



## Overhead Substrate

### 1 Introduction

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**Note:** The use of **shall** in this document denotes a binding provision that must be adhered to unless a deviation is granted in writing by the responsible Program Team Leadership and/or the component/subsystem Bill of Material (BOM) Family Owner (BFO). The use of **should** denotes a preference or desired conformance, which if not adhered to, must be documented and disclosed to General Motors. Unless otherwise noted, all requirements apply over the conditions and useful life as described herein. General Motors shall be the final arbiter of performance if the requirements stated herein are not objectively defined. The design and execution of the overhead substrate assembly must be in accordance with the application regulations of Section 2.

**1.1 Purpose.** This standard is a General Motors global document. All requirements herein shall be adhered to as GM global requirements for the overhead substrate assembly except where noted for specific GM programs. The main purpose of the overhead substrate assembly is to provide a decorative, acoustic, and functional trim covering of the underside of the vehicle's roof. The overhead substrate assembly subsystem also provides packaging provisions for all other functional or decorative elements in this region of the vehicle interior (i.e., overhead substrate, head impact foam, air ducts, controls, display, etc.)

**1.2 Applicability.** This standard established performance requirements, design constraints, and validation requirements for an overhead substrate assembly. The requirements contained in this document only apply to parts released under this version of requirements when included in supplier Statement of Requirement (SOR).

**1.2.1** The Analysis Development Validation (ADV) plan shall be complete per SOR Validation Appendix G2 (CG1419) requirements and any new standards/Component Technical Specification (CTS) updates at Integration Vehicle Material Required Date (IV/MRD) be included in the Design Review Based on Failure Modes (DRBFM) and/or peer reviews, with validation considerations considered in that process, and effected via Engineering Work Order (EWO) for program specific standard updating. (The program team shall contact the Global Technology Engineering (GTE) to ensure the latest standard templates are being used).

**1.3 Remarks.** The overhead substrate assembly is listed under the following Uniform Parts Classification (UPC), Functional Name Address (FNA) and Bill of Material (BOM) nomenclature.

- **UPC** = 1C3M
- **FNA** = 0049A Panel- Handling Trim Finish Assembly (HDLING TR FIN ASM)
- **BOM Row** = 40.3:03 Overhead Substrate Assembly Row

### 2 References

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

#### 2.1 External Standards/Specifications.

|             |            |              |            |
|-------------|------------|--------------|------------|
| CIR 575.105 | ECE R21.01 | FMVSS 302    | TRIAS 48   |
| CMVSS 201   | FMVSS 201  | GB 8410-2006 | TS 16949   |
| CMVSS 302   | FMVSS 208  | GSO 98       | TS-INT-001 |

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 1 of 22

**2.2 GM Standards/Specifications.**

|         |          |          |          |
|---------|----------|----------|----------|
| 9985744 | GMW3232  | GMW14406 | GMW16853 |
| 9986384 | GMW3259  | GMW14444 | GMW16998 |
| GMW3059 | GMW6992  | GMW14573 |          |
| GMW3115 | GMW14089 | GMW14797 |          |
| GMW3116 | GMW14124 | GMW14838 |          |
| GMW3118 | GMW14189 | GMW14892 |          |
| GMW3121 | GMW14231 | GMW15340 |          |
| GMW3205 | GMW14234 | GMW16331 |          |

**2.3 Additional References.**

- Best Practice (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).
- Best Practice 115759
- CG3496 – Overhead Substrate Steady State Part Monitoring (SSPM)
- Color and Trim Design Appearance Requirement (DAR) Document
- Component Technical Specification (CTS)
- Design Appearance Requirement (DAR)
- Development Planning Schedule
- Dimensional Technical Specification (DTS)
- GM Engineering Materials and Process Standards
- GM Ergonomic and Assembly Requirements
- GM Global Legal Database
- GM Legal Staff Requirement
- GM Supply Power
- Incomplete Vehicle Document
- Label and/or Molded-in Instructions
- Manufacturing Technical Specification (MTS)
- Master Process Document (MPD)
- Notice of Action (NOA) NOA GICC-112
- Notice of Decision 005
- Occupational Safety and Health Administration (OSHA) Requirements
- Owner's Manual
- Potential Contaminants Section of the Program Specific Vehicle Technical Specification (VTS)
- Program Plan
- Recycled Materials File
- Service Manual
- SOR Appendix B (CG2360)
- SOR Appendix C2 (CG2180)
- SOR Appendix F5 (CG1235)
- SOR Appendix F6
- SOR Appendix F7
- SOR Appendix F8
- SOR Appendix F9

**GM Confidential**

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 2 of 22

- SOR Appendix F10
- SOR Appendix H (CG1054)
- SOR Appendix W (CG2493)
- SOR Appendix X (CG2492)
- SOR Appendix Y
- SOR Appendix Z
- SOR Validation Appendix G2 (CG1419)
- Squeak and Rattle Noise Glossary
- Statement of Requirement (SOR)
- Thickness and Design Draft Criteria Sheets
- Validation Cross Reference Index
- Value Added Assembler (VAA) SOR
- Vehicle Technical Specification (VTS)
- World Vehicle Regulation Manual (WVRM)

### 3 Requirements

The use of **shall** in this document denotes a binding provision that must be adhered to. **Should** denotes a preference or desired conformance, which if not adhered to, must be documented and disclosed to General Motors. Unless otherwise noted, all requirements apply over the conditions and useful life as described herein. General Motors shall be the final arbiter of performance if the requirements stated herein are not objectively defined. The design and opinion of the roof trim subsystem must be in accordance with the application regulations of Section 2.

**3.1 System/Subsystem/Component/Part Definition.** The overhead substrate assembly shall cover the Body in White (BIW) Upper Inner Structure, and give an integrated impression and convey a quality image. The components in the Roof Trim Subsystem (RTS) include all fasteners, visor assemblies, coat hooks, head impact provisions and an array of features for comfort, convenience, stowage, communication, controls, entertainment, etc. The overhead substrate assembly will provide provisions for mounting the other components of the RTS.

The overhead substrate assembly covers the vehicle's roof underside while enhancing the vehicle's interior appearance and acoustical characteristics. In some applications, this panel also may be required to provide structural reinforcement to the roof panel of the vehicle.

The overhead substrate assembly for a vehicle interior is defined as the part that is shipped to the assembly plant for installation to the vehicle, or to a subsystem assembler for addition of backside components. The substrate assembly typically includes:

Overhead substrate composed of the foundation board, adhesives, cover material, and foam (if applicable).

- Substrate Reinforcements (Trim Ring, Edge Stiffeners, etc.)
- Fastener Retainers, if required.

The overhead substrate assembly supports safety requirements for interior occupant impact and field of vision.

**3.1.1 Appearance.** The overhead substrate assembly shall reflect the vehicle interior-styling theme in accordance with the brand character. It also reflects the design quality as expressed in surface attributes such as material texture, grain, color and gloss, as well as the execution of joints, interfaces (fit, flush and alignment). SOR Appendix F5 (CG1235) and/or SOR Appendix F10 defines the program grain, color and gloss requirements. The SOR Appendix F7 defines the fit and finish Dimensional Technical Specification (DTS) requirements for execution of joints, and interfaces. The SOR Appendix F7 also provides Key Product Characteristic (KPC)/Perceived Quality Characteristic (PQC) and part drawing tolerance and locating requirements. The color, pattern, aesthetics and other related qualities shall be evaluated and approved by the responsible engineering department as an acceptable match to the engineering approval sample when viewed under conditions set forth in GMW6992.

**GM Confidential**

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 3 of 22

**Documents**  
Document Sharing Hub

**3.1.1.1** A headliner that has a knit fabric with 3 mm foam shall provide minimum 2 mm foam after headliner processing, this requirement applies to the main body of the overhead surface however the thickness will vary at deep draw and transition areas on the overhead. Specific program direction is provided in SOR Appendix B (CG2360).

**3.1.1.2** All visible headliner trim edges should be aesthetically concealed. The following conditions shall not be visible from a normal standing or sitting position, inside or outside of the vehicle.

- Pin Holes
- Cut Edges
- Flow Lines
- Blisters
- Cracks
- Intake Point
- Discoloring
- Varnish Burrs
- Sink Marks
- Flashes
- Tool Parting Lines
- Frayed Material

### **3.1.2 Content.**

**3.1.2.1 Physical Content.** The typical content of an overhead substrate assembly shall consist of the substrate assembly, and necessary reinforcements. The required physical and functional content for the overhead substrate assembly are identified in SOR Appendix B (CG2360) - general program description.

### **3.1.2.2 Functional Content.**

**3.1.2.2.1** An aesthetic appearance that covers the sheet metal and is in harmony with the rest of the vehicle interior.

**3.1.2.2.2** Acoustic absorption for vehicle interior noise control.

**3.1.2.2.3** A secure and stable position for all components, which are functional to the occupants.

**3.1.2.2.4** Kinetic energy absorption to aid in meeting CMVSS 201U and FMVSS 201U Head Impact requirements.

**3.1.2.2.5** Color fastness, indentation recovery, durability, clean ability, resistance to environmental influences, and retention of physical and structural integrity.

**3.1.2.2.6** Allow for Roof Rail Airbag (RRAB) deployments.

**3.1.2.2.7** Structural reinforcement of the vehicle roof panel (in some applications).

**3.1.2.2.8** Vibration damping of the vehicle roof panel (in some applications).

**3.1.3 Ambient Environment.** Reference the Vehicle Technical Specification (VTS) for ambient environment. The overhead substrate assembly must meet the performance requirements identified in this specification while operating within these environmental conditions. Temperature ranges recommended are -30 °C to 85 °C unless otherwise defined in the VTS.

**3.1.3.1 Low Temperature Requirement.** For the vehicles sold in selected countries only, see Appendix A, Table A1, the cold temperatures can be modified as shown in Table 1.

**Table 1: Low Temperature Deviation Temperatures**

| Assumes Tinted Glass Usage | Low    | Normal         | High  |
|----------------------------|--------|----------------|-------|
| Overhead Surfaces          | -20 °C | Not applicable | 95 °C |
| Relative Humidity          | 0%     | 10% to 80%     | 100%  |

### **GM Confidential**

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 4 of 22



**Documents**

Document Sharing Hub

**3.1.3.2 High Temperature Requirement.** For the vehicles sold in selected countries only, (See Appendix A, Table A2), the hot temperatures can be modified as shown in Table 2.

**Table 2: High Temperature Deviation Temperatures**

| Assumes Solar Glass Usage | Low    | Normal         | High  |
|---------------------------|--------|----------------|-------|
| Overhead Surfaces         | -30 °C | Not applicable | 65 °C |
| Relative Humidity         | 0%     | 10% to 80%     | 100%  |

**3.1.3.3 Thermal/Humidity Environment.** The anticipated operating conditions relative to temperature and humidity are listed in the VTS.

**Note:** If no requirements are identified in the VTS then default to; 0% to 100% humidity.

**3.1.3.4 Shipping and Storage Environment.** The anticipated shipping and storage conditions relative to temperature and humidity are 90 °C and 50% Relative Humidity (RH) or program specific. There are shipping conditions which are unique and could be more severe than the environment inside a vehicle. These conditions must be anticipated and designed for when designing overhead substrate assembly and when designing shipping containers.

**3.1.3.4.1 Adhesion in Shipping and Storage Environment.** Adhesively applied components shall remain retained to overhead at the elevated temperatures used in shipping environments. Anticipated temperatures are 90 °C and 50% Relative Humidity (RH) or program specific. Do check the adhesion, run the Adhesion test per GMW14892, using 90 °C and 50% Relative Humidity (RH) or program specific temperature. Do not use the full environmental cycle, but soak the trim in a chamber for 4 h, prior to testing the adhesion.

**3.1.3.5 Contaminants.** The contaminants which may come in contact with the overhead substrate assembly are described in the Potential Contaminants Section of the Program Specific VTS.

#### **3.1.4 Interfaces.**

**3.1.4.1 External-To-Vehicle to Subsystem: General Assembly Process.** Vehicle assembly process imposes product requirements for the overhead substrate assembly.

**3.1.4.1.1 Modularity: Component Retention to Substrate.** The extent of modularity is program and/or region specific. When modularity is required the overhead substrate assembly reinforcements and other components as required, shall be securely retained to the overhead Substrate in such a manner as to withstand the rigors of shipping and the vehicle assembly process.

**3.1.4.1.2 Roof Trim Subsystem Mechanical Integrity During Assembly.** The roof trim subsystem shall have sufficient stiffness to permit handling without folding during installation and sufficient toughness and resiliency to avoid any noticeable crease lines/marks after installation is complete. Program-specific assembly procedures apply and are listed in the Value Added Assembler (VAA) SOR if applicable.

**3.1.4.1.3 Ergonomics during Assembly.** The installation process of the overhead substrate assembly shall meet GM Ergonomic and Assembly Requirements in all regions (i.e., weight, fastener insertion force, etc.) Requirements can be found in GMW14234. Additionally, all installation related Occupational Safety and Health Administration (OSHA) Requirements shall be met in North America.

#### **3.1.4.2 Subsystem to Subsystem.**

**3.1.4.2.1 Overhead Substrate Assembly Best Practice.** The overhead substrate assembly shall conform to the overhead substrate assembly Best Practice located in Enterprise Engineering Knowledge System (E2KS). The overhead substrate assembly Best Practice Knowledge Set is stored in Interior Community of Practice (CoP). (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).

#### **3.1.4.2.2 Safety Management.**

**3.1.4.2.2.1 Head Impact.** The overhead substrate assembly contributes to vehicle compliance with FMVSS 201u-Upper Interior Impact. The overhead substrate assembly shall include energy absorbing features that contribute to vehicle-level compliance to the requirements of FMVSS 201U, if required. The overhead substrate assembly shall be designed to meet all applicable Best Practice included in the FMVSS 201U

**GM Confidential**

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 5 of 22

Knowledge Set. Contact the appropriate safety performance engineer for details and requirements. (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).

**3.1.4.2.2.1.1** The initial design of the overhead substrate assembly shall be restricted to the design features listed in Best Practice Knowledge Set. Deviations from the Best Practices require the approval of the responsible FMVSS 201 Performance Engineer and BOM Leader.

**3.1.4.2.2.2 Roof Rail Airbag.** For all vehicles, which incorporate Roof Rail Airbag (RRAB), the following requirements apply:

**3.1.4.2.2.2.1 Attachments/Anchors.** The overhead substrate assembly shall have sufficient points of attachment to withstand the deployment loads of the RRAB without substantially dislodging from design position excepting the surfaces immediately over and outboard of the RRAB. The number and location of added fastener locations/fasteners will vary depending on included hard fastening points (Coat hook, etc.,) and deployment forces imparted to the Roof Trim Subsystem (RTS).

**3.1.4.2.2.2.2 Deployment.** The overhead substrate assembly will flex as necessary to meet the RRAB deployment requirements. The interfaces with garnish and the overhead substrate structural/mechanical properties shall meet the deployment mode requirements by flexing as necessary. It may be necessary to add stiffeners, scoring and/or a formed bend-line etc., in the B-surface to retard/promote bending during deployment. The overhead Substrate hinge or fold line (when used) shall be defined in math, and shall be generally reproducible. The hinge or fold line (when used) shall not create show side appearance related items including read-through, surface flaws, etc.

**3.1.4.2.2.2.3 Airbag Labels.** All vehicles that include roof rail airbag shall incorporate permanent identification using the word "AIRBAG". These can be located in either the garnish or overhead substrate surfaces. SOR Appendix B (CG2360) will state if the overhead Substrate contains this label.

Permanently locate the identification immediately adjacent to the pillar top(s) or along the rail(s) out of which the RRAB deploys, adjacent to each seating position with airbag coverage.

The identification shall be of sufficient size and contrast to be easily visible by vehicle occupants. (Reference Notice of Decision 005).

In vehicles with RRAB standard (100% content) the "AIRBAG" label may be located on the Roof Trim. Any implementation in the RTS should be coordinated with the garnish trim per the overall vehicle program requirements.

**3.1.4.2.2.2.4 Airbag Performance.** The Garnish Trim System (GTS)/Roof Trim Subsystem (RTS) shall not detrimentally delay airbag deployment per GMW3115, GMW3118 and GMW3121 or direction granted by the responsible vehicle performance engineer, through temperature ranges of -30 °C to + 85 °C.

Any components or fragments of the overhead substrate assembly that partially or fully separate from the subsystem (through fracture or dislodging) shall be evaluated for functional deficiency or injury potential to the occupant during the RRAB and/or Side Impact Airbag (SIAB) deployment through temperature ranges of -30 °C to +85 °C. Any component that diminishes the function of the RRAB or is judged to have injury potential shall be corrected-as evaluated by the RRAB/SIAB/overhead Product Development Team (PDT) members.

The overhead substrate assembly shall not damage the RRAB and/or SIAB itself during deployment.

The overhead substrate assembly shall not present sharp or rough edges that may cut or snag the RRAB and/or SIAB during deployment.

The overhead substrate assembly shall not prevent the RRAB and/or SIAB from meeting the deployment requirements as specified in GMW3121, GMW3115 and GMW3118.

For system validation with environmentally conditioned components, aging of the overhead substrate assembly shall be completed according to GMW3118 unless otherwise stated in the SOR Validation Appendix G2 (CG1419); aging of the RRAB and/or SIAB shall be completed according to the RRAB and/or SIAB Subsystem Technical Specification (SSTS). System testing shall be completed according to RRAB and/or SIAB validation specification.

**3.1.4.3 Appearance of RTS from External to Vehicle.** All visible headliner edges of the overhead substrate assembly that are or may become visible from outside the vehicle should be aesthetically covered.

## GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 6 of 22

**3.1.5 Usage Definition.** The range of physical dimensions of the user population for which the overhead substrate assembly requirements herein apply are bounded by the 5<sup>th</sup> percentile female and the 95<sup>th</sup> percentile male.

## **3.2 Product Characteristics.**

**3.2.1 Performance Requirements.** The following paragraphs specify the functional performance requirements for the overhead substrate assembly. The assembly is to perform as specified prior to and after exposure to durability and environmental conditioning as designated.

**3.2.1.1 Material and Part Performance.** Material and material related part performance requirements are specified in the SOR Appendix F10. The overhead substrate assembly shall meet the appropriate material related part performance requirements when tested as a complete molded assembly per GMW14444. **Note:** The following approvals shall be required as applicable: plastic, paint, textile, construction and color approval as defined in SOR Appendix F10. Additionally, adhesive requirements will be contained in the SOR Appendix F10.

**3.2.1.2 Color/Gloss/Grain/Appearance.** The requirements for the overhead substrate assembly relative to color/gloss/grain/appearance are identified in SOR Appendix F5 (CG1235) and later in a Color and Trim Design Appearance Requirement (DAR) Document.

**3.2.1.3 Interior Fittings.** The overhead substrate assembly shall aid in meeting Export ECE R21.01, CMVSS 201 and FMVSS 201 requirements for all countries that a vehicle is being exported to per program.

**3.2.1.4 Other Regulatory Requirements.** The overhead substrate assembly shall not degrade performance of the vehicle for any vehicle regulatory requirement.

**3.2.1.5 Squeak and Rattle Requirement.** Overhead substrate assembly; the requirement is to have absolutely no customer annoyance due to squeaks and rattles. The final authority for the determination of whether a noise is objectionable lies with the Buyer Lead Engineer and/or the Squeak and Rattle (S and R) Engineer. Squeaks and rattles include, but are not limited to all the noises described in the Squeak and Rattle Noise Glossary.

**3.2.1.5.1 Supplier Responsibility.** The supplier is to accept full responsibility to produce squeak and rattle free, subsystems and/or components. The supplier shall cooperate with the buyer and/or other supplier's to assure that no squeak and rattle annoyance occurs at the interface of their subsystem/component to the body, chassis or other subsystem/component. If an objectionable noise is found during any phase of the program, it will be the supplier's responsibility, with Buyer cooperation, to eliminate the noise and demonstrate resolution in a vehicle prior to exiting the program phase. If the noise is found in pilot or production, the supplier will be responsible to develop a containment plan (and fix), as well as short and long term solutions, as appropriate. Any issue raised during these processes, which is demonstrated to be the responsibility of the supplier, shall be corrected with urgency at no additional cost to GM. The supplier will be responsible for the Squeak and Rattle performance of their subsystem.

**3.2.1.5.2 Subsystem in the Integration Environment (Interfaces).** The requirement for this program is to have absolutely no customer annoyance due to squeaks and rattles. The final authority for the determination of whether a noise is objectionable lies with the Buyer Lead Engineer and/or the Squeak and Rattle (S and R) Engineer. Squeaks and rattles include, but are not limited to all the noises described in the Squeak and Rattle Noise Glossary.

**3.2.1.5.2.1** The supplier is to accept full responsibility to produce squeak and rattle free, as delivered, subsystems and/or components, as defined by functional requirements in the Subsystem and/or Component Technical Specifications. The supplier shall also cooperate with the buyer and/or other supplier's to assure that no squeak and rattle annoyance occurs at the interface of their subsystem/component to the body, chassis or other subsystem/component. If an objectionable noise is found during any phase of the program, it will be the supplier's responsibility, with Buyer cooperation, to eliminate the noise and demonstrate resolution in a vehicle prior to exiting the program phase. If the noise is found in pilot or production, the supplier will be responsible to develop a containment plan (and fix), as well as short and long term solutions, as appropriate. Any issue raised during these processes, which is demonstrated to be the responsibility of the supplier, shall be corrected with urgency at no additional cost to GM. The supplier will be responsible for the Squeak and Rattle performance of their subsystem.

**3.2.1.6 Headliner Substrate Structure, and Mechanical Integrity.** The roof trim subsystem shall withstand either fixture loading and/or manual handling within the program specific shipping; handling and assembly parameters without exceeding substrate yield point (i.e., folding).

## **GM Confidential**

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 7 of 22