

GENERAL ELECTRODEPOSITION PRIMER REQUIREMENTS

GM4384M

1 SCOPE. This specification details the general materials performance, compatibility, and processing information requirements for corporate approval of electrodeposition (ELPO, E-coat, Electrocoat) primers. This specification applies to low, medium, and high film build materials for use on vehicles, space frames and small parts. These primers are intended to provide corrosion and chip resistance and may or may not be intended for subsequent coating for appearance applications.

1.1 Materials qualified to this standard shall meet the performance requirements shown in Table 2 for the class of finish specified in the individual 998XXXX. Additional testing and any exceptions to the requirements detailed herein are noted in the individual primer's respective 998XXXX specification. The primers are classified as follows:

9984017: Low Film Build Sheet Metal & Service Parts (black)
 9984094: Medium Film Build used with primer surfacer (gray and black)
 9984070: High Film Build used with or without primer surfacer (gray)
 9984139: Space Frame (gray or black)

1.2 Materials targeted for approval under the specifications listed above must meet the 3 criteria listed below. The ELPO engineer responsible for approval will decide prior to submission which of these criteria will be applicable.

1.2.1 Materials must meet or exceed all the minimum durability requirements and meet or show significant progress towards meeting one or more of the expectations listed in Tables 2 and 4 for new product approvals.

1.2.2 Suppliers must demonstrate the technology as being production capable to reduce undue risk prior to release in a production facility.

1.2.3 Material must successfully complete a production trial in a target facility prior to release for other facilities.

2 REFERENCED STANDARDS.

GM1000M	GM9535P	9984139
GM4352M	GM9540P	ASTM B117
GM4389M	GM9612P	ASTM D1186
GM4465P	GM9618P	ASTM D1474
GM4466P	GM9619P	ASTM D1475
GM6185M	GM9626P	ASTM D1737
GM6201M	GM9631P	ASTM D2369B
GM9064P	GM9632P	ASTM D3363
GM9071P	GM9633P	ASTM D3960
GM9102P	GM9636P	ASTM D4399
GM9163P	GM9646P	ASTM E70
GM9508P	GM9832P	GP-3
GM9509P	9984017	SAE 1008
GM9511P	9984070	
GM9532P	9984094	

3 REQUIREMENTS.

3.1 RESTRICTED AND REPORTABLE CHEMICALS (GM1000M). By 1997 start of saleable vehicles, all materials supplied to this specification must comply with the requirements listed in GM1000M, "Restricted and Reportable Chemicals".

3.2 The GM ELPO engineer responsible for technology qualification shall be contacted prior to test initiation. The following product information shall be submitted at the start of testing. Typical measurement ranges shall be provided where applicable.

Product code
 Feed ratio
 Solution conductivity (ASTM D4399)
 Volume % solids (ASTM D2369B) for components
 Weight % solids for components
 VOC (ASTM D3960)
 Hardness - ASTM D3363 (Pencil hardness)
 ASTM D1474 (Tukon hardness)
 Density (ASTM D1475)
 Gallon weight
 pH (ASTM E70)
 Material life

3.2.1 Volatile Organic Compounds (VOC), ASTM D3960. The maximum allowable level of VOC is specified in each individual 998XXXX specification.

3.3 HAZARDOUS MATERIAL DOCUMENTATION. Material Safety Data Sheet (MSDS) and Critical Materials Register (CMR) or equivalent shall be furnished prior to initial submission and upon subsequent material modifications.

3.4 SUBMISSION PACKAGE. Two submission packages shall be prepared for distribution. One package should be prepared for the GM ELPO engineer and one for Documentation Retention in the GM Test Work Order System. One complete set of test panels shall be retained by the supplier and be available for review as long as the product is in production. The submission packages shall contain a submission letter, data, 8" x 10" photographs of test panels with test work order number on the front of each panel, key process control information, and a manufacturing process flow diagram. The package shall be dated and signed by an authorized representative, acknowledging that the testing procedures complied with this specification.

3.4.1 Chemical Fingerprint. GM may conduct infrared spectrophotometry analysis of the materials supplied to this specification. The IR spectra established for initial approval shall constitute a reference standard and shall be part of the submission package.

3.4.2 Formulating Range. Information on the technology's ingredient formulation ranges for the various resin systems, pigments, flow control agents, additives (biocides, UV stabilizers...), and key manufacturing control characteristics must be provided as part of the submission package. If a product

GENERAL ELECTRODEPOSITION PRIMER REQUIREMENTS GM4384M

change is proposed which is outside the technology formulation limits the GM ELPO engineer must be notified. A mini submission may be required for approval prior to release to any GM assembly and parts plants. All ingredient ranges, key manufacturing control limits, and CERTIFICATE OF ANALYSIS ranges must pass standard gage R&R studies. Refer to GM Supplier Development General Procedure Number (GP-3) for the method used to determine the materials/manufacturing key control characteristics.

3.5 PANEL PREPARATION.

3.5.1 Test Substrates. Table 2 outlines the test substrates and durability requirements. Following are the requirements for the test panels:

Thickness 0.75 to 0.90 mm.
Materials: Cold Rolled Steel (CRS, SAE 1008),
Electrogalvanized Steel (EG, GM6201M), Iron-Zinc (Fe-Zn, GM6185M), Bimetallic (CRS and EG 100 x 300 mm panels welded along the 300 mm side), Aluminum (2036 and 6111 alloys).

Specific number and substrate combinations are shown in Table 1.

3.5.1.1 For 9984139 testing, HDG steel may replace EG steel.

3.5.1.2 Oily panels shall be obtained by dipping clean bare panels in Quaker 61A-US mill oil and positioning vertically at room temperature for 24 h.

3.5.2 Sample Size. The number of samples for each test shall be a minimum of 3 unless the responsible GM paint engineer and the supplier agree otherwise prior to the start of testing. All substrates, pretreatments, and coating layers shall be fully identified with source, product code, batch number, bake description and film build.

3.5.3 Tests. Table 1 details the test substrate combinations and the testing required. Paint technologies to be tested shall be agreed upon by the GM ELPO engineer and the supplier prior to the initiation of testing.

3.5.4 Film Thickness (ASTM D1186). The film thickness range (minimum/maximum) and target shall be specified by the individual 998XXXX specification. The requirements detailed below shall be met within the specified film build range. All coatings shall be applied at their target coating weights/film builds.

3.5.5 Bake. The bake temperature and time ranges (minimum/maximum) and targets shall be recommended by the supplier. All test panels shall be baked in direct gas-fired ovens, unless specified otherwise by the GM ELPO engineer.

NOTE: Bake time refers to the amount of time the panel maintains the specified metal temperature. Acceptable bake conditions are those in which appearance and durability requirements are met. Marginal bake conditions are those in which appearance and durability test requirements are not met,

with test ratings being no more than one unit off from what is considered acceptable.

3.5.6 Conditioning. Prior to testing, coating samples shall be subject to an aging period of at least 72 h at room temperature following the bake cycle.

3.6 PANEL PERFORMANCE REQUIREMENTS. Performance requirements are outlined in Table 2. The system tested on the panels shall be identical to the intended production system and process, when known.

3.6.1 Appearance. The coating on samples shall be smooth and uniform: free of sags, craters, or other surface defects. The gloss shall be a minimum of 30, as measured on a 20° meter, unless otherwise noted in the 998XXXX specification.

3.6.2 ELPO Film Smoothness (Profilometer).

Vertical surfaces.....0.254 µm max
Horizontal surfaces.....0.381 µm max

3.6.3 Adequacy of Cure (GM9509P). MIBK shall be used as the solvent, unless recommended otherwise by the supplier. Acceptable rating shall be 0 or 1.

3.6.4 Throw Power (GM9535P). Minimum throw must meet the specified requirements, and be equal to or better than the current production control. Throw is the distance from the immersed opening to the point where panel surface hiding coverage ceases. After 40 cycles of accelerated corrosion (GM9540P) the results must meet the specified requirements and be equal to or better than the current production control.

3.6.5 Chip Resistance (GM9508P, Method A.). The results must meet the specified requirements and be at least equivalent to the control electrocoat.

3.6.6 Accelerated Corrosion Test (GM9540P, Cycle B, III). Average creepback and percent paint loss must not exceed the requirements.

3.6.7 Tape Adhesion (GM9071P, Methods A and B).

3.6.8 Deionized Water Immersion (GM4466P, 240 h @ 38° C) and Tape Adhesion (GM9071P, Method A). Perform tape adhesion before and after water immersion. Test panels shall have a 5 minute recovery after removal from water immersion.

3.6.9 Cyclic Chipping Test (GM9619P). Average creepback and percent paint loss must be equal to or less than the control.

3.6.10 Florida Exposure. (GM9163P). Minimum results for 3 months exposure and 1 year exposure with twice weekly salt mist (salt solution per ASTM B117). Panels shall be scribed per GM9102P before exposure. Scribes shall be measured zero to maximum peak (left side of scribe) and zero to maximum peak (right side of scribe) and recorded in total mm.

Exposure position: facing due south 5° from horizontal (black box).

GENERAL ELECTRODEPOSITION PRIMER REQUIREMENTS

GM4384M

After exposure, panels shall undergo deionized water immersion (GM4466P) for 72 h @ 55°C, followed by tape adhesion test (GM9071P, Method A) and gravelometer (GM9508P, Method A).

3.6.11 Rupture Voltage of Precoated Steel (A01 iron-zinc). ELPO shall be applied @ 150V, 200V, 250V, 275V, 300V, and 325V at standard bath temperature. The test rating shall be based on profilometer and percent of panel ruptured, and be equivalent or exceed that of the controls.

3.6.12 Lubricant Electrocoat Compatibility (GM9532P). The sandwich test shall be performed using Quaker 61A-US, Metal Lubricants Co. DF-4285 and SP-7106 lubricants.

3.6.13 Fume Yellowing of Topcoat from Cathodic E-Coat (GM9618P). The resulting yellowing exhibited on the panel shall not exceed that of the control electrocoat.

3.6.14 Edge Coverage (GM9632P). The amount of corrosion on the sharp edge of a razor blade shall not exceed that of the control.

3.6.15 Heat Resistance. After curing test panels at target temperature and film build, bake an additional 4 h @ 232°C. Subject test panels to 40 cycles of GM9540P, Cycle B. Results must be equal or better than the control.

3.6.16 Torque Tension (GM9064P). The results must exhibit similar torque characteristics when compared to the control ELPO.

3.6.17 Bake Off Loss (GM9636P). The amount of applied film that is lost as a result of curing must not exceed that of the control.

3.6.18 Delamination (GM9636P). ELPO that is intended for use under a topcoat, but without primer surfacer must not delaminate due to ultraviolet degradation at a rate exceeding that of the control. The test shall be performed even with an ELPO which is intended to be used with primer surfacer, although those results are for informational purposes only. Primer surfacer shall NOT be used for this test.

3.6.19 ELPO Sanding. See GM ELPO engineer for details of the test. A cured ELPO that has been sanded using ANSI grade 400 grit sand paper should not exhibit any projection of sand marks through topcoat, nor show any difference in flake orientation using light blue metallic topcoat.

3.6.20 Overbake and Underbake. Accelerated corrosion (GM9540P, Cycle B, 40 cycles), Gravelometer (GM9508P), Water Immersion (GM4466P) and Tape Adhesion (GM9071P, Methods A and B) tests shall be performed on overbake, normal bake and underbake combinations. See Table 3. GM9508P shall be performed before and after accelerated corrosion and independently as a separate test. GM9071P shall be performed before and after water immersion.

TABLE 3 - UPPER LIMIT/LOWER LIMIT BAKE COMBINATION

Primer	ELPO	Primer Surfacer	Topcoat
9984070	L	-	N
	O	-	N
	N	-	N
9984094	L	N	N
9984017	O	N	N
	N	N	N
9984139	N	-	-

N: Normal bake: target time and temperature.

L: Lower limit bake time: 20 minutes at target.

Bake temperature less 5°C (This temperature is dependent on the relationship between target temperature and the lower cure window limit).

O: Upper limit bake time: 90 minutes at target.

Bake temperature plus 14°C.

3.6.21 Milford Proving Ground Road and Lab Test for 5 year Cosmetic Corrosion Performance. The appropriate test for demonstrating new technologies shall be agreed upon by the GM ELPO engineer and the supplier at the start of the initial submission process. Results must be equal to or better than control panels.

3.6.22 Stationary Glass Bond Materials Compatibility (GM4352M). The test matrix shall be designed by the responsible GM ELPO engineer and issued in the form of a test request. Testing shall be performed with ELPO as a direct bonding surface, and as a primer layer.

3.7 BATH PERFORMANCE REQUIREMENTS. Performance requirements for the bath are outlined in Table 4. The system that is tested shall be identical to the intended production system and processing, when known. The bath should receive a 25% purge prior to the initiation of testing. To determine bath stability, these tests must be repeated after 30, 60, and 90 days of agitation. pH, conductivity, percent solvent, percent solids and P/B must also be recorded.

3.7.1 Odor Acceptability (to be tested @ 0 days agitation only). The material's odor acceptability shall be equivalent to the control when evaluated at Eastern Michigan University or an equivalent facility. Use 3 test and 3 control samples.

3.7.2 Corrosivity (information only). CRS panels shall be cleaned to remove all lubricants and submerged in 3.78 L of ELPO primer for the intended intervals. Following submersion, the soluble iron shall be measured in the gallon sample in parts per million.

3.7.3 Settling Test with Agitation (GM9633P). The dirt count on the horizontal panel that has been subjected to the test ELPO bath shall not exceed the count on the panel subjected to the control bath.