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| GM WORLDWIDE ENGINEERING STANDARDS | General Specification | GMW3118 |

# Verification of Requirements for Side Impact/Roof Rail Airbag Modules


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# 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:** In the case when multiple procedures are listed to conduct a validation test, the Vehicle Engineering Center (VEC) is the final arbiter on selecting the appropriate test method.

**1.1 Purpose.** This standard sets forth the validation procedures and associated performance requirements for Side Impact Airbag and Roof Rail Airbag Module assemblies (hereinafter referred to as the "Module") that will be used for side airbag systems in GM vehicles. This document does not address developmental test requirements. It shall be the responsibility of the Supplier to identify and conduct a Development and Concept Validation Test Plan as defined in the program Statement of Requirements (SOR), and/or the Design Failure Mode and Effects Analysis (DFMEA)/Process Failure Mode and Effects Analysis (PFMEA). Module Development Testing shall be completed prior to start of Design Validation (DV) testing.

The Module Validation Test Plans shall be structured in accordance to the DV (4.2.1.1 and 4.2.1.2) and Process/Production Validation (PV) Test Matrixes (4.2.2.1 and 4.2.2.2) in this document. These requirements shall contain but not be limited to a minimum set of tests and sample sizes for validating Modules. It shall be the Supplier's responsibility to evaluate the plans and determine if additional testing and/or larger sample sizes are recommended based on the Supplier's developed DFMEA and PFMEAs. The Module Development, DV, and PV test plans shall be approved by the responsible VEC Engineer prior to implementation. In addition to this specification, Module shall meet inflator (USCAR-24), Initiator (USCAR-28) and cover material specifications (according to GMW3133 and GMW14444).

The validation test setup and test procedure shall be approved by the responsible Vehicle Engineering Center (VEC) Engineer prior to implementation. If requirements stated herein are not objectively defined, the responsible VEC shall be the final arbiter of these requirements.

**1.2 Applicability.** This verification document applies to all Roof Rail Airbags (RRAB) and all Side Impact Airbags (SIAB).

**1.3 Remarks.**

**1.3.1** The Module supplements the protection offered by the vehicle structure, seat belt system, and interior trim for side impact collisions. The Module is intended to reduced injury potential in those accidents where there is a significant risk that the outboard seated occupants might otherwise be injured, meet applicable regulations, and address GM Worldwide performance goals.

**1.3.2 Classification.**

- Side Impact Airbag Module - (SIAB)
- Side Impact Airbag Module - Center Side Impact Airbag (CSIAB)
- Side Impact Airbag Module - Outboard (SIAB OB)
- Rear Side Impact Airbag Module - (RSIAB)
- Roof Rail Airbag Module - (RRAB)

# 2 References

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

**2.1 External Standards/Specifications.**

| | | | |
|---|---|---|---|
| EU 2007/23/EC | IEC 60068-2-14 | IEC 60068-2-64 | USCAR-24 |
| FMVSS 201 | IEC 60068-2-27 | ISO 1431-1 | USCAR-28 |
| FMVSS 226 | IEC 60068-2-38 | SAE J1794 | |



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### 2.2 GM Standards/Specifications.

| | | | |
|---|---|---|---|
| GMW3059 | GMW3133 | GMW14162 | GMW17860 |
| GMW3097 | GMW3286 | GMW14444 | |
| GMW3115 | GMW3417 | GMW15567 | |
| GMW3121 | GMW14011 | GMW16907 (ID) | |

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

### 2.3 Additional References.

- CG3378 Airbag Lot Acceptance Test Matrix
- CG3511 System Level SIAB/RRAB Seat Position Test Matrix
- CG3756 PRTS Severity Code Guidelines for Inflatable Restraints (ID)
- CG4657 Roof Rail Airbag (RRAB) Deploy and Restraint System Technical Specification (ID)
- CG4680 Airbag System Deployment Video Analysis Guidelines
- CG4754 Rollover Occupant Protection Feature Technical Specification (ID)
- CG5095 Acceptance Criteria for Airbag Manufacturing Margin Evaluation (MME) Testing
- CG5110 Airbag Validation Deployment Checklist
- Program Specific Statement of Requirements (SOR)

## 3 Requirements

The use of **shall** in this document denotes a binding provision that must be met unless a deviation is granted by the responsible VEC. A permanent Deviation EWO shall be written and approved by Global Subsystem Leadership Team (GSSLT) in order to grant deviation. Deviations to **shall** requirements will only be considered and, if approved, granted by the responsible VEC after evaluating appropriate available technologies and balancing all Module and restraint system performance considerations.

**Should** denotes a preference, or desired conformance that must be tested and, if not met, must be documented and disclosed by the Supplier and approved by the responsible VEC. **Should** requirements must be met unless non-compliance has been approved by the responsible VEC.

The term “Airbag” refers to the airbag subsystem and not a specific component (e.g., the cushion).

Test Equipment **shall** be utilized as specified, by the indicated test procedures, standards and specifications.

**Test Equipment.** Unless otherwise specified elsewhere in this document, tests shall be performed at local ambient pressure, relative humidity, and room temperature (+23 ± 3) °C.

Unless otherwise specified in this document, test condition tolerances shall be as stated in Table 1.

**Table 1: Test Condition Tolerances**

| Test Condition | Tolerance |
|---|---|
| Temperature | ± 3 °C |
| Relative Humidity (RH) | ± 3% of RH |
| Vacuums | ± 10 mm of Hg |
| Height | ± 0.05 m |
| Acceleration | ± 2% except were minimums are stated |
| Frequency | ± 4% or ± 2 Hz, whichever is smaller |
| Amps | ± 0.01 A |
| Volts | ± 5% |
| Ohms | ± 1.0% |
| Angle | ± 1.0° |



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All test conditions shall be within the stated tolerances in Table 1 at the time of test. These tolerances shall not be used independently.

**Test Samples.** For test sample size requirements, reference 4.2.1 and 4.2.2 “Design and Product Process Validation Requirements”.

**3.1 System/Subsystem/Component/Part Definition.** Not applicable.

**3.2 Product Characteristics.**

**3.2.1 Performance Requirements.** Refer to 4.2 “Validation Plan” for the number of test samples to use in each test.

**3.2.1.1 Static Deployment Test.**

**3.2.1.1.1 Module Level Static Deployment Test SIAB/RRAB.**

**Purpose:** To evaluate the Module performance and structural integrity.

**Test Fixtures and Equipment:**

- Conditioning chamber, capable of holding (-30 to +85) °C.
- Rigid fixture that represent in-vehicle Module orientation and mounting system.
- Module mounting shall simulate vehicle environment, including reaction surfaces when applicable.
- Module cover and/or door required.
- Actuation device that also switches on the measuring equipment.
- Approved Data Acquisition System.
- High Speed cameras (3000 frames/s minimum for tear seam opening, all others can be 1000 frames/s), three (3) required.
- Lights (high intensity to enable viewing of all components).
- Pressure Transducer that can measure pressures up to 690 kPa.
- Thermocouples that can measure temperatures up to +110 °C.
- Strobe Light (to indicate T = 0).
- ID labels (with test number and frames/s information).
- Frames per s counter.
- Test backdrop with grid.

**Data Required:**

- Conditioning temperature and ambient temperature in test cell during the test.
- Cushion pressure vs. time (If requested).
- Voltage and current vs. time.
- High Speed videos.

**Test Procedure:**

a. Set up and adjust high speed cameras. Each camera should have a lens which allows a full view of the Module and inflated cushion. Initial frames to include title block with test number, program ID, test date, camera speed. Set up lights in a manner that provides sufficient lighting for all camera views but does not wash out cushion image.

b. Set up strobe light to illuminate Module, to show T = 0 on all high speed cameras and videos.

c. Document test date, sample number and serial number. Attach ID label to front and side of the test fixture/seat or roof rail.

d. Take still photographs of Module before test.

e. Measure and record Module electrical resistance, insulation resistance, and shunt resistance, as follows:

f. Measure the terminal-to-terminal resistance. The resistance in terminal-to-terminal test mode shall be (2.0 ± 0.3) Ω.



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g. Measure the resistance in shorted terminal-to-inflator-case. The resistance in shorted terminal-to-inflator-case (insulation resistance) shall be ≥ 1.0 MΩ when subjected to 500 V direct current (VDC) for 2 s.

h. If applicable, measure the shorting clip resistance (shunt resistance) terminal-to-terminal. The shorting clip resistance terminal-to-terminal with shunt bar in position shall be ≤ 150 mΩ.

**Note:** Shunt resistance measurement "if applicable" applies to all shunt resistance paragraphs.

i. Mount Module in the rigid fixture that represents in-vehicle Module orientation and mounting system/Seat/Roof Rail Assembly. Module mounting shall simulate vehicle environment, including reaction surfaces when applicable. SIAB to use a clear flat reaction surface (Plexiglas or equivalent) placed at minimum in-vehicle distance from Module cover to trim (door trim, side wall trim or center console) or 50 mm if not specified.

j. Install Thermocouple to measure the Module Housing Assembly, if requested by VEC. (For verification of Module Temperature at Deployment.)
   - Thermocouple Type K (or equivalent type T) 24 gauge wire, 508 Teflon wrap: K24-2-508 Temprel.
   - Tungsten Inert Gas (TIG) welded thermocouple wire junction for surface temperature recordings.
   - For plastic surface – melted into surface w/soldering iron/gun.
   - For fabric material – pierced hole and inserted into/onto surface, held in place with 3M silver tape core series 292-7.
   - For glass surface – clear package/scotch tape covered entire welded junction.

k. Place the fixture (as stated in item (i)) with the Module in the conditioning chamber and condition at -30 °C, +23 °C, or +85 °C. The duration of Module conditioning shall be such that the core temperature of the Inflator within the Module reaches and maintains the nominal required conditioning temperature unless otherwise indicated. The Supplier shall provide data to the responsible VEC Engineer, indicating the time duration ($t_e$) required for the inflator's core temperature within Module assembly to reach and maintain the specified conditioning temperature. The method and Module quantity (Module quantity shall represent quantities used for DV/PV testing) used to demonstrate Inflator core temperature shall be reviewed and approved with the responsible VEC prior to testing and after approval test duration can be modified to ($t_e$) + 30 minutes. If the time duration ($t_e$) data is not provided, the minimum time for Module conditioning is 4 h after the conditioning chamber has reached and maintained specified temperature. This statement applies to all temperature conditioning.

l. Activate the data acquisition system. The following data shall be recorded:
   - Current plot.
   - Test temperature (activate the high speed cameras or videos).

m. Actuate each Module with the minimum actuation current (1.2 A) at the corresponding conditioning temperature. The Module shall be deployed at 2 minutes ± 5 s per VEC approval, after Module removal from conditioning chamber.

n. Take still photographs of Module, Cover/Door, Cushion Assembly, Trim and Module Housing after test including detailed close up photographs of any possible non-conformance to the performance requirements of GMW3115 and GMW3121. Refer to standard video analysis CG4680

o. Complete post-test documentation; and retain indefinitely: Reference Appendix A, Data Sheet A1.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3115 or GMW3121. Including in position time and compliance to coverage zone.

b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3115 or GMW3121, "Label Legibility".

c. The responsible VEC shall be the final arbiter of Module Static Deployment Testing.

**3.2.1.1.2 SIAB System Level Static Deployment Test.**

**Purpose:** To evaluate Side Impact Airbag (SIAB) system performance and structural integrity.

**Test Fixtures and Equipment:**

- Condition chamber, capable of holding (-30 to +85) °C.



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- Vehicle body in white that represents program content and body style.
- Module mounting shall simulate vehicle environment, including reaction surfaces (i.e., Door trim, garnish trim, console) where applicable.
- Seat belt in stowed position with latch taped to B pillar.
- Adjustable guide loop, adjustable console, and, seat position per Table 12.
- Seat, cover/door (if applicable) is required.
- Actuation device that also switches on the measuring equipment.
- Approved Data Acquisition System.
- High speed cameras or videos (3000 frames/s minimum for tear seam opening, all others can be 1000 frames/s), two required. (Three cameras/videos preferred; front, side, and oblique views.)
- Frames/s counter.
- Lights (high intensity to enable viewing all components).
- Thermocouples that can measure temperatures up to +110 °C.
- Strobe Lights (to indicate T = 0).
- Identification (ID) labels (with test number).
- Thermocouple location.
- One within chamber to record temperature.

**Data Required:**

- Conditioning temperature and ambient temperature in test cell during the test.
- Cushion pressure vs. time (if requested).
- Voltage and current vs. time.
- High speed Films.

**3.2.1.1.2.1 SIAB System Static Deployment Test – Hot.**

**Test Procedure:**

a. Condition SIAB System at +85 °C.

b. Open chamber door or remove Module and fixture from chamber and deploy Module at 3 minutes ± 5 s from removal.

**Note:** If test lab (deployment room) is humidity and temperature controlled can establish time to deploy based on surface temperature for the entire series. Need to re confirm for each temperature (i.e., hot, cold) and material type (i.e., leather, cloth). If test lab is not humidity and temperature controlled need to thermocouple every test.

c. Complete post-test documentation; and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3115. Refer to standard video analysis CG4680.

b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3115, “Label Legibility”.

c. The responsible VEC shall be the final arbiter of SIAB System Static Deployment Testing.

d. Follow CG3756 for Problem Resolution and Tracking System (PRTS) guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.2.2 SIAB System Static Deployment Test – Cold.**

**Test Procedure:**

a. Condition SIAB System at -30 °C.

b. Open chamber door or remove Module and fixture from chamber and deploy Module at 3 minutes ± 5 s.

c. Complete post-test documentation; and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**



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a. Module shall meet the functional requirements stated in GMW3115. Refer to standard video analysis CG4680.
b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3115, “Label Legibility”.
c. The responsible VEC shall be the final arbiter of SIAB System Static Deployment Testing.
d. Follow CG3756 for PRTS guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.2.3 SIAB System Static Deployment Test – Ambient.**

**Test Procedure:**

a. Condition SIAB System at +23 °C.
b. Monitor deployment surface and maintain +23 °C.
c. Deploy Module at +23 °C.
d. Complete post-test documentation; and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3115. Refer to standard video analysis CG4680.
b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3115, “Label Legibility”.
c. The responsible VEC shall be the final arbiter of SIAB System Static Deployment Testing.
d. Follow CG3756 for PRTS guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.3 RRAB System Static Deployment Test.**

**Purpose:** To evaluate Roof Rail Airbag (RRAB) system performance and structural integrity.

**Test Fixtures and Equipment:**

- Conditioning chamber, capable of holding (-30 to +85) °C.
- Vehicle Body in White (BIW) or fixture that represents in-vehicle Module orientation and mounting system.

Check BIW for sharp areas in RRAB deployment zone (spot weld whiskers, structural glue, sheet metal trim edges including punched holes and brackets, structural glue). If SVE find any observations with the BIW, SVE is to review observations with BIW DRE. All issues are to be documented with pictures and reported in evaluation report (reference CG5110 airbag validation checklist). Module mounting shall simulate vehicle environment, including reaction surfaces (door trim with inside release handle, if door handle is protruding (per RRAB Best Practice Number 9, Cushion Deployment Zone and Obstructions and Number 18, RRAB to Inside Release Handle (ISRH) Interaction)) (the Supplier shall work with the GM Design Responsible Engineer to comprehend this requirement), follow instructions per Evaluation procedure for ISRH in RRAB deployment zone include door hardware, and/or interacting components where applicable (grab handles, coat hooks, luggage rack, sunroof Module, sunvisor, eyeglass case, cargo net hooks, FMVSS 201 Upper countermeasure, etc. (this is not a comprehensive list, equip test with specific vehicle content)).

- Seat belt in stowed position.
- Adjustable guide loop and seat position per CG3511. See excerpts in Tables 11 and 14.
- Headliner (base, sunroof, and panorama) and applicable pillar trim required.
- Actuation device that also switches on the measuring equipment.
- Approved Data Acquisition System.
- Pre and post-test photographs.
- High speed cameras (3000 frames/s minimum for tear seam opening, all others can be 1000 frames/s), three (3) required. Lights (high intensity).
- Thermocouples that can measure temperatures up to +110 °C.
- Strobe Light (to indicate T = 0).


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- ID labels (with test number and frames/s information), visible for each camera/video view.
- Frames per second counter.
- Thermocouple location.
  - One within chamber to record temperature.

**Data Required:**

- Conditioning temperature and ambient temperature in test cell during the test.
- Voltage and current vs. time.
- High speed videos.

**3.2.1.1.3.1 RRAB System Static Deployment Test – Hot.**

**Test Procedure:**

a. Condition RRAB System at +85 °C.

b. Open chamber door or remove Module and fixture from chamber and deploy Module at 3 minutes ± 5 s.

**Note:** If test lab (deployment room) is humidity and temperature controlled can establish time to deploy based on surface temperature for the entire series. Need to reconfirm for each temperature (i.e., hot, cold) and material type (i.e., fabric wrapped or not). If test lab is not humidity and temperature controlled need to thermocouple every test.

c. Complete post-test documentation and retain indefinitely; reference Appendix A.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3121. Refer to standard video analysis CG4680.

b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3121, “Label Legibility”.

c. The responsible VEC shall be the final arbiter of RRAB System Static Deployment Testing.

d. Follow CG3756 for PRTS guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.3.2 RRAB System Static Deployment Test – Cold.**

**Test Procedure:**

a. Condition RRAB System at -30 °C.

b. Open chamber door or remove Module and fixture from chamber and deploy Module at 3 minutes ± 5 s.

c. Complete post-test documentation and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3121. Refer to standard video analysis CG4680.

b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3121, “Label Legibility”.

c. The responsible VEC shall be the final arbiter of RRAB System Static Deployment Testing.

d. Follow CG3756 for PRTS guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.3.3 RRAB System Static Deployment Test - Ambient.**

**Test Procedure:**

a. Condition RRAB System at +23 °C.

b. Monitor deployment surface and maintain +23 °C.

c. Deploy Module at +23 °C.

d. Complete post-test documentation and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**



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a. Module shall meet the functional requirements stated in GMW3121. Refer to standard video analysis CG4680.
b. Module traceability bar code and label legibility shall meet the requirements stated in GMW3121, "Label Legibility".
c. The responsible VEC shall be the final arbiter of RRAB System Static Deployment Testing.
d. Follow CG3756 for PRTS guidelines on fragmentation. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.1.3.4 RRAB 25 mm Gap fixture System Static Deployment Test – Ambient.**

**Test Procedure:**

a. Refer to GMW17860 for fixture setup and test procedure.
b. Condition RRAB System at +23 °C.
c. Monitor deployment surface and maintain +23 °C.
d. Deploy Module at +23 °C.
e. Complete post-test documentation and retain indefinitely. Reference Appendix A.

**Evaluation and Results:**

a. Module shall meet the functional requirements stated in GMW3121.
b. Rollover Occupant Protection Feature Technical Specification (CG4754) and the Roof Rail Airbag Deploy and Restraint System Technical Specification (CG4657) that the Roof Rail Air Bag (RRAB) Cushion deployment trajectory to be within 25 mm of the cross-car upper garnish. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.2.1.2 Module Sequential/Environment Test.**

**Purpose:** To evaluate the Module performance in a series of different environments.

**Note:** Refer to 4.2 "Validation Plan" for the number of test samples to use in each test.

**Note:** All tests shall include mating wire harness. Length determined by distance to first stress relief clip.

**3.2.1.2.1 Dynamic Shock Test.**

**Purpose:** To evaluate the effect of 25G and 45G mechanical shock inputs on the Module performance. Number of samples should be split between High G and Low G acceleration per validation matrix according to 4.2.

**Test Fixtures and Equipment:**

- Rigid fixture that represents the in-vehicle Module orientation and the mounting system.
- Shaker.

**Test Procedure:**

a. Condition Modules at +23 °C as specified in 4.2 "Validation Plan". Refer to IEC 60068-2-27 for complete test procedure. Complete the dynamic shock test according to the schedule in Table 2.
b. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 "Module Static Deployment Test", test procedure step f.

**Table 2: SIAB AND RRAB Dynamic Shock Test Schedule**

| Low G Test | High G Test |
|---|---|
| Acceleration: 25G<br>Nominal Shock Duration: 6 ms<br>Nominal Shock Shape: Half Sine<br>Number of Shock per Axis: 330<br>• 1980 total<br>• 6 axes: x, y, and z, both positive and negative directions | Acceleration: 45G<br>Nominal Shock Duration: 11 ms<br>Nominal Shock Shape: Half Sine<br>Number of Shock per Axis: 3<br>• 18 total<br>• 6 axes: x, y, and z, both positive and negative directions |


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| | |
|---|---|
| • Module shall represent in-vehicle orientation | • Module shall represent in-vehicle orientation |
| **Test Method:**<br>1. Apply 25G, 330 times per axis (x, -x, y, -y, z, -z).<br>2. Change axis and repeat step 1.<br>3. Repeat step 1 and 2 until all 6 axes are tested. | **Test Method:**<br>1. Apply 45G, 3 times per axis (x, -x, y, -y, z, -z).<br>2. Change axis and repeat step 1.<br>3. Repeat step 1 and 2 until all 6 axes are tested. |

**Evaluation and Results:**

a. The Module shall meet the Vibration and Dynamic Shock Resistance requirement stated in GMW3115 or GMW3121, "Vibration and Dynamic Shock Resistance".

b. The Module shall not be visibly damaged and shall meet the Cover/Door appearance requirements (if applicable) stated in GMW3115 or GMW3121, "Visible Cover Appearance".

**3.2.1.2.2 Vibration/Temperature Cycle Test.**

**Purpose:** To evaluate the effect of vibration and temperature on Module performance.

**Test Fixture and Equipment:**

- Temperature chambers, capable of maintaining (-30 to +85) °C.
- Rigid fixture that represents the in-vehicle Module orientation and design intent mounting (i.e., full length of vehicle).
- Shaker.

**Test Procedure:**

a. Complete Dynamic Shock Test according to 3.2.1.2.1.

b. Condition all Modules at +23 °C, as specified in 4.2, "Validation Plan".

c. Refer to IEC 60068-2-64, and IEC 60068-2-14-(test method Nb) for complete test procedure. Apply the random vibration profile shown in Table 3 for 22 h in the vehicle X-axis, see Figure 1 (Modules **shall** represent in-vehicle orientation).

d. Apply temperature cycle twice per axis as shown in Figure 2 during vibration testing. One temperature cycle consists of:
   1. Drop temperature to -30 °C at the rate of 2 °C/minute.
   2. Condition Modules for minimum of 272.5 minutes at -30 °C.
   3. Raise temperature to +85 °C at the rate of 2 °C/minute.
   4. Condition Modules for minimum of 272.5 minutes at +85 °C.
   5. Bring Modules to +23 °C at the rate of 2 °C/minute.

e. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 "Module Static Deployment Test", test procedure step f.

f. Condition Modules at +23 °C, as specified in 4.2, "Validation Plan". Change vibration direction to the vehicle Y-axis (Module shall represent in-vehicle orientation), repeat steps c and d.

g. Condition Modules at +23 °C, as specified in 4.2, "Validation Plan". Change vibration direction to the vehicle Z-axis (Module shall represent in-vehicle orientation), repeat steps c and d.

**Figure 1: Vehicle Axis**

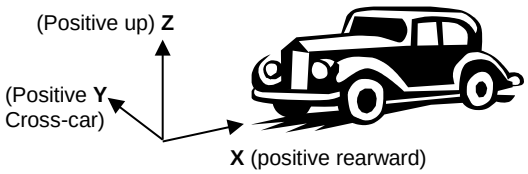



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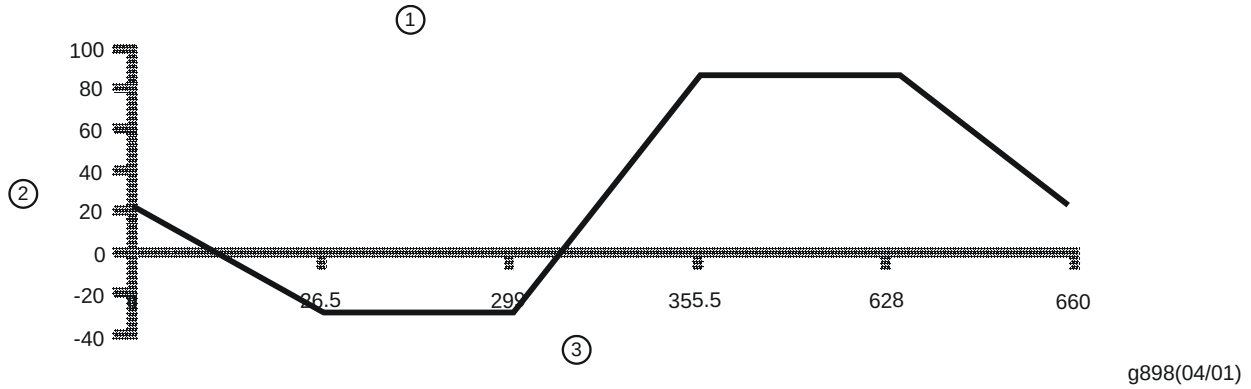
**Table 3: SIAB and RRAB Random Vibration Profile**

| Side Impact Airbag | | Roof Rail Airbag | |
|---|---|---|---|
| **Hz** | **$g^2$/Hz** | **Hz** | **$g^2$/Hz** |
| 10 | 5.20E-02 | 10 | 1.37E-01 |
| 30 | 5.20E-02 | 95 | 5.41E-03 |
| 200 | 1.30E-03 | 216 | 5.30E-03 |
| 1000 | 2.60E-04 | 465 | 3.89E-04 |
| Total Effective Acceleration (10 Hz to 1000 Hz): | 1.68 $g_{rms}$ | 645 | 3.14E-05 |
| | | 685 | 1.82E-04 |
| | | 1000 | 8.37E-06 |
| | | Total Effective Acceleration (10 to 1000) Hz: | 1.75 $g_{rms}$ |

**Figure 2: SIAB and RRAB Temperature Profile for Vibration Test**




1. Temperature Cycle 1, Cycle is 11 h minimum
2. Temperature in °C
3. Cycle Time in minutes

**Evaluation and Results:**

a. The Module shall meet the Vibration and Dynamic Shock requirements stated in GMW3115 or GMW3121, ""Vibration and Dynamic Shock Resistance".

b. The Module shall not be visibly damaged and shall meet the Cover/Door appearance requirements (if applicable) stated in GMW3115 or GMW3121, "Visible Cover Appearance".

c. All noted discrepancies shall be documented and reported to the responsible VEC Engineer.

**3.2.1.2.3 Thermal Shock Test.**

**Purpose:** To evaluate performance effects on materials within the Module due to rapid temperature changes.

**Test Fixtures and Equipment:**

- Temperature chambers, capable of maintaining -30 °C, +23 °C and +85 °C.
- Fixture that represents the in-vehicle Module orientation and mounting.

**Test Procedure:**

a. Complete Vibration/Temperature Test according to 3.2.1.2.2.

b. Condition all Modules at +23 °C as specified in 4.2 "Validation Plan".



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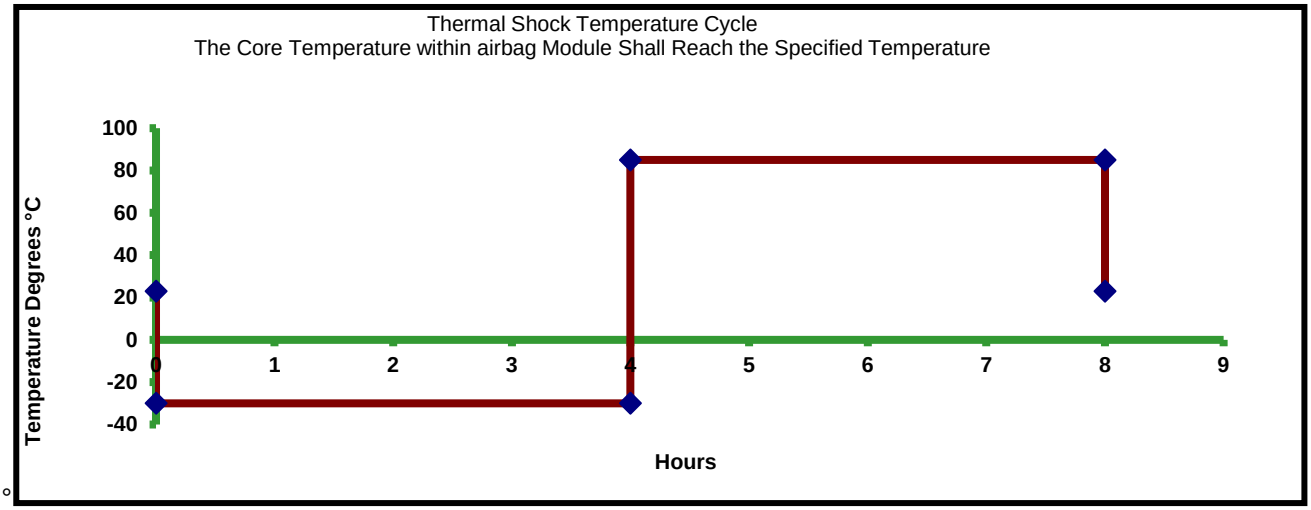
c. Refer to IEC 60068-2-14 for complete test procedure. Apply 60 temperature cycles as shown in Figure 3. One temperature cycle consists of:
   1. Place Module into -30 °C chamber within 30 s.
   2. Condition Module assemblies at -30 °C as specified in Figure 3.
   3. Place Module into +85 °C chamber within 30 s.
   4. Condition Module assemblies at +85 °C as specified in Figure 3.

d. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 “Module Static Deployment Test”, test procedure step f.

**Figure 3: SIAB and RRAB Thermal Shock Profile**




**Note:** Thermal shock temperature cycle: core temperature within Module shall reach the specified temperature. The cycle duration may be reduced if the inflator core temperature reaches the temperature specified in Figure 7 in < 4 h shown. Data shall be provided to verify any changes to the cycle duration. Refer to 3.2.1.1.1.

**Evaluation and Results:**

a. The Module shall not be visibly damaged and shall meet the Cover/Door appearance requirements (if applicable) stated in GMW3115 or GMW3121, “Visible Cover Appearance”.

b. All noted discrepancies shall be documented and reported to the responsible VEC Engineer.

**3.2.1.2.4 Humidity Resistance Test.**

**Purpose:** To evaluate the effect of humidity on Module performance.

**Test Fixtures and Equipment:**

- Temperature chambers, capable of maintaining -10 °C and +65 °C, and up to 100% relative humidity (RH).
- Fixture that represents the in-vehicle Module orientation and the mounting system.

**Test Procedure:**

a. Complete Thermal Shock Test according to 3.2.1.2.3.

b. Condition Modules at +23 °C, as specified in 4.2 “Validation Plan”.

c. Refer to IEC 60068-2-38 Z/AD for complete test procedure. Condition Module for 244 h with temperatures of -10 °C, +23 °C, +65 °C and with 95% maximum RH according to Figure 4.


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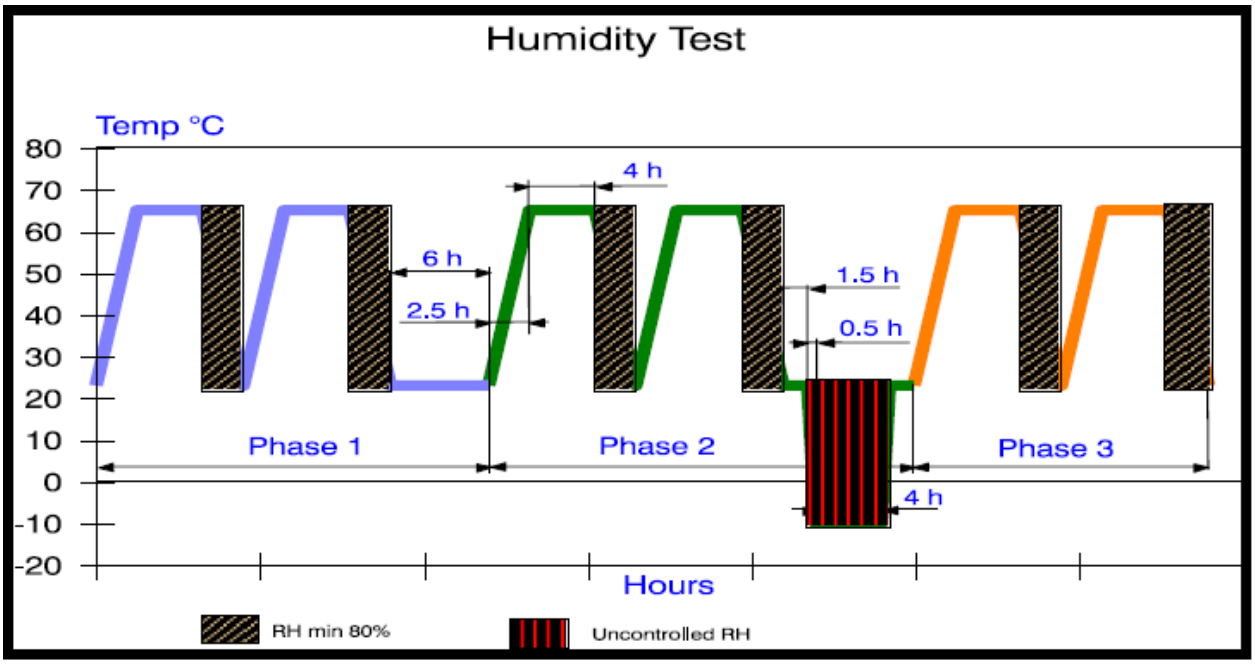
**Figure 4: SIAB and RRAB Humidity Cycle Profile Example**




The following steps briefly described the procedure for this test. Refer to IEC 60068-2-38 Z/AD for detailed test procedure.

a. Modules shall complete four cycles of phase one conditioning for total of 96 h. During this phase, the relative humidity level shall be 90% minimum except during the temperature transitions. In that case, the RH level shall be 80% minimum.

b. Modules shall complete five cycles of phase two conditioning for total of 130 h. The relative humidity level shall be 90% minimum except during the temperature transitions. In that case, the RH level shall be 80% minimum. The relative humidity cannot be controlled when the temperature is < +20 °C. Modules shall complete one cycle of phase three conditioning for total of 18 h. During this phase, the relative humidity level shall be 90% minimum except during the temperature transitions. In that case, the RH level shall be 80% minimum.

c. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 “Module Static Deployment Test”, test procedure step f.

**Evaluation and Results:**

a. The Module shall meet the “Humidity Resistance” requirements stated in GMW3115 or GMW3121.

**3.2.1.2.5 Salt Spray Test.**

**Purpose:** To evaluate the corrosion resistance of the Module.

**Test Fixtures and Equipment:**

- Refer to GMW3286 for complete list of equipment.

**Test Procedure:**

a. Complete Humidity Resistance Test according to 3.2.1.2.4.

b. Condition Modules at +23 °C, as specified in 4.2 “Validation Plan”.

c. Condition Modules for 24 h minimum with 5% salt solution according to GMW3286.

d. Modules shall not be cleaned or have surface corrosion wiped off after this test.

e. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 “Module Static Deployment Test”, test procedure step f.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**Evaluation and Results:**

a. The Module shall meet the "Salt Spray Resistance" requirements stated in GMW3115 or GMW3121.

b. All noted discrepancies shall be documented and reported to the responsible VEC Engineer.

**3.2.1.2.6 Service Durability Test.**

**Purpose:** To evaluate Module performance service durability performance for Modules with structural fasteners. Also need to check compatibility with mating fastener.

**Test Fixtures and Equipment:** The Seat/Roof Rail/Interior Trim and Module assembly that represents the in-vehicle Module orientation and the design intent mounting system.

**Test Procedure:**

a. Complete Salt Spray Test according to 3.2.1.2.5.

b. Condition Modules at +23 °C as specified in 4.2, "Validation Plan".

c. Perform three (3) RRAB and five (5) for SIAB cycle service durability test. Each cycle consists of the following steps:

   1. Disconnect all electrical connectors at the Module and harness interface.
   2. Remove Module from vehicle/ seat.
   3. Attach Module to the vehicle/seat Verify specified torque is applied.
   4. Reconnect all electrical connectors. Verify connector mating.

d. Verify Module electrical resistance, shunt resistance, and insulation resistance according to 3.2.1.1.1 "Module Static Deployment Test", test procedure step f.

**Evaluation and Results:**

a. Modules shall meet the "Attachment Insertion/Removal Cycles" requirements stated in GMW3115 or GMW3121.

**3.2.1.2.7 Squeak, Rattle, and Other Audible Noise Avoidance Test.**

**Purpose:** To evaluate if there is any discernible noise originating from the Module.

**Note:** This test only applies to SIAB Modules. RRAB to be assessed at vehicle level.

**Test Fixtures and Equipment:**

- Refer to GMW14011 for appropriate test fixture and equipment.

**Test Procedure:**

a. Complete Service Durability Test according to 3.2.1.2.6.

b. Condition six Modules (three from the High G and 3 from the Low G group) at +23 °C as specified in 4.2, "Validation Plan".

c. Perform objective evaluation of Module Noise as described in GMW14011 using the vibration spectrum shown in Table 4 at room temperature.



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