ACRYLIC (PMMA), OPTICAL GRADE, EXTERIOR	**WSS-M4D776-B1**
ACRYLIC (PMMA), OPTICAL GRADE, INTERIOR	**WSS-M4D776-B2**
ACRYLIC (PMMA), OPTICAL GRADE, HIGH HEAT, EXTERIOR	**WSS-M4D776-B3**
ACRYLIC (PMMA), OPTICAL GRADE, HIGH HEAT, INTERIOR	**WSS-M4D776-B4**
ACRYLIC (PMMA), TRIM GRADE, EXTERIOR	**WSS-M4D776-B5**

1. SCOPE

The materials defined by these specifications are a thermoplastic acrylic molding compound based on polymethylmethacrylate (PMMA).

2. APPLICATION

These specifications were released originally for materials used for lenses of rear, front and interior lamps, as well as exterior trims.

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.

3.1.1 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.

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

3.1.3 Materials approved to WSS-M4D776-B2 and –B4 must meet the requirements outlined in WSS-M99P2222-D1/Latest, *Performance, Vehicle Interior Environment Quality Material/Component Requirements*. Data must be included in material submission package.

3.1.4 Performance Criteria:
Parts using this specification shall meet the appropriate performance specifications:
Exterior: WSS-M98P13-C/latest
Lighting: WSK-M98P10-A/latest
Interior: WSS-M15P4-F/latest.

Date	Action	Revisions	Rev. 02
2014 01 16	Revised	See Summary of Revisions	G. Eaton, NA
2013 07 30	Revised	Editorial changes to Heat Deflection and Vicat Softening	G. Eaton, NA
2013 02 19	Released		G. Eaton, S. Draheim, NA

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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 8257-2*)*. 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

3.3.1 Weathering Resistance *(B1, B3, and B5 only)* 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.

3.3.2 1 and 2 year Florida *(B1, B3, and B5 only)* 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 Weathering Resistance *(Interior MIC Visible)* Rating 4 min
(FLTM BO 116-01, 977.6 kJ/m^2 exposure
Specimen C from smooth polished mold,
ISO 105-A02 / AATCC Evaluation Procedure 1)

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

Use regional choice for initial approval and report the color house used. See Table 2 for additional color durability submission

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3.3.4 Resistance to Scratch *(B5, Colored only)*
(FLTM BO 162-01, Specimen I, 7.0N, 6.0N, 4.5N, 3.0N, and 2.0N)

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 or high gloss samples in agreement with Materials Engineering. Details regarding color house, let down ratio, colors, grain, etc can be found in the approval package.

3.3.5 Resistance to Mar *(B5, Colored, A & B gloss finish only)* 70% Gloss Retention min
(FLTM BI 161-01)

3.4 MATERIAL PROPERTIES

3.4.1 Melt Flow Rate 1 – 5.6 g/10 minutes
(ISO 1133 230 °C, 3.8 kg)

The material shall be dried for 2 h minimum at 100 °C in a mechanical convection oven immediately preceding the test.

3.4.2 Density 1.18 – 1.20 g/cm^3
(ISO 1183, Method A)

3.4.3 Tensile Strength at Break 58 MPa min
(ISO 527-1 and ISO 527-2, Specimen A,
5 mm/minute test speed)

3.4.4 Elongation at Break 0.5% min
(ISO 527-1 and ISO 527-2, Specimen A,
5 mm/minute test speed)

3.4.5 Tensile Modulus 2.7 GPa min
(ISO 527-1 and ISO 527-2, Specimen A,
1 mm/minute test speed)

3.4.6 Flexural Modulus 2.5 GPa min
(ISO 178, Specimen D,
64 mm support span, 2 mm/minute test speed)

3.4.7 Heat Deflection Temperature (ISO 75-1 and ISO 75-2, Specimen D, flatwise, 0.34 +/- 0.1 mm deflection. At 1.80 MPa)	**B1/B2**	**B3/B4**	**B5**
	65 °C min	90 °C min	65 °C min

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.

3.4.8 Vicat Softening Temperature (ISO 306, Specimen D, Bath - silicone oil, temperature raise 50 +/- 5 °C/h. Dial gage reset to 'O' after addition of 5 kg weight, at 50 N load)	**B1/B2**	**B3/B4**	**B5**
	97 °C min	106 °C min	92 °C min

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