GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW3040

Heating System Maximum Performance Validation for Passenger Vehicles

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. Validate the performance capability of vehicle heating systems, using reproducible measurements in a climatic wind tunnel. The measurements include the following operating conditions.

- Soak.
- Warm up.
- Idle.

1.2 Applicability. For all passenger vehicle heating systems.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3058 GMW15845

2.3 Additional References.

- Motor Vehicle Dimensions Procedures.
- System level specifications.
- Test report.
- Vehicle Technical Specification (VTS).

3 Resources

3.1 Facilities. Climatic wind tunnel including a chassis dynamometer with adjusting possibilities for vehicle speeds of 100 km/h minimum, wind speeds of 100 km/h minimum and ambient temperatures of -35 °C minimum.

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.

3.2.1 General.

3.2.1.1 Temperature measuring and recording equipment per Appendix A, Tables A1, A2, A3, A4 and GMW15845.

3.2.1.2 Voltage and current measuring and recording equipment for compartment blower(s) and battery(ies).

3.2.1.3 Measuring and recording equipment for the engine speed.

3.2.1.4 Device for operation and adjustment of accelerator pedal.

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3.3 Test Vehicle/Test Piece. Passenger vehicle heating system.

3.4 Test Time.

Calendar time:	Prep time plus 4.5 h for each Cycle 1 and 4 h for each Cycle 2. (See 4.3.1 and 4.3.2)
Test hours:	Cycle 1: Test Time of 60 Minute + Variable Soak Time (≈ 3.5 h) Cycle 2: Test Time of 30 Minute + Variable Soak Time (≈ 3.5 h)
Coordination hours:	Not applicable.

3.5 Test Required Information. Test conditions as specified by the Vehicle Technical Specification (VTS). Motor Vehicle Dimensions Procedures as needed.

3.6 Personnel/Skills. Need one (1) climatic tunnel operator and one (1) driver (if necessary).

4 Procedure

4.1 Preparation. The vehicle shall be prepared for the climatic tunnel and shall be equipped with devices according to 3.2 and instrumentation installed per GMW15845. Instrumentation channels required to be monitored during this test are defined in Appendix A, Tables A1, A2, A3 and A4.

4.1.1 Engine Oil, Coolant and Fuel. As released for the engine at the test temperature.

4.1.2 Tire Pressure. Tires to be inflated to the maximum rated pressure.

4.1.3 Battery State of Charge. The vehicles low voltage battery should be of good health with state of charge > 60% prior to start of test. For applicable vehicles with a propulsion or propulsion assist battery, the maximum state of charge should be achieved prior to start of test.

4.1.4 Heating, Ventilation and Air Conditioning (HVAC) Settings. The vehicle ventilation system controls shall be set to Full Hot, Heater, and Outside Air Mode (OSA). The blower(s) switch position (or voltage) is specified in 4.3.4. Outboard panel outlets to remain in open position with airflow aimed parallel to respective side glass at the height of the occupant shoulder. Inboard panel outlets to remain closed.

Note: It is permissible to run test with air inlet in a partial recirculation condition, provided this logic is automatically controlled. Uncontrolled test chamber humidity should be monitored as it may have an impact on the function of partial recirculation.

4.2 Conditions.

4.2.1 Environmental Conditions. Standard conditions are as follows.

- Test Temperature: (-20 ± 1) °C.
- Accelerated soak: 5 °C below test temperature. See 4.2.2.2.1 for detailed instructions.

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 Vehicle and Wind Speeds. Vehicle and wind speeds as specified in the measurement programs (see 4.3) (wind speed for pre-soak may be modified to accelerate test).

4.2.2.2 Soak. It shall be ensured that the entire vehicle is at a uniform temperature which is in the range of ±1 °C of the test temperature prior to start of test. Temperatures of the vehicle's coolant, engine oil, and transmission oil should be monitored during the soak. A battery charger is to be applied to the vehicle's low voltage battery during the soak condition.

4.2.2.2.1 Accelerated soak has a cycle time of (2 to 3) h, with procedure as follows. Open all passenger doors. Sand bags should be apply to door hinge area to keep door open through the duration of the soak. Set chamber temperature to -25 °C and wind speed to 80 km/h. Once engine oil sump temperature reaches -21.5 °C bring the tunnel temperature back to -21 °C. Engine oil temperature will rebound to -20 °C. Once this occurs, bring tunnel temperature back to -20 °C. Monitor coolant, engine oil, and transmission oil temperatures. When all three are within ±1 °C of test temperature, the schedule should be started.

4.2.2.3 Warmup Conditions. Vehicle and wind speeds as specified in the measurement program (see 4.3).

4.2.2.4 Idle Conditions. Wind speed as required to maintain tunnel test temperature (10 km/h maximum).

4.2.2.5. Vehicle Weight. Test conducted with vehicle at curb weight plus one passenger.

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4.2.2.6 Electrical Power Supply. All electrical systems are supplied by the internal vehicle power supply. Headlights (low beam), backlight defogging system and heated seats on high setting (if standard equipment) are switched on at: t = 0 minutes.

4.2.2.7 Gear Steps or Drive Positions. The transmission gear should be Drive for an Automatic Transmission (AT) or the highest possible gear that can maintain the specified vehicle speed for manual transmissions. If excessive gear shifting is required to maintain vehicle speed, the lower transmission gear should be manually selected. Excessively is defined as more than four downshifts/upshifts in 1 km. For manual transmissions, if two gears are possible selections from a typical driver, the more probable gear should be selected.

4.2.2.7.1 For repeat measurements on vehicles with automatic transmissions, it shall be ensured that same vehicle speeds are driven at the same lowest engine speeds.

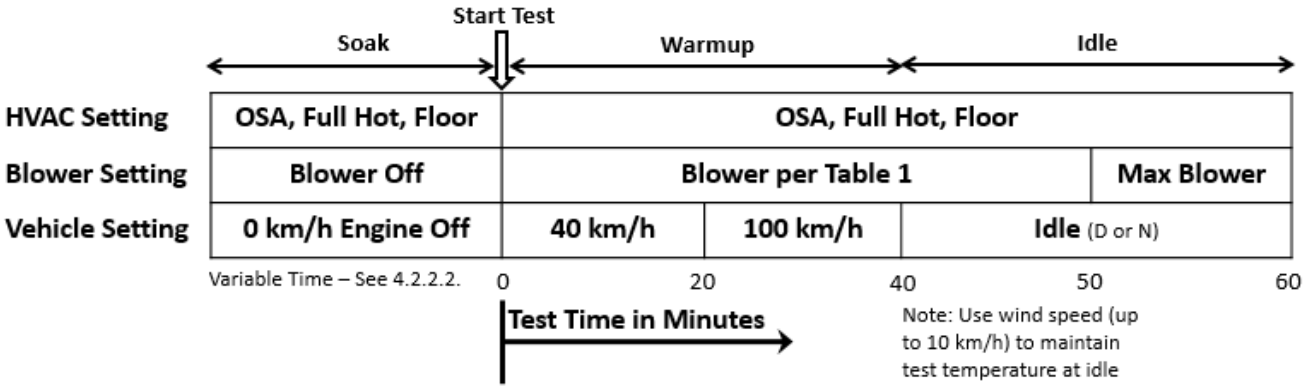
4.2.2.7.2 For manual transmissions, gears shall be changed as follows.

- Shifts at (3000 ± 200) min^{-1} (3000 ± 200 rpm).

4.3 Instructions.

4.3.1 Climatic Tunnel Cycle 1.

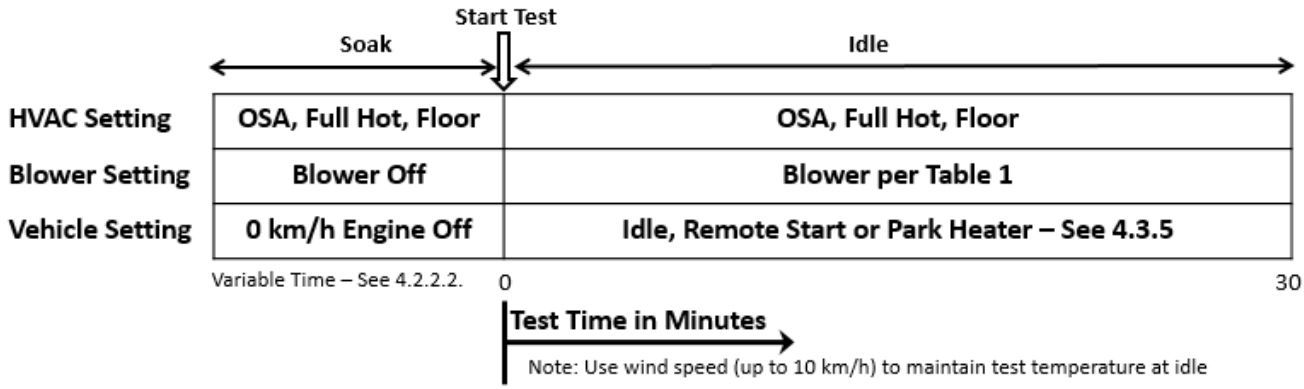
Figure 1: Measurement Program



Note Key: D = Drive, N = Neutral, Max = Maximum

4.3.2 Climatic Tunnel Cycle 2 (Idle Warm up, Remote Start, Parking Heater).

Figure 2: Measurement Program



4.3.3 Measuring Values and Data to Record. All data (see Appendix A, Tables A1, A2, A3 and A4) shall be recorded at ≤ 10 s intervals.

4.3.3.1 Further Data.

- Vehicle data, mileage and description of the system to be validated.

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