**POLYAMIDE (PA) 6, HEAT STABILIZED, 35% GLASS FIBER REINFORCED MOLDING COMPOUND** **WSS-M4D1038-A1**

**POLYAMIDE (PA) 6, HEAT STABILIZED 35% LOWER STRENGTH GLASS FIBER REINFORCED MOLDING COMPOUND** **WSS-M4D1038-A2**

## 1. SCOPE

The materials defined by this specification are 35% glass fiber reinforced, heat stabilized polyamide 6 molding compounds, utilizing standard or lower strength glass fibers.

## 2. APPLICATION

This specification was released originally for material used for intake manifolds and GOR/FEM.

### 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 does not contain UV stabilizers, long term exposure to direct sunlight will cause chalking and loss of gloss.
- This material is not suitable for direct long term exposure to engine coolant, or direct exposure to strong acids or bases. It is not suitable for continuous use above 150 °C.

## 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 hours 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 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. 1 |
|---|---|---|---|
| | | | |
| 2016 04 20 | Released | Released A2 suffix. Revised format | P Addis, EU |
| 2013 05 10 | Released | Released A1 | V Cerato, EU |


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## 3.4 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 materials 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 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 D6869).

All test materials have to be sealed in moisture-proof containers and stored at 23 ±2 °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 °C at a reduced pressure below 133 kPa.

Conduct tests in a controlled atmosphere of 23 ±2 °C and 50 ±5% relative humidity. Individual specimens shall not be removed from closed containers until immediately before testing.

3.4.5 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.

3.4.6 Performance Criteria:
Parts using this specification shall meet the appropriate underhood performance specification, W*SS*-M15P50-B/Latest. Contact Ford Materials Engineering regarding any color, appearance or alternative testing requirements, for the intended application.

3.4.7 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

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## 3.5 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. 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 x 100 x 1.0 ±0.1 mm (ISO 3795) |
| Specimen C | 145 x 60 x 3.2 ±0.2 mm |
| Specimen D | Center of Specimen A. 80 x 10 x 4.0 ±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 |

## 3.6 MATERIAL PROPERTIES

| | | A1 | A2 |
|---|---|---|---|
| 3.6.1 | Melt Temperature, °C (ISO 11357, 10 °C/min heating rate) | 215 – 225 | 215 – 225 |
| 3.6.2 | Determination of Ash, % (ISO 3451-4, Glass fiber, test temperature 600 ±25 °C, test portion 2 to 2.5 g) | 32 – 38 | 32 – 38 |
| 3.6.3 | Density, g/cm$^3$ (ISO 1183, Method A) | 1.36–1.45 | 1.36–1.45 |
| 3.6.4 | Tensile Strength at Break, MPa min (ISO 527-1 & ISO 527-2, Specimen A, 5 mm/minute test speed) | 160 | 145 |
| 3.6.5 | Tensile Modulus, GPa min (ISO 527-1 & ISO 527-2, Specimen A 1 mm/minute test speed) | 9.0 | 7.8 |
| 3.6.6 | Impact Strength, Notched Charpy, kJ/m$^2$ min (ISO 179-1eA, Specimen D) | | |
| 3.6.6.1 | At 23 ±2 °C | 9.0 | 7.5 |
| | | Report Break Type | |
| 3.6.6.2 | At –40 ±2 °C | 7.0 | 5.5 |
| | | 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.

| | | | |
|---|---|---|---|
| 3.6.7 | Heat Deflection Temperature, °C min (ISO 75-1 & ISO 75-2 Specimen D, flatwise, 0.34 ±0.1 mm deflection. At 1.80 MPa) | 190 | 190 |

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.

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