



## HVAC Module Evaporator Condensate Management

### 1 Introduction

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**1.1 Purpose.** The objective of this test is to ensure that condensate generated on the evaporator surfaces drains through the Heating, Ventilation, Air Conditioning (HVAC) module drain with no condensate coming out of air outlets, module joints or blower scroll and that no condensate is trapped within the module. Total evacuation of condensate from the module reduces the risk in mildew odors and flash fogging.

**1.2 Applicability.** HVAC systems with air conditioning capability.

**1.3 Remarks.** This specification evaluates the HVAC module at a subsystem bench level. For vehicle level testing, see GMW3055.

### 2 References

**Note:** Only the latest approved standards are applicable unless otherwise specified.

#### 2.1 External Standards/Specifications.

None

#### 2.2 GM Standards/Specifications.

GMW3055

#### 2.3 Additional References.

Subsystem Technical Specification (SSTS)

### 3 Resources

#### 3.1 Facilities.

**3.1.1 Calibration.** The test facilities and equipment shall be in good working order and shall have a valid calibration label.

**3.1.2 Alternatives.** Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

**3.2 Equipment.** Test equipment shall have a valid calibration label affixed to it and located in a prominent position.

**3.2.1** A fixture which allows the HVAC module to be oriented in each of the positions shown in Figure A1 in Appendix A.

**3.2.2** Inclinator or appropriate tool for measuring the module tilt angle.

**3.2.3** Test chamber with ambient temperature and humidity control and an air conditioning (A/C) refrigerant loop.

**3.2.4** Twelve (12) Voltage (direct current) (Vdc) power supply.

**3.2.5** Stopwatch.

**3.2.6** Graduated cylinders or beakers for collecting condensate.

**3.2.7** A borescope to capture images and video of dynamic tests.

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**3.3 Test Vehicle/Test Piece.** Includes an HVAC module with all components which affect airflow and condensate management including but not limited to an air inlet plenum, design intent HVAC module cases, blower motor and fan, evaporator, temperature and mode valves, drain hose, and grommet. Laboratory hoses shall not be used to replace the design intent drain tube. Actuators are not required if valves can be controlled manually while not affecting the interface between the valve, actuator, and case as it relates to sealing. If the refrigerant bench is capable of controlling the air outlet conditions specified in 4.2.2.2, a functioning Thermostatic Expansion Valve (TXV) is not required and may be substituted with a dummy, wide-open valve of the same exterior envelope.

The HVAC module seams and outlets shall not be sealed in a way which may impact airflow or condensate leak paths, unless those seals are part of the design intent. Any seals designed to compress against other vehicle components (i.e., Front-of-Dash seals) may be installed but shall not be compressed with auxiliary surfaces during the testing. The HVAC module must contain condensate independent of compression provided by components beyond the scope of the HVAC module.

Clear windows or cameras may be installed in the HVAC module in areas which do not affect HVAC seams or condensate paths to improve visibility. Craft paper or cameras located near each of the module outlets shall be set up to record condensate spitting. Airflow restriction plates or vehicle-specific HVAC ducts should be attached to the module to simulate true airflow back pressure. Methods for visualizing condensate spitting out of the HVAC outlets will need to account for duct or restrictor plate usage.

### 3.4 Test Time.

Calendar time: 2 days  
Test time: 10 h  
Coordination time: Not specified.

**3.5 Test Required Information.** Not applicable.

**3.6 Personnel/Skills.** To be determined by test facility.

## 4 Procedure

**4.1 Preparation.** Weigh the dry evaporator, including the TXV if it will be attached during testing. Weigh the dry HVAC module including all components and instrumentation that will be attached to the HVAC module during testing (not including the lines, fittings, and ducting).

Charge the evaporator with refrigerant and oil and allow the compressor and system to operate for ten (10) minutes to circulate and distribute the refrigerant. Evacuate the evaporator of refrigerant and oil. Weigh the evaporator after it has been evacuated to determine the amount of oil that is retained after evacuation. Repeat the evaporator charge, stabilization, evacuation, and weight measurement two (2) more times to capture variability in the charge and evacuation process. Enter the weight of the dry evaporator, the weight of the dry HVAC module, and the average of the three (3) weights of the evaporator after evacuation in the appropriate fields in Table 4.

### 4.2 Conditions.

**4.2.1 Environmental Conditions.** The module shall be soaked in ambient conditions where the dew point of the chamber is lower than the surface temperature of the module so that condensate does not form on the outside of the module during testing.

**4.2.2 Test Conditions.** Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

#### 4.2.2.1 HVAC Module Settings.

- Air inlet mode set to Outside Air (OSA).
- Start each test with outlet mode set to Vent mode and then follow the direction in the procedure.
- Start each test with temperature valve in Full Cold setting and then follow the direction in the procedure.

**4.2.2.2 Refrigerant Conditions.** Refrigerant type: As specified in program Subsystem Technical Specification (SSTS). If multiple refrigerants are expected over the program life, use whichever is less expensive or simpler to run. Indicate refrigerant used on the test report.

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Throughout the procedure, when *A/C Loop On* is requested, the test laboratory should adjust the refrigerant conditions such that the air discharge from the HVAC outlets is  $8^{\circ}\text{C} \pm 2\text{K}$  but the evaporator does not freeze. Indicate the module outlet temperature at each test condition in 4.3 measured in the test report.

#### 4.2.2.3 Airflow Conditions.

- Air flow rate: See test procedure.
- *High* blower airflow speed shall be the highest airflow expected in vehicle per the SSTs. *Low* blower airflow speed shall be the lowest airflow setting expected in vehicle per the SSTs. Contact the HVAC module design release engineer if there is any question on expected airflows. Indicate the airflow in L/s considered for each condition in 4.3 on the test report.
- Air inlet dry bulb temperature:  $36^{\circ}\text{C}$ .
- Air inlet relative humidity: 70%.

#### 4.3 Instructions.

##### 4.3.1 Steady-State Condensate Formation.

**4.3.1.1** Run HVAC module oriented at angle A per Appendix A, Figure A1 with the blower at *High* speed with A/C Loop On for fifteen (15) minutes.

**4.3.1.2** Place a beaker under the HVAC module drain tube. Record the amount of water that drips out of the module during three (3) minutes of A/C operation at high blower in Table 1. This value shall be known as the *High Blower Datum*.

**4.3.1.3** Maintaining A/C Loop On, turn the blower to *Low* speed and run the system for fifteen (15) minutes at Angle A.

**4.3.1.4** Place a new beaker under the HVAC module drain tube. Record the amount of water that drips out of the module during three (3) minutes of A/C operation at low blower in Table 1. This value shall be known as the *Low Blower Datum*.

**4.3.1.5 Data Collection and Acceptance Criteria.** This test is required but there is no specification for the amount of condensate created by the HVAC module during steady-state A/C-on conditions. Evidence of condensate leaking from the module other than the drain tube (e.g. moisture on module exterior, moisture on the craft paper at the module outlets) is unacceptable. Condensate trapped in the module is unacceptable. This must be confirmed by either opening the module or analyzing all surfaces inside the module with windows or a borescope. Condensate reaching the heater core is unacceptable. Condensate created on the evaporator pipes or condensate that rolls down the evaporator pipes and exits around the front-of-dash seal is unacceptable.

**Table 1: Data Table - Steady-State Condensate Formation (4.3.1)**

| §       | Blower Speed | Temperature Valve Position | Outlet Mode | Tilt Angle | Condensate Collected (mL) |
|---------|--------------|----------------------------|-------------|------------|---------------------------|
| 4.3.1.2 | High         | Full Cold                  | Vent        | A          | (High Blower Datum )      |
| 4.3.1.4 | Low          | Full Cold                  | Vent        | A          | (Low Blower Datum)        |

##### 4.3.2 Condensate Management with a Tilted Module.

**4.3.2.1** Run HVAC module oriented at angle A with the blower at *High* speed with the temperature valve position set to full cold position, the outlet mode set to Vent position, and the A/C loop on for fifteen (15) minutes.

**4.3.2.2** Maintaining A/C Loop On and blower speed, place a beaker under the HVAC module drain tube. Record the amount of water that drips out of the module during three (3) minutes of A/C operation at high blower.

**4.3.2.3** Change the outlet mode to Floor position. Maintaining A/C Loop On and blower speed, wait for three (3) minutes, then place a new beaker and repeat the measurement of 4.3.2.2.

**4.3.2.4** Change the outlet mode to Defrost position. Maintaining A/C Loop On and blower speed, wait for three (3) minutes, then place a new beaker and repeat the measurement of 4.3.2.2.

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