GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16243

Decorative Exterior Decals - Foils

1 Scope

This specification covers the performance requirements of exterior decorative striping and graphics with pressure sensitive adhesive and a suitable release liner. It also includes premasks for ease of application, location, and protection during application. Typical examples are shown in Appendix A, Figure A1. A special Type IIIB construction is intended for exterior wood grain film.

1.1 Material Description.

1.1.1 Types IA and IB films are used for accent stripes (pin stripes), blackout films (pillars and protected exterior surfaces) and inserts. Sill plate constructions can vary from Types IA and IB, by using multiple layers.

1.1.2 Type II films include usage in various graphic packages, legends, accent/two-tone stripe end caps, inserts, and door handle tapes.

1.1.3 Types IIIA and IIIB films include usage in various graphics packages, legends, and wood grains (Type IIIB).

1.1.4 Types IVA and IVB films include two-tone stripes.

1.1.5 Types VA and VB films include low profile individual letters and emblems, approximately 1 mm thick. They are available in various colors, and bright (chrome, gold, satin chrome, etc.)

1.1.6 Pressure Sensitive Adhesive. Many of the types use a 0.0125 mm (nominal) thick Pressure Sensitive Adhesive (PSA). The PSA thickness will be specified on the part drawing, or in the math data file. The adhesive can also be patterned for a Bubble Free (BF) application. A "BF-PSA" suffix will be added to the material call-out on the Part Drawing, or Math Data File.

1.2 Symbols. Not applicable.

1.3 Applicability. For exterior decorative striping and graphics.

1.4 Remarks. These films have limited gravel and abrasion resistance. Consider using urethane film (GMW15957) in high chip areas.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 7724-1	ISO 8510-2	SAE J2527
ISO 8510-1	SAE J1545	

2.2 GM Standards/Specifications.

GMW3010	GMW14124	GMW14698	GMW14873
GMW3059	GMW14270	GMW14700	GMW15957
GMW3208	GMW14333	GMW14729	GMW16745
GMW3221	GMW14334	GMW14829	GMW16996

2.3 Additional References.

- BYK Catalog located at http://www.byk.com/en/instruments/physical-properties/adhesion/cross-cut-tester.html
- Definition of Low Chip, and High Chip Areas
- Engineering Drawing

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- Math Data File
- Part Drawing

3 Requirements

3.1 General Requirements.

3.1.1 Appearance. Color, pattern and gloss of material shall be equivalent to approved master standards when viewed per GMW16996.

3.1.2 Premask. The premask shall be a clear plastic film, 0.035 mm ± 0.005 mm thick. Other types of premasks specified for ease of application are optional with the supplier. Specific samples must receive engineering approval.

3.2 Physical Requirements.

3.2.1 Sample Preparation.

3.2.1.1 Unless otherwise specified, test panels shall be representative of production intent substrates and coatings.

3.2.1.2 For Generic or Initial Approval. Region: GM North America, test on the paint systems listed in 3.2.1.2 a and 3.2.1.2 b. Other regions are to select their common paint system(s).

a. **Dupont** 541/542 basecoat, RK8148 clearcoat.

b. **BASF** R98/R99 basecoat, E10CG060X clearcoat.

3.2.1.2.1 For initial approval, all tests are required to be run.

3.2.1.2.2 Plastic squeegees must be used to apply decals to painted test panels.

3.2.1.2.3 For physical tests, test unapplied decals (film with adhesive) without premask and release liner.

3.2.1.2.4 For all other tests, apply decal to the paint systems mentioned above.

3.2.1.2.5 For application specific testing, test on the production intent substrate.

3.2.1.2.6 All samples, after environmental exposure unless otherwise specified, shall be conditioned and tested for 4 h to GMW3221, Code A**.**

3.2.2 Tensile Strength (Longitudinal and Transverse Direction) per GMW3010, Code E. Where D2 = 25 mm, D3 = 50 mm, D4 = 13 mm, and pretension = 0.5 N/mm^2.

- Types I, II, III and IV 12 MPa minimum
- Type V 10 MPa minimum

3.2.3 Elongation at Break (Longitudinal and Transverse Direction) per GMW3010, Code E. Where D2 = 25 mm, D3 = 50 mm, D4 = 13 mm, and pretension = 0.5 N/mm^2. The elongation shall be 100% minimum for Type IB, and 15% minimum for Types IA, II, III, IV and V.

3.2.4 Stress-Strain Curve per GMW3010, Code E, Load 10 N. Where D2 = 25 mm, D3 = 50 mm, D4 = 13 mm, and pretension = 0.5 N/mm^2. The stress-strain curve to be kept on file by the Material Engineer.

3.2.5 Temperature Resistance. Test samples (unapplied, with premask and release liner) of length 200 mm ± 1 mm shall be used. The test shall be performed immediately after conditioning or in the as received condition. The benchmarks shall be ≤ 1 mm wide, but are clearly visible and shall not have any adverse effect on the test material. For strip and extruded materials, the gauge length shall be the length of the test piece, 200 mm ± 1 mm. The test sample shall be subjected to the following test condition:

- 1 h ± 5% by 85 °C ± 2 °C
- After this test procedure, the test sample shall be allowed to cool down to a temperature of 23 °C ± 2 °C

Result: There shall be no visible signs of deterioration such as loss of grain, blistering, delamination, plasticizer migration, etc., or other deterioration likely to adversely affect serviceability. Maximum shrink 0.5%.

3.3 Performance Requirements.

3.3.1 Peel Strength (180 Degree) (ISO 8510-2). Cut the film (foil) into either 10 mm, or 25.4 mm wide strips. When bonded to a representative production substrate, prepared per 3.2.1, shall meet the minimum adhesion test requirements shown in Table 1. The samples shall be run on an Instron, or equivalent constant rate of extension machine, at a rate of 300 mm/minute. For sill plates, the top layer must remain attached when

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subjected to the environments in Table 1 (except Xenon). The minimum ambient 180 Degree Peel Strength is 600 N/m (about 15 N per 25.4 mm of width) applied anywhere on the part including the periphery. Type V decals are tested using the 90 degree peel strength test (ISO 8510-1, or equivalent). Mount the test sample, bonded to a painted test panel, to a fixture (sled) that will maintain a constant 90 degree angle during the peel strength test.

Table 1: 180 Degree Peel Strength

Environments	Types I, II, III and IV	Types V
30 minutes Room Temperature (RT) aging	350 N/m	500 N/m
72 h RT aging	600 N/m	750 N/m
Heat Aging per 3.4.1.1	600 N/m	750 N/m
Thermally Cycling per 3.4.1.2 After 72 h RT dwell	600 N/m	750 N/m
Humidity Resistance per 3.4.1.3 After 4 h RT dwell After 72 h RT dwell	350 N/m 600 N/m	350 N/m 750 N/m
After Xenon Arc Weatherometer per 3.4.1.5, 2500 kJ/m²	600 N/m	750 N/m

3.3.2 Appearance Durability. Samples prepared per 3.2.1 shall not show any surface deterioration, objectionable shrinkage (visible line of adhesive in the edge of film is unacceptable), objectionable color or gloss change, delamination, edge lifting, cracking, visible adhesion loss, pitting, blistering, or any other degradation after exposure to any of the following tests (see 3.3.2 a thru 3.3.2 f).

a. Heat Aging
b. Thermal Cycling
c. Humidity
d. Florida Exposure
e. Xenon Arc Exposure
f. High Temperature

3.3.2.1 The appearance requirements (except Florida and Xenon) in 3.3.2 also apply to any integrated layer of sill plate constructions.

Note: When accelerated test results and Florida exposure results are in disagreement, the exposure results shall overrule.

3.3.2.2 Florida exposure samples may be washed with a mild detergent and water (ratio 5:95 by volume).

3.3.3 Abrasion Resistance. Test samples prepared per 3.2.1 shall show no loss of pattern (wear through clearcoating and subsequent ink layer to Polyvinyl Chloride (PVC) base film) when tested per GMW3208 with a 500 g load using CS-17 abrading wheels for the following minimum number of cycles, see Table 2.

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Table 2: Abrasion Resistance Cycles

Type	Cycles
Type IA	minimum 500 cycles
Type IB	minimum 500 cycles
Type II	minimum 300 cycles
Type IIIA	minimum 300 cycles
Type IIIB	minimum 500 cycles
Type IVA	minimum 500 cycles
Type IVB	minimum 500 cycles
Type VA	minimum 300 cycles
Type VB	minimum 300 cycles

3.3.4 Chip Resistance GMW14700 Method B/Method C. Condition samples prepared per 3.2.1, and expose to the thermal cycle per 3.4.1.2. Run one pint of gravel (473 ml ± 10 ml stones). For low chip areas, run at room temperature (Method C). The requirement is a maximum stone chip diameter of 3 mm, or 5% maximum film removal. For high chip areas, run at -18 °C (Method B). Same requirements as low chip areas. Contact engineering for a Definition of Low Chip, and High Chip Areas. These areas can vary by vehicle design. Substrate will also have an effect on chipping.

3.3.5 Cleaning Solvent Resistance (GMW14334-B). Prepare samples per 3.2.1. Shall exhibit no loss of adhesion, color, or gloss change, and shall meet rating of three (3).

3.3.6 Fuel Resistance (GMW14333-A). Samples prepared per 3.2.1 shall exhibit no loss of adhesion, loss of gloss, color change, surface degradation, or tackiness.

3.3.7 Tape Test. Types I through V. The purpose of this test is to measure the interlayer adhesion between the clearcoating, or film, and underlying ink, or film layers. After any of the exposure conditions (72 h room temperature, heat aging in 3.4.1.1, thermal cycling in 3.4.1.2, humidity in 3.4.1.3, and Xenon Arc in 3.4.1.5), the topcoat must not be removed (minimum rating of one (1) when subjected to GMW14829 method A). After any of the exposure conditions, allow samples to recover for 24 h at room temperature before running the tape test.

3.3.8 Wrap Test (see Appendix B, Figure B1). After applying the film to a simulated hem flange panel (with a radius of 1.5 mm, and a 3.5 mm wrap beyond the tangent of the radius) and subjecting it to the thermal cycle described in 3.4.1.2, there shall be no evidence of delamination, edge lifting, cracking, or other objectionable degradation.

3.3.8.1 Simulated hem flange panels can be purchased from Advanced Coating Technology, or equivalent.

3.3.9 Release Liner and Premask. Removal of the release liner from the premask and decal shall not cause the transfer to be dislodged from the premask. Always remove the release liner from the decal, never the decal from the release liner. Upon installation of the decal, the premask shall be easily removed from the body surface and shall not cause lifting of the decal or tearing of the premask. Always remove the premask by pulling it back onto itself (180 degrees). Never pull it straight up off the decal (90 degrees).

3.3.10 Scratch Test. If specified on the Engineering Drawing, along with the requirement, the scratch test shall be conducted per GMW14698.

3.4 Additional Requirements.

3.4.1 Test Requirements.

3.4.1.1 Heat Aging. Samples prepared per 3.2.1 are oven aged at 168 h at 80 °C. Cool to room temperature prior to testing and test within 4 h.

3.4.1.2 Thermal Cycling (GMW14124). Expose appearance and durability samples, wrap test samples, and adhesion test samples prepared per 3.2.1 to two (2) cycles of Cycle C.

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