



Heating Unit, Air Conditioning Unit Durability Tests

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. This specification covers the operations and functionality of a heating unit and an air conditioning unit.

1.2 Applicability. Vehicles with heating unit and an air conditioning unit.

1.3 Remarks. None.

2 References

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

2.1 External Standards/Specifications.

SAE J2602

2.2 GM Standards/Specifications.

GMW3059

GMW14482

GMW17625

GMW17655

GMW3172

GMW17110

2.3 Additional References.

- Component Technical Specification (CTS) of the Cable Control Panel (CCP).
- Subsystem Technical Specification (STS).

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities. Not applicable.

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

3.1.1.2 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.

3.1.2 Equipment. Not applicable.

3.1.3 Test Vehicle/Test Piece. Not applicable.

3.1.4 Test Time. Not applicable.

3.1.5 Test Required Information. Not applicable.

3.1.6 Personnel/Skills. Not applicable.

3.2 Preparation. Not applicable.

3.3 Conditions.

3.3.1 Environmental Conditions. As defined in Section 4 of this standard.

3.3.2 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.

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May 2018

Page 1 of 8

As defined in Section 4 of this standard.

3.4 Instructions. As defined in Section 4 of this standard.

3.5 Data. The results recorded during the tests shall be analyzed and included in the test report per the referenced procedure or SSTs.

3.6 Safety.

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.7.1 Test Results. As defined in Section 4 of this standard.

3.7.2 Deviations from Test Procedure. Deviations from the test procedures shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4 Requirements and Procedure

4.1 Noise Test. Heating unit or air conditioning unit with control head and blower assembly shall not cause any objectionable noise like rattling, scraping, squeaking, whistling or hissing. The same requirement applies to the valve movement. Therefore, the valve stops shall be noise dampened. No airborne noises caused by air leaks are permitted in any possible valve positions and blower speeds. The heating unit or air conditioning unit with air inlet and blower housing shall be positioned as installed in vehicle. The assembly shall be twisted with varying frequency between 0 Hz and 1 Hz. The twisting amplitude results from the maximum vehicle installation tolerance. The direction of force is coincident with the screw axis. During this test, all valves are moved ten (10) times from stop to stop. No noise such as creaking, scraping, rustling, or squeaking may occur.

The measurement of the sound pressure level shall be performed to GMW14482. A subjective evaluation is required as well. Review GMW17625 documents for the requirements.

All door seals must be reviewed to select serrated or non-serrated seal concept for Design Failure Mode Effects Analysis (DFMEA) release by the GM Design Responsible Engineer (DRE) and GM Validation Engineer.

4.2 Durability Testing.

4.2.1 HVAC Module Control Unit. The Heating Ventilation Air Conditioning (HVAC) module control unit's all buttons and/or knobs shall be cycled 60 000 cycles. One (1) cycle is defined as: All control buttons of the control head are actuated two (2) times in order that each actuating function is activated and deactivated. The cycles shall be as follows:

- 5% cycles at -40 °C.
- 10% cycles at -20 °C.
- 40% cycles at 23 °C.
- 30% cycles at 60 °C.
- 15% cycles at 85 °C.

The six (6) control head units shall be tested.

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May 2018

Page 2 of 8

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4.2.2 HVAC Module Assembly Testing. HVAC front module and HVAC rear module durability testing includes vibration, mechanical, electrical and environmental cycling.

HVAC module front assembly with vehicle representing a portion of Front of Dash (FOD) with FOD seal and air-inlet seal in test fixture is recommended. For all non- Local Interconnect Network (LIN) actuators use production intent Silver Box or CTS Cable Control Panel (CCP) control head with software calibration provided by GM Engineering to drive the actuators. For all LIN actuators use a control box that complies with the SAE J2602 LIN communication requirements to drive the LIN actuators.

The reference for the actuator requirement is GMW17655 for LIN stepper motor and GMW17110 for the unipolar stepper motor.

4.2.2.1 Test Steps.

- a. **Vibration Test.** 12 h per axis. Total 36 h vibration. Use vibration profile as follows per Road Load Data (RLD) provided in Figure 1 and Figure 2 respectively. Keep air inlet to outside air and cycle all other doors.
- b. **Micro-Movement Test.** Follow micro-movement procedure as follows and start micro-movement test 4 h/axis at last part of vibration test. Adjust blower speed and actuator movement per micro-movement procedure.
- c. Repeat tests **a** and **b** for other two (2) axis.
- d. Continue actuator cycling test procedures until meeting one (1) life.
- e. Repeat tests **a** thru **d** for three (3) lives with six (6) samples and surviving three (3) samples put on Test to Failure (TTF).
- f. **Evaluation Criteria:** A subjective evaluation at every 12 h interval shall be conducted. At the end of each life test, a performance evaluation shall be conducted that includes airflow, airflow distribution, abnormal and linkage noise; current draw; airflow; heating; cooling; Evaporator Air Temperature Sensor pick-up; torque measurements and visual inspection of components. The performance degradation shall not be more than 10% at end of three (3) life tests. Electronics (i.e., Blower, Linear Power Module (LPM), etc.) must not de-rate during the 60 °C interval, during the 85 °C interval the components can de-rate but not shut-off completely. If any component de-rates then the value (i.e., Pulse Width Modulation (PWM)%) should be reported in the test report to GM.
- g. Complete a Design Review Based Teardown Review (DRBTR) at end of life tests. Additional testing may be required based on noted issues.
- h. Demonstrate module reliability R97C50.

4.2.2.2 Test Conditions.

- a. Actuator 14 V running. One (1) cycle is a movement in clockwise direction until stall and the backwards movement until stall. One (1) cycle is 0% to 100% to 0% opening.
- b. Manual control (CCP). All control buttons of the control head are actuated two (2) times in order that each actuating function is activated and deactivated in order to complete one (1) cycle.
- c. Use temperature -40 °C to 85 °C and humidity (90% at high temperature).
- d. Pressurize evaporator and heater core:
 - Evaporator: Air hold 550 kPa capped off.
 - Heater Core: Coolant (50/50) hold 120 kPa capped off.
- e. Total door cycles for one (1) life are as follows:

Front HVAC Module.

Mode Actuator/Door:

1. 60 000 cycles for Global A (Electrical Architecture).
2. 100 000 cycles for Global B (Electrical Architecture), Start-Stop and Onboard Diagnostic II (OBDII).

Temperature Actuator/Door:

1. 60 000 cycles for Global A.
2. 100 000 cycles for Global B, Start-Stop and OBDII.

Air Inlet Actuator/Recirculation Door:

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May 2018

Page 3 of 8



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