



## THERMOPLASTIC POLYOLEFIN ELASTOMER 15% MINERAL FILLED, HIGH IMPACT, LOW CLTE, MOLDING COMPOUND FULLY PAINTED ONLY, EXTERIOR

WSS-M4D873-B6

### 1. SCOPE

The materials defined by this specification are mineral filled high impact and low thermal expansion thermoplastic polyolefin elastomer (TPO) injection molding compounds based on polypropylene copolymers, rubber, color pigments and are for exterior painted applications providing that suitable surface pretreatment are used.

### 2. APPLICATION

This specification was released originally for materials used for painted exterior trim applications. Any color additives need to be reviewed and approved by the raw material supplier and Ford Materials Engineering. The process/heat stabilizers must be in the base resin from the material supplier.

#### 2.1 LIMITATIONS

Materials approved to specification are unlikely to contain UV stabilizers, therefore long term exposure to direct sunlight could cause chalking and loss of gloss.

### 3. REQUIREMENTS

#### 3.1 APPROVED SOURCES (CMB specifications)

This specification is part of the Ford Co-Managed Buy (CMB) agreement. Tier 1 Molders who are participating under the CMB agreement must use one the following approved sources (deviations require approval from Raw Materials Purchasing and Materials Engineering):

Molders not on the CMB program or regions without CMB are required to use materials as listed in in the Ford Approved Source List ([www.mats.ford.com](http://www.mats.ford.com)), and are also encouraged to use the CMB sources. This specification requires the use of approved sources. Only the sources identified on the Ford 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](http://www.mats.ford.com) or available externally through a Ford Materials Engineer.

#### 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 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 00 |
|------------|----------|-----------|--------|
|            |          |           |        |
|            |          |           |        |
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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.
- 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 performance specification, WSS-M2P181-C/Latest for painted applications. Parts must fulfill applicable SDS/CDS requirements.
- 3.4.6 Ford Materials Engineering may request a Control Plan and Certificate of Analysis (C of A) containing lot testing requirements which must include, but are not limited to:
- Melt Flow Rate
  - Determination of Ash
  - Impact Strength, Notched Charpy at 23 °C
  - Flexural Modulus
  - Molding Shrinkage (WSS-M4D873-B6)
  - Post Shrinkage (WSS-M4D873-B6)

### 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.

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 Tables 1 and 2 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                                          |
| 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 A) |
| 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 for C through N gloss surfaces. Use a smooth, polished tool to prepare specimens for A and B gloss surfaces.

### 3.6 APPEARANCE

The material must be fully painted - no additional appearance requirements apply.

### 3.7 MATERIAL PROPERTIES

|         |                                                                                                |                                               |
|---------|------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 3.7.1   | Determination of Ash<br>(ISO 3451-1, Method A, talc filler,<br>3h at 650 +/- 25°C)             | 14-17 %                                       |
| 3.7.2   | Density<br>(ISO 1183, Method A)                                                                | 0.97-1.02 g/cm <sup>3</sup>                   |
| 3.7.3   | Tensile Strength at Yield<br>(ISO 527-1 and ISO 527-2, Specimen A,<br>50 mm/minute test speed) | 16 MPa min                                    |
| 3.7.4   | Tensile Modulus<br>(ISO 527-1 and ISO 527-2, Specimen A,<br>1 mm/minute test speed)            | 1.3 GPa min                                   |
| 3.7.5   | Flexural Modulus<br>(ISO 178, Specimen D,<br>64 mm support span, 2 mm/minute test speed)       | 1.4 GPa min                                   |
| 3.7.6   | Impact Strength, Notched Charpy<br>(ISO 179-1/1eA, Specimen D)                                 |                                               |
| 3.7.6.1 | At 23 +/- 2 °C                                                                                 | 45 kJ/m <sup>2</sup> min<br>Report Break Type |
| 3.7.6.2 | At -40 +/- 2 °C                                                                                | 3 kJ/m <sup>2</sup> min<br>Report Break Type  |
| 3.7.6.3 | At 0 +/- 2 °C                                                                                  | 30 kJ/m <sup>2</sup> min<br>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. Test specimens must be reviewed by Materials Engineering.

|       |                                                                                                                                                                            |           |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 3.7.7 | Heat Deflection Temperature<br>(ISO 75-1 and ISO 75-2, Specimen D, flatwise,<br>Bath – silicone oil, 0.34 +/- 0.1 mm deflection.<br>At 1.80 MPa)                           | 48° C min |
| 3.7.8 | Coefficient of Linear Thermal Expansion<br>(ISO 11359-2, -30 +/- 2 °C to T <sub>g</sub> , T <sub>g</sub> to 100 +/- 2 °C,<br>3 curves per directions, flow and cross flow) |           |

Plaque size is 100 x 150 minimum at 3.2 +/- 0.2 mm thickness. Plaque to be fan or