

PIGMENTATION EVALUATION

GM9620M

1 SCOPE. This specification covers the annual testing required to evaluate the effects of new pigments or pigmentation changes made in approved topcoat technologies. This specification covers all rigid and flexible colors which will be supplied to GM assembly plants or to outside part sources.

1.1 Testing per this specification is initiated by a change in pigment type, a combination of pigments not previously used together, a change in the level of a pigment, or a change in pigment-to-binder ratio.

1.2 The intent of the testing in this specification is to ensure that all future GM colors, in previously approved topcoat technologies, will meet specified performance criteria as affected by pigmentation. This testing generally includes evaluation of: colorfastness, chip resistance, repair capability, flexibility, and resistance to UV transmission.

1.3 Performance criteria is dictated by the *Type* and *Class* of topcoat tested. Topcoat classes and types are defined in GM4367M, Table 1A and 1B. Generally, all paints which apply to this specification will meet the requirements of a Class 1 or 2 topcoat.

1.4 All colors are to complete a full 5 years of outdoor (Florida) exposure. This specification however, defines test procedures for colors to be released for production after 1 - 2 years of exposure.

1.5 All colors in all basecoat technologies used for fascias must be evaluated on flexible substrates, even though an identical basecoat color is used for body paint technology.

2 REFERENCED STANDARDS.

GM1000M	GM9534P
GM4348M	9984064
GM4352M	9984434
GM4364M	9984505
GM4367M	9984518
GM4494M	ASTM D279
GM9522M	ASTM D1474A
GM4465P	ASTM D1475
GM9071P	ASTM D2196
GM9125P	ASTM D2369B
GM9163P	ASTM D2697
GM9501P	ASTM D3960
GM9503P	ASTM D4212
GM9505P	SAE J1960
GM9508P	SAE J2020
GM9533P	

3 REQUIREMENTS. A formal submission package is required for all new colors. This includes a full description of the material and documentation of performance compliance. Color position must be approved to GM Color Guides prior to initiation of testing. Performance in specified tests must meet or exceed criteria defined in the following specifications:

GM4367M for topcoat qualification; individual technology requirements listed under material specification 998XXXX numbers; and appearance requirements defined in GM4364M and GM4348M. For colorfastness, there shall be no change after 1 year and no more than slight color change after 2 years. All data is to be documented on forms as shown in Figure 1 and provided as outlined below:

3.1 RESTRICTED AND REPORTABLE CHEMICALS (GM1000M). All material supplied to this specification must comply with the requirements listed in GM1000M, "Restricted and Reportable Chemicals."

3.2 GENERAL DESCRIPTION. Technology identification by system 998XXXX; basecoat 998XXXX and clearcoat 998XXXX where applicable. Target bake temperature (T) and target time at substrate temperature.

3.3 COLOR DESCRIPTION. Color name; GMXX color code; WAXXXX supplier code; and batch number used for testing.

3.4 PHYSICAL DESCRIPTION. Formula (theoretical) values for weights solids (ASTM D2369B), volume solids (ASTM D2697), and VOC (ASTM D3960) at viscosity used to spray the test panels; density (ASTM D1475); initial and application viscosity (ASTM D4212) for Newtonian fluids or (ASTM D2196) for non-Newtonian fluids. Description by detailed name and source code; each pigment as a percent of total pigment; and pigment-to-binder ratio. Document all data using the format in Figure 4.

3.5 PIGMENT REQUIREMENTS. Any new pigment not previously used in any GM color or a pigment not previously used in the proposed resin system, must have 2 years Florida exposure data submitted and approved by NAO, prior to use in any color or Concept color development.

3.6 BAKE AND FILMBUILD. Nomenclature to be used for both topcoat bake and film is:

Target (T)	= minimum to maximum range within which, all performance requirements can be met.
Low (L)	= target minimum
High (H)	= target maximum
Repair (R)	= repair

3.6.1 Target bake temperatures must be defined by the supplier for each topcoat technology. Parameters used for panel preparation are shown in Tables 1 and 2.

3.6.2 Technology Filmbuild Ranges. All minimum and maximum color film builds must be within the range specified for the technology shown in Table 3.

3.6.3 Film Build Minimum (L). The filmbuild minimum for all body paint (assembly plant usage) color developments will be defined through the laboratory feasibility study or design of experiment (DOE). These minimums must be equal to or greater than, the technology minimum and must also meet color match, appearance and UV transmission requirements.

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TABLE 1 - PRIMER BAKE DEFINITIONS

Material	Bake Type	Time (minutes)	Temp
ELPO	Target (T)	30	166°C
	Upper Limit (H)	60	180°C
Surfacer	Target	25	T
	Upper Limit (H)	60	(T + 14)°C
Plastic Primer	Target	25	T
	Upper Limit (H)	60	(T + 14)°C

TABLE 2 - TOPCOAT BAKE DEFINITIONS

Bake Type	Symbol	Description	Minutes @ Substrate Temp	Substrate Temp
High (Type A & B)	(T)	Target	25	99 – 149°C
	(L)	Lower Limit	20	(T – 5.6°C)
	(H)	Upper Limit	90	(T + 14°C)
	(R)	In-Line Repair	*	*
High (Type D)	(T)	Target	25	99 – 130°C
	(L)	Lower Limit	20	(T – 8.4°C)
	(H)	Upper Limit	90	(T + 8.4°C)
Low or Force Dry (Type A & B, D)	(T)	Target	25	< 99°C
	(L)	Lower Limit	25	(T – 8.4°C)
	(H)	Upper Limit	90	(T + 8.4°C)
Final Line Repair (Type A)	(F)	Target	20	82 – 99°C

*Details of OEM bake time and temperature are indicated in GM4494M in Tables 1 and 2 and in the text.

TABLE 3 - COLOR COAT FILM BUILD RANGE

998XXXX*	Technology	Color Coat Range (µm)
9984505	Solventborne BC	13 - 41 µm
9984518		(.5 - 1.6 mils)
9984434	Waterborne BC	10 - 36 µm
		(.4 - 1.4 mils)
9984064	High Solids Enamel	43 - 64 µm
		(1.7 - 2.5 mils)

* New 998 numbers may apply. Check individual specifications

3.6.4 UV Transmission Filmbuilds. For UV Transmission testing of basecoat or monocoat only: Minimum filmbuild (L), baked for 25 minutes at substrate target temperature.

3.6.5 Black/White Hiding Filmbuild. Unless otherwise agreed upon, hiding must be no more than 38 µm (1.5 mils) for basecoat colors and 51 µm (2.0 mils) for monocoats.

3.7 UV FORTIFICATION PACKAGE. Identify the generic chemical class and amount of screener and/or hindered amine in each color as a percent of resin solids. Identification as to the specific type is to be provided upon special request.

3.8 ULTRAVIOLET TRANSMISSION TEST (GM9534P). All testing must be done on the Perkin-Elmer Lambda 6 with a 150 mm diameter, Labsphere RSA-PE-60, integrating sphere or equivalent.

3.8.1 Prepare and test samples per detail in Table 4. Transmission must be run from 290 - 700 nanometers, on a scale of 0 - 20% for color coats and 0 - 100% for clearcoats, reported per format in Figure 2.

TABLE 4 - SAMPLE CRITERIA FOR UV

Layer	Film Build	Bake*	Criteria
BC Only	Color min (L)	25 minutes @ T	a & b
CC Only	38 µm	25 minutes @ T	a
BC + CC	Color min (L) + 38 µm CC	25 minutes @ T	a & b
Monocoat	Color min (L)	25 minutes @ T	a & b

*Bake is based on a target time of 25 minutes at target substrate temperature (T) unless otherwise determined from technology development.

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3.8.2 Acceptability Criteria.

- a. No more than 0.1% transmission from 290 - 360 nm.
- b. No more than 0.5% transmission at 400 nm for colors targeted for plants or plastic substrates not using surfacer.

NOTE: If test of basecoat/clearcoat or monocoat only samples do not meet item b requirements, retest at increasing Dry Film Thickness (DFT), until acceptable results.

3.9 PIGMENT STABILITY VERIFICATION. The supplier must document the following items:

3.9.1 The pigment is nonbleeding (ASTM D279).

3.9.2 The pigment is not photochromatic.

3.10 GLOSS. Appearance information is to be derived from panels sprayed and baked, in the vertical position. Other test panels can be sprayed and/or baked in the horizontal position. All details of panel preparation must be recorded.

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3.12 MATERIAL SAFETY DATA SHEET. The supplier must provide Material Safety Data Sheets for all new colors. The total pigmentation package must comply with GM1000M.

3.13 TEST PANEL PREPARATION AND REPORT.

All test panels must be documented as to substrate, paint layers, film builds and bakes at substrate temperature. Material selection must be reviewed with the appropriate GM engineer prior to initiation of panel preparation. All substrates and primers used must be approved materials per MATSPC. Combinations of substrates, primer and topcoat must also have a valid APOPS number, see Figure 3 for report format.

3.13.1 Application Equipment. Confirm the equipment selection with the appropriate color engineer. Document the equipment and parameters used for preparing the color/appearance panels and the test panels. There must be no difference in formulation between the color approval/appearance panels and the test panels.

3.13.2 Rigid Topcoat Systems for Metals. Use unpolished A.C.T. steel panels with a current, approved phosphate and electrodeposition primer. Apply surfacer as appropriate for the application. Use the procedure specified in GM4494M, "Exterior Topcoat Preparation Procedure."

3.13.3 Rigid and Flexible Topcoat Systems on Plastic. Use TPO substrate, powerwashed, pretreated and with adhesion promoter, as indicated in GM4494M. Coatings that are used on both rigid and flexible substrates may require testing/approval over multiple substrates. Requirements must be discussed with the appropriate engineer prior to the start of testing. Topcoats applied direct to substrate must be tested over the specific substrate intended for production.

3.13.4 Control Panels. The supplier is expected to incorporate control procedures into each test program to ensure that panel preparation and testing are correct and that there have been no unusual incidents of contamination at outdoor expo-

sure sites. ANY FAILURE TO MEET REQUIREMENTS WILL BE DEEMED TO BE A WEAKNESS IN PIGMENTATION.

3.14 TEST REQUIREMENTS. The test requirements for this specification are defined in Charts 1 - 4. Where applicable, combined laboratory testing may be performed on the same panel (i.e. If preferred, gravelometer and humidity/adhesion tests may be performed on upper/lower halves of one panel.). Performance testing may not be combined with any panel which is intended for evaluation of appearance, after Florida exposure or Xenon test.

3.14.1 Initial Testing. All initial testing must be completed, documented and reviewed with a GM engineer prior to Annual Color Reviews.

3.14.2 Accelerated Testing. Accelerated weathering tests are required for decision making prior to the full 5 years of actual exposure. Xenon Weatherometer testing is required on all colors. This testing should be initiated immediately following color match approval, so as to be complete and available at the Annual Color Review.

3.14.3 Outdoor Exposure Testing (GM9163P). Panels should be sent to approved exposure sites in order to meet timing requirements for Annual Color Reviews. All production intent colors must have a minimum of 12 months of exposure and meet minimum performance requirements, prior to Vehicle Pilots (~mid-February to March, annually).

Primary development colors must have a minimum of 2 years exposure, prior to Pilot. Exposure and test should continue for 5 years on all developed colors and be included at the Annual Color Reviews, whether or not the color is introduced for production.

The 12 months minimum exposure is conditional on proof of durability from longer term test data of individual pigments in the specific paint system, as well as accelerated weathering performance.

3.15 PIGMENTATION CHANGES. Any change in pigmentation (type, amount, blend, source, etc.) from that which initially tested and placed on exposure, must be reviewed with the responsible engineer to determine if additional testing is required. The responsible color engineer is to be advised per NOTIFICATION OF PROPOSED CHANGE document.

3.16 ANNUAL COLOR REVIEW. Formal reviews with GM Color Technology Engineers will be held annually, to review exposure and test results. Unless otherwise directed, all initial and exposure test panels shall be retained by the supplier for these reviews, until completion of 5 years exposure testing.

4 GENERAL INFORMATION. This standard was originated by the Topcoat Task Group and approved by the Paint Materials Specification Committee in January 1991. The latest revisions include:

Rev	Date	Description
D	9/95	Approved Sources Paragraph added
E	6/97	Significant revision of format and content.