ENAMEL, WATERBORNE, (3 WET) COMPLIANCE VOC, HIGH SOLIDS THERMOSET PRIMER, PROCESSED WITH WSS-M33J12-A2/WSS-M33J12-A4, EXTERIOR **WSS-M33J12-A1**

ENAMEL, WATERBORNE, (3 WET) COMPLIANCE VOC, HIGH SOLIDS THERMOSET BASECOAT PROCESSED WITH WSS-M33J12-A1/WSS-M33J12-A4, EXTERIOR **WSS-M33J12-A2**

ENAMEL, WATERBORNE, (3 WET) COMPLIANCE VOC, HIGH SOLIDS THERMOSET MIDCOAT, PROCESSED WITH WSS-M33J12-A1/WSS-M33J12-A2/WSS-M33J12-A4, EXTERIOR **WSS-M33J12-A3**

ENAMEL, 2-COMPONENT URETHANE, (3 WET) COMPLIANCE VOC, HIGH SOLIDS THERMOSET CLEARCOAT, PROCESSED WITH WSS-M33J12-A1/WSS-M33J12-A2, EXTERIOR–COMPOSED OF WSS-M33J12-A6/WSS-M33J12-A7 **WSS-M33J12-A4**

ENAMEL, 2-COMPONENT URETHANE, (3 WET) COMPLIANCE VOC, HIGH SOLIDS THERMOSET TINTED CLEARCOAT, PROCESSED WITH WSS-M33J12-A1/ WSS-M33J12-A2, EXTERIOR–COMPOSED OF WSS-M33J12-A6/WSS-M33J12-A7 **WSS-M33J12-A5**

PART A - POLYOL COMPONENT, (3WET) COMPLIANCE VOC, PROCESSED WITH WSS-M33J12-A7 **WSS-M33J12-A6**

PART B - ISO COMPONENT, (3WET) COMPLIANCE VOC, PROCESSED WITH WSS-M33J12-A6 **WSS-M33J12-A7**

1 SCOPE

The materials defined by these specifications are coatings, which consist of primer surfacers over which is applied a pigmented thermoset basecoat enamel and a clear or tinted clear thermoset clearcoat in a wet-on-wet-on-wet (3 Wet) process. These materials are monobaked. Unique tricoat colors are also included in this specification. 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-on-wet application and monobaked or in a wet on bake operation.

2 APPLICATION

These specifications were released originally for materials used as the combined primer surfacer (guidecoat), basecoat, and clearcoat finish when applied wet-on-wet-on-wet (3 Wet) and monobaked on automobile bodies, hoods, fenders and other exterior parts, and shall be satisfactory for use 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.

3 REQUIREMENTS

Tests shall be made on the basis of comparison with an approved production material chosen by the approving materials engineer.

Date	Action	Revisions	Rev. 0
2014 01 02	Released	T. Honey, T. Weingartz NA	

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3.1 STANDARD REQUREMENTS FOR PRODUCTION MATERIALS

Material suppliers and part producers must conform to the company's standard requirements for production materials (WSS-M99P1111-A). For the materials described within this specification those requirements include but are not limited to the performance specification and the system design specification.

3.2 COMPOSITION

3.2.1 Resin

3.2.1.1 Primers shall be waterborne modified polyester and/or modified polyurethane crosslinkable resin(s), with melamine and/or reactive urethane crosslinker(s) or equivalent.

3.2.1.2 Basecoats and traditional tricoat midcoat shall be waterborne thermosetting, synthetic resins with a melamine crosslinking system or equivalent.

3.2.1.3 Clearcoats will be thermosetting, 2-component urethane synthetic resins with a hybrid crosslinking system or equivalent.

Each will be appropriately fortified so as to meet the durability requirement of 10 years. The primer composition will meet all performance expectations in terms of stone chip damage and adhesion.

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.

3.2.4 Ultra Violet Light Absorber(s) (UVA) and Hindered Amine Light Stabilizers (HALS)

All approved materials shall include with the initial Sample Report an Ultra-Violet/Visible spectroscopic analysis. This shall be recorded and filed by the approving Paint Material Engineering Laboratory of the Ford Motor Company as a reference standard for future use and recertification.

The coating system shall contain sufficient fortification of suitable UVA and HALS to provide 10 year long term durability.

3.2.5 Flash Point

The flash point shall conform to the safety regulations applicable to the plant and/or country where the materials are used.

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3.3 PHYSICAL PROPERTIES LIQUID STATE

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

3.3.1	Non-Volatile Content (ASTM D2369-07 for North America) (FLTM BI 102-01 for Europe)	See initial sample +/- 2%
3.3.2	Volatile Organic Content (ASTM D3960)	See initial sample +/- 1.5%
3.3.3	Weight per Volume (ASTM D1475)	See initial sample +/- 0.025 g/ml
3.3.4	Volume Solids, range at Application Viscosity (ASTM D2697 or FLTM BI 154-02)	See initial sample +/-1.3% Primer 30% minimum Basecoat 19% minimum Clearcoat 48% minimum
3.3.5	Pigment Content in Tinted Clearcoat (ASTM D2471, max weight % [on total formula] of colored pigment)	0.25% max
3.3.6	Viscosity (ASTM D7395)	Report at application rate
3.3.7	Stability (ASTM D1849)	
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.

After the accelerated stability test, the material shall pass all specification requirements. Critical testing must include; solvent pop, sag resistance, appearance, direct to glass bonding, intercoat adhesion, repair paint system wetting, and tape/label adhesion.

3.3.8	Resistivity WSS-M33J12-A7 Polyol Clearcoat Component (ASTM D5682)	0.05 to 2.00 megohms
3.3.9	pH WSS-M33J12-A1,A2,A3 Waterborne Coatings (ISO 976:1996)	7.8 – 8.6

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3.4 PREPARATION OF TEST PANELS

Substrate: All current production substrates, including but not limited to, pretreated galvanized steel, pretreated electro galvaneal steel, pretreated aluminum, unpolished pretreated cold rolled steel and current production primed exterior thermosetting plastic. Record all substrate information. See para 4.1.

Electrocoat: Current Ford production approved medium build gray cathodic electrocoat, applied at 20 - 23 micrometers and baked utilizing the appropriate bake schedule. Record electrocoat and oven type used.

Primer: Within a wet-on-wet-on-wet application process apply primer surfacer to required dry film thickness (10-25 microns) by spray under conditions appropriate for primes, and flash prime coat 120 seconds (+5' x 82℃) or as specified, prior to basecoat application. Record primer application information and include with the submission data package for system approval.

Basecoat: Apply basecoat, directly to the just flashed primer, to the required dry film thickness (typical color dependent range – 15- 30 microns) by spray under (OEM) conditions appropriate for basecoats, and flash 120 seconds (+4' x 82℃) or as required. Record basecoat application information and include with the submission data package for system approval.

Clearcoat: Apply clearcoat to required dry film thickness (60 microns) and flash 10 minutes or as required. Bake for 20 minutes at 140 degrees centigrade metal temperature with 10 minute ramp-up. Bake target is obtained using appropriate bake schedule as defined by paragraph 3.5. Record clearcoat application information and oven type used and include with the submission data package for system approval.

Catalyzed Low Bake Repair: LBR For catalyzed low-bake repair, a current production basecoat/clearcoat system from the same manufacturer that has been (LBR) 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 100 ℃ metal temperature. A blocked ISO Part B is recommended for LBR.

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. Process application and coating thickness optimization including target ranges are to be defined within para 3.5 process window.

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 four variables/parameters to be included in the design are bake temperature, bake time, primer 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 response surface DOEs will be based on the materials tested and will be chosen from tests listed within the specification. Minimal critical performance testing required: cross-hatch adhesion, condensing humidity, acid/alkali resistance, scratch resistance, stone chip (SAE J400 and Erichsen), intercoat adhesion (ICA), and quick knife glass bonding adhesive adhesion. The candidate coating system versus a control will also be required to be evaluated for application robustness utilizing DOEs agreed upon by the Ford responsible

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Approving Engineer. 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. The appearance target values herein listed should be consistent with the fourth quartile values defined by the process window, and should be used as directional targets for production.

3.6.1 Color
(FLTM BI 109-01)
(SAE J1545 X-Rite MA68II Multi-Angle Spectrophotometer or equivalent)

Shall match the Master Appearance Standard color panel.

3.6.2 Wave Scan CF — equal or better than control
(Appearance is to be measured with a reliable instrument such as Byk Gardner Wave Scan.)

Target Values:	Horizontal	Vertical
Dark Solids (L15 <50)	65	55
Medium Solid (L15 89-50)	65	55
Light Solids (L15 >90)	65	55
Dark Metallic (L15 <50)	65	55
Medium Metallic (L15 89-50)	65	55
Light Metallic (L15 >90)	60	50
Tricoat	60	45

3.6.3 Gloss — 92 min
(ASTM D523, 20 degree Glossmeter)

3.6.3.1 Gloss After Rebake — 4 unit decrease max

Rebake panel at target bake conditions.

3.6.4 Leveling

The surface of material(s) 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 Wavescan data 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 the 3 Wet paint system is applied over sanded (P400 and P800 grit sand-paper) and unsanded ecoat, OEM repaired topcoat, and plastic substrate. There shall be no prominence of sand scratches.

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3.6.5.2 Telegraphing

There shall be no evidence of color shift when the 3 Wet paint system is applied over sanded (P400 and P800 grit sandpaper) and unsanded ecoat OEM repaired topcoat, and plastic substrate.

3.6.6 General

The material system 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 D1186)

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

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

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 shall be no more than 0.1% at 360 nm and 5% at 400 nm. The complete primer/basecoat/clearcoat system shall at 80% of minimum film builds (e.g. Primer 12 mircrons, Basecoat 80% of dry hiding, & Clearcoat 28 microns) have 0.05% light transmission 290 nm – 470 nm and < 0.5% light transmission 470 – 550 nm. All primer surfacers used are to be free of aromatic epoxy resins. 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 — None Permitted
(ASTM D279)
New Pigments Only

3.7.5 Hardness — $\geq$ 7.0 KHN
(ASTM D1474)

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.

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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 (FLTM BI 106-01, Part B)	Grade 1 max

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. See Table 5 in AVP-T118-001 for panel conditions.

Prior to making any changes in properties and/or composition of originally approved paint, the supplier must certify compliance to a ll requirements of Direct Glazing Systems specification (test values, not nominal values) and obtain approval from the responsible Materials Engineering activity. For approved Direct Glazing System contact the responsible materials Engineering activity.

3.8 RESISTANCE PROPERTIES

(Resistance properties are measured with the complete primer/basecoat/clearcoat system applied.)

3.8.1 Condensing Humidity
(ASTM D4585, 43 °C, 240h)

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 (ASTM D7356 – 07)	Equal or better than control

Method ASTM D7356-07 or equivalent shall be used. Process window evaluation will be conducted following this testing method: Solution by weight (1) 997.5 grams DI Water, (2) 15 grams Sulfuric Acid - H_2SO_4 0.02N, (3) 2.2 grams Nitric Acid - HNO_3 0.3%, (4) 2.5 grams Sodium Hydroxide - NaOH 0.02N, (5) 1.8 grams $CaCl_2$ – Calcium Chloride 0.01M, and (6) 1.0 grams KCl – Potassium Chloride 0.01M.

Panel testing outlined in table 1 utilizing the following solutions shall be tested on candidate materials: 0.5 N HCl solution; 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; Formic Acid 47 gm, Tannic Acid in 10% water 24 gm, Honey 24 gm, Albumin 5 gm) and Ford European Solution 10 (10 grams Iron Sulfate/1N Sulfuric Acid solution H_2SO_4).

Apply 2.0 ml of specified solutions along entire length of 2 test panels. Place the uncovered panels in a test cabinet at 40 °C for 1 hour. Repeat at 50 °C and 60 °C. Rinse any remaining solution with water. Examine panels for etching, discoloration, pitting, etc. Report etch-free temperature for test material and control.

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