

WSDOT Test Method T 425

Test Method for NEMA Type Traffic Controller Cabinet, 300 Series (Type 170/2070) Traffic Controller Cabinet, and Advanced Transportation Controller (ATC) Cabinet Environmental Chamber Testing

1. Scope

The purpose of this test method is to evaluate Traffic Controller Cabinet operation at environmental extremes. The environmental extremes in this document are derived from the reference documents listed below. To maintain uniformity and efficiency, all environmental extremes and test conditions listed in this document shall take precedence over those listed in each reference document. This test method will subject the Traffic Controller Cabinet to environmental conditions ranging from -30°F (-34°C) with no humidity control to 165°F (74°C) with 18% humidity at line Voltages ranging from 95 V_{ac} to 135 V_{ac}.

2. Reference Documents

- AASHTO/ITE/NEMA Publication ATC 5301, Advanced Transportation Controller (ATC) Cabinet Standard
- Caltrans Transportation Electrical Equipment Specifications
- FHWA-IP-78-16. Type 170 Traffic Signal Controller System Hardware Specification
- NEMA Standards Publication TS-1, Traffic Control Systems
- NEMA Standards Publication TS-2, Traffic Controller Assemblies with NTCIP Requirements

3. Safety

The environmental chamber produces extreme environmental conditions. Exercise caution to prevent injury to personnel and damage to equipment. A Respirator Hood Assembly connected to a supply of breathable air, grade D shall be worn when working inside the chamber at extreme temperatures. Leather gloves shall be worn when handling surfaces inside the chamber at extreme temperatures. Slip-resistant footwear shall be worn inside the chamber at all times.

4. Apparatus

A chamber in which the Unit Under Test (UUT) can be subjected to the environmental conditions specified in section 1 and provide safe access. A temperature recording device shall record the temperature inside the chamber during the test with an accuracy of $\pm 3^{\circ}\text{F}$. The air inside the chamber shall be circulated so that no more than a 3°F variance will occur. The chamber control shall maintain constant absolute humidity from 109°F (43°C) to 165°F (74°C).

Variable Voltage transformer capable of delivering $95 V_{ac}$ to $135 V_{ac}$ at a frequency of $60 \text{ Hz} \pm 3\text{Hz}$.

Digital Multi-Meter (DMM) capable of measuring Voltage with a minimum resolution of 1 Volt.

Resistance load device to simulate each traffic signal light the UUT shall be equipped to operate.

5. Procedure

5.1 Low-Temperature, Low-Voltage Test:

5.1.1 Test Conditions:

- a) Environmental chamber door: closed
- b) Temperature: -30°F (-34°C)
- c) Voltage: $95 V_{ac}$ (see below for exceptions)
- d) UUT door(s): open
- e) Humidity control: off

5.1.2 Test Procedure:

- 5.1.2.1 Place UUT into environmental chamber. While at room temperature, adjust the variable Voltage transformer output to $95 V_{ac}$ ($100 V_{ac}$ for ATC Cabinets, $102 V_{ac}$ for UUTs equipped with both a 2070 Controller and a standard 2010ECL Conflict Monitor Unit). This Voltage shall be monitored with the DMM. Verify that the UUT is fully operational.
- 5.1.2.2 Set the UUT Controller to operate at minimum recall. Lower the environmental chamber temperature to -30°F (-34°C) at a rate not to exceed 30°F (18°C) per hour. The UUT shall be on during the temperature ramp-down.
- 5.1.2.3 Once the temperature has stabilized at -30°F (-34°C), verify the items listed in Table 1 to ensure proper operation.
- 5.1.2.4 Remove power from the UUT. The UUT shall soak at -30°F (-34°C) for a period of 3 hours.

- 5.1.2.5 Restore power to the UUT. Verify that the UUT initiates its start-up sequence and resumes cycling on minimum recall.
- 5.1.2.6 Verify the items listed in Table 1 to ensure proper operation.
- 5.1.2.7 Upon satisfactory completion of this test, proceed to the Low-Temperature, High-Voltage Test.

5.2 Low-Temperature, High-Voltage Test:

5.2.1 Test Conditions:

- a) Environmental chamber door: closed
- b) Temperature: -30°F (-34°C)
- c) Voltage: 135 V_{ac}
- d) UUT door(s): open
- e) Humidity control: off

5.2.2 Test Procedure:

- 5.2.2.1 While at -30°F (-34°C) with the humidity control off, adjust the variable Voltage transformer output to 135 V_{ac}. This Voltage shall be monitored with the DMM.
- 5.2.2.2 Allow the UUT to cycle on minimum recall for a period of 1 hour.
- 5.2.2.3 After 1 hour, verify the items listed in Table 1 to ensure proper operation.
- 5.2.2.4 Upon satisfactory completion of this test, proceed to the High-Temperature, High-Voltage Test.

5.3 High-Temperature, High-Voltage Test:

5.3.1 Test Conditions:

- a) Environmental chamber door: closed
- b) Temperature: 165°F (74°C)
- c) Voltage: 135 V_{ac}
- d) UUT door(s): open
- e) Humidity control: in accordance with Table 2

5.3.2 Test Procedure:

- 5.3.2.1 With the UUT cycling on minimum recall, raise the environmental chamber temperature to 165°F (74°C) at a rate not to exceed 30°F (18°C) per hour. The UUT shall be on during the temperature ramp-up.
- 5.3.2.2 Set the humidity controls not to exceed 95% relative humidity over the temperature range of 40°F (4°C) to 109°F (43°C). When the temperature reaches 109°F (43°C), readjust the humidity control to maintain constant humidity; 109°F (43°C) wet bulb which results in the relative humidities shown in Table 2.
- 5.3.2.3 Allow the UUT to soak at 165°F (74°C), constant humidity for a period of 10 hours.
- 5.3.2.4 After 10 hours, verify the items listed in Table 1 to ensure proper operation.
- 5.3.2.5 Upon satisfactory completion of this test, proceed to the High-Temperature, Low-Voltage Test.

5.4 High-Temperature, Low-Voltage Test:**5.4.1 Test Conditions:**

- a) Environmental chamber door: closed
- b) Temperature: 165°F (74°C)
- c) Voltage: 95 V_{ac} (see below for exceptions)
- d) UUT door(s): open
- e) Humidity control: in accordance with Table 2

5.4.2 Test Procedure:

- 5.4.2.1 While at 165°F (74°C) with constant humidity, adjust the variable Voltage transformer output to 95 V_{ac} (100 V_{ac} for ATC Cabinets, 102 V_{ac} for UUTs equipped with both a 2070 Controller and a standard 2010ECL Conflict Monitor Unit). This Voltage shall be monitored with the DMM.
- 5.4.2.2 Allow the UUT to cycle on minimum recall for a period of 1 hours.
- 5.4.2.3 After 1 hour, verify the items listed in Table 1 to ensure proper operation.
- 5.4.2.4 Upon satisfactory completion of this test, proceed to the Nominal-Temperature, Nominal-Voltage Test.

5.5 Nominal-Temperature, Nominal-Voltage Test:

5.5.1 Test Conditions:

- a) Environmental chamber door: closed
- b) Temperature: 68°F (20°C)
- c) Voltage: 120 V_{ac}
- d) UUT door(s): open
- e) Humidity control: off

5.5.2 Test Procedure:

- 5.5.2.1 While at 165°F (74°C) with constant humidity, adjust the variable Voltage transformer output to 120 V_{ac}. This Voltage shall be monitored with the DMM.
- 5.5.2.2 Lower the environmental chamber to 68°F (20°C) at a rate not to exceed 30°F (18°C) per hour. The UUT shall be on during the temperature ramp-down.
- 5.5.2.3 Allow the UUT to cycle on minimum recall for a period of 1 hour.
- 5.5.2.4 After 1 hour, verify the items listed in Table 1 to ensure proper operation.

6. Report

- 6.1 A failure shall be defined as any occurrence which results in other-than-normal operation of the UUT; refer to 6.2 for details. If a failure occurs, the UUT shall be repaired or components replaced by the vendor, and the test during which the failure occurred shall be restarted from the beginning.
- 6.2 The UUT is considered to have failed if any of the following occur:
 - a) If the UUT skips intervals or interval portions, places false calls, presents false indications, exhibits disruption of normal sequence, produces changes in timing, or
 - b) If the UUT fails to satisfy the requirements of any portion of section 5
- 6.3 An analysis of the failure shall be performed and corrective action taken before the UUT is retested in accordance with this document. The analysis must outline what action was taken to preclude additional failures during the tests.
- 6.4 Upon completion of the tests, the UUT shall be visually inspected. If material changes are observed which will adversely affect the life of the UUT, the cause and conditions shall be corrected before material acceptance.

- 6.5 Record and report all findings, corrective actions, and pass/fail results taken on the test report. Verification tests shall be recorded in MATS as “As Received” if sufficient, and “As Shipped” if deficient but corrected. Inspection tests that do not apply shall have neither option checked. The overall test result shall be recorded as a “Pass” or “Fail” for test T425 in MATS.

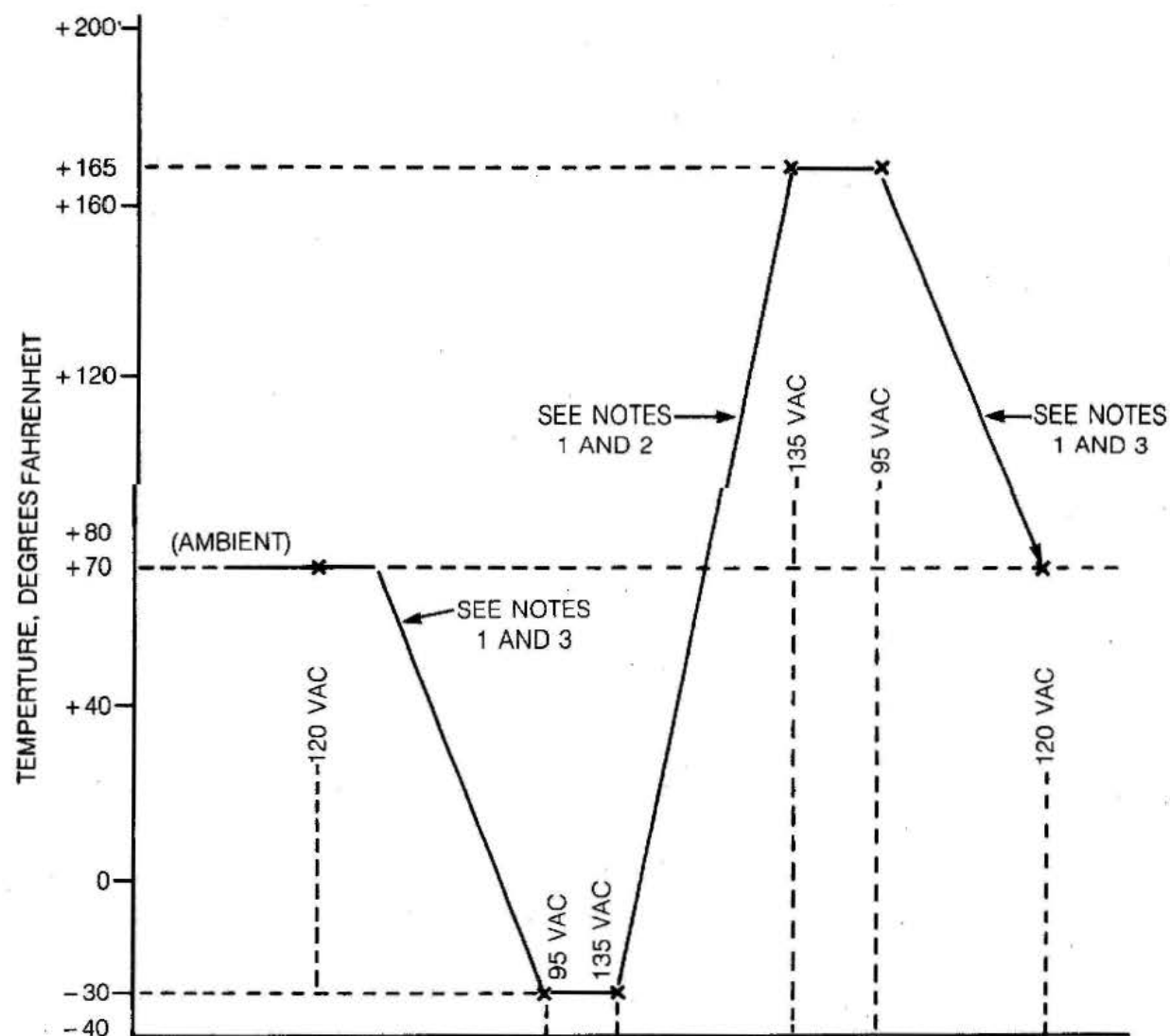
Table 1 Functional Verification

Item Number	Item Description
1	Verify the function of the intersection display panel switches (if equipped).
2	Verify the function of the police panel switches.
3	Verify the function of the stop-time switch (inside).
4	Verify the function of the auto/flash switch (inside).
5	Reserved for future use.
6	Verify the function of external logic (NEMA, if equipped).
7	Verify the function of the loop detection panel (if equipped).
8	Verify the function of the pre-emption pushbutton on the door (NEMA, if equipped).
9	Verify the function of the pre-emption switches on the phase selectors.
10	Verify the operation of the emergency indication light (if equipped).
11	Verify the CMU/MMU is functioning properly.

Table 2 Wet-Bulb Dry-Bulb Relative Humidity at Barometric Pressure of 29.92 inHg (Sea Level)

Dry Bulb		Relative Humidity, Percent (For Dynamic Testing)	Wet Bulb	
°F	°C		°F	°C
40	4.4	75	37	2.8
50	10.0	80	47	8.3
60	15.6	83	57	13.9
70	21.1	86	67	19.4
80	26.7	87	77	25.0
90	32.2	89	87	30.6
100	37.8	89	97	36.1
110	43.3	90	107	41.7
120	48.9	70	109	42.8
130	54.4	50	109	42.8
140	60.0	38	109	42.8
150	65.6	28	109	42.8
160	71.1	21	109	42.8
165	73.9	18	109	42.8

Figure 1 Environmental Test Profile



NOTE 1 – The rate of change in temperature shall not exceed 30°F (18°C) per hour.

NOTE 2 – Humidity controls shall be set in accordance with the humidities given in Table 2 during the temperature change between the Low-Temperature and High-Temperature tests.

NOTE 3 – If a change in both Voltage and temperature are required for the next test, the Voltage shall be selected prior to the temperature change.

Performance Exam Checklist

Test Method for NEMA Type Traffic Controller Cabinet, 300 Series (Type 170/2070) Traffic Controller Cabinet, and Advanced Transportation Controller (ATC) Cabinet Environmental Chamber Testing
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Participant Name _____ Exam Date _____

Procedure Element

Yes No

1. Test Setup – Place UUT into the Environmental Chamber
2. Low-Temperature, Low-Voltage Test
3. Low-Temperature, High-Voltage Test
4. High-Temperature, High-Voltage Test
5. High-Temperature, Low-Voltage Test
6. Nominal-Temperature, Nominal-Voltage Test
7. Report

First Attempt: Pass Fail Second Attempt: Pass Fail

Signature of Examiner _____

Comments:

