COMMUNICATION CABINET TEST PROCEDURE

1. DEVICE NAMING COORDINATION

1.1. The System Integrator shall coordinate with the TMC/ROC to identify the device names for each device.

1.2. The System Integrator shall then send a request to TOTS to identify the network name, IP address, and any pertinent configuration information.

2. EXPLANATION – STANDALONE (SALT) TESTING

2.1. The System Integrator shall work with the DEVICE VENDOR (if required by the testing form) and complete the NDOT specified SALT tests (non-network) on each unit of equipment after installation.

2.2. Conduct SALT testing on each unit of equipment as outlined on the NDOT provided testing form.

2.3. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.

2.4. The System Integrator shall submit the DEVICE vendor commissioning documents, if applicable, with the SALT testing to the Engineer for review and approval.

2.5. Supply a bucket truck and operator, or suitable equivalent equipment necessary to carry out procedures as required by the testing documents, at no direct payment.

COMMUNICATION CABINET (COMM CABINET) SALT PROCEDURE

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
Comm Cabinet Name:		**IP Address:**	**GPS:**
TOTS Network Name:		**Associated Cabinet Name:**	
Purpose and General Verification			
System Integrator: *This SALT tests the proper installation of a functional Comm Cabinet. The system integrator will use a laptop to perform this test. Using the manufacture's software, the integrator will be able to verify the Comm Cabinet is operational.* ***General Verification****: For each test below, complete the Comm Cabinet SALT Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH Comm Cabinet being tested.*			
Equipment Information			
1.	Verify Comm Cabinet Information using the manufacturer label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____N/A_____**	Pass / Fail
2.	Verify GPS transceiver Information using the manufacturer software or device label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____**	Pass / Fail
3.	Verify universal power supply (UPS) or battery backup system (BBS) Information using the manufacturer software or device label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____**	Pass / Fail
4.	Verify external antenna Information using the manufacturer software or device label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____**	Pass / Fail
5.	Verify power distribution unit (PDU) Information using the manufacturer software or device label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____**	Pass / Fail
6.	If applicable, verify Field Hardened Ethernet Switch (FHES) Information using the manufacturer software or device label.	**Manufacturer: _____** **Model: _____** **Serial Number: _____** **Firmware Version: _____**	Pass / Fail / N/A

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
7.	Verify Comm Cabinet material.	Circle one: Aluminum Steel Approved Metal: _____	Pass / Fail
8.	Manufacturer's commissioning of Comm Cabinet equipment.	Manufacturer confirmation of full operation of all Comm Cabinet -associated equipment.	Pass / Fail
Equipment Verification			
9.	Verify Comm Cabinet meets internal and external dimensions and features as specified in the current NDOT Std. Plan	Comm Cabinet meets specified internal and external dimensions and features as specified in the current NDOT Std. Plan.	Pass / Fail
10.	If applicable, the side-mounted cabinet is supported into the foundation.	The side-mounted Comm Cabinet is independently supported and anchored to the foundation.	Pass / Fail / N/A
11.	Verify all external labeling is accurate and conforms to the current NDOT Std. Plan.	External labels conform to the current NDOT Std. Plan.	Pass / Fail
12.	Verify all cabling is labeled with the to/from on each end and at any major transition point and is neatly managed throughout the cabinet.	All premise or inside plant cables originating and ending in the cabinet are properly terminated and labeled. Labeling material rated for Outside Plant (OSP) use. Cables are neatly managed using adjustable hook-and-loop fastener straps.	Pass / Fail
13.	Provide the power one-line or block diagram.	The power one-line or block diagram has been delivered to NDOT Engineer.	Pass / Fail
14.	Using a meter, verify the system is properly bonded to earth ground.	Meter reading of 5 Ohms or less.	Pass / Fail
15.	Verify exothermic weld bonds are properly welded.	Exothermic weld bonds are verified for proper adhesion.	Pass / Fail
16.	Verify the installation of bolts in the required and expected locations.	Bolts are installed in the proper locations.	Pass / Fail
17.	Verify all bolts are torqued to manufacturer's recommendations.	All bolts are torqued to manufacturer's recommendations.	Pass / Fail
18.	Verify the cabinet interior and exterior are painted or powder coated white in conformance with the Special Provisions.	The cabinet interior and exterior are painted or powder coated white in conformance with the Special Provisions.	Pass / Fail
19.	Verify the cabinet interior and exterior are in good condition with no visible damage.	The cabinet interior and exterior are free of dents, scratches, or other defects.	Pass / Fail

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
20.	Verify the cabinet is firmly anchored or mounted in position.	Cabinet is firmly anchored to the foundation or mounted to the standard.	Pass / Fail
21.	Verify the door vents have louvre vent covers.	Louvre vent covers are present.	Pass / Fail
22.	If applicable, verify the agency-approved lock conforms to the requirements of the agency responsible for this specific cabinet.	The agency-approved lock conforms to the responsible agency's requirements.	Pass / Fail / N/A
23.	If applicable, verify the agency-approved lock operates properly.	Agency-approved lock unlocks and locks as expected.	Pass / Fail / N/A
24.	Verify both the front and rear cabinet door lock teeth are oriented upward.	Both the front and rear cabinet door lock teeth are oriented upward.	Pass / Fail
25.	Verify the front cabinet door lock operates properly.	Front cabinet door lock unlocks and locks as expected.	Pass / Fail
26.	Verify the condition and proper operation of the front cabinet door.	The front cabinet door is free of dents, scratches, or other defects. The front cabinet door opens freely.	Pass / Fail
27.	Verify the condition and proper operation of the front top and bottom doorstop arms.	The front top and bottom doorstop arms is free of dents, scratches, or other defects.	Pass / Fail
28.	Verify proper operation of the front top and bottom doorstop arms.	The front top and bottom doorstop arms keep the door open securely in place.	Pass / Fail
29.	Verify the rear cabinet door lock operates properly.	Rear cabinet door lock unlocks and locks as expected.	Pass / Fail
30.	Verify the condition and proper operation of the rear cabinet door.	The rear cabinet door is free of dents, scratches, or other defects. The rear cabinet door opens freely.	Pass / Fail
31.	Verify the condition and proper operation of the rear top and bottom doorstop arms.	The rear top and bottom doorstop arms is free of dents, scratches, or other defects. The rear top and bottom doorstop arms keep the door open securely in place.	Pass / Fail
32.	Verify proper operation of the rear top and bottom doorstop arms.	The rear top and bottom doorstop arms keep the door open securely in place.	Pass / Fail
33.	If applicable, verify the side-mounted cabinet is firmly anchored or mounted in position.	Side-mounted cabinet is firmly anchored to the foundation or mounted to the standard.	Pass / Fail / N/A
34.	If applicable, verify the side-mounted cabinet door lock teeth are oriented upward.	side-mounted cabinet door lock teeth are oriented upward.	Pass / Fail / N/A
35.	If applicable, verify the side-mounted cabinet door lock operates properly.	Side-mounted cabinet door lock unlocks and locks as expected.	Pass / Fail / N/A

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
36.	If applicable, verify the condition and proper operation of the side-mounted cabinet door.	The side-mounted cabinet door is free of dents, scratches, or other defects. The side-mounted cabinet door opens freely.	Pass / Fail / N/A
37.	If applicable, verify the condition and proper operation of the side-mounted cabinet top and bottom doorstop arms.	The side-mounted cabinet top and bottom doorstop arms is free of dents, scratches, or other defects. The side-mounted cabinet top and bottom doorstop arms keep the door open securely in place.	Pass / Fail / N/A
38.	If applicable, verify proper operation of the side-mounted cabinet top and bottom doorstop arms.	The side-mounted cabinet top and bottom doorstop arms keep the door open securely in place.	Pass / Fail / N/A
39.	Verify the interior cabinet light and fan are intact and securely mounted in the cabinet.	The interior cabinet light and fan are securely mounted.	Pass / Fail
40.	Verify the interior cabinet light and fan are in good condition with no visible damage.	The interior cabinet light and fan are free of dents, scratches, or other defects.	Pass / Fail
41.	Perform Megger test on cabinet ground per Megger tester directions using three-terminal-fall-of-potential method.	The Megger test value provides resistance to ground of 5 Ohms or less.	Pass / Fail
42.	Verify the presence of separate and isolated ground bus bars for equipment grounding and power conductor grounding.	The commercial AC ground is tied back to the service pedestal. The equipment ground is tied locally to the ground rod or local grounding method.	Pass / Fail
43.	Verify the Comm Cabinet is free from 60Hz noise using an oscilloscope.	The Comm Cabinet produces a non-distorted AC sine wave between the power conductor (load 1 and/or load 2) and neutral bus bar, neutral bus bar and ground bus bar, and power conductor (load 1 and/or load 2) and ground bus bar.	Pass / Fail
44.	Verify the fans turns on and off.	The fans turn on and off.	Pass / Fail
45.	Verify the fans turns on when temperature exceeds 65°F.	The fans turn on when the temperature exceeds 65°F.	Pass / Fail
46.	Verify the fans turn off when temperature falls below 65°F.	The fans turn off when the temperature falls below 65°F.	Pass / Fail
47.	For each door, verify the cabinet LED lights turn on/off when the door actuator push button switch is activated/deactivated.	The cabinet LED lights turn on/off when the door actuator push button switch is activated/deactivated.	Pass / Fail
48.	Verify each power receptacle produces 120VAC.	Each power receptacle reads between 115 and 125 VAC.	Pass / Fail

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
49.	Verify the operation of each breaker.	Each breaker is activated when in the on position. Each breaker is deactivated when in the off position.	Pass / Fail
50.	Verify the presence of a replaceable pleated paper filter behind the door vents.	A replaceable pleated paper filter is inserted behind the door vents.	Pass / Fail
51.	Verify the presence of the dual circuit, IP addressable 120 VAC 16-outlet rack mounted PDU.	The dual-circuit PDU is present.	Pass / Fail
52.	Verify each of the 16-outlets in the dual-circuit PDU are remotely and individually operated.	Each outlet in the dual-circuit PDU provides between 115 and 125 VAC when in the "On" status and ceases to provide power when in the "Off" status. Each outlet is operable remotely and individually of each other	Pass / Fail
53.	Verify the programmability of events for PDU.	PDU is able to be programmed with events.	Pass / Fail
54.	Verify the ground fault circuit interrupt (GFCI) is functional.	The GFCI outlet breaker trips and is reset when the test and reset buttons are pressed.	Pass / Fail
55.	If applicable, verify the power distribution assembly (24/120 V rack (206 shelf) for ramp metering only) maintains power after removing and replacing the fuses.	Voltage reads 24VDC, +/-3VDC after removal and replacement of fuses.	Pass / Fail / N/A
56.	If applicable, verify the presence of a Field Hardened Ethernet Switch (FHES).	A FHES is present and properly secured in the cabinet.	Pass / Fail / N/A
57.	Verify the presence of a native IP GPS transceiver.	A native IP GPS transceiver is present and properly secured in the cabinet.	Pass / Fail
58.	Verify the geocoordinate location using the GPS transceiver.	LAT: _____ LONG: _____	Pass / Fail
59.	Verify the coordinates transmitting from the GPS transceiver match the actual Comm Cabinet coordinates.	GPS transceiver coordinates match the actual Comm Cabinet coordinates.	Pass / Fail
60.	If applicable, verify the presence of an uninterruptible power supply (UPS) or battery backup system (BBS).	UPS or BBS is present and properly secured in the cabinet or side mounted cabinet.	Pass / Fail / N/A
61.	If applicable, operate the UPS/BBS for 20 minutes without AC input power and under load.	The UPS/BBS shall power connected devices and transition back to utility power when AC power is restored.	Pass / Fail / N/A

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
62.	If applicable, verify the failover functionality of the UPS or BBS.	Failover procedure performs as expected.	Pass / Fail / N/A

Signatures

DATE	AGENCY/FIRM	PERFORMED BY (Print Name) (Integrator)	INTL	AGENCY/FIRM	WITNESSED BY (Print Name) (NDOT)	INTL

Integrator Signature	
NDOT RE Signature	
NDOT TOTS Signature	

3. EXPLANATION - SUBSYSTEM (SST) TESTING

3.1. At the beginning of the SST phase, the System Integrator shall submit, in PDF format and original signed hard copies of the certified SALT results for approval by the Engineer.

3.2. The Engineer shall approve all SALT testing prior to the System Integrator starting the SST testing.

3.3. Conduct SST testing in accordance with NDOT's testing documentation for all field and related equipment once the system has been interconnected to form a complete subsystem (i.e. Network connectivity).

3.4. The SST test shall demonstrate connectivity to all field equipment utilizing NDOT's current freeway management system (FMS).

3.5. The SST test consists of a 45-day period of operations without major failure of equipment. The Resident Engineer can require the SST be restarted if any major failure occurs. A major failure for the Communication Cabinet is defined as:

3.5.1. Any failure of the equipment associated with the PRIMARY FUNCTION of the Communication Cabinet.

3.6. Demonstrate that the total system (hardware, firmware, software, materials, and construction) are properly installed, free from problems, exhibits stable and reliable performance, and meets project requirements.

3.7. Once per week, the System Integrator shall demonstrate that all system functions tested in the SST are operational and meets requirements.

3.8. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.

3.9. The System Integrator must provide proof that each device has been tested each week for the duration of the testing period witnessed by an NDOT representative.

3.10. The testing time must be scheduled a minimum of one week prior and coordinated and approved by the Resident Engineer and the Construction Crew.

COMMUNICATION CABINET (COMM CABINET) SST PROCEDURE

TEST #	SST TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL

Comm Cabinet Name:		**IP Address:**		**GPS:**	
TOTS Network Name:		**Associated Cabinet Name:**			

Purpose and General Verification

System Integrator: *This SST tests the proper installation of a functional Comm Cabinet. The system integrator will use an Operator Workstation at the TMC/ROC to perform this test.*

General Verification*: For each test below, complete the Comm Cabinet SST Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH Comm Cabinet being tested.*

System Information

All references to Comm Cabinet network equipment, network equipment, Comm Cabinet network components, Comm Cabinet devices, Comm Cabinet equipment, etc. are in reference to any and all IP capable, networkable, etc. devices, which include but is not limited to the universal power supply (UPS), power distribution unit (PDU), GPS transceiver, field hardened ethernet switch (FHES), cellular modem, and microwave radio.

1.	Verify network connectivity of Comm Cabinet network equipment by issuing a ping test from a workstation located at the TMC/ROC.	Comm Cabinet network equipment responds to the ping test.	Pass / Fail
2.	Verify Comm Cabinet network equipment device operation with system turned on from a workstation located at the TMC/ROC.	Visual confirmation of Comm Cabinet network equipment device activation.	Pass / Fail
3.	Verify Comm Cabinet UPS/BBS and PDU SMTP functionality by sending a test email.	Comm Cabinet UPS/BBS and PDU correctly sent an email to the TMC/ROC.	Pass / Fail
4.	Verify Comm Cabinet network equipment device operation with system turned off from TMC/ROC.	Visual confirmation of field device deactivation.	Pass / Fail
5.	Verify Comm Cabinet network equipment device access to the Web User Interface (UI) from the TMC/ROC.	Web User Interface (UI) is accessible.	Pass / Fail
6.	Verify the PDU's network clock.	The PDU's network clock syncs to the Traffic Operations Technology Section (TOTS) NTP server.	Pass / Fail

Signatures

SST DAY	DATE	**PERFORMED BY**(Integrator)	INTL	**WITNESSED BY**(NDOT)	INTL
1					
8					

15					
22					
29					
36					
45					
Integrator Signature					
NDOT Signature					
NDOT TOTS Signature					