



Seat Belt Subsystem Technical Specification

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 specification establishes the Seat Belt Subsystem to Vehicle and other Subsystems interface requirements for future GM vehicles. It defines key physical and functional requirements that are intended to drive commonality across GM vehicles worldwide and interchangeability between suppliers' systems worldwide. The common functions, performance, reliability and validation required of the subsystem interfaces are defined in this document.

1.2 Applicability. Vehicle seat belts are intended to provide injury protection benefit to occupants of the vehicle in the event of a crash. Their primary function is to restrain an occupant (or child seat), and to reduce the risk or severity of injury by managing the occupant's kinetic energy.

The seat belts should function in harmony with other vehicle subsystems, be as comfortable and unobtrusive as practicable, and be in harmony with the interior theme of the vehicle.

The seat belts must also respond to the differences in governmental and market requirements of the different countries in which they are sold.

1.3 Remarks. Seat belts are classified as single retractor or two retractor systems, which generally provide restraint for both the lap and torso. They can be body or seat mounted. Variations occur for front and rear belts. A lap-only belt variation is used for some center and rear positions.

2 References

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

2.1 External Standards/Specifications.

49 USA Code	CMVSS 209	ECE R14	FMVSS 209	NBR 7337
Chapter 301				
ADR 34/02	CMVSS 210	ECE R16	FMVSS 210	SAE J1110
ADR 69/00	CMVSS 210.1	ECE R44	FMVSS 225	SAE J1819
CMVSS 208	CMVSS 302	FMVSS 208	FMVSS 302	TX160147

2.2 GM Standards/Specifications.

GMW3059	GMW14310	GMW14792	GMW15010	GMW15862
GMW3232	GMW14617	GMW14793	GMW15562	
GMW14264	GMW14791	GMW14831	GMW15762	

2.3 Additional References.

- CM 20200
- CM 20331
- CM 20336
- Comfort Belt Routing Manual Math Procedure
- Component Technical Specification (CTS)

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- Corporate Restraint System Evaluation Considerations Document
- Escutcheon Designs Best Practices
- Global Legal Database
- Incident Reports
- Korea regulation of MVCA article 40-9 (See GM Global Legal Database)
- Label Design Criteria Section of the Labels and Literature Web site
- Label Material Specification Section of the Labels and Literature Web site
- Production Process
- Program Portfolio Proposal
- Requirements For The Passive Safety Behavior of Vehicles For All Markets - Opel/Vauxhall Best Practices
- Seat Belt Assembly Drawing
- Seat Belt Design Best Practices
- Statement of Requirements (SOR) Appendix J
- Subsystem Technical Specification (SSTS) EICC-80.201.01 - Power and Signal Distribution Requirements
- United States Code 19, Chapter 4, Section 304 Tariff Act of 1930
- Vehicle Technical Specification (VTS)
- WVRM II-J

3 Requirements

The use of "shall" in this document denotes a binding provision that must be met.

The use of "should" denotes a desired performance level or conformance, e.g., a materials specification which, if not met, must be documented and approved by both the platform Release Engineer and the Belt Subsystem Leadership Team.

Demonstration of compliance is necessary for seat belt systems. Performance shall be demonstrated to meet CMVSS 209 and FMVSS 209 requirements by independent labs. Performance shall be demonstrated to meet CMVSS 208, FMVSS 208, CMVSS 210, FMVSS 210, CMVSS 302, and FMVSS 302 requirements by using procedures specified in GMW14617 and GMW3232. Performance shall be demonstrated to meet ECE R16 requirements by independent labs, and by GM internal test facilities. Performance shall be demonstrated to meet ADR 34/02 and ADR 69/00. Performance shall be demonstrated to meet NBR 7337. Performance to GM internal requirements should be demonstrated by using GM test procedures.

3.1 System/Subsystem/Component/Part Definition. The seat belt system is to provide the capability to restrain an occupant or child seat (where appropriate) and provide occupant protection benefit in the event of a crash.

It must be implemented to function for a full range of occupant sizes.

It must have features available to tune its Energy Absorption (EA) to function in the presence of, or absence of, a Supplemental Inflatable Restraint (SIR) as appropriate.

It must be capable of securing a child seat at all appropriate positions in countries where required by law, or as requested by the platform release organization.

The Functional Context diagram is shown in Appendix A, Figure A1.

3.1.1 Appearance. Not applicable.

3.1.2 Content.

3.1.2.1 Physical Content.

3.1.2.1.1 General.

- a. Seat belts for front outboard forward-facing seating positions shall be lap and shoulder belts.
- b. Seat belts for forward-facing center seating positions shall be either lap belts or lap and shoulder belts as directed by the platform release organization.

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- c. Seat belts for front center positions that have lap and shoulder belts, shall design the shoulder belt to pass over the shoulder adjacent to the driver for the center occupant.
- d. Seat belts for rear outboard forward-facing seating positions shall be lap and shoulder belts unless otherwise dictated by local needs.
- e. Seat belts for front outboard seating positions in four door vehicles should have an Adjustable Guide Loop (AGL) (unless a fixed guide loop is specified by the responsible platform release engineer).
- f. All seat belts for designated child seating positions should be compatible with typical aftermarket rear and forward facing child seat systems.
- g. Buckles shall be end-release type with one design for all positions (unless keyed buckles are used for center positions).
- h. Buckles shall offer provisions to make them resistant to release during the impulse of a pretensioner or energy management device when used with a pretensioner or energy management device.

3.1.2.1.2 Required or Recommended for General Motors North American Vehicles. Seat belts for each designated seating position, except the driver's position, shall have a lap belt portion that is lockable so that the seat belt assembly can be used to secure a child restraint system.

3.1.2.1.3 Required or Recommended for GM Europe (GME) Vehicles. Not applicable.

3.1.2.1.4 Required or Recommended for Australian Vehicles. Not applicable.

3.1.2.1.5 Required or Recommended for GM Brazil (GMB) Vehicles. Not applicable.

3.1.2.1.6 Required or Recommended for GM International Operations (GMIO) Vehicles. Not applicable.

3.1.2.1.7 Required or Recommended for Mexico Vehicles. Not applicable.

3.1.2.2 Functional Content. The primary functions of the Seat Belt System are described in 3.1.2.2.1 thru 3.1.2.2.4. The requirements for these functions are outlined in 3.3 - Design and Construction.

The relationship between these functions and to other imposed requirements are shown in the function flow diagram in Appendix B, Figure B1.

3.1.2.2.1 Provide Occupant Protection Benefit in Conjunction with SIR. The seat belt subsystem shall maintain integrity and manage energy of occupants in the event of a crash. It shall also accommodate infant and child seats.

3.1.2.2.2 Provide Acceptable Comfort and Fit. The seat belt subsystem shall provide proper routing for 5th percentile female to 95th percentile male occupants. Routing for the 50th percentile 6-year old child occupants should be examined to assure acceptable fit. It shall also limit pressure on chest.

3.1.2.2.3 Provide Acceptable Ease of Use. The seat belt subsystem shall limit effort to engage and disengage latch in buckle, and to adjust Adjustable Guide Loop (AGL) Mechanism.

3.1.2.2.4 Indicate Status to Occupants and Crash Recorders. The seat belt subsystem shall provide audible click on engaging latch in buckle. It shall also supply information on use of SIR recorder System Diagnostic Module (SDM) and warning light in countries where required by law, or as requested by the platform release organization.

3.1.3 Ambient Environment. The seat belt system is expected to be subjected to temperature extremes, corrosion, humidity, dust and sun load. Federal Motor Vehicle Safety Standard (FMVSS), Canada Motor Vehicle Safety Standard (CMVSS) and Economic Commission for Europe (ECE) Regulatory Standards specify environmental exposure before and during test sequences. All systems shall satisfy all environmental requirements.

3.1.3.1 Temperature Extremes. The temperature range over which a seat belt system is expected to fully function is from -20 °C to 100 °C. In addition, the belt system is expected to function reasonably between -40 °C and -20 °C.

3.1.3.2 Corrosion. All metal belt system parts should meet corrosion exposure per Seat Belt Component Technical Specification and corresponding material tree.

Parts mounted on horizontal floor surfaces with high corrosion potential, may require higher corrosion protection. Refer to the "seat belt specific" material tree for additional corrosion level recommendations for parts mounted in areas with high corrosion potential, e.g., on the floor in the door opening.

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3.1.3.3 Sun Load. Seat Belt system appearance should not degrade due to sun load as specified in the Component Technical Specification.

3.1.4 Interfaces. The following paragraphs specify the critical interface requirements for the seat belt system.

3.1.4.1 External-to-Vehicle to Subsystem.

3.1.4.1.1 Required or Recommended for GM North America (GMNA) Vehicles. Vehicles for North America should consider the Child Seat – Fitment Study GMW15762. Additionally, to ensure the ability to accommodate various size child seats, the seat belt should be able to cinch down across an empty seat.

GMNA engineered vehicles, shall accept and restrain a child seat in all designated seating positions, except driver, as defined in the SAE J1819, Securing Child Restraint Systems in Motor Vehicle Rear Seats.

3.1.4.1.2 Required or Recommended for Non North American Vehicles. Safety belts in Opel/Vauxhall brand vehicles shall meet the installation requirements for "Universal" category child restraint systems as defined in ECE R16.

For Opel/Vauxhall Brand Vehicles Sold in Western Europe and Eastern Europe Group 1, 2, 3 Markets. The requirements of ECE R44 and ECE R14 shall be met.

For Opel/Vauxhall Brand Vehicles. The requirements for child seats defined in "Requirements for The Passive Safety Behavior of Vehicles For All Markets" shall be considered and balanced relative to total vehicle performance and the use of "best practice" technology. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement. Deviations from the requirements have to be addressed by the vehicle safety department.

3.1.4.2 Subsystem to Subsystem. The following interface requirements apply to interfaces existing between the seat belt system and the other subsystems. Seat belt design must comply with all Best Practices, Interface Control Documents and Upper Control Limit (UCL). The supplier shall work with the GM Design Responsible Engineer to comprehend these requirements.

3.1.4.2.1 Interface with Electrical. If equipped, the following interface requirements apply to interfaces existing between the seat belt system and electrical power and signal distribution subsystem.

- The seat belt shall be equipped with connectors, wires, wire colors, electrical connection scheme, according to CM 20200.
- Power and Signal Distribution Requirements are specified in SSTS EICC-80.201.01.
- Seat Belt System to interface with all applicable requirements CM 20331 Weight Based Suppression.

3.1.4.2.2 Interfaces with Seats.

3.1.4.2.2.1 Lateral Loading of Seat Belt Buckle. Interface attachment from buckle to seat shall maintain a 9 kN load when pulled at 60 degrees upward and 60 degrees outward from attachment. Reference GMW14310.

3.1.4.3 Users. The seat belt restraint subsystem shall be designed to accommodate a full range of occupants in all designated vehicle-seating positions.

The defined occupant range normally includes the 5th percentile adult female, the 50th percentile adult male, and the 95th percentile adult male.

The 50th percentile 6-year old child should be considered in all designated seating positions except the driver's seat without requiring additional hardware.

Refer to the Vehicle Technical Specification (VTS) for platform defined range.

3.1.4.4 Usage Cycles. Cycle requirements for specific belt system components are given in the component technical specifications.

3.2 Product Characteristics. Product characteristic technical requirements for the seat belt system are defined in the following paragraphs.

3.2.1 Performance Requirements.

3.2.1.1 Occupant Protection. In addition to the occupant protection performance requirements identified in the Vehicle Technical Specification, the safety belts shall contribute to protection of occupants and child seats as specified for the defined conditions.

3.2.1.1.1 Maintain Integrity. The integrity of the seat belt subsystem and its components shall be maintained under the following conditions.

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3.2.1.1.1.1 CMVSS 209 and FMVSS 209. The seat belt system shall meet the government requirements for CMVSS 209 and FMVSS 209.

3.2.1.1.1.2 CMVSS 210 and FMVSS 210. Seat Belt systems must meet CMVSS 210 and FMVSS 210 requirements. Locking capabilities of the system shall be verified by either the vehicle level test or by a sub-system level test that incorporates the vehicle geometry. Subsystem testing is to be completed with a 20% safety margin.

3.2.1.1.1.3 Export. The seat belt subsystem shall meet the export requirements found in WVRM II-J.

3.2.1.1.1.4 The seat belt subsystem shall be capable of maintaining integrity during reasonably expected crash events. (See ECE R16 sled test for integrity in component requirements.)

3.2.1.1.1.5 The seatbelt supplier shall be responsible for ensuring that all seatbelt component hardware is compatible with the released pretensioning devices.

The supplier shall demonstrate hardware pretensioner compatibility by providing GM Engineering with design, component, and system performance information.

Proof and assurance of pretensioner compatibility can be demonstrated to GM Engineering by providing validation performance data in bench, sled, and barrier test conditions, which are representative of vehicle environment.

The supplier shall prescribe the design criteria, testing methods and criteria, and performance criteria best suited for the released system. The supplier shall also obtain approval of the test plan from the GM responsible engineer. This agreed upon method shall be documented on the Seat Belt Assembly Drawing. Any process sensitive critical parameters shall also be identified as Key Product Characteristics (KPC) on the drawing.

3.2.1.1.2 Child Seat Retention.

3.2.1.1.2.1 CMVSS 208 and FMVSS 208 Child Seat Restraint Lockability. All seating positions (except driver seat) shall provide a means to secure a child seat. A child seat cinching latch or an automatic locking retractor shall be provided.

3.2.1.1.2.2 CMVSS 210.1. A means shall be provided to secure the upper child seat tether to meet the government requirements of CMVSS 210.1.

3.2.1.1.2.3 FMVSS 225. All owners' manuals shall contain instructions for proper use of tether anchors.

3.2.1.1.3 Manage Energy. The seat belt subsystem shall be capable of managing energy of a high severity crash event (see Best Practices and Corporate Restraint System Evaluation Considerations Document).

The seat belt subsystem for SIR positions shall have a provision for limiting load on the chest.

3.2.1.2 In-Vehicle Assessments.

3.2.1.2.1 Comfort and Fit. The force on the chest due to shoulder belt retraction force shall not exceed 3.1 N when measured in accordance to FMVSS 208, S7.4.3. Retraction effort should be sufficient to assure belt contact with occupant is maintained through full range of occupant motions. Demonstrated and documented with GMW14617.

The seat belt subsystem shall provide smooth and light extraction effort when installed in vehicle position. The seat belt subsystem shall provide appropriate fit when installed in vehicle position. Seat belt supplier to provide hardware consistent with meeting comfort guidelines for extraction/retraction.

3.2.1.2.1.1 Design Objectives. Unless otherwise directed by platform management, the safety belt system should meet the following design objectives.

Shoulder belt pressure on the chest and shoulder. The forces exerted on an occupant by the shoulder belt portion, as measured by belt pressure against the torso, should be equal to or less than:

- 5 N (1.1 lb) at 10 mm (0.4 in) extraction and
- 6 N (1.3 lb) at 20 mm (0.8 in) extraction on the sternum and
- 1.5 N (0.3 lb) at 10 mm (0.4 in) extraction and
- 2 N (0.4 lb) at 20 mm (0.8 in) extraction on the clavicle

As measured by the Belt Pressure Assessment Tool, reference GMW14792.

3.2.1.2.1.2 Seat Belt Routing. The front seat belts should not contact the neck or lose contact with the shoulder for the following conditions, Alpha virtual with math analysis using the Comfort Belt Routing Manual Math

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Procedure available on the Interior Center web site and when evaluating with physical properties, reference GMW14791. See Table 1.

Table 1: Front Seat Belt Routing Conditions

Subject	Condition
5 th Percentile Female	seat full forward and full up
50 th Percentile Male	seat middle/middle
95 th Percentile Male	seat full rear and full down

The rear seat belts should not contact the neck or lose contact with the shoulder for the following conditions, Alpha virtual with math analysis using the Comfort Belt Routing Manual Math Procedure available on the Interior Center web site and when evaluating with physical properties, reference GMW14791. See Table 2.

Table 2: Rear Seat Belt Routing Conditions

Subject	Condition
5 th Percentile Female	outboard rear and center rear Type 2 belt
50 th Percentile Male	outboard rear and center rear Type 2 belt
95 th Percentile Male	outboard rear center rear Type 2 belt

Refer to the Comfort Belt Routing Manual Math Procedure for 6-year old occupants for determining the mounting location and length of cord for the Child Comfort Guide if required by the platform. See Table 3.

Table 3: Six-Year Old Child Seat Belt Routing Conditions

Subject	Condition
Six (6)-Year Old child	outboard rear and center rear Type 2 belt

3.2.1.2.2 Ease to Buckle. Refer to Best Practices for "Ease to Buckle". The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement. Vehicle evaluations for seat belt buckle and latchplate accessibility to be completed using GMW14617.

3.2.1.2.3 Ease of Use. Reference GMNA Dynamic Seat Performance Evaluation Ride Process (GMW15562), monitor responses to the "seat belt ease of use" questions.

3.2.1.2.4 Passive Occupant Detection System (PODS) or Suppression Systems. For interface evaluations on Suppression or PODS systems, refer to TX160147 Electronic specification and applicable component specifications such as Seat Belt Tension Sensor Specification CM 20336.

3.2.1.2.5 Panic Braking. Seat belt system should lock during 0.7G braking deceleration, and a heavy braking deceleration from 64 km/h (40 mph).

Test results may require engineering judgment as to the acceptability of the performance. When engineering judgment is used, the rationale shall be presented to the Subsystem Leadership Team (SSLT) and the final views of the SSLT team shall be documented.

Reference GMW14793.

3.2.1.2.6 Nuisance Locks. Seat Belt System should perform to a minimum rating of 8 (per GMW14264) when evaluated under the following conditions. A rating of 7 (per GMW14264) or less requires evaluations/benchmarking of competitive vehicles for analysis if additional improvements are required.

- a. 72 km/h (45 mph) on 12 Mile Road at Milford Proving Ground (MPG) in both directions.

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