



## **Performance Testing of Heater and Coolant Hoses**

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### **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.** Test for performance of the engine coolant hose, including kink, burst, circulation, vacuum, pressure impulse, and fatigue.

**1.2 Applicability.** Vehicles with engine coolant hose.

**1.3 Remarks.** Not applicable.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

ASTM D380

#### **2.2 GM Standards/Specifications.**

GMW3059

GMW3420

GMW15024

GMW15184

#### **2.3 Additional References.**

- Final report.
- GM Best Practice (BP) 313.035 (Global Metric Coolant Connections/Heating, Ventilation and Air Conditioning Powertrain Cooling (HVACPTC 264)). The supplier shall work with the GM responsible engineer to comprehend this requirement.

### **3 Test Preparation and Evaluation**

#### **3.1 Resources.**

##### **3.1.1 Facilities.**

**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.**

**3.1.2.1 Heating chamber** (approximately 1 m<sup>3</sup> air volume) with an adjustable and replaceable connecting fixture for five hoses.

##### **3.1.2.2 Chamber Regulation.**

- Fluid pressure and temperature.
- Chamber ambient air temperature adjustment.
- Chamber air circulating ventilator.

##### **3.1.3 Test Vehicle/Test Piece.**

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**3.1.3.1** Test samples, of 300 mm length, are to be taken from hoses or hose assemblies which represent the production construction, shape and manufacturing process.

**3.1.3.2** For hose assemblies containing bends, 300 mm samples shall all be cut from the same section of hose such that all samples have the same length and shape. To be approved by GM Engineering.

**3.1.3.3** For hoses shorter than 300 mm, or if the 300 mm sample includes a coupling or fitting, the sample may be extended with a length of similar hose to facilitate simultaneous testing of multiple hose designs. To be approved by GM Engineering.

**3.1.3.4 This testing requires 24 hose samples.**

- Six (6) samples shall be used for testing per 4.1, and reused for 4.2.
- Six (6) samples shall be used for testing per 4.3.
- Six (6) samples shall be used for testing per 4.4, and reused for 4.5.
- Six (6) samples shall be used for testing per 4.6.

**3.1.4 Test Time.**

Calendar time: 45 days

Test hours: 1040 h

Coordination hours: Not applicable

**3.1.5 Test Required Information.** Not applicable.

**3.1.6 Personnel/Skills.** Not applicable.

**3.2 Preparation.** Both ends of the hoses are clamped on the connecting sockets, in an untwisted condition, using the production clamps. Spring hose clamp connections to be made according to GMW15184 whenever possible. Alternate clamp type may be allowable with GM Engineering approval.

**3.3 Conditions.**

**3.3.1 Environmental Conditions.** Not applicable.

**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.

**3.4 Instructions.** Not applicable.

**3.5 Data.** Not applicable.

**3.6 Safety.** This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

**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.** Initial test result shall be supplied to GM Engineering by the end of the following business day following test completion. The final report is to be provided within two weeks.

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

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## 4 Requirements and Procedure

**Note:** All hose performance properties have to be in accordance with GMW15024 - Engine Coolant Hose.

**4.1 Kink.** This paragraph applies to heater hose sizes: Condition 300 mm lengths of hose at room temperature for at least 6 h. With care, bend the hose around a mandrel in the direction of the natural curvature of the hose. For hoses of 15 mm Inside Diameter (ID) (Type C hose, per Best Practice (BP) 313.035), use a 90 mm mandrel (the supplier shall work with the GM responsible engineer to comprehend this requirement). For hoses of 19 mm ID (Type D hose, per BP 313.035) use a 125 mm mandrel.

**4.1.1 Requirement.** Measure the amount of collapse at point of greatest flattening. Hose must meet requirements specified in GMW15024 - Performance Properties Table.

**4.2 Burst Pressure.** Subject hose to internal hydraulic pressure increasing at a rate of  $(50.0 \pm 5)$  kPa/s until hose burst or, for non-reinforced types, until internal pressure drops.

Hose shall be preconditioned for 2 h minimum at the specified burst temperature prior to burst. The duration of preconditioning in the burst chamber can be reduced by preconditioning in a separate environmental chamber. However, the supplier must submit documentation with the test results to confirm that the sample was properly conditioned at the burst temperature prior to burst.

**4.2.1 Requirement.** The hose must withstand the required minimum pressure listed in GMW15024 - Performance Properties.

**4.3 Coolant Circulation.** Test according to ASTM D380, except as follows: Use 90% Ethylene Glycol (GMW3420)/10% Water. Deflect the hose 10 mm each side of center position at a rate of: 200 cycles/minute (see Figure 1). Shut off pump for 4 h out of each 24 h period. Replace the fluid after each test.

- Coolant Flow Rate: (0.5 to 1) L/minute.
- Circulate Fluid for: 400 h, Total Test 480 h.
- Minimum Pressure:  $(200 \pm 10)$  kPa.
- Ambient Temperature:  $(90 + 5/-0)$  °C.
- Coolant Temperature. (Type per GMW15024):
  - Type A and H =  $(120 + 0/-5)$  °C.
  - Type B =  $(100 + 0/-5)$  °C.
  - Type C through G =  $(130 + 0/-5)$  °C.

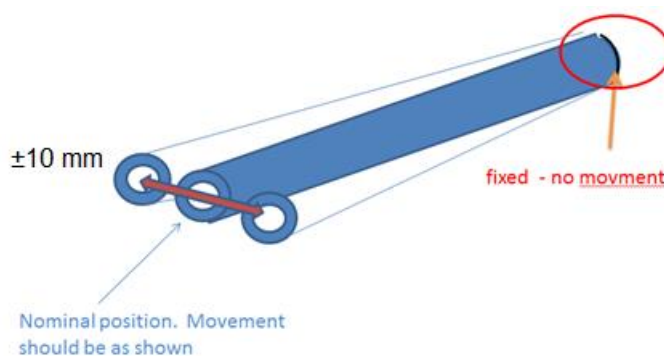


Figure 1: Coolant Circulation Hose Movement Example

**4.3.1 Requirement.** After completion of test, the hose may not leak or show any cracks. Fatigue cracks beginning at the cut edges of the hose clamp may not represent a non-compliance of the hose to this test procedure - review with GM engineer for approval. Within 2 h after test, and with test fluid at 100 °C, conduct burst test and note ability to withstand minimum pressure specified in GMW15024 - Performance Properties Table.

**4.4 Vacuum Collapse Test.** All the hoses shall be exposed to a vacuum pressure of 0.50 bar (50 kPa) for 30 s.

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**4.4.1 Requirement.** The test can be considered as passed under any of the following circumstances:

- a. The minimum outside diameter shall decrease by no > 20% during application of vacuum pressure.
- b. There is no indication of delamination between rubber layers.
- c. No permanent deformation of the hose ID after application of vacuum pressure.
- d. No bulge or crack effects of hose outer surface.

After completion of vacuum pressure, conduct burst test and note ability to withstand minimum pressure specified in GMW15024 - Performance Properties Table.

**4.5 Pressure Impulse Test (PIT).** This is a short term test without movement simulation. Use 90% Ethylene Glycol (GMW3420)/10% Water (see Figure 2).

- Coolant Flow Rate: (0.5 to 1) L/minute.
- Frequency  $f$ : = 0.5 Hz.
- Maximum Pressure: (350  $\pm$  10) kPa.
- Minimum Pressure: (150  $\pm$  10) kPa.
- Ambient Temperature: (90 + 5/-0) °C.
- Number of Cycles: 150 000.
- Coolant Temperature. (Type per GMW15024)
  - Type A and H = (120 + 0/-5) °C.
  - Type B = (100 + 0/-5) °C.
  - Type C through G = (135 + 0/-5) °C.

**4.5.1 Requirement.** After completion of test, the hose may not leak or show any cracks. Fatigue cracks beginning at the cut edges of the hose clamp may not represent a non-compliance of the hose to this test procedure - review with GM engineer for approval. Hose must comply with GMW15024 - Performance Properties Table.

In addition to and superceding GMW15024 - Performance Properties Table (Pressure Impulse), within 2 h after test and with test fluid at 100 °C, conduct burst test.

- Burst after PIT hoses ID > 20 mm. (Radiator Hoses) = 0.8 MPa minimum.
- Burst after PIT hoses ID  $\leq$  20 mm. (Heater Hoses) = 1.1 MPa minimum.

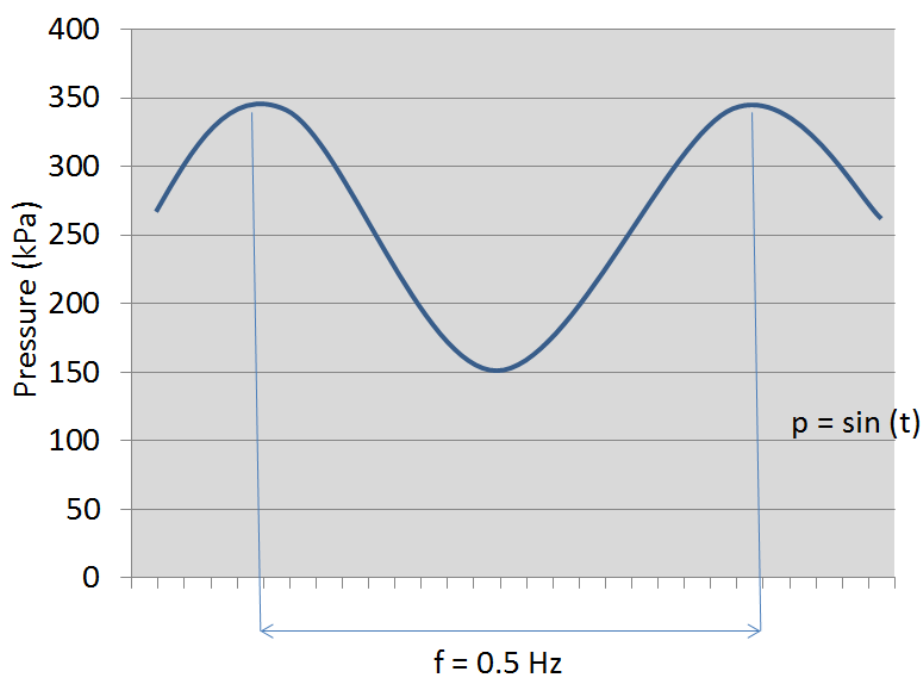


Figure 2: Pressure Impulse Test Example

**4.6 Fatigue Test.** This is a long-term test with movement simulation. Use 90% Ethylene Glycol (GMW3420)/10% Water. One test cycle is comprised of 20 h of temperature, pressure, and movement, and 4 h at room temperature, with no pressure, and no movement (see Figure 3). The test sample is installed in a heating chamber and hose is filled with the coolant. The sample is tested by having the end which is attached to the engine (in vehicle) moved in a circular motion. The circle shall be a 20 mm diameter relative to the axis of the hose end when in static position. The other end of the hose shall be static (see Figure 4).

- Coolant Temperature. (Type per GMW15024)
  - Type A and H =  $(120 + 0/-5)$  °C.
  - Type B =  $(100 + 0/-5)$  °C.
  - Type C and D =  $(130 + 0/-5)$  °C.
  - Type E, F, and G =  $(145 + 0/-5)$  °C.
- Ambient Temperature:  $(90 + 5/-0)$  °C.
- Pressure:  $(350 \pm 10)$  kPa.
- Movement:  $\pm 10$  mm along a circle axis of the hose at a frequency of (0.5 to 1.0) Hz.

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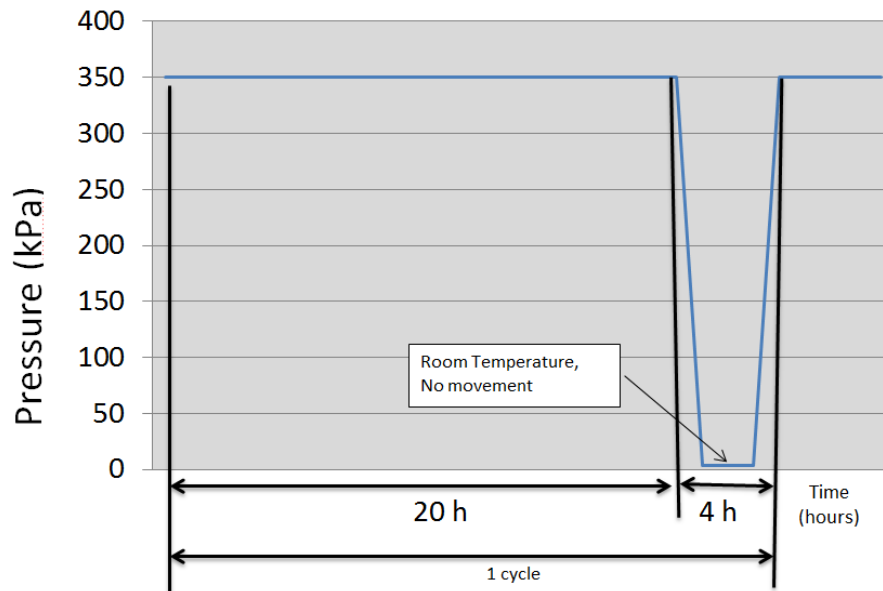


Figure 3: Fatigue Test Cycle

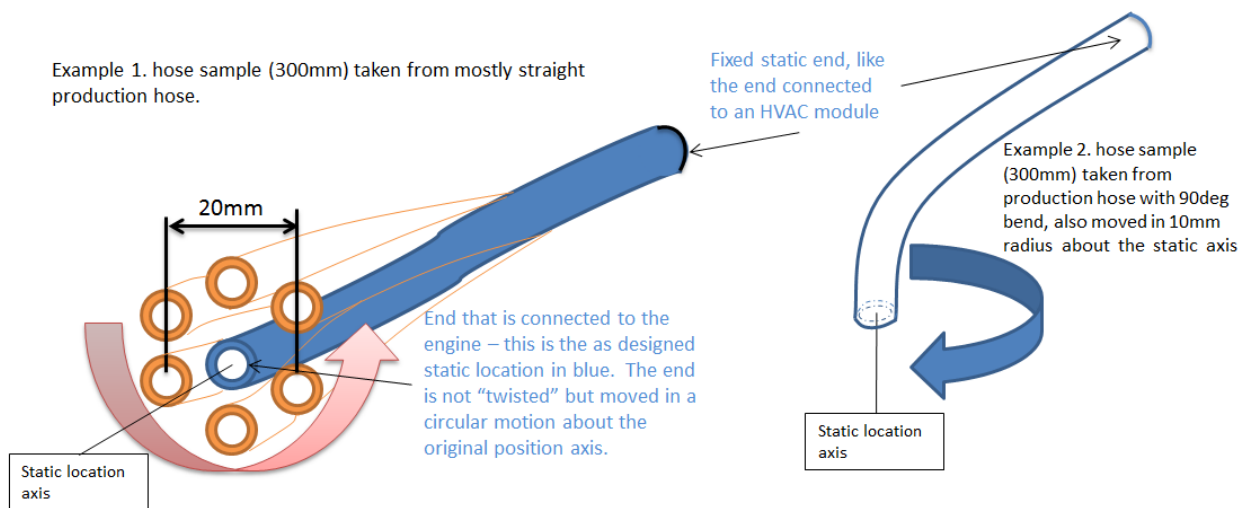


Figure 4: Fatigue Test Setup Example

**4.6.1 Requirement.** After completion of test, the hose may not leak or show any cracks. Fatigue cracks beginning at the edge of the hose clamp, may not necessarily represent a non-compliance of the hose to this test procedure - review with GM engineer for approval. The review of damage at clamps must consider the attachment and motion at the hose ends - these must properly represent the vehicle conditions for the specific hose on test. The circumferential expansion and the permanent deformation must be measured at the greatest diameter of the coolant hose and at least 25 mm clearance/distance to the adjacent bend. Hose must comply with GMW15024 - Performance Properties Table.

## 5 Provisions for Shipping

Not applicable.

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## 6 Notes

**6.1 Glossary.** Not applicable.

### 6.2 Acronyms, Abbreviations, and Symbols.

<b>BP</b>	Best Practice
<b>GSSLT</b>	Global Subsystem Leadership Team
<b>HVACPTC</b>	Heating, Ventilation and Air Conditioning Powertrain Cooling
<b>ID</b>	Inside Diameter
<b>PIT</b>	Pressure Impulse Test
<b>SSLT</b>	Subsystem Leadership Team

## 7 Additional Paragraphs

**7.1** All parts or systems supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances**.

## 8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

GMW14329

## 9 Release and Revisions

This standard was originated in September 2005. It was first approved by the Global Plumbing SSLT in November 2005. It was first published in December 2005.

Issue	Publication Date	Description (Organization)
1	DEC 2005	Initial Publication.
2	JUN 2007	Paragraphs 3.1 through 3.3 revised. Paragraph 4 added. Table 1 removed. Figures 1, 2, 3 added. (Plumbing GSSLT and Global Material Engineering)
3	NOV 2012	5 Year Refresh. (Thermal – Fluid Handling GSSLT)
4	JUN 2016	Modification in 4.4 to update values according with SAE J20 vacuum test procedure. (HVAC - Refrigerant, Coolant Plumbing and Hardware)

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