



Roof Trim Subsystem

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.

1.1 Purpose. This standard is a General Motors (GM) global document. All requirements herein shall be adhered to as GM global requirements for the Roof Trim Subsystem (RTS) except where noted for specific GM programs.

1.1.1 This standard establishes performance requirements, design constraints, and validation requirements for a Roof Trim Subsystem. The requirements contained in this document only apply to parts released under this version of requirements when included in supplier Statement of Requirement (SOR).

1.1.2 The Analysis/Development/Validation (ADV) plan shall be complete per SOR Appendix G2 (CG1419 Appendix G2 for Overhead Systems) requirements and any new standards/Subsystem Technical Specification (SSTS) 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. **Note:** The program team shall contact Global Technology Engineering (GTE) to ensure the latest standard templates are being used.

1.2 Applicability. The main purpose of the Roof Trim Subsystem is to provide a decorative, acoustic, and functional trim covering of the underside of the vehicle's roof. The Roof Trim Subsystem also provides packaging provisions for all other functional or decorative elements in this region of the vehicle interior (i.e., coat hook, head impact foam, air ducts, controls, display, etc.)

1.3 Remarks. The Roof Trim Subsystem is listed under the following Uniform Parts Classification (UPC), Functional Name Address (FNA) and Bill of Material (BOM) nomenclature.

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

2 References

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

2.1 External Standards/Specifications.

49 CFR Part 575	ECE R94	FMVSS 302	KMVSS 102
CMVSS 201	FMVSS 118	GB 8410	KMVSS Article 95
CMVSS 302	FMVSS 201	GSO 98	TRIAS 48
ECE R21.01	FMVSS 208	ISO/TS 16949	

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September 2015

Page 1 of 28

2.2 GM Standards/Specifications.

GMW3058	GMW6992	GMW14264	GMW17078
GMW3059	GMW7293	GMW14444	GMW17079
GMW3115	GMW7294	GMW14573	GMW17250
GMW3116	GMW8518	GMW14838	GMW17251
GMW3118	GMW14011	GMW14892	GMW17252
GMW3121	GMW14089	GMW15340	GMW17253
GMW3172	GMW14118	GMW15609	GMW17254
GMW3205	GMW14124	GMW16331	GMW17255
GMW3232	GMW14234	GMW16835	GMW17000

2.3 Additional References.

Note: For 2.3 Additional References available internally to General Motors and not accessible outside this company, contact the GM Lead Engineer for further instructions.

Best Practice Knowledge Packet (KPAC) MVSS 201-X (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR)) (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).

Best Practices KPAC MVSS 201-X included in the FMVSS 201U 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).

CG1663 (Controls Appendix C Template)

CG3496 (Overhead Substrate Steady State Part Monitoring)

Component Technical Specification (CTS)

Design Appearance Requirement (DAR)

Design Best Practices (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR)) (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).

Dimensional Technical Specification (DTS) (See SOR Appendix F7)

Global Dimensioning and Tolerancing (GD&T) Drawing

Global Fastening Catalog

GM Global Legal Database

GM Legal Staff Requirements

GM Materials Specification found on the subsystem drawing, released in the GM Math System in the Vehicle Information System (VIS) in GM Socrates.

GM SupplyPower

Government Regulations can be found in the GM Global Legal Database

Human Factors Design Objective (HFDO) (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR))

Incomplete Vehicle Document (see Socrates Global Document Management (GDM) system in the "Vehicle Literature Compliance Documents").

Interior Best Practices for Dimensional Specifications that define gap, flush, and crush interface fits (see SOR Appendix F7).

Interior Lighting Best Practices (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR))

Interior Lighting Subsystem Performance Specification

Master Process Document (MPD) in GM Socrates

Noise and Vibration Integration, Resource Center Application (Test procedures, performance data and workflow instructions)

Noise and Vibration Program Values

Notice of Action (NOA) GICC-112

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September 2015

Page 2 of 28

Notice of Decision 005

Recycled Materials File

Roof Rail Airbag (RRAB) and/or Side Impact Airbag (SIAB) Validation Specification

Roof Trim Subsystem Best Practices located in Enterprise Engineering Knowledge System (E2KS) (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR))

Statement of Requirements (SOR)

SOR Appendix B (CG2360 Molded Roof Trim Appendix B)

SOR Appendix C2 (CG2180 Roof Trim Appendix C2)

SOR Appendix C2 (CG2180 Roof Trim Appendix C2): 433 Roof Trim for Acoustic Requirement Values

SOR Appendix F5

SOR Appendix F7

SOR Appendix F10

SOR Appendix H (CG1054 Appendix H GM Specific Location Specific Requirements)

SOR Appendix G2 (CG1419 Appendix G2 for Overhead Systems)

Squeak and Rattle (S&R) Noise Glossary

Subsystem Technical Specification (SSTS)

Supplier Process Monitoring Plan

TS-INT-001

Validation Test Complete Milestone

Value Added Assembler (VAA) SOR

Validation Cross Reference Index (VCRI) (see SOR Appendix G2)

Vehicle Owner's Manual

Vehicle Service Manual

Vehicle Technical Specification (VTS)

3 Requirements

The use of **shall** in this document denotes a binding provision that must be met. **Should** denotes a preference or desired conformance, which if not met, 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 applicable regulations of Section 2.

3.1 System/Subsystem/Component/Part Definition. The RTS for a vehicle interior is defined as the headliner substrate assembly including all of the trim components which are located within its envelope.

The RTS shall cover the Body in White (BIW) upper inner structure, and give an integrated impression and convey a quality image. The components in the RTS include all fasteners, visor assemblies, coat hooks, head impact provisions and an array of features for comfort, convenience, stowage, communication, controls, entertainment, etc., (see Table 1).

The headliner 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.

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September 2015

Page 3 of 28



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Table 1: Roof Trim Subsystem Content

Typical Base Content	
	Substrate/Trim Panel Assembly
	FMVSS 201, Head Impact Countermeasure Provisions
	Sun Visor/Sun Roof Shade Assemblies
	Coat Hook Assemblies
	Power and Signal Distribution
	Overhead Interior lighting (Dome/Reading)
	Fasteners
Additional Feature Content	
	Assist Handle Assembly(s)
	Overhead Console(s)
	Heating/Ventilation/Air Conditioning (HVAC) Air Distribution Ducting and Outlets
	Control(s) and Switch(s)
	Display(s)
	Sensor(s)
	Audio/Video and Infotainment
	Roof Reinforcement Measures
	Storage
	Other

An illustration of entities that have a major influence on the functionality, design and/or implementation of the Roof Trim Subsystem is shown in the functional context diagram (see Figure 1). A Roof Trim Subsystem may be complete, with fasteners, and ready for assembly into the vehicle as a self-contained unit and also integrate functional aspects such as air distribution ducts and wire harness routing. The large size of some assemblies imparts constraints related to handling, prior to and during the vehicle assembly process.

The subsystem, headliner and associated parts support safety requirements for interior occupant impact and field of vision.

3.1.1 Appearance. The overhead 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 (i.e., fit, flush and alignment). SOR Appendix F5 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 Characteristics (KPC)/Perceived Quality Characteristics (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.

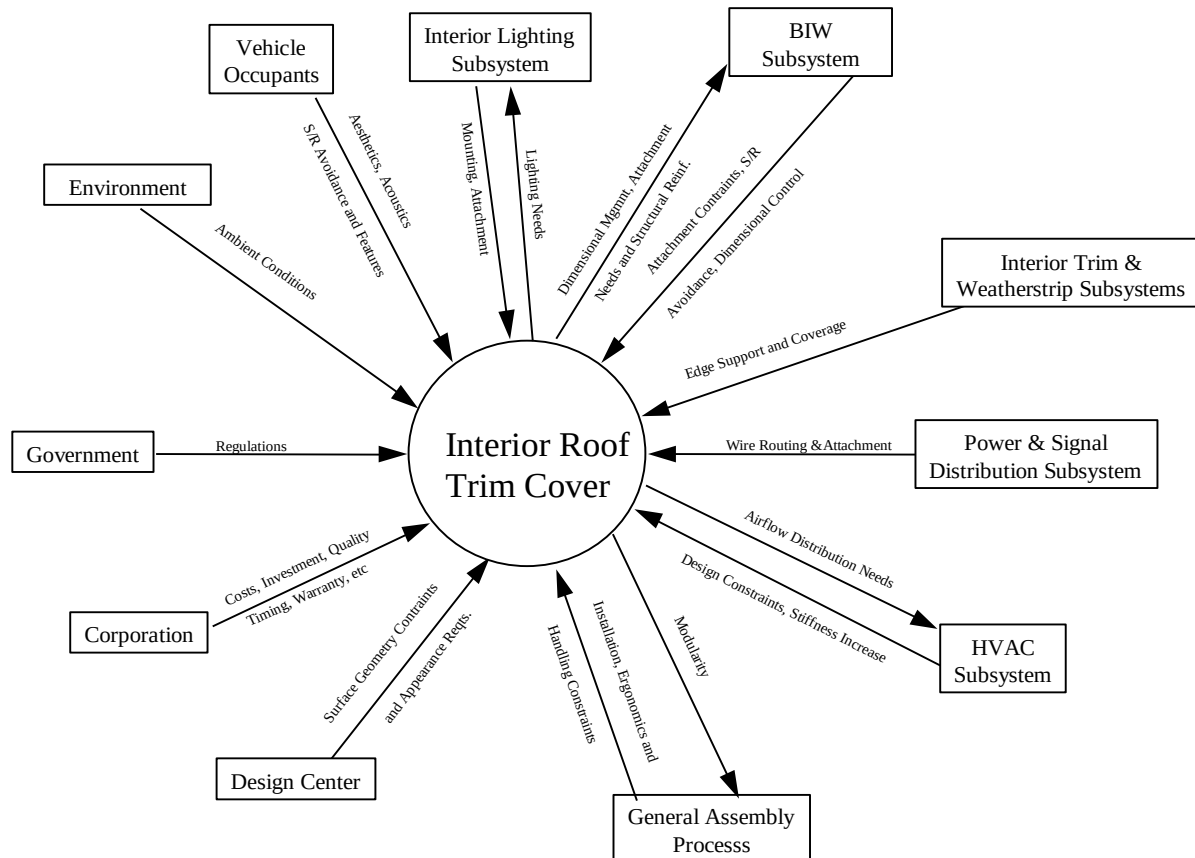
3.1.1.1 A headliner that has a knit fabric with 3 mm foam shall provide a minimum of 2 mm foam after headliner processing in order to provide a pleasing feel and to close out potential gaps to adjacent components. Specific program direction is provided in SOR Appendix B (CG2360 Molded Roof Trim Appendix B).

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Page 4 of 28



Note: Mgmt. = Management, Reinf. = Reinforcement, Reqs. = Requirements

Figure 1: Roof Trim Subsystem Functional Context Diagram

3.1.1.2 All visible headliner trim edges shall 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

3.1.1.3 Haptics. The haptic characteristics which is the tactile feel of trim functions (e.g., cover installation/release, button activation, etc.) shall be evaluated according to GMW14264 with a rating of seven (7) or higher.

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September 2015

Page 5 of 28



Documents

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3.1.2 Content. The Roof Trim Subsystem physical and functional content is identified in 3.1.2.1 through 3.1.2.2.13.

3.1.2.1 Physical Content. The typical content of a Roof Trim Subsystem shall consist of the substrate assembly; FMVSS 201 head impact countermeasures, two sun visor assemblies, coat hook assemblies, dome lamp, and vehicle assembly fasteners. Additional content/features are listed in the Value Added Assembler (VAA) SOR if applicable.

3.1.2.2 Functional Content. The Roof Trim Subsystem should provide the basic functions described in the following.

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 satisfy CMVSS 201U and FMVSS 201U (U meaning the Upper Interior Impact - Head Impact Requirements).

3.1.2.2.5 A soft feel (tactility) for intentional and unintentional vehicle occupant contacts.

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

3.1.2.2.7 Allow for Roof Rail Airbag (RRAB) deployments.

3.1.2.2.8 A means for providing illumination of the interior for entry, exit and/or reading (lighting function).

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

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

3.1.2.2.11 A controllable means of blocking the rays of the sun (i.e., sun visor/sun shade function).

3.1.2.2.12 A means for retaining garments, garment rods and hangers (i.e., coat hook function).

3.1.2.2.13 A means of assisting occupants with vehicle entry and exit and providing stability (i.e., assist handle function).

3.1.3 Ambient Environment. The overhead assembly subsystem 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 Vehicle Technical Specification (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 2.

Table 2: Low Temperature Deviation Temperatures

Assumes Tinted Glass Usage	Low	Normal	High
Overhead Surfaces	-20 °C	Not applicable	95 °C
Exposed Panoramic Roof Surfaces	-20 °C	Not applicable	95 °C
Relative Humidity (RH)	0%	10% to 80%	100%

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 3.

Table 3: High Temperature Deviation Temperatures

Assumes Solar Glass Usage	Low	Normal	High
Overhead Surfaces	-30 °C	Not applicable	65 °C
Exposed Panoramic Roof Surfaces	-30 °C	Not applicable	65 °C

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September 2015

Page 6 of 28

Relative Humidity (RH)	0%	10% to 80%	100%
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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% humidity 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% 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 garnish trim and when designing shipping containers.

3.1.3.4.1 Clip Retention in Shipping and Storage Environment. The retention force of the clip to the fastener retaining feature shall be in a range of 10 N to 30 N. The insertion force of the clip to the fastening retaining feature shall be in a range of 1 N to 20 N.

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

3.1.3.4.3 Component Retention During Shipping and Installation in Vehicle. Applied components shall remain attached to the overhead assembly during both shipping and plant handling and installation.

3.1.3.5 Contaminants. The contaminants which may come in contact with the overhead assembly are described in the potential contaminants section of the program specific Vehicle Technical Specification (VTS).

3.1.4 Interfaces. The interfaces and associated requirements that the Roof Trim Subsystem has with other entities.

3.1.4.1 External-To-Vehicle to Subsystem: General Assembly Process. Vehicle assembly process imposes product requirements for the Roof Trim Subsystem.

3.1.4.1.1 Modularity: Component Retention to Substrate. The extent of modularity is program and/or region specific. When modularity is required all components, accessories, wiring, fasteners, etc., which comprise this subsystem shall be securely retained to the 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 VAA SOR if applicable.

3.1.4.1.3 Ergonomics During Assembly. The installation process of the Roof Trim Subsystem 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. Interfaces between the Roof Trim Subsystem and other subsystems with which it has a physical or functional relationship.

3.1.4.2.1 Roof Trim Best Practices. The Roof Trim Subsystem shall conform to the Roof Trim Subsystem Best Practices located in Enterprise Engineering Knowledge System (E2KS) (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR)), The Roof Trim Subsystem Best Practice Knowledge Set. (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 Roof Trim Subsystem contributes to vehicle compliance with FMVSS 201U-Upper Interior Impact. The Roof Trim Subsystem shall include energy absorbing features that contribute to vehicle-level compliance to the requirements of FMVSS 201U. The Roof Trim Subsystem shall be designed to meet all applicable Best Practices KPAC MVSS 201-X included in the FMVSS 201U 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).

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September 2015

Page 7 of 28



Documents
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3.1.4.2.2.1.1 In the initial design of the Roof Trim Subsystem, added countermeasures components shall be restricted to those listed in Best Practices KPAC MVSS 201-X. Deviations from this Best Practice require the approval of the responsible FMVSS 201 performance engineer on the program. All countermeasures must meet the requirements of the Materials Specification GMW15609. (The supplier shall work with the GM Design Release Engineer to comprehend this requirement).

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

The RTS shall provide all necessary requirements and accommodations for the RRAB by providing a deployment opening, and otherwise performing as further indicated in this section.

Note: A general enabler to RRAB deployment is lower cut lines in the RTS/garnish trim interface resulting in deeper RTS sections near the pillars. This may require different substrate, tooling and/or processing than past practices.

3.1.4.2.2.2.1 Attachments/Anchors. The RTS 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 fasteners will vary depending on included hard fastening points (e.g., coat hook, etc.) and deployment forces imparted to the RTS.

3.1.4.2.2.2.2 Deployment. The RTS will flex as necessary to meet the RRAB deployment requirements. The interfaces with garnish and the RTS 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 RTS hinge or fold line shall be defined in math, and shall be generally reproducible. The hinge or fold line 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 RRAB shall incorporate permanent identification using the word "AIRBAG".

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 Subsystem. 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 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 GTS 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/Garnish Trim Product Development Team (PDT) members.

The GTS shall not damage the RRAB and/or SIAB itself during deployment.

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

The GTS 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 GTS shall be completed according to GMW3118 unless otherwise stated in the SOR Appendix G2 (CG1419 Appendix G2 for Overhead Systems); aging of the RRAB and/or SIAB shall be completed according to the RRAB and/or SIAB SSTs. System testing shall be completed according to RRAB and/or SIAB Validation Specification.

3.1.4.2.2.3 FMVSS 208 Accommodation. The sun visor assembly (when installed in the overhead assembly) requirements for FMVSS 208 are:

3.1.4.2.2.3.1 The sun visor assembly shall meet the label and position requirements as written in FMVSS 208 when applicable.

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September 2015

Page 8 of 28

3.1.4.2.2.3.2 The sun visor assembly in the stowed position shall provide clearance to the 50% occupant crash projectile under the conditions stated in FMVSS 208.

3.1.4.2.2.4 Interior Fittings. The overhead 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.

3.1.4.2.2.5 Flammability. The subsystem and its components, shall satisfy the burn resistance requirements of FMVSS 302, CMVSS 302 (Canada - where applicable), KMVSS Article 95, GSO 98 (Gulf State Countries where applicable) TRIAS 48 (Japan - where applicable), and GB 8410 (China - where applicable) according to GMW3232.

3.1.4.2.2.6 Other Regulatory Requirements. The overhead assembly shall meet KMVSS 102 and ECE R94 for Airbag labels. Switches/Buttons shall conform to FMVSS 118. Other regulatory requirements applicable to the vehicle countries of export. The overhead assembly shall not degrade performance of the vehicle for any vehicle regulatory requirement.

3.1.4.3 Component Retention. The overhead assembly components shall stay retained during barrier/crash testing.

3.1.4.4 Appearance of Roof Trim Subsystem from External to Vehicle. All visible headliner edges of the RTS that are or may become visible from outside the vehicle shall be aesthetically covered.

3.1.5 Usage Definition. The range of physical dimensions of the user population for which the RTS requirements herein apply are bounded by the 5th percentile female and the 95th percentile male.

3.2 Product Characteristics. The extent of modularity is program and/or region specific. When modularity is required all components, accessories, wiring, fasteners, etc., which comprise this subsystem shall be securely retained to the substrate in such a manner as to withstand the rigors of shipping and the vehicle assembly process.

3.2.1 Performance Requirements. Functional performance requirements for the RTS. The RTS 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 RTS shall meet the appropriate material related part performance requirements per GMW14444. **Note:** Approvals shall be required as applicable: plastic, paint, textile, and headliner substrate 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 RTS relative to color, gloss, grain and appearance are identified in SOR Appendix F5 and later the Design Appearance Requirement (DAR).

3.2.1.3 Human Vehicle Interface. The following RTS components and interfaces shall comply with the Human Factors Design Objective (HFDO) (See Auros/E2KS Application in GM Socrates => Roof Trim (ROOFTR)) (see Table 4).

Table 4: HFDO for Roof Trim Subsystem/Components and Interfaces

Component/Subsystem	Section in Human Factors Design Objective (HFDO)	Includes (but not limited to)
Sun Visors	Interior Section I – Roof and Headers	Hand clearances to trim, reach curve, efforts, grasp widths, etc.
Vanity Mirrors	Interior Section I – Roof and Headers	Hand clearances to trim, reach curve, efforts, grasp widths, etc.
Coat Hooks (Garment Hooks)	Interior Section I – Roof and Headers	Hand clearances to trim, reach curve, efforts, grasp widths, etc.
Assist Handles	Interior Section I – Roof and Headers	Hand clearances to trim, reach curve, efforts, grasp widths, etc.
Overhead Reach Comfort Zones	Interior Section I – Roof and Headers	Reach limits to controls

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Page 9 of 28



Documents
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