



POLYPROPYLENE (PP), 35% SHORT GLASS FIBER REINFORCED, CHEMICALLY COUPLED, HEAT RESISTANT, MOLDING COMPOUND

WSS-M4D1055-A1

1. SCOPE

The material defined by this specification is a thermoplastic injection molding compound based on polypropylene with 35% chemically coupled short glass fiber reinforcement.

2. APPLICATION

This specification was released originally for material used for air intake manifolds on naturally aspirated engines.

2.1 LIMITATIONS

This specification does not contain UV stabilizers and is not suitable for visible interior applications.

3. REQUIREMENTS

3.1 APPROVED SOURCES

This specification requires the use of approved sources. Only the sources identified on the Ford materials Approved Source List (ASL) can be used when this specification is listed on the drawing, CAD file or other documents. The list of approved sources is located within Ford at www.mats.ford.com or available externally through a Ford Materials Engineer.

3.2 CONDITIONING AND TEST CONDITIONS

All test values are based on materials conditioned for not less than 24 h prior to testing in a controlled environment of 23 ± 2 °C and $50 \pm 5\%$ Relative Humidity. Testing of the material should occur in the conditioning environment or soon after removal.

3.3 INFRARED SPECTROPHOTOMETRY AND/OR THERMAL ANALYSIS

IR spectra and thermograms from initial material approval shall constitute the reference standard and shall be kept on file at the designated material laboratory. The material supplier shall ensure that all future material supplied to the specification shall produce IR spectra and thermograms that correspond to the reference standard when tested under the same conditions.

Date	Action	Revisions	Rev. 0
2017 01 04	Released		

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3.4 STANDARD REQUIREMENTS FOR PRODUCTION MATERIALS

- 3.4.1 Many 4D resin specifications prior to 2011, identified certain requirements with the symbol (s), which indicated that the mean and ± 3 sigma values were to be reported. The specification minimum, maximum or range was established using 3 sigma data. For 2011 and beyond, refer to Table 1 for number of samples required for each test.
- 3.4.2 This specification is based on virgin material and does not allow the addition of recycled content (PIR/PCR).
- 3.4.3 The use of regrind is permitted, for economic / environmental reasons. Part manufacturers using this specification must complete DV and PV testing with the allowable amount of regrind and the maximum allowable regrind content must be specified on the engineering drawing. Any changes to what is specified on the drawing (no specific amount implies zero regrind) must be approved by Materials and PD Engineering through the formal Ford Motor Company process (SREA).
- 3.4.4 Materials requiring High Strain Rate, Creep or fiber oriented Tensile Modulus may be required to test to the requirements of WSS-M99D68-A1/Latest, *Thermoplastic Property Determination For CAE, High Strain Rate Tensile, Creep and Tensile Modulus*. Material Suppliers should be prepared to submit data upon request.
- 3.4.5 Performance Criteria: Parts using this specification shall meet the appropriate underhood performance specification, WSS-M15P50-B/Latest. Contact Ford Materials Engineering regarding any color, appearance or alternative testing requirements, for the intended application. For applications that have a direct impact on the interior air quality, such as heater and A/C Unit, please note that the Odor test (FLTM BO 131-03, Variant C) is required as prescribed in the relevant performance specification.
- 3.4.6 Ford Materials Engineering may request a Control Plan and Certificate of Analysis (CofA) containing lot testing requirements which must include, but are not limited to:
- Melt Temperature
 - Filler Content
 - Impact Strength, Notched Charpy at 23 ± 2 °C
 - Flexural Modulus

3.5 SAMPLE PREPARATION

All tests shall be carried out on production materials manufactured from the production process unless correlation to a non-production process has been reviewed and approved by Ford Materials Engineering. Production level material must be used in preparing test parts / panels. The use of improper sample preparation material can influence test results.

Unless otherwise specified all tests shall be carried out on injection molded, one-end gated test specimens. The test specimens A and D shall be molded using molding conditions defined in ISO 1873-2. No annealing is allowed. See Table 1 for the number of samples required. Mechanical testing shall be carried out on specimens that have been conditioned, at 23 ± 2 °C and $50 \pm 5\%$ relative humidity, for a minimum of 96 hours.

Specimens shall be as follows:

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|------------|---|
| Specimen A | 150 minimum x 10 x 4.0 ± 0.2 mm (ISO 527-2, Specimen Type 1A) |
| Specimen B | 355 x 100 x 1.0 ± 0.1 mm |
| Specimen C | 145 x 60 x 3.2 ± 0.2 mm |
| Specimen D | 80 x 10 x 4.0 ± 0.2 mm (may be cut from the center of Specimen D) |



Specimen E	100 mm diameter x 3.2 mm
Specimen F	80 mm diameter x 3.2 mm
Specimen G	90 mm x 200 mm
Specimen H	50 ±1 mm diameter x 3.2 ±0.2 mm
Specimen I	100 mm x 150 mm, min

For Appearance Testing: Use an ungrained, non-polished, tool to prepare specimens

3.6 APPEARANCE

Refer to Ford Materials Engineering for appearance testing, for environmental and fluids resistance, per the performance specification. Peak thermal cycling test temperature for engine applications to be 150 °C, unless otherwise advised.

3.7 MATERIAL PROPERTIES

3.7.1	Determination of Ash (ISO 3451-1, Method A, 1 h @ 750 ±25 °C)	32-39 %
3.7.2	Density (ISO 1183, Method A)	1.16-1.20 g/cm ³
3.7.3	Tensile Strength at Break (ISO 527-1 and ISO 527-2, Specimen A, 50 mm/minute test speed)	100 MPa min
3.7.4	Elongation at Break (ISO 527-1 and ISO 527-2, Specimen A, 50 mm/minute test speed)	2.4 % min
3.7.5	Tensile Modulus (ISO 527-1 and ISO 527-2, Specimen A, 1 mm/minute test speed)	7.2 GPa min
3.7.6	Flexural Modulus (ISO 178, Specimen D, 64 mm support span, 2 mm/minute test speed)	7.5 GPa min
3.7.7	Impact Strength, Notched Charpy (ISO 179-1/1eA, Specimen D)	
3.7.7.1	At 23 ±2 °C	10 kJ/m ² min Report Break Type
3.7.7.2	At -40 ±2 °C	6 kJ/m ² min Report Break Type

The test specimen must be conditioned for minimum of 6 hours at the above specified temperature prior to test. Low temperature testing shall be done within the cold chamber, if not possible, test may be conducted outside, but within 5 seconds. Tested specimens must be reviewed by Materials Engineering. Break types are listed in section 4.5.

3.7.8	Heat Deflection Temperature (ISO 75-1 and ISO 75-2, Specimen D, flatwise, Bath - silicone oil, 0.34 ±0.1 mm deflection, at 1.80 MPa).	150 °C min
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