Ford Motor Company

# ENGINEERING MATERIAL SPECIFICATION

| Material Name | Specification Number |
|---|---|
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET BASECOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS WITH WSS-M33J7-A2, ETCH RESISTANT, EXTERIOR** | **WSS-M33J7-A1** |
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET CLEARCOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS WITH WSS-M33J7-A1, ETCH RESISTANT, EXTERIOR** | **WSS-M33J7-A2** |
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET TINTED CLEARCOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS, ETCH RESISTANT, EXTERIOR** | **WSS-M33J7-A3** |
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET BASECOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS WITH WSS-M33J7-B2, ETCH & SCRATCH RESISTANT, EXTERIOR** | **WSS-M33J7-B1** |
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET CLEARCOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS WITH WSS-M33J7-B1, ETCH & SCRATCH RESISTANT, EXTERIOR** | **WSS-M33J7-B2** |
| **ENAMEL, COMPLIANCE VOC, HIGH SOLIDS, THERMOSET TINTED CLEARCOAT, BASECOAT/CLEARCOAT WET-ON-WET PROCESS, ETCH & SCRATCH RESISTANT, EXTERIOR** | **WSS-M33J7-B3** |

## 1. SCOPE

The materials defined by these specifications are coatings which consist of a pigmented thermoset basecoat enamel over which is applied a clear or tinted clear thermoset clearcoat in a wet-on-wet process. These materials are monobaked. Unique tricoat colors are also included in these specifications. Tricoat colors consist of a pigmented basecoat followed by a non-hiding midcoat over which is applied a clear or tinted clear. Tricoat colors may be processed wet-on-wet-on-wet application and monobaked or in a wet on bake operation.

## 2. APPLICATION

These specifications were released originally for materials used as the topcoat finish on automobile bodies, hoods, fenders and other exterior parts, and shall be satisfactory for use over specified primers or over previously baked enamel, as in paint repair or two toning operations. These materials have been formulated to provide windshield bonding without the use of flange primer (direct glazing) and allow for flush glass designs. The basecoat portion is used alone, without clearcoat, as an interior baking enamel for some applications.

| Date | Action | Revisions |
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The material defined by these specifications is supplied at normal viscosity and solids level as shown in this document.

## 3. REQUIREMENTS

Test shall be made on the basis of comparison with approved production material, to be chosen by approving materials engineer.

Note: For purposes of the specifications, paint systems which utilize a standard basecoat/ clearcoat, a basecoat/midcoat/clearcoat and/or a system with a tinted clearcoat shall be considered the "complete basecoat/clearcoat enamel system". For basecoat-only applications refer to para 3.10.

### 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).

### 3.2 COMPOSITION

3.2.1 Resin

Basecoats shall be thermosetting, synthetic resins, and clearcoats will be thermosetting, acrylic-modified synthetic resins or equivalent. Each will be appropriately fortified so as to meet the durability requirement of 10 years.

3.2.2 Pigments

Pigments are exterior quality automotive grade selected to meet durability requirements.

3.2.3 Solvents

The volatility of the solvents will be such that there shall be no paint sagging, roughness or dry spray at specified film thicknesses. Solvents shall be HAPS compliant if it is required by local government regulations.

### 3.3 PHYSICAL PROPERTIES LIQUID STATE

The following evaluation must be conducted at application viscosity. Over the application viscosity range, material shall be in compliance with local emissions regulations.

| | | |
|---|---|---|
| 3.3.1 | Non-Volatile Content, range (ASTM D 1353) | See initial sample +/- 4 % |
| 3.3.2 | Volatile Organic Content, range (ASTM D 3960) | See initial sample +/- 1 % |

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| 3.3.3 | Weight per Volume, range (ASTM D 1475) | See initial sample +/-0.03 g/ml |
| 3.3.4 | Volume Solids, range (ASTM D 2697) | See initial sample +/-2.0 % |
| 3.3.5 | Pigment Content in Tinted Clearcoat, max (ASTM D 2471, max weight % [on total formula] of colored pigment) | 0.25 % |

3.3.6 Viscosity
(ASTM D 1200)

Supplier shall report value at application reduction.

3.3.7 Stability
(ASTM D 1849)

After test, the material shall pass all specification requirements.

3.3.7.1 Shelf Stability 90 days

No more than 30 % increase in viscosity permitted.

3.3.7.2 Accelerated Stability
(60 °C, 16 h)

No more than 30 % increase in viscosity permitted.

3.3.8 Resistivity 0.05 to 2.00 megohms
(ASTM D 5682)

Volatile solvents and other components affecting electrical conductivity shall be adjusted such that the resistivity at application viscosity shall be within specified limits.

## 3.4 PREPARATION OF TEST PANELS

Substrate: Current production phosphated galvanized steel and current production primed exterior thermosetting plastic. Record all substrate information. See para 4.1.

Electrocoat: Current production medium build gray cathodic electrocoat, applied at 20 - 23 micrometers and baked 10 minutes at 182 °C metal temperature (MT). Record electrocoat and oven type used.

Primer: Current production primer surfacer in a color consistent with production, applied at 25 - 28 micrometers and baked 10 minutes at 149 °C MT. Record primer and oven type used.



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| Enamel: (OEM) | Apply basecoat to required dry film thickness by spray under conditions appropriate for basecoats, and flash as required. Apply clearcoat to required dry film thickness. Bake using appropriate bake schedule. Record enamel and oven type used. |
| Catalyzed Low Bake Repair: (LBR) | For catalyzed low-bake repair, a current production basecoat/ clearcoat system from the same manufacturer that has been approved for use may be substituted, provided that it meets all the catalyzed repair systems criteria. Catalyze enamel as per manufacturer's recommendations. Prepare (OEM) panels at target conditions. Wipe panels using naphtha and mask half of panel vertically. Apply low bake system, remove masking, flash and bake 10 minutes at 99 °C MT. |

See para 4.2 Table 1 for Topcoat Processing Matrix, Table 2 and 3 for New Resin Technology Test Matrices, and Table 4 for New Pigments/New Colors Test Matrix.

## 3.5 PROCESS WINDOW DEFINITION - NEW RESIN TECHNOLOGIES ONLY

The supplier shall perform a Design of Experiments (DOE) (Response Surface Analysis is recommended) to determine the process window of the control and candidate materials. The three variables/parameters to be included in the design are bake temperature, bake time, and clearcoat film thickness (basecoats applied at hiding). An initial screening experiment should be run to determine what levels should be tested for the variables/parameters. This screening experiment should be reviewed with the materials engineer to set up the final DOE. Responses to the DOE will be based on the materials tested and will be chosen from tests listed within the specification. Minimal critical testing required: cross-hatch adhesion, condensing humidity, acid/alkali resistance, scratch resistance, stone chip (SAE J400 and Erichsen), and intercoat adhesion (ICA). Information will be used by materials engineer to determine acceptable plant processing conditions. See also para 4.2.

## 3.6 APPEARANCE

Note: Appearance panels will be sprayed using standard plant processing parameters. Consideration should be given to an application process window DOE to assess impact of key process variables/parameters on final appearance.

3.6.1 Color
(FLTM BI 109-01)
(SAE J1545 X-Rite MA58 Three-Angle CMC)

Shall match the Master Appearance Standard color panel.

| | | |
|---|---|---|
| 3.6.2 | QMS or Wave Scan DOI, min<br>(Appearance is to be measured with a reliable instrument such as Autospect Inc QMS-BP or Byk Gardner Wave Scan.) | equal or better than control |



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3.6.3 Gloss, min 90
(ASTM D 523, 20 degree Glossmeter)

3.6.3.1 Gloss After Rebake, max 4 unit decrease

Rebake panel at target bake conditions.

3.6.4 Leveling

The surface of material under test shall be equal to or better than currently approved production material for smoothness when applied and baked under identical conditions. Orange peel values taken from QMS data obtained using Autospect shall be reported.

3.6.5 Sanding

3.6.5.1 Holdout

There shall be no evidence of dulling, gloss loss or change of image clarity when enamel color coat is applied over sanded (P400 and P800 grit sand-paper) or unsanded primer surfacer. There shall be no prominence of sand scratches.

3.6.5.2 Telegraphing

There shall be no evidence of color shift when enamel color coat is applied over sanded (P400 and P800 grit sandpaper) or unsanded primer surfacer.

3.6.6 General

The enamel shall cure to a presentable, serviceable, mar-resistant film showing no craters, seediness, abnormal roughness or excessive metallic mottling. It shall have reasonable tolerance for ordinary cleaning (such as automatic car washes) and exhibit excellent polishing characteristics when wheel polished with a wide range of various compounds and cleaners.

## 3.7 FILM PROPERTIES

3.7.1 Film Thickness
(ASTM D 1186)

Target values shall be defined from process window (para 3.5).



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3.7.2 Dry Hiding - Pigmented Basecoat (FLTM BI 158-01) — 15 - 30 micrometers

The basecoat is required to provide complete visual hiding over black and gray hiding chart.

When an exception to this hiding requirement is needed for special colors, concurrence must be obtained from all affected Ford activities.

3.7.2.1 Pigmented Midcoat

The pigmentation of the midcoat shall be such that hiding of the basecoat does not occur. The max allowable pigment to binder ratio (P:B) is 0.15.

3.7.3 Ultraviolet Light Transmittance

Max light transmission through basecoat applied at 80 % of dry hiding directly over epoxy-free spray primer shall be no more than 0.1 % at 360 nm and 5 % at 400 nm. The equipment used for this measurement is an integrating sphere spectrophotometer or equivalent. Non-fortified (without UV package) clearcoat is used for this evaluation.

3.7.4 Bleeding of Pigments (ASTM D 279) — None Permitted

New Pigments Only

3.7.5 Hardness (ASTM D 1474)

Record value at target film and bake conditions. Coating shall be sufficiently cured after baking so that it can meet the polishing requirements of para 3.7.7.

3.7.6 Adhesion

3.7.6.1 Scratch Test (FLTM BI 106-01, Part A) — No chipping or loss of adhesion permitted

3.7.6.2 Scribe Test, max (FLTM BI 106-01, Part B) — Grade 2



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3.7.7 Polishing

Shall be capable of being sanded with 1200 grit sandpaper and polished in accordance with current plant processes to minimize orange peel or to remove defects. No noticeable change in gloss or appearance except for a min of swirl marks is permitted. Deep polishing lines or swirl marks are unacceptable.

3.7.8 Glass Bonding / Paint System Compatibility

Shall meet all requirements of Ford Automotive Operations Procedure No. AVP-T118-001, latest revision

## 3.8 RESISTANCE PROPERTIES

3.8.1 Condensing Humidity (ASTM D 4585, 43 °C) — 240 h

No blistering, dulling, wrinkling, softening and/or loss of adhesion permitted. Panels will be checked for adhesion upon removal from humidity cabinet, at no greater than 20 minutes elapsed time from removal, and meet the requirements of para 3.7.6.2.

3.8.2 Acid/Alkali Resistance — Equal or better than control

The Gradient Bar Method or equivalent shall be used. The following solutions shall be tested on candidate materials: Solutions of sulfuric acid ($H_2SO_4$) adjusted to pH of 2, 3, 4; a solution in water of 0.75 % by weight $CaSO_4$ adjusted to a pH of 4; deionized water (DI) and tap water, Bee Dropping (Ford Method 24) available from Global Paint Engineering (North America Paint Engineering).

Apply 0.05 ml of specified solutions along entire length of 2 test panels. Place on gradient bar (38 - 82 °C, calibrated for heat-up rate of 2 minutes or less for 0.9 mm steel substrate). Remove 1 panel after 15 minutes at temperature, other after 30 minutes. Rinse any remaining solution with water. Examine panels for etching, discoloration, pitting, etc. Report etch-free temperature for test material and control.

NOTE: Process window evaluation will be done using 2 solutions: (1) Sulfuric Acid pH3, 15 minute exposure; and (2) $CaSO_4$ pH4, 30 minute exposure.

3.8.3 Xylene Resistance — No softening, or dulling permitted

Using a circular motion, rub surface of enamel 10 times with wetted cheesecloth.



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