



Constrained Layer Dampers - Nonreactive

1 Scope

This standard details the material and performance requirements for pressure sensitive constrained layer dampers.

These types of materials shall be utilized for local vibration and sound damping.

1.1 Material Description. Constrained layer dampers are composed of a viscoelastic layer which is laminated to a constraining layer. The viscoelastic layer is typically butyl-rubber based, self-adhesive and non-reactive. The constraining layer is typically a thin sheet of aluminum. Aluminum constraining layers shall comply with SAE J454. Only constraining layers that have been validated as meeting the performance requirements of this standard shall be allowed. The part is supplied with the adhesive surface protected by a temporary release paper.

1.2 Symbols. Not applicable.

1.3 Applicability. These materials are typically applied manually at Body Shop, Paint Shop or Trim Shop. Use should be restricted to relatively flat or gently contoured panels so that complete contact of this material to the panel can be assured. After the application, these constrained layer dampers shall be pressed on for optimum wet out.

Typical application areas include vertical surfaces such as inner surfaces of door outer panels and inner surfaces of quarter outer panels, and inverted surfaces such as inner surfaces of the decklid outer and inner surfaces of roof outer panels.

1.4 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM D2369	EN 10140	IATF 16949	SAE J454
DIN 1544	EPA Method 24	ISO 8510-2	SAE J1637

2.2 GM Standards/Specifications.

9986321	GMW3016	GMW14270	GMW15635
GMW2	GMW3059	GMW14692	GMW15735
GMW8	GMW3182	GMW14729	GMW16152
GMW11	GMW3205	GMW14872	GMW16700
GMW3002	GMW3221	GMW15192	GMW16723
GMW3005	GMW3232	GMW15416	L 000 0131
GMW3008	GMW14019	GMW15477	
GMW3011	GMW14124	GMW15634	

2.3 Additional References.

Advanced Product Quality Planning (APQP)

3 Requirements

Unless otherwise specified, the following requirements shall be met. All testing shall be performed with materials that are representative of production processes.

3.1 Requirements on Test Specimens. Reference GMW3221, Code D.

3.2 Physical Requirements.

3.2.1 Thickness. The maximum total thickness of the constrained layer damper shall not exceed 4.5 mm. Report the following, as tested (see 3.2.1a thru 3.2.1d):

- Total thickness of the composite material.
- Thickness of the viscoelastic layer.
- Thickness of the constraining layer.
- Description of the constraining layer.

3.2.2 Weight per Unit Area. Report the weight per unit area as tested per GMW3182. Guideline values of material weight per unit area corresponding to low, medium and high loss factor performance are shown in Table 1.

Table 1: Guideline Values of Weight per Unit Area for Each Loss Factor Grade

Loss Factor Grades	Loss Factor (LF) Code	Typical Weight per Unit Area in kg/m ²
Low (L)	LF-L	2.5
Medium (M)	LF-M	3.5
High (H)	LF-H	4.5

Key: Loss Factor Low (LF-L), Loss Factor Medium (LF-M), Loss Factor High (LF-H)

Note: The lightweight constrained layer dampers may provide similar damping performance at lower mass. Such materials can also be qualified to the corresponding loss factor grades.

3.2.3 Odor. The material shall have a neutral odor that is not unpleasant in the uncured condition.

3.2.4 Plant Emissions.

3.2.4.1 Plant Emissions Volatile Organic Compounds (VOC) Determination (EPA Method 24, see 6.2 using ASTM D2369 Method E). EPA Method 24 is required for the United States (US) and Canada. For US, Hazardous Air Pollutants (HAP) shall be 1% by mass maximum, based on Material Safety Data Sheet (MSDS) formula. Local plant review and approval may be required prior to each new plant implementation of this material.

3.2.4.2 Oven Condensing Volatiles Test. Test to GMW3016. Evaluate after maximum bake per 3.3.2.3, followed by 2 h at +23 °C ± 5 °C. VOC shall be 2% by mass maximum. If reported VOC exceeds 2% by mass, the composition of the VOC shall be declared.

3.2.5 Flame Resistance (GMW16723). The material shall resist 50 passes with an open flame and be self-extinguishing.

3.3 Performance Requirements for Constrained Layer Dampers after run-through of the Plant Process.

3.3.1 Composite Vibration Damping Properties. Test to SAE J1637, Beam Size B. Constrained layer damper candidates shall be evaluated for acoustic performance per SAE J1637.

3.3.1.1 The composite loss factors shall be measured at each specified temperature per SAE J1637 for the 2nd, 3rd, 4th and 5th vibration modes of the test sample per SAE J1637. The measured composite loss factors shall be interpolated or extrapolated to values at 200 Hz, 400 Hz, 600 Hz and 800 Hz at each specified temperature. The constrained layer dampers are graded based on frequency minimum composite loss factor performance. The minimum composite loss factor is the minimum value in composite loss factors over 200 Hz, 400 Hz, 600 Hz and 800 Hz at each specified temperature.

Note: Table 4 specifies the lower limits of composite loss factor performance for each material grade.

3.3.1.2 Material shall be evaluated at non-bake condition and after maximum bake per 3.3.2.3. The tests shall be performed with the following dimensions (see 3.3.1.2.1 and 3.3.1.2.2):

3.3.1.2.1 Test Bar Dimensions.

- a. Total Length: 241 mm
- b. Free Length: 216 mm
- c. Width: 12.7 mm
- d. Thickness: 1 mm

Note: Test bar quality: Spring steel (CK 75 per DIN 1544 or C 75 S per EN 10140) or equivalent.

3.3.1.2.2 Test Material Dimensions.

- a. Length: 215 mm (from the edge)
- b. Width: 12.7 mm
- c. Thickness: per 3.2.1

3.3.1.3 The test material shall meet one of the following minimum loss factor grades in Table 2. The test results shall be provided in tabular and graphical form per SAE J1637.

3.3.1.4 Measurement shall start at +55 °C to get reproducible and condensate unaffected results.

Table 2: Performance Levels of Composite Loss Factors

Temperatures in Degree Celsius (°C)	Frequency Minimum Composite Loss Factors		
	Low (LF-L)	Medium (LF-M)	High (LF-H)
-20	0.03	0.03	0.04
-5	0.05	0.06	0.07
+10	0.07	0.10	0.15
+25	0.09	0.18	0.28
+40	0.08	0.15	0.23
+55	0.04	0.07	0.12

3.3.2 Resistance to 180 Degree Peel, Adhesion and Corrosion. Constrained layer damper candidates shall be evaluated for resistance to peel per ISO 8510-2, Separation mode and corrosion.

Peel Speed: 100 mm/minute.

3.3.2.1 Substrates. Testing shall be completed with the substrates in Table 3.

Table 3: Substrates

Substrate Description by Application Area
For Body Shop Application: ^{Note 1} Oily Cold Rolled Steel (CRS) (GMW2) Oily Hot Dipped Galvanized (HDG) Steel (GMW8), 60 g/m² galvanized coating weight Oily Electrogalvanized (EG) Steel (GMW11), 60 g/m² galvanized coating weight Oily Aluminum (AL) (GMW15192) Oil Quality: Use one challenging GMW14019 approved lubricant as specified by the approving material engineer.

Substrate Description by Application Area

For Paint Shop Application:

ELPO: Use one widely used, GMW3008 approved ELPO as specified by the approving material engineer.

For Trim Shop Application:

ELPO: Use one widely used, GMW3008 approved ELPO as specified by the approving material engineer.

ELPO plus Primer Overspray plus topcoat overspray: Use one widely used GMW3008 approved ELPO, GMW3002 approved primer and GMW3005 top coat as specified by the approving material engineer. Overspray is a discontinuous film.

Note 1: After application of the damping patches, the oily metal panels shall be processed through pretreatment and Electrodeposition Paint Operation (ELPO) prior to baking and exposure per 3.3.2.4.4 corrosive tests. Use any GM approved pretreatment (GMW3011) and ELPO (GMW3008) at target film thickness, as specified by the approving engineer.

3.3.2.2 Test Piece Preparation. Processing temperature of the damping film is +20 °C to +40 °C.

- Dimensions and preparation per ISO 8510-2.
- For Body Shop Application degreasing and oiling of the substrates per GMW15477.
- In deviation to ISO 8510-2 use a 2000 g $\pm$ 20 g roller for pressing on the test material by rolling twice in each direction at a speed of $\approx$ 10 mm/s without applying additional force.
- Allow test pieces to age for a minimum of 24 h at +23 °C $\pm$ 5 °C following any specified bake, prior to exposure to any test environments, unless otherwise specified.

3.3.2.3 Bake Conditions. All bakes are specified as times at metal temperature, and defined in Table 4. Panels shall be baked horizontally, unless otherwise specified.

Table 4: Bake Conditions

Bake Description	Bake Conditions (Time at Metal Temperature)
Body Shop Applications:	
Minimum	15 minutes at +160 °C
Maximum	60 minutes at +190 °C
Paint Shop Applications:	
Minimum	Not required, trim is worst case minimum bake
Maximum	60 minutes at +190 °C
Trim Shop Applications:	
Minimum	Not applicable.
Maximum	Not applicable.

3.3.2.4 Test Environments for Resistance to Peel, Adhesion and Corrosion. Evaluate for peel resistance, separation mode and corrosion.

See Appendix A, Table A1 for the classification of test environments to application areas/substrates. For following tests evaluate the classified substrates with the respective bakes per 3.3.2.3.

3.3.2.4.1 Initial. Per the application area, testing shall be completed after adhesive cure or non-cure, followed by a minimum of 24 h aging at +23 °C $\pm$ 5 °C.

3.3.2.4.2 Cold Test. Testing shall be completed after a minimum of 24 h aging at -40 °C. Testing shall be completed immediately upon removal of the test sample from the freezer. Actual test temperature shall be recorded and reported as part of the test.