



Evaluation of Steering Wheel Heating Performance

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 standard determines the evaluation of the performance of single stage (one-level) Steering Wheel Heating (SWH) -systems in the steering wheel assembly.

1.2 Applicability. Applicable to all steering wheel heating system types with one-level (single stage) control unit.

1.3 Remarks. This standard shall measure the steering wheel heater mat's temperature control behavior and heating characteristics during the heat-up curve (temperature over time) on single steering wheels in the climate chamber, on steering wheels in the vehicle in the climate chamber or on steering wheels in the vehicle during driving conditions (i.e., a road test).

This standard shall also subjectively evaluate the steering wheel heating in the vehicle to determine the overall performance rating, the Vehicle Technical Specification and the customer needs.

Note: Tests with a single steering wheel in a climate chamber are considered as a component test. Validation tests are conducted during the in-vehicle condition.

Note: Tests shall be performed with a complete steering wheel with all add-on parts, e.g. wiring harness, switches, airbag-module etc.).

Note: This Test Procedure is not suitable for initial heater mat sampling tests. Heater mats should consider the requirements described in GMW14095 and GMW14096.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14095

GMW14096

GMW14264

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.

3.1.3 Test lab with a temperature test chamber. The minimum requirements for the test chamber are described in Table 1.

Table 1: Test Chamber Requirements

Chamber	Requirement
Test Area ^{Note 1} (L x W x H)	1.0 x 1.0 x 1.0 m
Temperature Range	(-20 to +60) °C
Temperature Stability	±2 °C
Relative Air Humidity	(10 to 90) %
Rate of Temperature Variation	1 °C/minute
Electrical Connection	Controllable

Note 1: Only for single components, otherwise (vehicle in the climate chamber) according to the vehicle dimension.

3.2 Equipment.

3.2.1 Portable, shock and climate resistant measurement system. Measurement computer shall be capable of capturing the data described in Table 2.

Table 2: Measured Values

Measure	Value
Temperatures	(-20 to +60) °C
Voltages	(0 to 20) V
Currents	(0 to 20) A
Acquisition Rate	1 Hz

3.2.2 Laptop computer for interpretation of measured data.

3.2.3 Adapter for measurement signal conversion (optional).

3.2.4 Wire thermocouples for determination of the steering wheel surface temperature, vehicle interior temperature, ambient (vehicle outside) temperature and temperature sensor area. The individual thermocouples shall each be soldered onto a piece of 15 mm x 15 mm blackened copper foil.

3.2.5 Voltage/current measurement module for measuring system to measure the system voltage and current.

3.2.6 Thermography camera (preferred) or infrared thermometer for the localization of the heating wires. The thermography camera is required to perform the thermography picture of the heated surface distribution.

3.2.7 External battery or transformer for measurement computer power supply or adapter for onboard supply system.

3.2.8 Timer or measurement computer timer function.

3.3 Test Vehicle/Test Piece. A steering wheel heater mat, which shall be tested and evaluated in the steering wheel and vehicle type for which it is intended. The vehicle electrical system shall be dimensioned for connection of steering wheel heating.

Note: If the same steering wheel heater mat is utilized for different steering wheel equipment and trim levels, the heater mat shall be evaluated and validated separately for each equipment level.

3.4 Test Time. Test time is dependent upon the control design of the heater mat to be tested. Cumulative test times including data recording time are shown.

Note: Winter sessions are preferred for vehicle tests.

Calendar time: 1 day

Test hours: Objective Evaluation: Heat-up curve measurement for determination of the temperature level (steady state temperature)

- 1 Stage Control: 45 minutes

Subjective Evaluation and Measurement of heating performance under customer conditions

- 1 Stage Control: > 40 minutes

Coordination hours: 10 h

3.5 Test Required Information.

3.5.1 The evaluation of the performance of the steering wheel heating system shall be performed in the order described in 3.5.1.1 thru 3.5.1.3.

3.5.1.1 Climate chamber test with single steering wheels (component test).

3.5.1.2 Vehicle test in the climate chamber or in comparable climate condition (driving operation preferred).

3.5.1.3 Subjective evaluation during driving operation.

3.5.2 No vehicle test shall be performed until the results from a single steering wheel test (component test) in the climate chamber are not according to specification.

3.5.3 A subjective evaluation of the steering wheel heating system in the vehicle during driving shall always be preferred to an evaluation in the climate chamber.

3.5.4 Comfort evaluations in the climate chamber can only serve development purposes.

3.6 Personnel/Skills.

3.6.1 Tester. It shall be pointed out that, in order to achieve a relevant test result, a certain level of technical evaluation is always a pre-condition for evaluations.

The development of the steering wheel heating is performed by test engineers or lab technicians with proper training to perform the steering wheel heating test procedure.

3.6.2 Comfort Evaluators. For subjective evaluation in the vehicle, additional evaluators shall be called in to form a representative customer group of at least eight (8) persons.

3.6.3 Required Clothing. Without gloves.

4 Procedure

4.1 Preparation.

4.1.1 Number of Temperature Measuring Points on the Steering Wheel Surface.

4.1.1.1 At least six (6) wire thermocouples shall be located on the heated surface shown in Figure 1.

4.1.2 Location of Temperature Measuring Points on Steering Wheel and in Vehicle.

4.1.2.1 Steering Wheel. Affix at least six (6) thermocouples (additional if requested) on the upholstered steering wheel surface directly above the heating wire as shown in Figure 1 and described in Table 3.

The thermocouples shall be fixed with self-adhesive fabric tape.

Note: For the exact determination of heating wire location during steering wheel heating running (see Figure 2), perform a thermography survey or measure surface temperature with an infrared temperature measuring unit.

Should be a seam or stitches exist in the measurement area, then the temperature sensor shall be positioned next to this above the heating wire.

4.1.2.2 (Vehicle) Interior Temperature. Install one (1) thermocouple in the (vehicle) interior, centered close to the steering wheel. This thermocouple shall be used to measure the vehicle interior temperature.

4.1.2.3 Ambient Temperature. Install one (1) thermocouple on the vehicle roof. This thermocouple shall be used to measure ambient (outside) temperature.

4.1.2.4 Temperature Sensor (optional). Install one (1) thermocouple directly on the heater wire near of the temperature sensor. This thermocouple shall be used to obtain an information on the control response of the heater mat.

4.1.3 Document Steering Wheel Surface Installation Positions.

4.1.3.1 In order to have the ability of reproducing the test environment, the positions of the temperature measuring points on the heater wire shall be documented by means of a photo (preferred) or a drawing.

4.1.3.2 If several measurements are performed at the same steering wheel level, the measuring positions shall be determined at the start of the measurement sequence. Measurement positions shall be reused maintaining a tolerance of ± 5 mm.

Figure 1: Thermocouple Positions

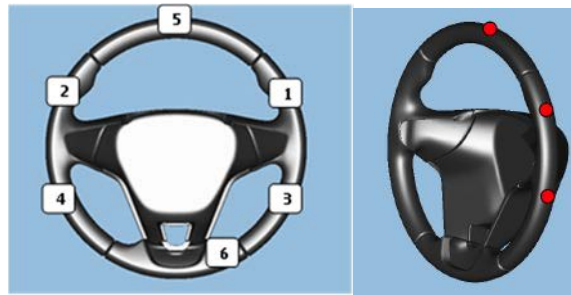
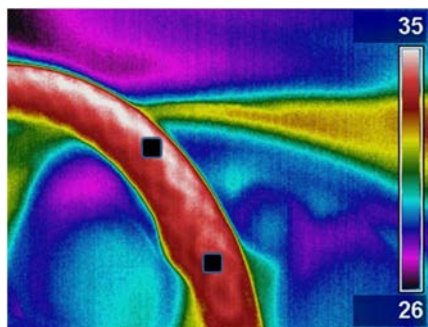


Table 3: Thermocouple Position Location Key

M1	1/2 o'clock
M2	10/11 o'clock
M3	4 o'clock
M4	8 o'clock
M5	12 o'clock
M6	5/6 o'clock
M7	not shown (used by GME HFC) 3'clock

Steering Wheel: (example of fully heated wheel, 3 spoke design)

Figure 2: Thermography Picture (for localization of heating wire)



4.1.4 Connect Volt/Ampere Measurement Module. Connect the Volt/Ampere measuring module between the heater mat and the vehicle power supply to measure the applied voltage and the current consumption of the heater mat.

4.1.5 Conditioning of Steering Wheels before Testing. To assure a steady temperature of the steering wheel before starting the measurement/evaluation, the steering wheel shall be soaked at a defined test condition temperature described in 4.2 for a time period as specified in 4.1.5.1 thru 4.1.5.3.