General Motors

GLOBAL

60.03.0.1 Sunroof

Single Panel Tilt & Slide or Spoiler Sunroof

Subsystem Technical Specification

Effective Date: xxxxx

Sunroof and Program Name

Template Approved: Axel Boywitt

Authored: _____ _____

DRE NAME ***Date***

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7. Ensure that all supporting specifications (SSTS or Component Technical Specifications [CTS]) for related systems to be supplied by the Sunroof supplier or systems that require close coordination with the Sunroof system are:
    a. Completed by the appropriate specification author,
    b. Compatible with the program requirements specified in this SSTS and
    c. Included in the Sunroof system SSTS provided to GM Purchasing.
8. Conduct a peer review with the appropriate GM stakeholders before issuing an SSTS for a specific program to ensure that the SSTS is accurate and comprehensive for that program.

The Sunroof Subsystem Technical Specification shall define general physical content and functional content of the Sunroof system. However, the Sunroof System, depending on content, may also require supporting specifications, including, but not limited to, those listed below, to ensure that applicable system-specific requirements are specified and best practices are utilized for each of these areas.

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1. INTRODUCTION

1.1. Scope of Document

This specification establishes the sunroof subsystem for the **Program Name** program. The functions, performance, design constraints, reliability, and validation required of the sunroof subsystem are defined in this document. Engineering drawings and other specifications identified herein may provide additional requirements for the sunroof assembly.

1.2. Mission / Theme / Scope

The Sunroof is a functional power-operated, Tilt & Slide or Spoiler glass panel subsystem (type is specified in Appendix B) that allows the selection of either an open or closed cabin driving environment. With a closed sunroof, the passenger compartment is protected from the outside environment including water, wind noise and road noise. The sunroof operation is controlled by the driver via a mode selector switch.

1.3. Classification / Definition

The Tilt & Slide or Spoiler sunroof consists of one glass-panel which is moveable and a sun protection system. The sunroof module system is to be designed that the operation is electrical. The moveable glass panel must open to a vent position to achieve venting of the vehicle interior compartment. Also the moveable glass panel must open below or above the roof contour to the rear of the car to achieve an open air condition.

2. References

The specifications and regulations listed in this section may apply to this subsystem or vehicles equipped with this subsystem. If the specification / regulation is a vehicle-level requirement, the subsystem shall not prevent the vehicle from meeting that requirement.

2.1. External Standards/Specifications

In the event of a conflict between the text of this specification and the documents cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws unless a specific exemption has been obtained.

The following legal regulations are the base for the requirements of this specification. Suppliers are expected to be aware of and comply with worldwide component and vehicle standards and regulations where applicable. Requirements of national governments shall apply even if not explicitly stated below. This requirement shall include the correct marking of all production and service parts with the appropriate government information.

2.1.1. Australia

ADR 08/01	Safety Glazing Material
ADR 21/00	Instrument Panel
ADR 29/00	Side Door Strength
ADR 42/04	General Safety Requirements
ADR 72/00	Dynamic Side Impact Occupant Protection

2.1.2. Austria

2.1.3. Belgium

2.1.4. Brazil

Inmetro Edict No 156/09 - TEMPERED SAFETY GLAZING
Inmetro Edict No 157/09 - LAMINATED SAFETY GLAZING

2.1.5. Canada

CMVSS 118	Power Operated Window Systems
CMVSS 201	Occupant Protection in Interior Impact
CMVSS 205	Glazing Materials
CMVSS 214	Side Door Strength
CMVSS 216	Roof Crush Resistance
CMVSS 302	Flammability of Interior Materials

Quebec Provincial Regulation 101 - Charter of the French Language

2.1.6. China

CNCA-02C-060:2005	Interior Timing Materials (CCC)
CNCA-04C-028:2006	Certification of Safety Glass
GB 8418-94	Flammability of Automotive Interior Materials
GB 9656-2003	Safety Glazing Materials
GB11552	Interior fittings of passenger car

2.1.7. Finland

2.1.8. France

2.1.9. Germany

DIN 1396.5	Aluminum
DIN 6784	Edges of work pieces
DIN 25448	FMEA
DIN 75220	Sun-Simulation
DIN 75302	Crash Test
DIN IEC 68 T2 -14	Electrical Engineering; Basic Environmental Testing Procedures; Tests; Test N: Change of Temperature

2.1.10. Israel

2.1.11. Japan

Article 18 Frame of Body

2.1.12. Korea

KM34	Power Operated Window Systems, Glaszing Materials (KS L2007 - 1998)
KM88, 98, 101,102	Occupant Protection in Interior Impact
KM92	Roof Crash
KM94	Forward Vision
KM95	Flammability of Interior Materials

2.1.13. Saudi Arabia/Gulf States

2.1.14. Economic Commission for Europe

ECE R 10.03	Electromagnetic Compatibility
ECE R 21.01	Interior Fittings
ECE R 26.02/3	External Projections
ECE R 33.0	Behavior of the Structure in a Frontal Collision
ECE R 43.00	Safety Glass and Glazing Materials

2.1.15. European Community

74/483/EEC (2007/15/EC)	External Projections
92/22/EEC	Glazing Materials
96/27/EC	Side Impact Resistance of Motor Vehicles
96/79/EC	Protection of the Occupants in the Event of a Frontal Collision
98/C 411/01	Operating Instructions
2004/4/EC	Power Operated Window / Sunroof

2.1.16. United States

FMVSS 118	Power Operated Window Systems
FMVSS 201	Occupant Protection in Interior Impact-Upper Interior Head Impact Protection
FMVSS 205	Glazing Materials
FMVSS 214	Side Impact Protection
FMVSS 216	Roof Crush Resistance
FMVSS 302	Flammability of Interior Materials

2.2. GM Standards / Specifications

GM 2745M	One Piece Headlining Construction
GM 2746M	Headlining, Sunshade and Pillar Top Materials
GM 3640M	Performance Requirements of Anti-flutter Adhesives
GM 3660	Commodity Validation Sign Off
GM 4472M	Anodic Coatings on Aluminum
GM 8015G	Corrosion Avoidance - Sunroofs/Vista Vents
GME 14090	Part Identification
GMW 3067	Validation of Static Body Air Leakage Static Body Leakage
GMW 3089	GMLAN Single Wire CAN Physical and Data Link Layers Specification
GMW 3091	Global Specification for Vehicles, Electromagnetic Compatibility
GMW 3097	Global Specification for Electrical/Electronic Components and
GMW 3103	Global Specification for Electrical/Electronic Components and
GMW 3104	GMLAN Communication Strategy Specification
GMW 3110	GMLAN Enhanced Diagnostic Test Mode
GMW 3122	Dual Wire CAN Physical Layer and Data Link Layer Specification
GMW 3136	Automotive Safety Glazing, Requirements
GMW 3172	General Specification for Electrical/Electronic Components
GMW 3191	Connector Test and Validation Specification
GMW 3220	Laminate Bond Strength
GMW 3232	Test Method for Determining the Flammability of Interior Trim Materials

GMW 3428	Established Road Structural Durability Test
GMW 3425	Developing Road Regions Structural Durability Test
GMW 3600	Generic Supplier Analysis/Development/Validation Process Tasks and
GMW 7293	Subjective Subsystem/Component Squeak and Rattle Test
GMW 7879	Squeak and Rattle Degradation Test for Passenger Cars & Trucks
GMW 8463	Wind Noise Test Procedure
GMW 8518	Subjective Squeak and Rattle Evaluation Vehicle Level
GMW 8738	Proving Ground Corrosion Test (Vehicle Test)
GMW 14011	Objective Subsystem/Component Squeak and Rattle Test
GMW 14089	Global Label Design Criteria
GMW 14093	Impact Resistance of Plastic Components
GMW 14153	Laboratory Evaluation of Power Sunroof Sounds
GMW 14155	Subsystem or Component Sound Master Laboratory Recording and
GMW 14162	Colorfastness to Artificial Weathering
GMW 14168	Elastomeric Seal
GMW 14188	Squeak and Rattle Degradation Evaluation Procedure
GMW 14444	Material Related Interior Part Performance
GMW 14527	Body Dust Intrusion
GMW 14528	Vehicle Total Body Water
GMW 14553	Security Shade Fabric
GMW 14650	Performance Requirements for Exterior Plastic Parts
GMW 14651	Material Related Interior Plastic Part Performance
GMW 14665	Anodic Oxidation Coatings
GMW 14669	Organic Coating/Finish Performance for Exterior and Interior Metallic
GMW 14872	Cyclic Corrosion Laboratory Test
GMW 15010	Global Supplier Serviceability Requirements
GMW 15214	Automatic Wash - Component Strength / Durability
GMW 15272	Corrosion Performance Specification
GMW 15443	Established Roads Durability Test
GMW 15470	Full Vehicle Static Air Leakage
GMW 15531	Vehicle Durability Test
GMW 15576	Vehicle Exterior Freeze Test
GMW 15760	Multi-Vari Sample Selection Procedure for Product Validation
GMW 15862	Bar Code Content, Format, and Label Requirements
GMW 16412	Sunroof Development and Validation Test Procedure
GMW 16591	Sunroof Anti Pinch Test Procedure
GMW 16679	Sunroof Development and Validation Vehicle Test Procedure
GMW 16602	Sunroof Drain Hose Environmental Testing
HFD #107	GM Human Factors Design Objective #107 Sunroof Sunshade

2.3. Additional References

2.3.1. Industry Documents

PPAP	Production Part Approval Process (PPAP), Automotive Industry Action Group (www.aiag.org)
SAE J551	Standard to Minimize Interference with Radio Communication Services
SAE J1113	Electromagnetic Susceptibility Measurement Procedures for Vehicle Components (Except Aircraft)
SAE J1211	Recommended Environmental Practices for Electronic Equipment

ISO 5393	
SAE J2527	
GP11	Pre-Prototype and Prototype Material (GM1820, GM1826, GM1829)
FMEA	Design and Process FMEA

USCAR EWCAP Performance Standard for Automotive Electrical Connection Systems (latest issue), United States Council for Automotive Research (www.uscar.org)

2.3.2. Supplier Documents

Not Applicable.

2.3.3. Program Specific Documents

(Listed below are examples, modify as required for specific program)

Vehicle Technical Specification (VTS) for PROGRAM NAME

Dimensional Technical Specification (DTS)

Electric Systems, SSTS, CTS

Weather Seal System CTS (GMNA)

Data of surrounding parts

2.3.4. Best Practice

The Tilt & Slide or Spoiler Sunroof system shall comply with all GM design best practices unless otherwise specified and agreed to by GM Engineering (Sunroof BOM leader and TIE).

3. Requirements

3.1. System / Subsystem / Component / Part Definition

The Tilt & Slide or Spoiler Sunroof system shall consist of a frame with guide rails and glass panel mechanism, movable glass panel, sunshade, drive-train for glass panel with attaching hardware including sight shields, water management system and wind-deflector. All components shall be completely assembled and checked to meet all specifications.

3.1.1. Appearance

Tool marks such as; split lines, parting lines, weld lines, injection mold gate lines and or burrs that may be visible to the customer are not permitted on any component within the sunroof system.

Interior Appearance

a. Glass panel must meet appearance color and light transmission requirements.
b. All visible mechanical parts, all 4-aft beams and covers shall be matt black, unless otherwise specified by GM Engineering. See appendix B for Guide rail colors.
c. Headliner interface to the sunroof DLO to be specified in appendix B.
d. All seals on the sunroof system shall be black in color.
e. All colors and graining must meet al GM Engineering requirements per appendix F5.

f. The appearance characteristics of all visual exterior surfaces of the sunroof shall be compatible with other vehicle content.
g. The upper surface of the sunshade and all other visible parts shall have black finish, except the pull cup handle unless otherwise specified by GM Engineering.
h. See Appendix B for sunshade vent.
i. With sunroof glass closed and sunshade open, water which passing from the seal into the water management system must not be visible.
j. The sunshade shall cover and overlap the inner opening to the headliner. The gap between the sunshade and the nominal surface contour of the headliner treatment shall not exceed the minimal gap requirement.
k. The visible parts shall not have ejection marks, burrs or other disruptive elements.

3.1.1.2 Exterior Appearance

a. Reference to Appendix F5 for specific appearance requirements.
b. Height position of the glass panel shall be adjustable such that the front edge upper glass panel is flush with the roof contour or below of it by not more than 0.5 mm and rear edge upper glass panel is flush with the roof contour or protrudes not more than 0.5 mm at the outboard corners comprehending all vehicle level GD&T and assembly tooling variation.
c. The glass panel surface shall possess the same contour around the entire periphery of the sunroof opening (flush design).
d. With encapsulated & non encapsulated non glass systems the outer edge or sides of the moveable glass panel shall have a shield or skirt incorporated in the design such that in the opened vent position the mechanism will not be visible from the exterior of the vehicle.
e. The cross curvature of the wind deflector in its lifted position should be parallel with the roof contour.
f. All visible mechanical parts, front cross carrier, guide rails and covers shall be matt black, unless otherwise specified by in Appendix B.

3.1.2. Content

The required physical and functional contents for the sunroof are identified in the following paragraphs.

Physical Content

3.1.2.1.1 Sunroof Roof Opening and Reinforcement

a. The sunroof opening must be a stepped flange design or hem design.
b. The reinforcement attachment to the roof opening must be welded to the step flange design or hemmed into the roof panel.
c. The reinforcement design and interfaces to be specified by GM Engineering and reviewed by the sunroof source.
d. All sunroof mounting provisions must be provided in the reinforcement or other roof components. Any other locating strategies in the body that are not located to the master locating datum's of the Sunroof Roof assembly (reinforcement) are not allowed and must be approved by GM Engineering.
e. The reinforcement and sunroof module shall have the corresponding locating scheme one four way and one two way locating hole corresponding to each other. Additional locating holes will be determined by GM Engineering.

3.1.2.1.2 Roof Bow Rear, Optional

a. Improving the dent resistance of the roof.

b. Optional Roof bow that is used as a fastener position for the sunroof module must be assembled to the sunroof roof panel and located to the main reinforcement prior to assembly to the vehicle if the traditional reinforcement cannot be used.
c. Stabilize and distribute the load of the sunroof when the glass is in the open position.

3.1.2.1.3 Sunroof Module Assembly

a. The module assembly shall be completely pre-assembled and tested prior to shipment.
b. All attachment brackets must be part of the module assembly with a non rotational feature unless otherwise specified by GM Engineering.
c. Attachment fasteners shall be M6. Alternate fasteners must be approved by GM Engineering.
d. When a power sunshade is used both module and sunshade motors must be positioned as close to the center as possible to ensure proper cable travel.
e. When the sunroof is in the vent mode and express close function is used the gap at the side from interior to exterior must have a suitable molding or mechanism cover (i.e. side accordion).
f. The sunroof module or any other components that make up the module assembly must not have any Silicone based lubricants or release agents that could cause any paint defects in the GM Assembly process.
g. Lifter mechanism covers shall be installed with a minimum number of visible fasteners and joints.
h. The sunroof shall include an integral air deflector, if necessary, to meet vehicle wind/buffeting requirements given in the VTS.
i. The sunroof drive mechanism shall be completely located in a dry area of the sunroof module side frames.
j. The opening in the sunroof module side frames through which the drive cable connects with the sunroof mechanism shall not be open in the upward direction.
k. The sunroof mechanism shall permit mounting of the sunroof glass panel with horizontally outward driven screws that are accessible from the interior of the vehicle with the sunroof in the closed position.
l. Build up of static electricity in any component of the sunroof is not permitted.
m. Sunroof fasteners which are part of the assembly shall have retainers.

3.1.2.1.3.1 Movable Glass Panel

a. The sunroof glass panel thickness and color is specified in Appendix B.
b. The access to the fasteners must meet manufacturing clearance requirements for tool (13 mm diameter) access and be accessible with a full open sunshade.
c. Side mechanism covers for masking the adjustment fasteners and mechanism shall be POA, unless otherwise specified by GM Manufacturing Assembly.
d. If the module is shipped with loose glass the fasteners may not scratch or damage the glass tabs. Minimum thread engagement is required, fasteners shall not fall off during transport.
e. The glass panel shall be fastened to the mechanism with M5 fasteners with a minimum of 4 fasteners on (tilt slide) and a maximum of 6 on a (spoiler).
f. For all glass panels, a Free Body Diagram (FBD) must be submitted verifying that the attachment scheme is optimized and meets criteria for strength and high speed, glass loading.
g. The positions of the screw points shall be position to meet all modal analysis and manufacturing requirements to prevent any squeak and rattle conditions.
h. Required washers shall be free spinning and integrated with screws.
i. Thread size minimum M5 / internal TORX T 25. And have a GM approved anti rotational adhesive applied Ex. (Loctite, Es-Lock, Tuff-Lock, Poly-Lock).
j. The glass panel must be adjustable to take up +/- 2 mm variation.

3.1.2.1.3.2 Glass Panel Seal

a. If the seal is mechanically attached to the glass. It must be designed to be serviceable.
b. The glass panel seal slip coating must be developed and validated for all paint systems that the seal is used on to avoid seal squeak / itch under all conditions.
c. Welded joints on the seal must meet all GM seal adhesion requirements.
d. Must maintain sectional shape under environmental conditions and durability no hour glass failures are acceptable.
e. No TPV material seals to be used.

3.1.2.1.3.3 Sunshade

The sunshade pull cup color on the upper surface of the sunshade may be interior color.

3.1.2.1.3.4 Water Management

a. The sunroof's water management components consisting at a minimum a front and rear drain hoses, grommets, clips and drain channels of the sunroof module.
b. Water management shall be made with drain hoses accessible at all 4 corners.
c. The drain hose asm. shall have integral attaching pins or clips for attachment to the body and rattle free in the vehicle body. Spacing and locations are specified in the best practice and the design must be approved by GM engineering.
d. The routing of the drain hoses shall be installed in such a way with a minimum of 3 degree flowing angle to prevent collecting of water in the hoses.
e. Drain spout and connector design must meet Global Best Practice.
f. Drain hose attachment to the module shall not use clamps.
g. Drain spouts on the module shall be barbed for hose attachment
h. Drain hose routing must maintain design clearance to all surrounding components to a minimum of 5mm.
i. Drain hose systems must be color keyed to error proof location (LH/RH) of the vehicle.

3.1.2.1.3.5 Water Channel

a. A water management channel must be designed under the glass seal and the roof flange opening to manage the water.
b. The upper edge of this water-channel shall follow the contour of the roof skin.
c. The distance between the water channel upper edge and roof skin or glass panel shall be kept to a 5 mm minimum not exceeding the typical clearance requirements.
d. Tilt able water channels must be at a minimum clearance to the glass panel to prevent rattles and water spillage into the vehicle compartment.
e. It shall be ensured that during opening into tilt position any water resting on the roof can be drawn off forward into the water channel in any position specified.
f. Water separation in the channel shall be designed such that the water is leading off in a smooth lament flow from the center of the water channel into the side exit points.
g. A water management channel must be designed to prevent Splashing or water over flow into the vehicle compartment at all vehicle angels stated in section 3.2.1.15.

3.1.2.1.3.6 Wind Deflector

a. A wind deflector is required to meet the wind noise buffeting requirements stated in 3.2.1.20.
b. During opening and closing movements of the glass panel the wind deflector shall automatically actuate with smooth operation.
c. The wind deflector shall not come in contact to the glass panel or roof flange during any operating positions for both static and dynamic driving conditions. Contact between control cams and actuators on the glass panel or wind deflector is permissible.

d. Blade wind deflector stops must have an isolator pad between the stop tabs and the down standing flange of the roof opening to prevent rattles.
e. Blade wind deflector shall have a seal which is in contact with the roof flange, when the deflector is deployed.
f. The wind deflector shall not spray water into the interior during opening of the glass panel.

3.1.2.1.3.7 Wiring Harness

a. All sunroof electrical connections to the vehicle harness shall meet all applicable harness connector requirements.
b. A small jumper / wire harness to be specified in Appendix B.
c. The main body wire harness connection must connect to the side of the rail or to an agreed position location on the module per the GM Best Practice.
d. If a main wiring harness must be used, the wiring harness must be attached to the module and secured. Wire harness cannot be damaged or pinched during installation and fastening of the module into the vehicle that may cause pinching and/or shorting of the electrical system.
e. Pin assignment must comply with GM requirements.
f. The wire harness must be sufficiently restrained and/or insulated to the sunroof module to prevent rattles, buzzing or itching to its surroundings

3.1.2.1.3.8 Drive Motor and Control Unit

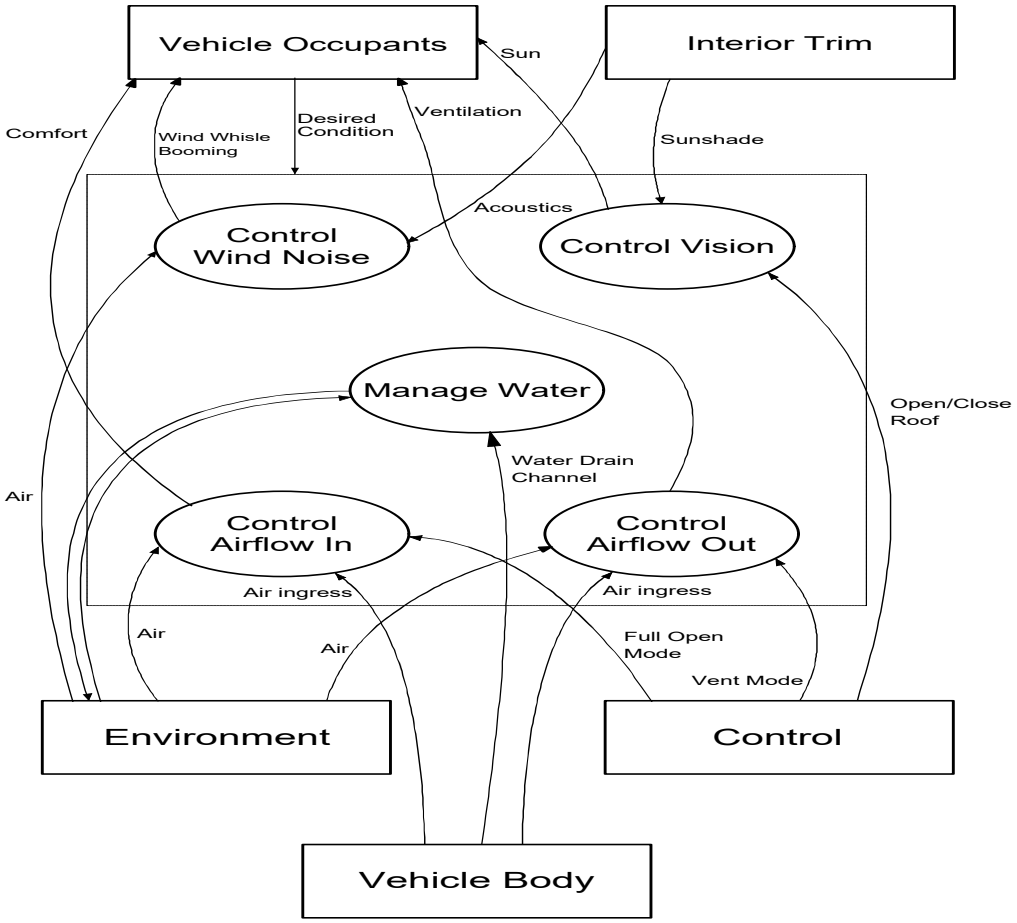
a. The motor and control unit shall be integrated into the subassembly.
b. The module and control unit shall be pre initialized at the supplier prior to the shipment to the assembly plant.
c. The integrated circuit board must be coated.

3.1.2.2 Functional Content

The Tilt & Slide or Spoiler Sunroof shall offer the following functions to the user.

3.1.2.2.1 Functional Flow Diagram

Figure 3.1.2.2.1



3.1.2.3 Sunroof Module Assembly

a. An electronic soft start and stop is preferred to minimize excessive wear and noise to the module. A soft start and stop must meet all mechanical requirements to control arm position.
b. Unrestrained loops or service loops must be wrapped with a soft material (foam etc) to prevent rattle or itch.
c. Attachment brackets fastened to the sunroof frame (fore-aft rails or cross car beams) must have an anti-rotation feature to maintain the dimensional relationship of the bracket to the interface components.
d. The sunroof module shall permit height adjustment of the sunroof glass panel at the front and rear by a minimum of (+/-) 2mm from the design nominal position at the attachment point between the sunroof panel frame and the actuation mechanism locations.
e. The sunroof module shall permit a minimum of +/- 1.5 mm fore-aft adjustment of the glass panel at the panel attachment point on the mechanism.
f. The sunroof glass panel (Seal Set Function) always approaches the roof panel from the same direction (either from the top or the bottom) when traveling to the closed position regardless of whether the sunroof is closing from the open or from the vent position.
g. The drain channel on a Tilt & Slide sunroof shall travel with the sunroof panel to the open position to ensure that any water on the sunroof panel can drain rearward into the drain channel.
h. The sunroof module shall permit sliding the sunshade rearward until only the handle area remains forward of the rear interior aperture when the sunroof panel is in the closed position or in the vent position.
i. The sunroof module shall not allow a hard panel or 100% light block roller sunshade to move forward of the sunroof panel.

3.1.2.3.1 Movable Glass Panel

a. During fastening of the glass panel screw the adjusted position of the glass panel must not move when the fasteners are being tightened.
b. The outer edge of the encapsulation shall have a surrounding dripping edge to allow water to drip into the water management area.

3.1.2.3.2 Movable Glass Panel Operation

a. Electrical opening and closing of the glass panel is controlled by a switch to function glass panel movement from any position.
b. Permitted only by national governmental vehicle regulations. It shall be possible to close the sunroof from the vent position or full glass opening position using the key fob remote control or via the door lock, (control unit for central locking). Must refer to Appendix B for usage.

3.1.2.3.3 Glass Panel Seal

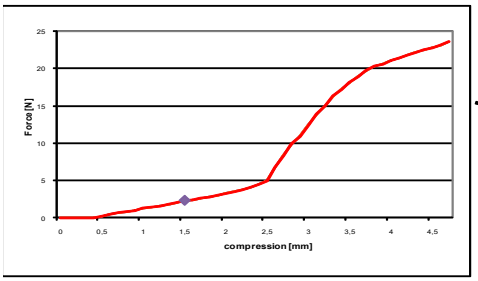
Minimum required thickness for Anti Itch coating is 8 µm.

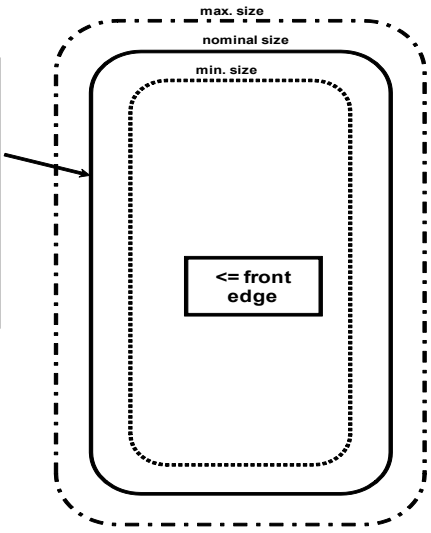
Table 3.1.2.3.3 Seal Compression Curve

3.2.1.3.3 T&S Seal Compression Curve

Temperatur: **RT**

Spec. Glaspanel seal	
Material	Elastomeric Seals for Glass Sealing GMW14168
Shore hardness profile	45 +/- 5
Shor hardness base	70 +/- 5





Sealing Function	Unit	Target	upper limit	lower limit
pull through force light box gage	N	40	50	30
shore hardness Sealing Profile	Shore	45	50	40
Component				
Seal widht	mm	7,5	8	7
Seal height	mm	10	12	9
pull off force 100mm Seal	N	140	180	100

Seal front edge	
Force [N]	compression [mm]
0	0
0	0,1
0	0,2
0	0,3
0	0,4
0,2	0,5
0,5	0,6
0,7	0,7
0,8	0,8
1	0,9
1,3	1
1,4	1,1
1,6	1,2
1,8	1,3
2	1,4
2,3	1,5
2,4	1,6
2,6	1,7
2,8	1,8
3	1,9
3,3	2
3,5	2,1
3,8	2,2
4,1	2,3
4,5	2,4
5	2,5
6,8	2,6
8,4	2,7
9,9	2,8
10,9	2,9
12,5	3
13,9	3,1
15	3,2
16,3	3,3
17,2	3,4
18,1	3,5
18,9	3,6
19,7	3,7
20,3	3,8
20,6	3,9
21,1	4
21,4	4,1
21,8	4,2
22,2	4,3
22,5	4,4
22,8	4,5
23,1	4,6
23,6	4,7

3.1.2.3.4 Inner Seal

The inner seal shall provide seal function between glass lid and roof module assembly with regard to the following aspects:

a. Noise
b. Air
c. Dust
d. Water

The inner seal shall be serviceable, the joint of the inner seal need to be glued together.

3.1.2.3.5 Drive Mechanism

a. The force application point for the mechanics shall be placed in the center in order to avoid tipping or twisting.
b. The loading of the drive elements caused by angle tolerances shall be compensated or absorbed so, that the torque is not above the allowed maximum value (Table 3.2.1.25 l).
c. In order to compensate the tolerances of drive parts the mechanics shall be designed such that movement of the drive system of ± 5 mm around zero position no movement of the glass panel will take place.
d. Zero adjusting is achieved by pushing the guides against a front stop of the guide rails.
e. The electrical zero position shall be reached without touching the mechanical stops after the first initialization.
f. Cross play compensation of at least ± 1.0 mm shall be provided.
g. The mechanics must always be contained in the guide tracks/rails during all movements.
h. A zero position marking shall be on the glass panel mechanic.

3.1.2.3.6 Sunshade

a. The use of vented sunshades shall not allow direct light in the occupant eyes. Use of vented sunshades is specified in Appendix B.
b. The sunshade pull cup must not transmit light.
c. The sunshade pull cup must meet all ergonomic hand requirements when the sunshade is in the full open position and when the glass panel is in the closed or vented position.
d. The sunshade may be fully retracted into the headliner opening providing the pull cup is moved back to an acceptable position when the glass panel is closed.
e. A hard panel sunshade shall not move forward of the glass panel leading edge at any position during vehicle dynamic road inputs.
f. The sunshade panel shall be able to compensate for non-parallelism of the guide system and eliminate any cross car play.
g. Sunshade to headliner, lace or trim ring gap shall be contact-free with a constant of 1mm - 2mm gap in any sunshade position.
h. The sunshade shall be continuously guided in the rail over the entire movement of the sunshade with the glass in the closed or vent position.
i. The forward and rearward movement of the sunshade shall be damped.
j. The sliding channel for the sunshade must not be open at the top of the rail section.
k. The headliner daylight opening must be covered completely by the sunshade.
l. The driver shall manually activate opening and closing or venting of the sunshade with the glass the closed or vented position.
m. The visible outer edge of the roller sunshade (Nonattached to the guide rails) must not show fabric fraying.
n. The sunshade shall cover and overlap the inner opening to the headliner.

3.1.2.3.7 Sunshade Operation

a. A hard panel or 100% light block roller sunshade shall move with the glass panel while the glass is moving in the opening direction.
b. Alternative sunshade operation which is independent from the glass panel movement shall be offered as requested in the Appendix B.

3.1.2.3.8 Water Management

a. The drain hoses shall be fastened directly by hand over the spouts on the sunroof module and must meet the ergonomic attachment requirements.
b. The drain hoses, at the body interface where the water exits the vehicle, shall not allow dust, noise, water and CO intrusion back into the vehicle.

3.1.2.3.9 Water Channel

When opening a tilt & slide or spoiler glass panel to the full open position, it shall be ensured that any standing water located on the sunroof panel can drip forward or rearward into the water channel.

3.1.2.3.10 Wind Deflector

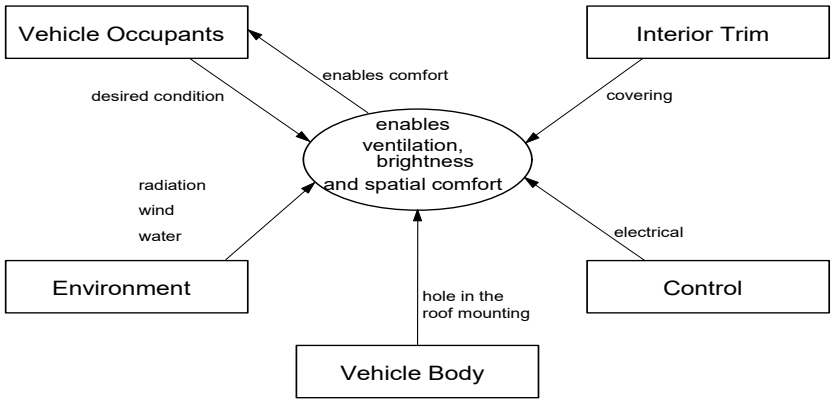
3.1.2.3.11 Wire Harness

3.1.2.3.12 Drive Motor and Control Unit

a. When a soft electrical stop is used the mechanism shall stop within the defined electronic end positions and in each selected position.
b. A smooth start and a smooth stop shall be provided.
c. The controller must not lose initialization data when power is removed.
d. In order to ensure perfect positioning after supply voltage failure or re-installation, an initializing run from zero point identification (closed position) is permitted. In this case one system blockage may occur. During the initializing run the glass lid shall move only in closing direction.
e. When the glass panel or hard power shade panel is in the closed position and the operating element is pushed in the closing direction for longer than 10 s the motor will be reinitialized.
f. The cable or drive belt must always be engaged to prevent spring load slippage in cable at all times.

3.1.2.4 Function Features Diagram

Figure 3.1.2.4 ROOF – Function



3.1.2.5 Further interfaces

a. Body in white
b. Internal trim to Tilt & Slide or Spoiler Sunroof, formed headliner, drive cover, roof-console, pillar trim, grab-handles, sun-visors, interior elements, sensors, covers, curtain airbag, wiring harness, DVD bracket, fixture for grab-handle, fastener positions of the headliner, bracket cargo-net, interior lamps, switches, theft warning system, park assistant system, garage door opener
c. Drain tubes with connectors, clips, grommets, anti rattle foam/tape and valves for water management.
d. Control elements, i.e. a switch with cable and connector
e. Roof load carrier systems, roof-antenna, window washer, wiper, roof rails, tail lamp, third stop-lamp (CHMSL), rear seat belt system.

f. Tailgate/Hatch Lid

3.1.3. Ambient Environmental Conditions

The Tilt & Slide or Spoiler Glass panel sunroof can be exposed to the following influences during a shorter or longer time period:

The vehicle operation and environment performance shall satisfy the requirements specified in Table 3.1.3 I Operation Environment Conditions.

Table 3.1.3 I Operation Environment Conditions

Pos	Kind of Influence	Range	Conditions
1	Operating Temperature	(-20°C to 85°C)	Lifetime Test
2	Storage Temperature	(-40°C to 105°C)	24 hr
3	Repainting Temperature	105°C ± 3°C	1 hr
4	Humidity	0 - 98%	50°C ± 3°C
5	Radiation	> 5400 kJ/m²	240 hr (Outer resp. Inner parts)
6	Hail and Snow		No Damage
7	Rain	13-30 $dm^3/min\ m^2$	72 hr
8	Maximum Vehicle Speed	0-260 km/hr 0-180 km/hr	with Roof Box (large)
9	Dust Load	Acc to table 3.2.2.9 I (SEC020)	No Damage
10	Ice Thickness	1mm	No Itch, No Rattle, No Damage
11	Air Bag Operation		No Damage
12	Jack Test		No Damage
13	Car Wash Test		No water entry in the passenger compartment must be confined only in the water management areas.
14	Door Closure Test		No Squeaks or Rattles, No Damage
15	Luggage Rack Test		Free access to lifted glass panel; no obstruction of glass panel movement
16	Vibration		No Squeaks or Rattles, No Damage
17	Chemical Resistance		No Damage
18	Rear Washing System		No water progressing (forward to the roof opening)
19	Water Test at end of assembly line	60 dm^3 / (Min. x m^2)	8 min Duration

This section defines the minimum acceptable cold weather vehicle performance. The vehicle operation and performance in a cold environment shall satisfy the requirements specified in Table 3.1.3.II Thermal Operation in Cold Environment.

3.1.3. II Thermal Operation in Cold Environment

Reqmt.	Ambient Temperature	Vehicle Requirement *1
a	> -29°C	Vehicle components shall have no loss of function.
b	(-29°C ≥ T ≥ -40°C)	Assisted vehicle starting shall be permitted *2
c	(-29°C ≥ T ≥ -40°C)	Temporary loss of component function shall be permitted, but permanent loss of function shall not be permitted *3

d	(-29°C ≥ T ≥ -40°C)	After vehicle has been operational (started), the vehicle shall not encounter a temporary loss of function which would result in an occupant "walk home" situation *3
e	< -40°C	Vehicle shall not be expected to operate
f	< -40°C	Conditioned vehicle *4 shall not encounter permanent damage

Requirement Notes:

*1 All driving operations such as idle, city, highway.

*2 Start-up requirements defined in detail in Tables

*3 Temporary loss of component function shall not compromise occupant safety

*4 Cold Weather Package Vehicle: Requires use of fluids (e.g., windshield washer fluid, coolant) which are compatible with this environment.

3.1.4. Interfaces

External Interface
FOR External influences see ambient environment section

Body- In-White

a. Closed position = Roof, glass panel with edge seal
b. Vent position = Roof, glass panel with edge seal, sunshade, Guide rails, covers, water channel, Mechanics
c. Opened, Slide Position = Roof, Guide rails, wind deflector, sunshade

3.1.4.2 Internal Interface - Operating Unit to Attached Parts

3.1.4.2.1 Installation to the Body-In-White Bottom Load

a. Tilt & Slide or Spoiler Glass panel Sunroof to roof ASM with 2 locating pins.
b. The loading device should have a rough locating provision for the module be placed into the roof opening.
c. Attachment of the Tilt & Slide or Spoiler Glass panel Sunroof with screws. Position and number of screws will be determined by supplier and GM Engineering.
d. Metal bushings inserts are required at each of the plastic mounting bosses where the sunroof attaches to the vehicle structure.
e. The sunroof frame shall have provisions for attachments of edge wrapped headliner, Trim lace or trim ring.

3.1.4.3 Plug to Wiring Harness

Pin assignment and connector type to be specified by GM Electrical Engineer and must comply with the requirements.

3.1.4.4 Frame to Formed Headliner

See Appendix B for details

3.1.4.5 Door Lock to Control Unit (Vehicle)

Door lock control unit to control unit Tilt & Slide or Spoiler Glass panel Sunroof (functional release), reference to Electrical CTS.

3.1.5. Usage Definition

3.2. Product Characteristics

The required product characteristics for the Sunroof Tilt & Slide or Spoiler System are identified in the following paragraphs.

3.2.1. Performance Requirements

The functional performance requirements for the sunroof are specified in the following paragraphs.

Sunroof Module Assembly

3.2.1.1.1 Movable Glass Panel

a. See SOR Appendix B for details
b. The surface profile tolerance rate of change of the glass panel assembly shall meet the vehicle DTS requirement.
c. The sunroof glass panel thickness shall be 4.0 mm, unless otherwise specified in Appendix B
d. The push through force (30-40 N) of the glass lid needs to be checked in the light box in order to ensure the correct seal compression.

3.2.1.1.2 Glass Panel Seal

a. The glass panel seal slip coating must be developed and validated for all paint systems that the seal system is used on to avoid seal squeak/itch.
b. The glass panel sunroof weather seal shall interface peripherally with the BIW roof opening to seal out water, wind, dust, noise and other contaminants.
c. Seal contact to the BIW body flange with a minimum of 3.0mm must have a 1.5mm seal compression. Note, with sunroof properly installed and adjusted to a vehicle body the seal may allow up to 12 drop per minute into the water management system during the 8 minute water test.
d. Seal must not create any squeak noises during all temperature driving conditions.
e. Any water ingress into the seal must be managed out (not retained) in the seal and into the sunroof drain system.
f. With 5.0 mm of standing water on top of the glass panel the sunroof seal will not allow more than 12 drops per minute before temperature and humidity durability cycling. There shall be no, capillary movement of water outside of the wet areas of the drain channels or, water in dry areas of the water management system. Water intrusion after the life cycle temperature and humidity durability cycling shall not exceed one (1) liter per minute, total.

3.2.1.1.3 Operating Element Glass Panel

Switch is not part of the delivery content.

a. Vehicle key - Comfort closing with remote control door key. To be specified in Appendix B Function release.
b. If all suitable criteria's are fulfilled the signal "functional release" will be supplied via LIN-Bus.

3.2.1.1.4 Lin-Bus Signals

See electronic CTS Appendix C2 Spoiler Tilt Slide SRC CTS V2.0.2.

3.2.1.2 Electrical

The functional performance of the “drive motor(s) shall meet all applicable electronic requirements” per GMW3172

3.2.1.3 Stowage of Operation Elements

a. Switch
b. Vehicle key
c. Remote Key Fob.

3.2.1.4 Mechanics

The mechanics shall be designed in such matter that in case of an upward tension force in the center on the back edge of the glass panel of $F_{z\zeta}$ = 200 N the torque from tilt up to closed position is not exceeding ζ = 4 Nm.

3.2.1.5 Sunshade

a. Disturbing sliding panel noises are not permitted. Sound quality must be approved by GM Squeak and Rattle Engineer.
b. The sunshade shall not move by itself during maximum braking maneuvers, (panic stop).
c. The sunshade must be tested for resonant frequency to insure the sunshade does not emit any rattles or noises during driving condition. This must be tested in full opened / closed position and in 1/3, 1/2, 2/3 open position in between.

3.2.1.6 Power Sunroof Sound Quality

When installed in the vehicle all sounds shall convey solid construction and smooth operation. For Multi Panel Sunroof Systems and Tilt, Slide Sunroof Systems, all sounds shall meet the requirements listed in Table 3.2.1.6 I Power Sunroof Sound Quality when tested to GMW14153 Test Procedure, Laboratory Evaluation of Power Sunroof Sounds. Likewise, for Spoiler Type Sunroof Systems, all sounds shall meet the requirements listed in Table 3.2.1.6 J Power Sunroof Sound Quality when tested to GMW14153 Test Procedure, Laboratory Evaluation of Power Sunroof Sounds. Compliance of the sounds will be determined by the GM Customer Actuated Sound (CAS) Performance Engineer. These requirements apply throughout the life specified under reliability evaluation point and at lab ambient temperature throughout the entire operating range.

A sunroof with good Sound Quality performance will be identified to the sunroof supplier as a “reference part”. This reference sunroof will be a GM agreed sunroof to possess GMUTS ≥8.0 performance capabilities. It is the task of the supplier to create and generate the noise targets by performing objective noise tests of the above mentioned sunroof and processing the test data as described in component related test procedure GMW14155, Subsystem or Component Sound Master Laboratory Recording & Evaluation Procedure, Customer Actuated Sound.

After the supplier has determined that their sunroof has met the Sound Quality performance requirements, then they are to ship (2) samples of their sunroof to the respective GM Region for GM to perform confirmation of the sunroof sound performance with an on-vehicle test fixture and/or integration vehicle. Objective targets will be generated out of the reference sunroof for maximum and steady state loudness, relative pitch metrics and steady state specific loudness.