



POLYAMIDE (PA6,6) 25% GLASS FIBER / MINERAL REINFORCED, HEAT STABILIZED MOLDING COMPOUND (contact Materials Engineering)

WSS-M4D366-B1

POLYAMIDE (PA6,6) 25% GLASS FIBER / MINERAL REINFORCED HEAT STABILIZED MOLDING COMPOUND, 75% PCR/PIR CONTENT

WRS-M4D366-B2

1. SCOPE

The material defined by this specification is a thermoplastic 10% glass fiber and 15% mineral filled, heat stabilized molding compound based on polyamide 6,6.

2. APPLICATION

WSS-M4D366-B1 This specification was released originally for material used for engine cooling fan and shroud.

WRS-M4D366-B2 This specification was released originally for materials containing post consumer or post industrial recycled content.

2.1 LIMITATIONS

- This material absorbs and retains moisture. Part design and tolerances must accommodate changes in part dimensions and physical properties due to moisture absorption or loss in the service/assembly environment.
- This material absorbs and retains moisture. Part design and tolerances must accommodate
- This material does not contain UV stabilizers, long term exposure to direct sunlight will cause chalking and loss of gloss.

3. REQUIREMENTS

3.1 STANDARD REQUIREMENTS FOR PRODUCTION MATERIALS

Material suppliers and part producers must conform to the Company's Standard Requirements for Production Materials (WSS-M99P1111-A).

3.1.1 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 to establish specification limits.

3.1.2 WSS-M4D366-B1 is based on virgin materials.

3.1.3 WRS-M4D366-B2 must contain 75% Post Consumer Recycled (PCR) and/or Post Industrial Recycled (PIR) content as defined by WRS-M99P42-A1. The remaining portion of the material can come from virgin sources.

Date	Action	Revisions	Rev 2
2013 07 10	Revised	See Summary of Revisions	G. Kowalski, NA
2007 09 05	Revised	Updated graph on page 5	G. Kowalski, NA
2007 08 31	Activated	New Specification	G. Kowalski, NA



3.1.4 The use of regrind is permitted, for economic / environmental reasons, with compliance as indicated in Ford Engineering CAD and Drafting Standard E-4

3.1.5 Dry as molded:

All test values indicated herein are based on material and specimens with moisture content not exceeding 0.2% except where noted (Moisture Conditioned) (test according to ISO 15512 Method B/ASTM D 6869).

All test materials have to be sealed in moisture-proof containers and stored at $23 \pm 2^\circ\text{C}$ for at least 24 h immediately after processing. If the moisture content exceeds 0.2%, conditioning the material for a minimum of 16 h at $40 - 50^\circ\text{C}$ at a reduced pressure below 133 kPa.

Conduct tests in a controlled atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity. Individual specimens shall not be removed from closed containers until immediately before testing.

3.1.6 Moisture conditioned:

Specimens shall be stored in an atmosphere of $70 \pm 1^\circ\text{C}$ and $62 \pm 1\%$ relative humidity for seven days, then place the specimens in standard atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity for at least 1h before testing (according to ISO 1110).

3.1.7 Performance Criteria:

Parts using this specification shall meet the appropriate performance specifications, WSS-M15P50-B/Latest when required.

3.1.8 As specified in WSS-M99P1111-A, paragraph 3.2, Ford Materials Engineering may request a Control Plan and Certificate of Analysis (CoA) containing lot testing requirements which must include, but are not limited to:

Filler Content
Impact Strength, Notched Charpy at 23°C
Flexural Modulus

3.2 SAMPLE PREPARATION

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 1874-2. No annealing is allowed. See Table 1 for the number of samples required.

Specimens shall be as follows:

Specimen A	150 minimum x 10 x 4.0 ± 0.2 mm (ISO 527-2, Specimen Type 1A)
Specimen B	$355 \times 100 \times 1.0 \pm 0.1$ mm (ISO 3795)
Specimen C	$145 \times 60 \times 3.2 \pm 0.2$ mm
Specimen D	Center of Specimen A, $80 \times 10 \times 4.0 \pm 0.2$ mm
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

**3.3 MATERIAL PROPERTIES**

3.3.1	Melt Temperature (ISO 11357, 10 °C/min heating rate)	251 - 269 °C
3.3.2	Filler Content (ISO 3451-4, test temperature 600 +/- 25° Test portion 2-2.5g)	22 - 30 %
3.3.3	Density (ISO 1183, Method A)	1.26 – 1.40 g/cm ³
3.3.4	Tensile Strength at Break (ISO 527-1 and ISO 527-2, Specimen A, 5 mm/minute test speed)	95 MPa min
3.3.5	Tensile Modulus (ISO 527-1 and ISO 527-2, Specimen A, 1 mm/minute test speed)	7.2 GPa min
3.3.6	Flexural Modulus (ISO 178, Specimen D, 64 mm support span, 2 mm/minute test speed)	5.1 GPa min
3.3.7	Impact Strength, Notched Charpy (ISO 179-1/1eA, Specimen D)	
3.3.7.1	At 23 +/- 2 °C	4.7 kJ/m ² min Report Break Type
3.3.7.2	At -40 +/- 2 °C	3.0 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 impact test. Low temperature testing shall be done within the cold chamber, if not possible, test may be conducted outside, but within 5 seconds.

3.3.8	Heat Deflection Temperature (ISO 75-1 and ISO 75-2, Specimen D, flatwise, 0.34 +/- 0.1 mm deflection. At 1.80 MPa)	206 °C min
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All specimens dry as molded. If not tested immediately after molding, specimens must be stored in a sealed, moisture-proof container filled with silica gel.

3.3.9	Heat Aging Performance (ISO 188, 150 +/- 50 air changes/h, 1000 h at 140 +/- 2 °C. After heat aging test specimens are to be conditioned in a desiccator for 3 - 5 h at 23 +/- 2 °C. Unaged property values shall be determined at the time of the aged properties determination)	
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