available sections two (2) weeks prior to the commencement of the 60-day test period for any device or system. The Engineer will review the draft TRM prior to the test period and work with the Contractor to correct any sections prior to the end of the test period. The 60-day test period shall not conclude until a final draft of the TRM has been submitted and accepted by the KDOT ITS unit. The 60-day test period may be stopped at any time by the Engineer if corrections to the TRM are not made in a timely manner.

Include in the TRM, as a minimum, the following subsections:

1. Master Items Index
2. Project Information, Documents, and As-Builts
3. Device Documentation
4. Configuration Files
5. Test Results
6. Warranties
7. Cable and Conductors Certifications
8. Splice Vault / Pull Box Documentation
9. GPS Documentation and Tie-Point Measurements
10. In-Cabinet Documentation

#### 20.8.1 MASTER ITEMS INDEX

Provide a master items index or table of contents as the first section of the TRM.

#### 20.8.2 PROJECT INFORMATION, DOCUMENTS, AND AS-BUILTS

Contain in this section any documents pertaining to the project.

Include an as-built plan set. Legibly mark plans in a contrasting, reproducible color to depict any changes or deviations that have been made to the plans, including buried or concealed construction and utility features that are revealed during the course of construction. Record the locations of all buried utilities that differ from the location indicated or that were not indicated on the contract plans. Include as-built communication schematic drawings. Supplement as-built documents with detailed sketches or pictures as necessary or directed, to indicate existing conditions and the work as constructed.

Include approved permits in electronic .PDF form including railroad, waterway, bridge, and city permits.

Include a table listing each new power service with corresponding addresses, service type, and utility contact information.

#### 20.8.3 DEVICE DOCUMENTATION

Contain in this section user manuals for all vendor-supplied software and equipment that describes how to operate each component of the system and each particular type of equipment and software.

Tab or highlight in the manual fault diagnostic and repair procedures to permit the location and correction of faults to the level of each replaceable module. In addition, tab or highlight preventative maintenance procedures in order to maintain the performance parameters of each component of the various systems, equipment and cables within the requirements of the specifications.

Include a list of all parts with a description, part number, and a directory of recommended suppliers with correspondence address and telephone number.

Include all final submittals and drawings as electronic PDF with bookmarks. Final submittals shall include: structural weld drawings, system wiring or block diagrams, and cabinet rack elevations.

NO.	DATE	REVISIONS	BY	APP'D
KANSAS DEPARTMENT OF TRANSPORTATION				
ITS EQUIPMENT SPECIFICATIONS				
<del>ITS-S13</del> VERSION DATE: 05-29-17				
APP'D	DESIGNED	DETAILED	QUANTITIES	TRACED
DESIGN CK.	DETAIL CK.	QUAN. CK.	TRACE CK.	