THERMOPLASTIC POLYOLEFIN ELASTOMER (TPO), HIGH MELT FLOW, 22% MINERAL FILLED, MOLD-IN-COLOR ONLY, MOLDING COMPOUND, FASCIA / THIN-WALLED EXTERIOR — **WSS-M4D1005-A1**

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1. SCOPE

The material defined by these specifications are 22% mineral filled thermoplastic molding compounds for mold-in-color (A1) and painted (A2) applications, based on thermoplastic polyolefin elastomer.

2. APPLICATION

WSS-M4D1005-A1 — This specification was released originally for material used for mold-in-color exterior bumper applications (where the fascia thickness is less than 3mm), requiring high melt flow rate. Any color additives need to be reviewed and approved by the raw material supplier and Ford Materials Engineering. The UV/process/heat stabilizers must be in the base resin from the material supplier, not in the color concentrate, specifically for mold-in-color applications at the press.

WSS-M4D1005-A2 — This specification was released originally for material used for painted exterior bumper applications (where the fascia thickness is less than 3mm), requiring high melt flow rate. 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

Material approved to WSS-M4D1005-A1 is likely to contain additives that may negatively affect paint adhesion, therefore should not be used for painted applications.

Material approved to WSS-M4D1005-A2 is unlikely to contain UV stabilizers, therefore long term exposure to direct sunlight could 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). Note: 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.

Date	Action	Revisions	Rev. 3
2016 08 31	Revised	See Summary of Revisions	G. Kirsankina, EU
2015 02 16	Editorial	See Summary of Revisions	K. Mueller, NA
2008 11 20	Activated		K Mueller, FNA

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This specification is based on virgin materials, however materials with recycled content as defined by WRS-M99P42-A1 (post-consumer and/or post industrial recyclates and repolymerised recycled materials) should be used whenever technically feasible and following all materials and PV testing required by Ford Materials Engineering. The use of regrind is permitted, for economic / environmental reasons, with compliance as indicated in WSS-M99P1111-A.

3.1.1 Performance Criteria: Exterior mold-in-color substrates approved to WSS-M4D1005-A1 must comply with all the requirements of WSS-M98P13-C/Latest. Painted substrates approved to WSS-M4D1005-A2 must comply with all the requirements of paint performance WSS-M2P181-C/Latest. Parts must fulfill applicable SDS/CDS requirements.

3.1.3 The material supplier must retain 30-50 lbs. (14-23 kg) of pelletized material / lot produced for 6 months (WSS-M4D1005-A2 only).

3.1.4 Unless otherwise agreed to by Ford Materials Engineering, Control Plan and Certificate of Analysis (CoA) lot testing requirements must include, but are not limited to:

- Melt Flow Rate
- Mineral Filler Content
- Impact Strength, Notched Izod at 23C
- Flexural Modulus
- Molding Shrinkage (WSS-M4D1005-A1 / A2)
- Post Shrinkage (WSS-M4D1005-A2)

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 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 (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

3.3 APPEARANCE (WSS-M41005-A1 only)

3.3.1 Weathering Resistance — Rating 4 min
(SAE J2527 Atlas Water Cooled,
Rotary Drum Xenon-Arc Apparatus only.
Modified Type "S" borosilicate inner and outer filters,
0.55 W/m^2 radiant exposure monitored at 340 nm,
3000 h total exposure or as otherwise defined,
Specimen C, from smooth polished mold,
ISO 105-A02 / AATCC Evaluation Procedure 1)

For color durability submissions, test all program colors

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3.3.2 1 and 2 year Florida — Rating 4 min
Initial Qualification for new resin technology
(SAE J1976, 5° south, direct weathering inland,
Specimen C from smooth polished mold,
ISO 105-A02 / AATCC Evaluation Procedure 1)

After exposure the material shall show no color change in excess of the specified AATCC Rating. In addition, there shall be no cracking, crazing or other deterioration.

A slight loss of gloss or chalking will be allowed provided an acceptable appearance can be achieved as specified below by washing with mild detergents and water (ratio 5:95 by volume) or equivalent after the outdoor exposure only.

All initial approvals may be based on the accelerated weathering exposure, pending real world outdoor exposure results for final approval.

3.3.3 Resistance to Scratch and Mar
(FLTM BO 162-01, Specimen I)

Scratch	Rating 2 at 2 N, max
Whitening/Color Change	Rating 1 at 7 N, max
Marring	Rating 2 at 2 N, max

These values are derived from colored and grained samples in agreement with Materials Engineering. Details regarding color house, let down ratio, colors, grain, etc can be found in the approval package.

3.4 MATERIAL PROPERTIES

3.4.1 Melt Flow Rate — 26 - 46 g/10 minutes
(ISO 1133, 230 °C, 2.16 kg)

3.4.2 Filler Content — 21 – 23.5%
(ISO 3451-1, Method A, talc filler, — (online process control)
3 h at 650 +/- 25 °C, test portion 1 -2 g)

3.4.3 Density — 1.04 – 1.08 g/cm^3
(ISO 1183, Method A)

3.4.4 Hardness, Durometer D — 56 - 67
(ISO 868, 15 s dwell)

3.4.5 Tensile Strength at Yield — 17 MPa, min
(ISO 527-1 & ISO 527-2, 150 minimum x
10 x 4.0 +/- 0.2 mm specimen A, test speed:
50 mm/minute)

3.4.6 Tensile Modulus — 1994 MPa, min
(ISO 527-1 & ISO 527-2,
150 minimum x 10 x 4.0 +/- 0.2 mm specimen A
test speed: 5 mm/min)

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