



Engine Coolant Thermostat Durability Procedure

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 purpose of this document is to describe the series of component bench tests and data reporting required by Global Propulsion Systems (GPS) for evaluation of a thermostat assembly.

Note that successful completion of these tests does not constitute final acceptance of the proposed design.

1.2 Applicability.

1.2.1 Test List. Sections 1.2.1.1 through 1.2.1.8 give a brief overview of the bench tests.

1.2.1.1 Test A: Start to Open (STO) Temperature. The purpose of this test is to determine the statistical distribution of the STO temperature and verify that it meets the supplier's specified range as noted on the drawing.

1.2.1.2 Test B: Minimum Full Open (FO) Valve Travel. This test is run to determine the statistical distribution of the minimum FO stroke and verify that it meets the supplier's specified minimum as noted on the drawing.

1.2.1.3 Test C: Closed Thermostat Leakage. The purpose of this test is to determine the statistical distribution of the fluid leakage rate and to verify that it meets the supplier's specified range or maximum as noted on the drawing.

1.2.1.4 Test D: Flow vs. Valve Travel. The results from this test are used to determine the statistical distribution of fluid flow through the thermostat assembly as a function of valve stroke.

1.2.1.5 Test E: Rate of Valve Travel for a Step Temperature Change. The purpose of this test is to determine the statistical distribution of the response of the thermostat assembly when subjected to a sudden change in coolant temperature.

1.2.1.6 Test F: Valve Travel Hysteresis. This test is performed to determine the statistical distribution of the hysteresis in the main valve travel. This test is also performed in conjunction with Test G.

1.2.1.7 Test G: Power Element Environmental Seal. This test is used to assess the dependability of the thermostat assembly when subjected to various environmental conditions. Parts are subjected to temperature and pressure extremes as would be experienced in the field. There are four basic subsections to the test:

- G1 Normal Operation.
- G2 Hot Climate Operation.
- G2 Cold Climate Operation.
- G4 Extreme Hot Climate Operation.

Note: For thermostats with an electric heating element, there are three (3) additional subsections, G1A, G2A, and G3A. Periodic measurements of thermostat operational characteristics as described in Tests A through F are made during the course of Test G, to evaluate any performance degradation or damage.

1.2.1.8 Test H: Power Element Overheat. This test is used to statistically determine the effects of damage (e.g., bulging, bursting, etc.) done to the power element structure during a severe overheat in the absence of coolant.

2 References

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

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2.1 External Standards/Specifications.

ISO/IEC 17025

2.2 GM Standards/Specifications.

GMW3420

3 Resources

3.1 Facilities. A suitable lab area or room with a stable environment is needed to conduct testing. There must also be the capability to safely handle engine coolant. The lab should be certified per ISO/IEC 17025 or equivalent. A schedule for machine maintenance and instrument calibration should be available for inspection.

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 An open vessel, with agitator, large enough to fully submerge the thermostat assembly (with inlet/outlet if integrally designed), and containing coolant meeting the GMW3420 (dexcool®) specification and water mix, with a heating device and controller capable of raising the fluid temperature at the specified rate to the specified level.

3.2.2 A pressure vessel, with agitator, large enough to fully submerge the thermostat assembly (with inlet/outlet if integrally designed), and containing coolant meeting the GMW3420 (dexcool®) specification and water mix, with a heating device and controller capable of raising the fluid temperature at the specified rate to the specified level.

3.2.3 A pressurized flow pipe or tube apparatus large enough to fully contain the thermostat assembly (with inlet/outlet if integrally designed). The apparatus will be part of a circuit that establishes a flow of coolant meeting the GMW3420 (dexcool®) specification and water mix. Provision is needed to apply, maintain, and measure, the hydraulic differential pressure across the main valve of the thermostat assembly to a resolution of 1 kPa or better. Provision must also be made to measure the flow rate. A heating device and controller capable of maintaining the fluid temperature at the specified level will be part of the circuit as a well as means of measuring the bulk fluid temperature with resolution to 0.1 °C.

3.2.4 A device to measure the displacement (stroke) of the thermostat main valve to a resolution of 0.025 mm or better.

3.2.5 An oven capable of heating (dry) thermostat assemblies to > 135 °C.

3.3 Test Vehicle/Test Piece. An adequate supply of thermostat assemblies for test is required, typically 60 to 140 pieces.

3.4 Test Time.

Calendar time: 90 days

Test time: 2000 hours

Coordination time: 60 hours

3.5 Test Required Information. Suppliers shall be required to provide data and supporting information whenever a new design concept or design modification is being proposed.

3.6 Personnel/Skills. A technician familiar with hydraulic and thermal measurement practice.

4 Procedure

4.1 Preparation.

4.1.1 Test Fluid Preparation. The ratio of dexcool® engine coolant and water is specified in each test and is to be measured by volume percent, at ambient conditions, with a tolerance of ± 5%.

4.1.2 Sample Selection.

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4.1.2.1 Production Parts. Using a sampling strategy that covers a range of conditions likely to exist in the production process (e.g., machine, operator, material batch, etc.), randomly select the number of components or complete thermostat assemblies specified in the set up instructions for each individual test.

4.1.2.2 Prototype Parts. Randomly select from the lot the number of samples specified in the set up instructions for each individual test.

4.1.2.3 Sample Inspection. Components or assemblies selected at random from a production run are to be used as is.

Parts selected at random from a prototype run are to be used as is, unless the intended production process would have automatically rejected the component.

Note: Once a part is placed on test, results cannot be rejected from the database for reasons of production or process flaws.

4.1.3 Sample Preparation. All samples for each test are to be numbered. New thermostat assemblies to be characterized using Tests A, B, C, E, or F may be thermally cycled a maximum of five (5) times from a minimum of 7 °C below the nominal STO temperature to a minimum of 7 °C above the nominal FO temperature, prior to test.

4.2 Conditions.

4.2.1 Environmental Conditions. Temperature and humidity fluctuations in the laboratory should not affect the bath temperature.

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.

4.3 Instructions.

4.3.1 Test A: STO Determination.

4.3.1.1 Select 40 samples using the sampling technique described in 4.1.2.

4.3.1.2 Prepare an agitated liquid bath at atmospheric pressure consisting of a 70/30 ratio of dexcool® and water. The initial temperature of the bath shall be a minimum of 7 °C below the nominal STO temperature.

4.3.1.3 Completely immerse the thermostat assembly in the agitated liquid bath for a minimum of 4 minutes, monitoring the valve position.

4.3.1.4 Zero the displacement measuring device.

4.3.1.5 Increase the bath temperature at a rate of < 0.6 °C/minute and monitor the valve position. The recorded STO temperature shall be that temperature at which the valve travel is 0.30 mm.

For consistency it is recommended that the measurement be taken at the center of the base of the motor cup or at the center of the end of the bypass valve stem, if so equipped.

4.3.1.6 Provide a copy of the recorded data in tabular format from all parts sampled. Calculate and provide the sample mean and the sample standard deviation. Also, identify the high and low values measured. Provide a histogram of the measured data rounding temperatures to the nearest whole degree.

4.3.2 Test B: Full Open (FO) Stroke.

4.3.2.1 Select 40 samples using the sampling technique described in 4.1.2.

4.3.2.2 Prepare an agitated liquid bath at atmospheric pressure with a 70/30 ratio of dexcool® and water.

4.3.2.3 Maintain the bath at the specified minimum FO travel temperature of ± 0.25 °C.

4.3.2.4 Zero the displacement measuring device on the thermostat assembly.

4.3.2.5 Completely immerse the thermostat assembly in the agitated liquid bath and monitor the valve travel.

4.3.2.6 Allow the rate of valve travel to decrease to < 0.25 mm/minute, and then record the total valve travel (relative to its closed position at ambient temperature).

4.3.2.7 Provide a copy of the recorded data, in tabular format, from all parts. Calculate and provide the sample mean and the sample standard deviation. Also, identify the high and low values measured. Provide a histogram of the measured data rounding the stroke to the nearest 0.1 mm.

4.3.3 Test C: Closed Thermostat Leakage.

4.3.3.1 Select 40 samples using the sampling technique described in 4.1.2.

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