

**THERMAL MATERIAL PROPERTY DETERMINATION FOR
METALS AND POLYMERS, TASE, HEAT PROTECTION MODELING****WSS-M99P51-A1****1. SCOPE**

This specification defines the requirements for measuring selected material properties used in CAE thermal analysis simulation or equivalent modeling of automotive components made from metals (ferrous and non-ferrous) and polymeric (thermoplastics, thermosets, and thermoplastic elastomers) production materials.

2. APPLICATION

This specification was released originally to communicate test methods, test parameters, sample size and recommended test facilities for thermal material property data collection. The data collected supports Thermal Aerodynamic System Engineering (TASE) modeling of various automotive components.

3. REQUIREMENTS**3.1 APPROVED SOURCES**

This specification does not use approved sources. Any reliable supplier meeting these requirements may be used.

3.2 CONDITIONING AND TEST CONDITIONS

All test values are based on material conditioned for not less than 24 h prior to testing in a controlled environment of 23 +/- 2 °C and 50 +/- 5% relative humidity. Testing of the material should occur in the conditioning environment or soon after removal.

3.3 DENSITY at 23 +/- 2 °C
(ASTM C559, ASTM D792, ISO 1183 – Method A)Report (g/cm³)**3.4 THERMAL CONDUCTIVITY****3.4.1 Polymers: Thermoplastic resins, Thermoplastic Elastomers,
and Thermoset Elastomers by Guarded Heat Flow**
(ASTM E1530)Report over
a temperature range
in table (W/ (cm·K))

Sample size and test temperature:

- 50.8 +/- 0.25 mm diameter with uniform thickness as shown below. Test plaques with flat and parallel surfaces. The recommended thickness for each sample should be as follows:
 - Thermoplastics/ Elastomers: 3.2 +/- 0.025 mm
 - Thermoset Plastics: 2.5 +/- 0.025 mm
 - Rubber: 2.0 +/- 0.025 mm
- Test temperature range for rubber: 50°C to max short term use temperature (See Table of typical rubber materials below), report in increments of 50°C up to Max short term temp. Consult materials engineering for test temperature appropriate for materials not listed below

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Documents
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Table 1: Max. Short Term use temperatures for select Rubber

Rubber max short term use temperatures								
Polymer type	PUR, NR, IR	ECO, BIIR, CR	IIR, SBR,	SBr, NBR	CSM	EPDM/ EPM	ACM, HNBR	VMQ /SI
Temperature (°C)	100	150		160	175	180	200	225
								350

- Test temperature range for thermoplastics and thermosets: 50°C to max short term temperature as listed in the table below. For Resins and other thermoplastics: 50°C to 20°C below the melting temperature. Consult materials engineer for test temperature appropriate for other polymers not listed.

Table 2: Max Short Term use temperatures for Thermoplastic Elastomers

Thermoplastic Elastomers max short term use temperatures					
Polymer type	TES/TPU	TEEE	TPO	TPV (EPDM+PP)	TPV(ACM+PA6)
Temperature (°C)	100	110	120	140	160

- 3.4.2 Metals: Ferrous and Non-Ferrous by measuring Thermal Diffusivity (ASTM E1461, modified temperature range) Report over a temperature range (W/ (cm·K))

Sample size and test temperature:

- 10.0-12.5 mm diameter, 2 mm thick
- Surface must be flat and parallel within 0.5% of their thickness
- Test temperature range: 23°C to 600°C, report at 23°C, 50°C, 100°C and then in increments of 100°C up to 600°C. (Note: For metals that melt below 600°C, reduce the upper test temperature to 50°C below the typical melt temperature for that material)

3.5 SPECIFIC HEAT CAPACITY

Report (J/kg·K)

(Differential Scanning Calorimetry (DSC), ASTM E1269 for metals, ISO 11357-2, 3, 4 for polymers)

Report T_g , T_m and x-y data of the scan. Plot 2 heats for polymeric materials.

Thermoplastic materials: Test temperature range 0 °C to 20 °C before the melt temperature

Thermoset materials: Test Temperature range 0 °C to max short term use temp. Per Table 1

Metals: Test Temperature range 23°C to 600°C

(Note: For metals that melt below 600°C, reduce the upper test limit to 50°C below the typical melt temperature for that material.)

3.6 EMISSIVITY

Report

(ASTM E408)

Sample Size: 75 mm x 75 mm but will work with smaller samples. Samples must have a flat surface.

Note: Typically, emissivity is not measured on finished parts.

4. GENERAL INFORMATION

The information given below is provided for clarification and assistance in meeting the requirements of this specification. Contact gmfs@ford.com for questions concerning Engineering Material Specifications. This specification is intended to complement existing Ford Engineering Material Specifications and the data collected and stored in the corporate materials database.

