GM	WORLDWIDE ENGINEERING STANDARDS	General Specification	GMW14831

Specification for the Seat Belt Component

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 component requirements intended to provide design verification and compliance direction to Federal Motor Vehicle Safety Standard 209 (FMVSS 209) and other global regulatory requirements for future GM vehicles. It also defines common physical and functional requirements enabling interchangeability between supplier systems for GM vehicles worldwide. This set of specifications is intended to provide uniform design requirements, testing, and validation of each belt system. In part, when validated to these requirements, the seat belt system will provide a reasonable and appropriate level of performance in real world crash events.

1.2 Applicability. All vehicle seat belt systems.

1.3 Remarks. 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 of injury by managing the occupant's kinetic energy.

1.3.1 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.

1.3.2 Seat belts must also satisfy the regulatory and market requirements of the different countries in which the seat belts are sold.

1.3.3 Classification. Seat belts generally provide restraint for both the lap and torso. Seat belts can be body or seat mounted. A lap-only belt variation is also sometimes used for some center positions.

2 References

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

2.1 External Standards/Specifications.

2013/29/EU	FMVSS 302	CNCA-02C-063	SAE/USCAR-2
CMVSS 209	MIL-STD-202G	SAE J211-1	SAE/USCAR-21
FMVSS 208	MIL-STD-331B	SAE J361	SAE/USCAR-28
FMVSS 209	MIL-STD-833D	SAE J1113-13	UN R16
FMVSS 210	MIL-STD-1576	SAE J1819	

2.2 GM Standards/Specifications.

GMW3020	GMW14162	GMW14308	GMW15049
GMW3059	GMW14188	GMW14309	GMW15272
GMW3172	GMW14231	GMW14310	GMW15424
GMW3191	GMW14232	GMW14311	GMW15478
GMW3232	GMW14300	GMW14312	GMW15559
GMW3417	GMW14301	GMW14317	GMW15626
GMW3431	GMW14303	GMW14413	GMW15745
GMW14011	GMW14304	GMW14793	GMW15862

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GMW14089	GMW14305	GMW14444	GMW17375
GMW14154	GMW14306	GMW14573	GMW17786
GMW14155	GMW14307	GMW14617	

2.3 Additional References.

- Bruceton Method Appendix D and/or Neyer D-Optimal per Neyer, Appendix E.
- CG1950 Validation Cross Reference Index (VCRI). The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- CG3059 Motorized Seat Belt (MSB) Electrical CTS. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- CG5287 Seat Belt Supplier Function Checks SOR Appendix C3 CTS Template. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- China Certification Centre for Automotive Products (www.cccap.org.cn).
- China Quality Certificate Centre (www.cqc.com.cn).
- Engineering Work Order.
- GM1724 Shipping/Parts Identification Label Standard.
- GM1738 Packaging and Identification Requirements for Production Parts.
- Notice of Action (NOA) associated with the Vehicle Reliability Evaluation Point.
- Shanghai General Motors (SGM) Exact Part List.
- Statement of Requirements (SOR), Appendix B, G3.
- United States Environmental Protection Agency Clean Air Act.
- USCAR Initiator Technical Requirements Appendix F.
- Vehicle Technical Specification (VTS).

3 Requirements

a. The tests referred to in the following requirements are based on historic performance which has been deemed satisfactory for meeting customer performance needs.

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

c. The use of should denotes a desired performance level or conformance, (e.g., Materials Specification which, if not met, must be documented and approved by both the Design Release Engineer and the Belt Subsystem Leadership Team).

d. Demonstration of compliance is necessary for seat belt systems. Performance shall be demonstrated to meet FMVSS 209 and CMVSS 209 requirements by independent labs. Performance shall be demonstrated to meet FMVSS 208, FMVSS 210, and FMVSS 302 requirements by using GMW14617, GMW14413 and GMW3232. Performance shall be demonstrated to meet UN R16 requirements by independent labs and by GM internal test facilities. Performance to GM internal requirements should be demonstrated by using the General Motors Worldwide (GMW) specifications listed in this document.

3.1 Systems/Subsystem/Specifications.

a. The seat belt system is to provide the capability to restrain an occupant or child seat and provide occupant protection benefit in the event of a crash.

b. The seat belt system must be implemented to function for a full range of occupant sizes.

c. The seat belt system must have energy management features available with and without air bags.

d. The seat belt system must be capable of cinching a child seat in all appropriate positions in countries where required by law, or as requested by the design release organization.

e. The functional context diagrams are shown in Appendix A, Figure A1 and Figure A2 and Appendix B, Figure B1.

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3.1.1 Appearance.

3.1.1.1 Gloss and Grain.

3.1.1.1.1 Visible (above beltline) Components. Seat belt subsystem components that are visible in the occupant compartment shall meet the color, gloss and grain requirements of the responsible Design/Styling group.

3.1.1.1.2 Hidden (below beltline) Components. Components below the beltline should use an industry common gloss and grain.

3.1.1.1.2.1 General Motors designed vehicles should use appropriate gloss and sand grain (master standard plaques can be obtained from General Motors North America Color and Trim Engineering in all approved colors). Gloss may be used on critical performance parts where Gloss Level A (GLA) cannot be attained.

3.1.1.2 Color/Pattern Matching. The color and pattern of all portions of belts for General Motors North America vehicles shall match within the limits set forth in SAE J361.

3.1.1.2.1 Color and pattern matching for non-General Motors North America vehicles shall be approved by the responsible Design Release Engineer and Design/Styling group.

3.1.1.3 Surface Finish and Texture Approval. Finish and texture of exterior surfaces shall be agreed to by Product Engineering for appearance purposes. Samples shall be submitted by source for final approval.

3.1.1.3.1 Die models of exterior visible components shall be submitted by source for styling consideration prior to tooling.

3.1.2 Content.

3.1.2.1 Physical Content.

3.1.2.1.1 General.

3.1.2.1.1.1 Seat belts for front outboard forward facing seating positions shall be lap and shoulder belts.

3.1.2.1.1.2 Seat belts for rear outboard forward facing seating positions shall be lap and shoulder belts unless otherwise dictated by local needs.

3.1.2.1.1.3 Seat belts for forward facing center seating positions shall be either lap belts or lap and shoulder belts as required by law or as requested by the design release organization.

3.1.2.1.1.4 Seat belts for front outboard seating positions in four door vehicles should have adjustable guide loop unless a fixed guide loop is specified by the responsible **Design** Release Engineer.

3.1.2.1.1.5 Seat belts for all passenger seating positions should be compatible with typical aftermarket child restraint systems.

3.1.2.1.1.6 Buckles shall be end-release with one design for all positions (unless keyed buckles are used for center positions).

3.1.2.1.1.7 Buckles shall offer provisions to make the buckle resistant to release during the impulse of a tensioner 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 European 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 Latin America, Africa and Middle East Vehicles. Not applicable.

3.1.2.1.6 Required or Recommended for Asia Pacific 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 as follows for the requirements for these functions outlined in 3.7.

The relationships between these functions and to other imposed requirements are shown in the functional flow diagram in Figure B1 (see Appendix B).

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3.1.2.2.1 Provide Occupant Protection Benefit in Conjunction with Air Bag. 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 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 plate in buckle, and to adjust the Adjustable Guide Loop (AGL) mechanism (if available).

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

3.1.3 Ambient Environment. The seat belt system is expected to be subjected to temperature extremes, corrosion, humidity, dust and sunload. Federal Motor Vehicle Safety Standard (FMVSS) and the United Nations (UN) each 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 to +85) °C. In addition, the belt system is expected to function reasonably between -40 °C and -20 °C, and between +85 °C and +100 °C.

3.1.3.2 Corrosion.

3.1.3.2.1 All metal belt system parts should pass 50 h corrosion exposure per FMVSS 209 S5.2 (a).

3.1.3.2.2 Components and/or subsystems shall meet the requirements found in GMW15272.

3.1.3.3 Colorfastness to Artificial Light (GMW14162, Natural Weathering GMW3417). All parts shall meet Natural Weathering as designated in GMW3417 for colorfastness. Refer to Figure K1 (Appendix K) for test method based on historical data.

3.1.3.4 Common Environmental Conditioning. An environmental conditioning sequence combining, FMVSS and UN requirements shall be contained in the validation sequence Design Verification Plan and Report (ADVP&R) where indicated in the individual specifications in Appendix G.

3.1.4 Interfaces.

3.1.4.1 External to Vehicle to Subsystem. Vehicles for North America should consider the SAE J1819 child seat accommodation fixture. Vehicles for UN regions should consider the UN R16 "universal" child restraint fixture (i.e., Gabarit fixture).

3.1.4.2 Subsystem to Subsystem.

3.1.4.2.1 Trim. Slot size and alignment tolerance to assure no belt contact.

3.1.4.2.2 Electrical. All electrical interfaces (switches, connectors, sensors, etc.) are to be evaluated to the test sequences outlined in the GMW3172 workbook tab in CG1950 (VCRI). The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.1.4.2.2.1 Sensor Fault State. Sensor output for open/short circuit or reverse polarity per GMW3172.

Table 1: Simple Mechanical Switch Requirements Evaluated per Appendix G - G.1.1.1.1.2 and G.1.2.1.1.2

Interface Resistance (Ω)	Seat Belt Filtered State
> 200 for 200 ms Minimum	State "A" (Seat Belt Fastened/Latch plate Inserted)
< 10 for 200 ms Minimum	State "B" (Seat Belt Unfastened/Latch plate Not Inserted)

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Table 2: Diagnosable Switch Requirements Evaluated per Appendix G - G.1.1.1.1.2 and G.1.2.1.1.2

Interface Current (mA)	Electrical Condition	Seat Belt Filtered State/Fault State
14.5 ± 2.5	- -	State "A" (Seat Belt Fastened/Latch plate Inserted)
6.0 ± 1.0	- -	State "B" (Seat Belt Unfastened/Latch plate Not Inserted)
- -	Short/Open Circuit	State "C" - Fault
- -	Reverse Polarity	State "C" - Fault

3.1.4.2.2.3 Electrical Connection Integrity. The electrical connection shall **not** experience any impaired function or damage when a load is applied to the electrical connect**ion** as described in 3.1.4.2.2.3.1 and 3.1.4.2.2.3.2 as follows:

3.1.4.2.2.3.1 For Non-Direct Connectors (pigtails, buckle switch wire etc.) No damage or electrical malfunction when loaded up to 150 N.

3.1.4.2.2.3.1.1 Pull in all Orthogonal Directions. See Appendix S, Figure S1.

3.1.4.2.2.3.1.2 Any length of wire that is exposed must be evaluated for each individual section, including at or near the restraint hardware.

3.1.4.2.2.3.2 For Direct Connectors (AK-2, ABX5, etc.) No damage or electrical malfunction when loaded up to 150 N.

3.1.4.2.2.3.2.1 Electrical Connector Insertion/Retention Proof Load.

3.1.4.2.2.3.2.1.1 1st Install - Measure insertion force (< 45 N) and measure electrical resistance.

3.1.4.2.2.3.2.1.2 Apply 60 N proof load and measure electrical resistance.

3.1.4.2.2.3.2.1.3 Remove 60 N proof load and measure electrical resistance.

3.1.4.2.2.3.2.1.4 Remove connector, inspect/record any damage to connector. Retainer and MGG (cracks, galling, bent pins, etc.)

3.1.4.2.2.3.2.1.5 2nd Install - Measure insertion force (< 45 N) and measure electrical resistance.

3.1.4.2.2.3.2.1.6 Pull and record ultimate strength and record failure mode. See Appendix S, Figure S2.

3.1.5 Usage Definition.

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

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

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

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

3.1.5.2 Usage Cycles. Cycle requirements for specific belt system components are given in the ADVP&R outlines (Appendix G) for Retractors, Buckles and Adjustable Guide Loops.

3.2 Product Characteristics.

3.2.1 Performance Requirements.

3.2.1.1 Occupant Protection.

3.2.1.1.1 Maintain Integrity. The seat belt subsystem shall be capable of maintaining integrity during reasonably expected crash events (see UN R16 sled test for integrity in component requirements).

3.2.1.1.2 Manage Energy. The seat belt subsystem shall be capable of managing 100% of the energy of a high severity crash event (see UN R16 sled test for integrity in component requirements).

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3.2.1.2 Comfort and Fit. The seat belt supplier is to provide the hardware capable of meeting comfort guidelines for extraction/retraction, and for meeting component comfort requirements.

3.2.1.3 Ease of Use. The customer must be able to operate the seat belt hardware without any special instructions.

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity.

3.2.2.1.1 Retractor Size and Mounting. The package sizes of the retractors shall meet the packaging envelopes as specified in Appendix B of the program Statement of Requirements (SOR), or in the authorizing Engineering Work Order (EWO).

3.2.2.1.1.1 For carryover programs, the package size and mounting shall conform to the platform specifications.

3.2.2.1.2 Adjustable Guide Loop (AGL) Size and Mounting. For new programs, a corporate common AGL shall be used. For carryover programs, the package size and mounting shall conform to the platform specifications. Reference Appendix B of the program SOR, or in the authorizing Engineering Work Order (EWO).

3.2.2.1.3 Buckle Size and Latch Plate Dimensions. The package size of the buckles shall meet the packaging envelopes as specified in Appendix B of the program SOR, or in the authorizing EWO.

3.2.2.1.3.1 Latch Plate Size. The package size of the locking latch plate shall meet the packaging envelopes as specified in Appendix B of the program SOR, or in the authorizing EWO.

3.2.2.1.3.2 Latch Plate Tip. The tip of the latch plate shall meet the dimensions as shown in Appendix M, Figure M1.

3.2.2.1.4 Buckle Tensioner Size and Mounting. For new programs, the package size of the buckle tensioner shall meet the packaging envelopes as specified in Appendix B of the program SOR, or in the authorizing EWO.

3.2.2.1.5 Guide Loop Size. For new programs, the guide loop size and mounting shall meet the packaging envelopes as specified in Appendix B of the program SOR, or in the authorizing EWO.

3.2.2.1.6 Lap Anchor Tensioner Size and Mounting. For new programs, the package size of the anchor tensioner shall meet the packaging envelopes as specified in Appendix B of the program SOR, or in the authorizing EWO.

3.2.2.2 Mass Properties. The mass of the seat belt system for one seating position includes the following parts:

3.2.2.2.1 Retractor with fasteners and noise boot (if applicable), Emergency Locking Retractor (ELR) and Automatic Locking Retractor (ALR) function, 3.0 m webbing, intermediate guide (if applicable), stop buttons, guide loop with fastener, latch plate, anchor plate with fastener, and buckle with fastener.

3.2.2.2.1.1 Basic System without any tensioner, electrical motorized seat belt (MSB), or load limiter should not exceed 1.0 kg.

3.2.2.2.1.2 Retractor tensioner should not add more than 0.500 kg.

3.2.2.2.1.3 Load limiter should not add more than 0.200 kg.

3.2.2.2.1.4 MSB including Electronic Control Unit (ECU) should not add more than 1.2 kg.

3.2.2.2.1.5 Buckle tensioner should not add more than 0.500 kg.

3.2.2.2.1.6 Anchor tensioner should not add more than 0.500 kg.

3.2.2.2.1.7 Electrical switch should not add more than 0.025 kg including 1000 mm cable.

3.2.2.2.1.8 Dynamic Locking Latch Plate (DLLP) should not add more than 0.050 kg (+0.050 kg compared to a free falling latch plate).

3.2.2.2.2 Additional parts must be approved by the GM Release Engineer.

3.2.3 Reliability.

3.2.3.1 Reliability Evaluation Point. General Motors Company Vehicles normally have an expected product life as described in Notice of Action (NOA) associated with the Vehicle Reliability Evaluation Point. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.2.3.2 Reliability Requirements. See 3.2.3.3.

3.2.3.2.1 Class 1 Type. Not applicable.

3.2.3.2.2 Class 2 Type. Not applicable.

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3.2.3.3 Reliability Requirements. The reliability is based on a 50% confidence interval and further defined in CG1950 Validation Cross Reference Index (VCRI), for this specification. Weibull analysis should be completed for durability tests. The sample size as designated in CG1950 (VCRI) reflects success testing based on a known beta form historical data for all pass requirements. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.2.3.4 Seat Belt Subsystem Reliability. The seat belt subsystem should meet the reliability requirements found in Section 4.

3.2.3.5 Seat Belt Subsystem Durability. In addition to meeting component durability requirements according to 3.7.3, the seat belt subsystem shall be functional/operational at the end of the durability schedule outlined in the Vehicle Technical Specification. The supplier shall assist in resolving part durability concerns.

3.2.3.5.1 Seat belt supplier is responsible to provide hardware consistent with vehicle durability schedule as outlined in the SOR.

3.2.3.6 Quality Assurance. Not applicable.

3.2.4 Serviceability. The following paragraphs (3.2.4.1 through 3.2.4.5) define the constraints and requirements associated with serviceability of the seat belt subsystem. Serviceability is the ease and cost of performing the maintenance, diagnosis, and repair operations necessary to preserve the original performance level of the vehicle throughout its target life.

3.2.4.1 Service Infrastructure.

3.2.4.1.1 Essential Tools. The subsystem should not require the development of any new essential tools as defined as follows, for the performance of diagnosis, maintenance, and repair procedures. (Essential tool = a tool called out in the manufacturer's service manual diagnosis or repair procedure, which is required to perform that operation.)

3.2.4.1.2 Fasteners/Fittings/Connectors/Seals.

3.2.4.1.2.1 Fasteners with a service specification of torque plus angle should be avoided in the areas where customer performed maintenance or service is recommended (wheel lug nuts, oil pan drain plug, etc.)

3.2.4.1.2.2 Effort should be made to avoid the use of torque to yield fasteners in areas where fasteners are typically reused or in areas where an adjustment point is located.

3.2.4.1.2.3 All serviceable fasteners that are considered reusable shall withstand a minimum of five remove and replace procedures.

3.2.4.1.2.4 Fasteners requiring a backup wrench for removal shall have adequate clearance for backup tools.

3.2.4.1.2.5 The system shall use fasteners that are readily available from GM.

3.2.4.1.2.6 Dynamic torque values shall be provided for service publications.

3.2.4.2 Maintenance.

3.2.4.2.1 Performance of Scheduled/Unscheduled Maintenance. System components shall not interfere with normal maintenance procedures.

3.2.4.2.2 Lubricants and Chemical Products. Lubricants and chemical should be compatible with current products currently released by GM.

3.2.4.2.3 Exterior and Interior Cleaning. The seat belt shall be capable of being cleaned with any current cleaning agents already released by GM.

3.2.4.3 Repair.

3.2.4.3.1 Mechanical and electronically integrated components shall be serviced separately.

3.2.4.3.2 System components should be accessible for adjustment or replacement with standard shop hand tools and without removal of unrelated parts or components.

3.2.4.4 Service Parts. GM part numbers shall be released for any parts identified in 3.2.4.5, as well as any additional assembly, subassembly, or component specified by the Design Release Engineer or aftersales service engineer.

3.2.4.5 Service Part Release Criteria.

- Part Description.
- Seat Belt Assembly (Seat Belt Kit).

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- Buckle Assembly (Buckle Kit).
- Detachable Wiring Harness.
- Bezels/Escutcheons/Covers.
- Web Stop Buttons.
- Fasteners.

3.2.5 User System/Subsystem/Component/Part Interface. Not applicable.

3.3 Design and Construction.

3.3.1 Materials, Processes and Parts Selection Guidelines.

3.3.1.1 Material Guidelines.

3.3.1.1.1 Material Manufacturability. Not applicable.

3.3.1.1.2 Material Fungus Resistance. The vehicle and its components shall be fabricated using materials that are non-nutrient to fungus growth in accordance with GMW14231.

3.3.1.1.3 Material Recyclability. The use of recyclable materials shall be given high priority in vehicle design.

3.3.1.1.3.1 Any plastic parts used should be recyclable.

3.3.1.1.3.2 All polyurethane foamed parts shall comply with requirements of the Clean Air Act (reference page 279, part (d), paragraph (B) of the Clean Air Act).

3.3.1.1.3.3 The use of paint on plastic parts should be minimized.

3.3.1.1.3.4 The use of adhesives on plastic parts should be minimized.

3.3.1.1.4 Approved Materials. All appearance materials identified in the SOR shall be GM approved through the "GM Approved Materials Process" and be in the GM Materials Approved Source List or the North American Appearance Materials Database or Blue Sky, and be clearly listed in the math file log.

3.3.1.1.5 Plastics.

3.3.1.1.5.1 Aging. All internal and external plastic components of the belt subsystem should meet the requirements specified in the material requirement in the appearance block, and as directed in the seat belt "preferred materials trees".

3.3.1.1.5.2 Regrind. Regrind may be used if the amount of regrind can be controlled, and is documented. Parts using regrind shall meet all specifications, and a specific plan that shows how quality is to be maintained shall be prepared. Refer to GMW14444 Section 7, 7.4 for regrind requirements.

3.3.1.1.6 Prohibited Materials. All materials used in the belt subsystem should conform to GMW3059. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.3.1.2 Processes Guidelines.

3.3.1.2.1 Supplier Function Checks.

3.3.1.2.1.1 Steady State Part Monitoring (SSPM). Refer to CG5287 Seat Belt Supplier Function Checks SOR Appendix C3 CTS Template for these function checks. These requirements will be communicated per the standards defined in GMW15049 Key Characteristics Designation System (KCDS) Process and GMW15745 Dimensional SOR. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.3.1.2.1.2 Lot Acceptance Testing (LAT). Refer to CG5287 Seat Belt Supplier Function Checks SOR Appendix C3 CTS Template for these function checks. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.3.1.2.1.3 Frequency of checks for Steady State Part Monitoring and Lot Acceptance Testing shall be defined in the component control plan and approved by GM Engineering/Supplier Quality.

3.3.1.3 Parts Guidelines.

3.3.1.3.1 Critical Parts. Critical parts that are typically made by tier two suppliers are expected to meet or exceed the quality and function standards of the recognized industry leaders.

3.3.1.3.2 Attachment Bolts. All seat belt attachment bolts shall be specified or approved by GM Fastener Engineering.

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3.3.2 Design Guidelines and Constraints. Not applicable.

3.3.3 Identification and Marking.

3.3.3.1 Part Numbers. Parts/components/assemblies shall be identified by a permanent identification, broadcast code, or part number, contained on the assembly itself. If parts/components/assemblies change, the permanent Identification (ID) shall also change.

3.3.3.2 Labels. All belt assemblies shall bear a permanently attached manufacturing identification label or marking. This identification label shall bear the manufacturer's name, model number, date of manufacture, plant identification, and any other regulatory markings as appropriate. Use non-staining blue, black, or white medium for all normal production labels. Markings for the retractor assembly may be marked into the metal or plastic components.

3.3.3.2.1 The application of the identification label or marking is to be certified in writing by the vendor that each belt assembly so labeled does comply with Federal specifications.

3.3.3.2.2 Reworked or re-inspected assemblies shall be stamped in designated re-stamp areas using non-staining, blue, black, or white medium, or stamped in the metal or plastic parts for retractors.

3.3.3.2.3 Engineering samples or experimental seat belts shall be clearly identified as such.

3.3.3.2.4 Labels shall meet all performance and durability requirements as specified in GMW14573 for sewn on labels or GMW14573 (Label Classification D) for all other label applications. All labels must be produced by approved global label suppliers.

3.3.3.2.4.1 Label designs must meet the requirements of GMW14089 – Label Design Criteria. All labels shall have a GM part number. All label designs require approval by the GM Label Global Subsystem Leadership Team Bill of Materials (BOM) Family Owner prior to release.

3.3.3.2.4.2 Bar codes must meet the requirements of GMW15862 - Bar Code Content, Format, and Label Requirements for Part Identification, Verification, and Traceability.

3.3.3.2.5 Service belt labels should be the same as production design and shall meet all applicable regulatory service belt requirements.

3.3.3.2.6 Seat belt assemblies that have an energy management loop or that require special information shall bear permanently attached information label. Energy Management (EM) loop labels are to be located inside the EM loop, and be visible after the loop unfolds.

3.3.3.2.7 GM tensioner warning labels are to be positioned on the tensioner assemblies in a position that is readily visible to the operator/technician during installation or servicing of the tensioner. It is not intended to have the labels visible in their installed position in vehicle. The GM part number and the exact location of the label are to be shown on the seat belt assembly drawing.

3.3.3.2.8 China Compulsory Compliance. For parts that will be exported to or sold in the China Market; part number, cavity number, material identification, China Compulsory Certification marker and date of manufacture appearing on the part should comply with the following requirements:

3.3.3.2.8.1 For exact traceability part (see SGM Exact Traceability Part List), suppliers are required to add the bar code on the part according to the requirement of the drawing or related technical information, and comply with Specification of Components for Shanghai General Motors (SGM).

3.3.3.2.8.2 It is the supplier's responsibility to contact the China Quality Certificate Centre (www.cqc.com.cn) or the China Certification Centre for Automotive Products (www.cccap.org.cn) for China Compulsory Certification (CCC) activities and to ensure all Corporate Common Components (CCC) related parts meet China Compulsory Certification (CCC) requirements (see CNCA-02C-063). All salable parts shall have China Compulsory Certification (CCC) marking after proper authorization. A copy of the certificate for the parts should be sent to GM Engineering before the Production Part Approval Process (PPAP).

3.3.3.2.9 Conformité Européene (European Conformity) (CE) Marking. All tensioner assemblies for European applications must meet the CE requirements for pyrotechnic devices, and be marked according to that standard.

3.3.3.3 Traceability. All end item assemblies shall be serialized and have traceability per GMW15862.

3.3.3.3.1 All load bearing and selected critical members shall be lot controlled. The following are considered to be examples of load bearing components: buckle assemblies, latch and anchor plates, retractor frame, lock bar,

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adjustable guide mechanisms, guide loop assemblies, and sprockets. The lot control level is to be determined by quality, reliability, and engineering.

3.3.4 Workmanship. Not applicable.

3.3.5 Interchangeability. Deproliferation of seat belt subsystem designs shall be addressed through physical and functional interchangeability of all designs proposed for use in GM future vehicles.

3.4 Documentation. See Statement of Work (SOW).

3.5 Support of System/Subsystem/Component/Part After Sale. Not applicable.

3.6 System/Subsystem/Component/Part Operator Training. Not applicable.

3.7 System/Subsystem/Component/Part Characteristics. See Figure B1 (Appendix B).

3.7.1 System/Subsystem/Component/Part Definition. The following is a description of the component groups that make up a seat belt system.

3.7.1.1 Retractor/Guide Loop. The retractor and guide loop assembly defined here consists of the seat belt retractor mechanism and the guide loop. The webbing may be required to perform some of the validation requirements for this assembly.

3.7.1.2 Buckle/Latch Plate. The buckle and latch plate assembly defined here consists of the seat belt buckle and the compatible latch plate.

3.7.1.3 Webbing. Seat belt webbing consists of the fabric strap of the seat belt.

3.7.1.4 Adjustable Guide Loop Mechanism. The adjustable guide loop mechanism defined here consists of a means to adjust the vertical (and potentially the fore/aft and lateral) position of the guide loop and thus provide the occupant with a means of re-routing the webbing across the upper torso.

3.7.1.5 Tensioner. The seat belt pre-tensioning device operates to remove the slack from the system during a crash. The device can be part of the retractor, buckle or outboard anchor assemblies.

3.7.1.6 Comfort Feature. The seat belt comfort feature is a means for reducing but not eliminating the tension in the seat belt webbing caused by the retraction spring, for applications where improved comfort is needed. It consists of a transmission between the spring and the retractor spindle and can be tuned to reduce the tension in the usage area and provide enough retraction force for stowage.

3.7.1.6.1 Not applicable.

3.7.1.6.2 Not applicable.

3.7.1.7 Sliding Bar. A sliding bar consists of a rod attached to the vehicle body and serves as an outboard anchor where there is a need for the belt to be able to slide out of the way in a two-door vehicle to allow easy entry into the rear seats.

3.7.1.8 Intermediate Guide. A guide located between retractor and guide loop to route the webbing away from interior trim parts between the retractor and the guide loop.

3.7.1.9 Tear Stitch. A part of the seat belt webbing folded in a loop and sewn with a number of stitches in a specific pattern. The function is to allow the stitches to tear at a predetermined belt load for energy absorption and occupant kinematics. The tear seam is normally placed close to the outboard anchor.

3.7.1.10 Detachable Anchor. A device that allows the anchorage of the belt system to be attached/detached to the vehicle structure through a manual and fast operation; this normally consists of a special buckle and latch plate type anchor. A typical application is the rear center detachable anchor which may be detached for cargo loading.

3.7.1.11 Assembly. The seat belt assembly is a combination of some or all of the components of the seat belt system.

3.7.1.12 Block out Mechanism. The seat belt block out feature is a means for preventing the vehicle sense mechanism to lock. This feature is used in folding seat backs to prevent the retractor from locking when the seat back is in a folded position, or in other positions to minimize noise and avoid end-locks when the belt is stowed.

3.7.1.13 Motorized Seat Belt. A retractor assembly including an electric motor, transmission, and electronic control unit which provides additional capability to actively retract the seat belt to provide occupant support and comfort functions.

3.7.2 Component Interface Description. See Figure B1 (Appendix B).

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3.7.3 Assignment of Requirements to Components. The following is an outline of the specifications for the seat belt subcomponents.

Note: Demonstration of compliance to these specifications is expected, with the methodology indicated.

Note: Those specifications that indicate statistical demonstration have reliability levels listed in Section 4. The purpose of the reliability levels is to assure product uniformity, both in design capability and manufacturing capability.

3.7.3.1 Retractor/Guide Loop.

3.7.3.1.1 Retractor Strength.

3.7.3.1.1.1 Retractor Tensile Strength.

3.7.3.1.1.1.1 All retractors shall have a minimum tensile strength of 14.7 kN with all webbing.

3.7.3.1.1.1.2 All retractors should have a statistically demonstrated minimum tensile strength of 13.3 kN with all webbing extracted.

3.7.3.1.1.1.2.1 Evaluation to be done after the common environmental conditioning and durability cycling.

3.7.3.1.1.1.2.2 Reference of GMW14310.

3.7.3.1.1.1.3 Retractor/Webbing Tensile Strength. All retractors without load limiters (i.e., internal energy management) should have a minimum tensile strength of 14.7 kN with (475 ± 10) mm of webbing remaining on the retractor. All retractors without load limiters (i.e., internal energy management) should have a statistically demonstrated minimum tensile strength of 13.3 kN with (475 ± 10) mm of webbing remaining on the retractor.

3.7.3.1.1.1.3.1 Evaluation to be done after the common environmental conditioning and durability cycling.

3.7.3.1.1.1.3.2 Reference GMW14310.

3.7.3.1.1.1.4 Retractor Angular Tensile Strength. All retractors without load limiters should have a statistically demonstrated minimum angular tensile strength of 11 kN, with 475 mm of webbing remaining on the retractor, when loaded at ±15° from straight extraction in the plane of the webbing. Test only for positions without a guide loop. All retractors without load limiters should have a statistically demonstrated minimum angular tensile strength of 9.8 kN, with 475 mm of webbing remaining on the retractor, when loaded at ±15° from straight extraction in the plane of the webbing. Test only for positions without a guide loop.

3.7.3.1.1.1.4.1 Reference GMW14310.

3.7.3.1.1.1.5 Load Limiter Retractor Angular Tensile Strength. All retractors with load limiters should have a statistically demonstrated minimum angular tensile strength of 9.8 kN, with all webbing extracted, when loaded at ±15° from straight extraction in the plane of the webbing. This is only for positions without a guide loop.

3.7.3.1.1.1.5.1 Reference GMW14310.

3.7.3.1.2 Energy Management. Energy Management or Load Limiting devices should conform to the following:

3.7.3.1.2.1 Force Level. The load limiting device should provide a nominal force level of 4 kN. Alternative versions with constant force levels between 2 kN and 6 kN should be available. Progressive, digressive, and switchable load profiles may also be required and are described in 6.1.

Activation should occur within ±0.5 kN of specified level (±1 kN in a static pull test). After activation (within 40 mm of displacement), the force should be maintained within ±0.5 kN of the specified level. Tensile test at a rate of 100 mm/minute, starting with 450 mm of webbing on spool. Reference Appendix C, Figure C1.

3.7.3.1.2.2 Displacement. A minimum of 400 mm webbing extension is required at the specified force level for air bag positions. A positive stop or progressive load limiter should be available for non-air bag positions that meet the strength requirements of a retractor without load limiting.

3.7.3.1.2.3 Activation Indicator. An indicator should be available to notify the occupant that the load limiting device has been exercised. It shall be designed to activate when the webbing is loaded to the load level specified for the system. Alternately, the retractor should be fully functional, or permanently locked to notify the customer that the load limiter has been exercised.

3.7.3.1.2.4 Function After Activation. Non-tensioning retractors should be capable of retracting webbing and locking after being subject to the UN R16 sled test. Tensioning retractors should be capable of retracting webbing and locking, or should be permanently locked, after being subject to the UN R16 sled test.

3.7.3.1.2.5 Positive Stop. See 3.7.3.1.2.2.

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3.7.3.1.3 Cover Retention.

3.7.3.1.3.1 All covers that protect lockup mechanisms should have a statistically demonstrated (0.999 Reliability at 50% Confidence level) minimum removal force of 222 N at room temperature, by means of pulling OR pushing the cover off of the retractor frame.

3.7.3.1.3.2 All covers that protect other mechanisms than the lockup mechanism should have a statistically demonstrated (0.99 Reliability at 50% Confidence level) minimum removal force of 222 N at room temperature by means of pulling OR pushing the cover off of the retractor frame.

3.7.3.1.3.2.1 Reference GMW14308.

3.7.3.1.4 Locking Acceleration.

3.7.3.1.4.1 North American Applications Required. All retractors for North American (NA) use shall have a statistically demonstrated capability not to lock before 0.3G, but to lock before 0.7G with < 25.4 mm of webbing payout, with 475 mm of webbing remaining on the retractor. All retractors for NA use shall have a statistically demonstrated capability to lock up by 0.45G with < 50 mm of webbing payout, with 400 mm of webbing remaining on the retractor, an onset rate of 38G/s, at any position of the retractor spool (scanning). Evaluation is to be done before and after the environmental conditioning sequence as specified in Appendix G of this document. All retractors shall be tested at the supplier to lock before 0.68G, in the forward or least sensitive direction, with < 25.4 mm of webbing payout.

3.7.3.1.4.2 Non North American Applications. All retractors for non-North American (non-NA) use shall meet either the North American requirement, or the UN lockup acceleration sensitivities, or both, as specified by the design release organization.

3.7.3.1.4.3 All retractors shall lock by 0.68G within 150 mm of webbing payout with a deceleration onset rate of 2G/s (demonstrate by analysis or appropriate test).

Note: For seatback mounted retractors, lockup sensitivity shall be demonstrated at a full range of fore/aft tilt angles (seatback design position, most upright and most reclined positions).

3.7.3.1.4.3.1 Evaluation to be done before and after the common environmental conditioning and durability cycling.

3.7.3.1.4.3.2 Reference GMW14300.

3.7.3.1.5 Tilt-Lock Requirements.

3.7.3.1.5.1 All retractors for NA applications shall not lock when tilted in any direction to an angle of 15° or less from vehicle installation position for body mounted retractors.

3.7.3.1.5.2 All retractors for NA applications shall not lock when tilted in any direction to an angle of 15° or less from seatback design angle for seatback mounted retractors.

3.7.3.1.5.3 All retractors for NA applications shall lock at any angle of 45° or more from vehicle installation position for body mounted retractors.

3.7.3.1.5.4 All retractors for NA applications shall lock at any angle of 45° or more from seatback design angle for seatback mounted retractors.

3.7.3.1.5.4.1 Not applicable.

3.7.3.1.5.5 All retractors for non-NA applications shall not lock when tilted in any direction to any angle of 12°or less from vehicle installation position for body mounted retractors.

3.7.3.1.5.6 All retractors for non-NA applications shall not lock when tilted transversely to any angle of 12° or less from design position for seatback mounted retractors. All retractors should also not lock at any angle of 12° or less when tilted forward from the most upright seatback position, and rearward from the most reclined seatback position.

3.7.3.1.5.7 All retractors for non-NA applications shall lock when tilted in any direction to an angle of 27° or more from vehicle installation position for body mounted retractors.

3.7.3.1.5.8 All retractors for non-NA applications shall lock when tilted transversely to an angle of 27° or more from design position for seatback mounted retractors**.** All retractors must also lock at an angle of 27° or more when tilted forward from the most upright seatback position, and rearward from the most reclined seatback position.

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3.7.3.1.5.8.1 Evaluation to be done before and after the common environmental conditioning and durability cycling.

3.7.3.1.5.8.2 Reference GMW14300.

3.7.3.1.6 Web Sensing Lockup Acceleration.

3.7.3.1.6.1 All retractors for NA use should not lock before 3G (webbing acceleration) and should lock before 5.5G, within 50 mm of webbing displacement (with 300 mm of webbing stowed).

3.7.3.1.6.2 All retractors for non-NA use shall at least meet the UN requirements, or, if specified by the design release organization, should not lock before 1.2G and shall lock before 3.0G.

3.7.3.1.6.2.1 An evaluation is to be done before and after the common environmental conditioning and durability cycling.

3.7.3.1.6.2.2 Reference GMW14300.

3.7.3.1.7 Web Sensing Mechanism Strength. The web sense portion of all emergency locking retractors should have a statistically demonstrated capability to withstand 500 web sense lock cycles with a force of 90 N on the webbing, with 475 mm of webbing remaining on the retractor, at any position of the retractor spool (scanning). The vehicle sense lockup mechanism should not be affected by any failure of the web sense portion.

3.7.3.1.7.1 Reference GMW14300.

3.7.3.1.8 Webbing Payback to Unlock. The retractor should unlock within 10 mm and shall unlock within 15 mm of webbing payback, with 1700 mm of webbing remaining on the retractor, for both lockup initiated by the vehicle sense mechanism and the web sense mechanism.

3.7.3.1.8.1 Reference GMW14300.

3.7.3.1.9 Webbing Capacity. The retractor should be capable of stowing 1900 mm, and 200 mm of webbing extraction beyond that for child restraint system accommodation, without the webbing extending past the back plane of the retractor spool or out of the specified package size. A minimum spool diameter of 32 mm should be provided.

3.7.3.1.10 Retractor Efforts for Comfort and Stowage. The extraction and retraction forces of the belt system (retractor and guide loop) should conform to the following guidelines.

3.7.3.1.10.1 With 1600 mm of webbing remaining on spool of a single retractor system, the maximum extraction force should not exceed 11.50 N. The minimum retraction force should be > 1.50 N.

3.7.3.1.10.2 With 800 mm of webbing remaining on spool of a single retractor system, the maximum extraction force should not exceed 16.0 N. The minimum retraction force should be > 2.0 N.

3.7.3.1.10.3 Extraction effort should not increase by more than 1 N per 100 mm in the range from (10 to 90)% of webbing stored on the spool.

3.7.3.1.10.4 Cyclic variation of extraction or retraction efforts shall be limited to no more than ±1/4 N per spool revolution, e.g., variation around a theoretical smooth curve during 1 revolution.

3.7.3.1.10.5 Hysteresis shall be < 85% calculated as follows with 1600 mm webbing on spool: extract force minus retract force divided by extract force.

3.7.3.1.10.5.1 Reference GMW14301.

3.7.3.1.10.5.2 Alternate springs shall be available to meet the requirements on systems without a guide loop (evaluation done straight out of the retractor).

3.7.3.1.10.5.3 Alternate springs shall be available at nominally 1 N lower output for system tuning.

3.7.3.1.10.5.4 Spring torque characteristics shall be chosen by the supplier to meet the extraction and retraction levels of the comfort specification. The torque curve should remain flat (nominally 3 N per 800 mm of webbing extraction) throughout the defined working range of the system (nominally full stowed to 600 mm of webbing remaining on spool). Spring uniformity shall be statistically demonstrated to be within 7% of the specified torque at 1600 mm of webbing remaining on the spool and at 800 mm of webbing remaining on the spool.

3.7.3.1.11 Webbing Useful Range. The retractor and spring efforts should be designed to provide 1900 mm of extraction meeting comfort requirements, and 200 mm of webbing extraction beyond that for child restraint system accommodation.

3.7.3.1.11.1 Reference GMW14301.

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3.7.3.1.12 Chest Force. 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.

3.7.3.1.12.1 Reference GMW14793.

3.7.3.1.13 Retractor Vibration Noise. All configurations of retractor have an Instationary Zwicker Loudness of ≤ 6.0 sones N10. Evaluations to be completed in the vertical, fore/aft and lateral direction according to GMW14011 Component Squeak and Rattle Testing using the vibration input frequencies and amplitudes defined in Appendix D, Table D1. Self-compensating retractors should not exceed this by > 1 sone.

3.7.3.1.13.1 Evaluation to be done with both 800 mm and 1700 mm of webbing remaining on the spool.

Note: For seatback mounted retractors, evaluation shall be done at retractor angles of 5.5° to 40° from vertical, and at any worst case angle defined by the Design Failure Mode and Effects Analysis (DFMEA).

3.7.3.1.13.2 Reference GMW14188.

3.7.3.1.14 Extraction/Retraction Noise. The maximum noise level of the retractor (without guides or guide loop), while webbing is being extracted (at a nominal 0.5 m/s), shall be statistically demonstrated to < 4 sones (0.83 Reliability at 50% Confidence) when measured according to the methodology of procedures GMW14154 and GMW14155.

3.7.3.1.15 ALR Function Sound. Not applicable.

3.7.3.1.16 Vibration Tolerance. All retractors should be functional (static tilt, vehicle and web sense lockup, webbing retraction) after being subjected to 8 h of vibration from (5 to 20) Hz. Evaluation shall be done for 8 h with the retractor in the expected installed position with 600 mm of webbing remaining on the spool, and for 8 h in the expected shipping position with webbing fully stowed.

3.7.3.1.16.1 Any engaged comfort mechanism should remain engaged during the full vibration test in the installed position.

3.7.3.1.16.2 Reference GMW14306.

3.7.3.1.17 ELR Retractor Cycle Life.

3.7.3.1.17.1 All retractors shall have a minimum cycle life of 75 000 extraction and retraction cycles with 15 000 lock cycles. Extraction/retraction efforts tilt lock and acceleration sensitivity shall be met.

3.7.3.1.17.2 Evaluations to be done before and after the common environmental conditioning and durability cycling.

Note: For seatback mounted retractors with self-adjusting vehicle sensor cycle life shall be demonstrated at back recline angles from full upright to full recline.

3.7.3.1.17.3 Reference GMW14305.

3.7.3.1.18 ALR Retractor Cycle Life. All retractors that have only an ALR mechanism for lockup shall have a minimum extraction/retraction cycle life of 36 000 cycles and a minimum lock activation cycle life of 18 000 cycles. Extraction/retraction and lock activation shall be met.

3.7.3.1.18.1 Evaluations to be done before and after the common environmental conditioning and durability cycling.

3.7.3.1.18.2 Reference GMW14304.

3.7.3.1.19 ELR/ALR Mechanism Cycle Life. The ALR mechanism of an ELR/ALR retractor shall have a minimum cycle life of 15 000 lock cycles. Extraction/retraction, engagement, and disengagement shall be met. This test may be run separately or in combination with the ELR cycle life test.

3.7.3.1.19.1 Evaluations to be done before and after the common environmental conditioning and durability cycling.

3.7.3.1.19.2 Reference GMW14304.

3.7.3.1.20 ALR Mechanism Range of Engagement. The ALR should activate in the last 100 mm of webbing available. The disengagement point should be adjustable to accommodate any final, in vehicle, stowed webbing length, and be controlled to ±120° of spool rotation (nominally ±40 mm) from specified position. The retractor design shall be such that webbing cannot twist before entering, which may cause the ALR mechanism not to disengage.

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3.7.3.1.20.1 Check for appropriate activation and disengagement points in a vehicle.

3.7.3.1.20.1.1 ALR should remained engaged with the seat belt system buckled over an empty seat.

3.7.3.1.20.1.2 ALR shall disengage between 100 mm and 140 mm of full stowage of the seat belt system in the vehicle.

3.7.3.1.21 Hot Cycling Mechanism Integrity. The integrity of all retractor mechanisms should be maintained after 500 cycles of extraction and retraction from (10 to 90)% at a temperature of (+100°± 2) °C. Retractor to soak at +100 °C for 6 h before cycling.

3.7.3.1.22 Webbing Abrasion from Guide Loop. The webbing shall **not** be cut or damaged by the guide loop assembly during 75 000 extraction/retraction cycles of 500 mm webbing travel, loaded with 20 N, at an angle 30° inboard of the guide loop mounting surface and 30° forward of vertical. Reference the comfort requirement for setup. This webbing strength should be a minimum of 80% of original strength after test. The guide assembly should be statistically demonstrated to meet original tensile strength after test.

3.7.3.1.22.1 In addition, the guide loop surface shall **not** be damaged by the webbing abrasion during the test.

3.7.3.1.22.2 Systems with intermediate guides should also meet this requirement with the intermediate guide installed (nominal 150 mm outboard position may be used).

Note: This test may be combined with the following "webbing abrasion from retractor exit".

3.7.3.1.22.3 Reference GMW14317.

3.7.3.1.22.4 After testing, the webbing should not have excessive webbing fray or unacceptable appearance.

3.7.3.1.23 Webbing Abrasion from Retractor Exit. The webbing should not be cut or damaged by the retractor assembly during 75 000 extraction/retraction cycles of 500 mm webbing travel. The webbing strength should be 80**%** minimum of original strength after test.

3.7.3.1.23.1 Reference GMW14317.

3.7.3.1.23.2 After testing, the webbing should not have excessive webbing fray or unacceptable appearance.

3.7.3.1.24 Drop Integrity. Non-tensioning retractors shall meet all functional requirements, or shall be nonfunctional in a manner that would prevent installation, after being dropped from a height of 1 m (39.4 in) in six different orientations (e.g., once on each side), using six different retractors. The drop test should not cause any invisible damage that could affect function or internal damage to the retractor. Retractors shall pass 15 000 vehicle sense lockup cycles after drop testing.

3.7.3.1.24.1 Tensioning retractors shall have Master Process Documents (MPD) instructions that prohibit installation of dropped retractors.

3.7.3.1.24.2 Reference GMW14309.

3.7.3.1.25 Interference Rod Immunity. Retractors that mount with one bolt shall pass 5 g vehicle sense lockup in all directions, should tilt lock by 45°, shall **not** lock at 0° (posttest position) when bolted to a rigid fixture with 3 mm (0.12 in) diameter interference rod placed at the spool centerline.

3.7.3.1.25.1 Reference GMW14307.

3.7.3.1.26 Interference Shim Immunity. Retractors that mount with two bolts shall pass 5 g vehicle sense lockup in all directions, should tilt lock by 45°, shall **not** lock at 0° (posttest position) when bolted to rigid fixture with interference shims.

3.7.3.1.26.1 Reference GMW14307.

3.7.3.1.27 Function at Full Attachment Torque. Retractor shall meet all specified functional requirements as defined in this technical specification and the SOR. Satisfying these requirements must be demonstrated as the retractor is installed under production conditions (seat structure, body structure, underbody interfaces, etc.) including to the specified fastener torque range (nominal, minimum and maximum).

3.7.3.1.28 Retractor Heat. Heat caused by retractor solenoids or other electrical devices should not cause warping or discoloration of retractor cover/trim and should not cause loss of function of any part of the belt system.

3.7.3.1.29 Shielding from Foreign Matter. The retractor mechanism should be designed to minimize the entry of foreign matter that could affect the normal function of the retractor.

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3.7.3.1.30 Wiring Holes. All holes in metal panels through which retractor cables or electrical wires are routed shall have turned flanges or equivalent.

3.7.3.1.31 Guide Loop Tensile Strength.

3.7.3.1.31.1 All guide loops should have a minimum tensile strength of 14.7 kN (loop load). The retractor side belt segment is to be at an angle 10° inboard of the guide loop mounting surface. The latch side belt segment shall be pulled at an angle of 75° inboard of the guide loop mounting surface, and 65° forward of vertical.

3.7.3.1.31.2 All guide loops should have a statistically demonstrated minimum tensile strength of 13.3 kN (loop load). The retractor side belt segment is to be at an angle 10° inboard of the guide loop mounting surface. The latch side belt segment shall be pulled at an angle of 75° inboard of the guide loop mounting surface, and 65° forward of vertical.

3.7.3.1.31.3 Reference GMW14310.

3.7.3.1.31.4 Function at Full Attachment Torque. Guide loops shall meet all specified functional requirements as defined in this technical specification and the SOR. Satisfying these requirements must be demonstrated as the guide loop is installed under production conditions (seat structure, body structure, underbody interfaces, etc.) including to the specified fastener torque range (nominal, minimum and maximum).

3.7.3.1.32 Retractor Webbing Guide Strength. All webbing guides mounted in seat belt retractors shall withstand a minimum load of 2 kN on the webbing with all webbing extracted.

3.7.3.1.33 Webbing and Latch Plate Abrasion.

3.7.3.1.33.1 Webbing Abrasion and Latch Plate Damage. The webbing shall not be cut or damaged by the latch plate assembly during 75 000 extraction/retraction cycles of 35 mm webbing travel, loaded with 20 N, at an angle 15° fore and aft of the latch plate symmetry plane and 15° of the latch plate plane between the two webbing runs. The webbing strength should be 80% minimum of original strength after test. The latch plate assembly should be statistically demonstrated to meet original tensile strength after test.

The latch plate surface shall not be visually damaged by the webbing abrasion during the test. For purposes of this evaluation, visual damage is defined as cracking of any plastic component, or wear through of the plastic to underlying metal.

3.7.3.1.33.2 Webbing Abrasion from Latch Plate. The webbing shall not be cut or damaged by the latch plate during 75 000 extraction/retraction cycles of 200 mm webbing travel, at a rate of six (6) cycles per minute, over a 50th Percentile Hybrid III Anthropomorphic Test Device (ATD).

3.7.3.1.33.2.1 The test setup is defined in Appendix P, Figure P1. The test is for driver seat only. Seat to be set up at vehicle design position. Retractor origin point to be set up relative to the seat in vehicle design position. The remaining test setup coordinates are to emanate from the retractor origin point. The webbing strength should be 80% minimum of original strength after test.

3.7.3.1.33.2.2 After testing, the webbing should not have excessive webbing fray or unacceptable appearance. Appendix P, Figure P2 depicts acceptable and Figure P3 depicts unacceptable condition/appearance.

3.7.3.1.34 Retractor Static Tensioning Forces. The belt system shall be tested according to the test method as specified in Appendix F.

3.7.3.1.34.1 High Power Performance. Not applicable.

3.7.3.1.34.2 Standard Power Performance. See Figure F1 (Appendix F) for performance requirements.

3.7.3.1.34.2.1 F1: The shoulder belt force at tensioning shall **not** exceed 3.0 kN (peak) and shall **not** exceed 1.5 kN for more than 3 ms.

3.7.3.1.34.2.2 F2: The tensioner shall preload the belt in the range between 0.08 kN to 1.0 kN.

3.7.3.1.35 Tensioner Retraction Capacity. A retractor tensioner shall be capable of retracting ≥ 80 mm webbing when tested according to the test method as specified in 3.7.3.1.34. The design shall allow a tension travel of 200 mm minimum, with (750 ± 5) mm webbing on the retractor, when measured immediately above the retractor assembly.

3.7.3.1.36 Tensioning Duration. The total tensioning time (time difference from ignition signal t_1 to maximum stroke t_2) shall be achieved within 12 ms ($t_2 - t_1 \leq$ 12 ms) within the entire temperature range from (-30 to +85) °C when tested according to the test method as specified in 3.7.3.1.34.

3.7.3.1.37 Integrity. The retractor tensioner must withstand:

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3.7.3.1.37.1 Tensioner activation with webbing unloaded without damage.

3.7.3.1.37.2 Tensioner activation with webbing blocked without damage.

3.7.3.1.37.3 UN R16 sled test with tensioner deployment at any time during the impact.

3.7.3.1.37.4 UN R16 sled test with no deployment of the tensioner.

3.7.3.1.38 Retractor Function After Deployment. Tensioning retractors should be capable of retracting webbing and locking, or should be permanently locked after deployment.

3.7.3.1.39 Emitted Gas Vent/External Temperature. The gas emission vent shall **not** point directly towards the vehicle occupants.

3.7.3.1.39.1 Documentation shall be submitted to show the external temperature of the tensioner housing and emitted gas temperature when the pre-tensioner is actuated at +21 °C and +85 °C. This documentation shall include the external temperature of the tensioner housing, the emitted gas temperature. The emitted gas temperature shall not exceed +167 °C at a distance > 30 mm from any potential surface emission point.

3.7.3.1.39.2 Thermal Emission Verification (DV and PV). No open flame or emitted sparks are to occur per F.1.9 in Appendix F.

3.7.3.1.40 Motorized Retractor. The Global A electrical performance requirements for the motorized functions are defined in CG3059, the supplier shall work with the GM Design Responsible Engineer to comprehend this requirement. Other standard retractor functions are defined in preceding paragraphs of 3.7.3.1.

3.7.3.1.41 Dynamic Angular Locking Performance.

3.7.3.1.41.1 Retractors must be capable of locking and holding, at any angle up to 15° in both cross-car directions, when the webbing is tested dynamically according to Appendix Q. Requirement for retractors without load limiting is 11 kN within 60 ms and the system must maintain integrity. Requirement for retractors with load limiting is the system must see energy management activation within 60 ms and the system must maintain integrity. Applies only to retractors without a guide loop.

3.7.3.1.41.2 Evaluation to be done before and after the common environmental conditioning and durability cycling (Appendix G).

3.7.3.2 Buckle and Latch Plate.

3.7.3.2.1 Buckle, Latch, Webbing Junction Strength.

3.7.3.2.1.1 The buckle assembly/latch junction shall have a statistically demonstrated minimum tensile strength of 18.0 kN when pulled straight longitudinal or all samples should have a minimum strength of 22 kN.

3.7.3.2.1.2 The buckle assembly/latch junction should have a minimum tensile strength of 18 kN when pulled at 30° inboard over a 3.2 mm radius break edge located at the center of the latch plate opening. The latch shall **not** disengage from the buckle.

3.7.3.2.1.3 The buckle assembly includes but is not limited to webbing, steel cable or rigid bracket junction or fixtures. The test must demonstrate that the whole buckle subsystem is able to withstand the specified load.

3.7.3.2.1.4 Evaluation to be done after the common environmental conditioning and durability cycling.

3.7.3.2.1.5 Reference GMW14311.

3.7.3.2.2 Dynamic Buckle/Latch Strength. The buckle assembly/latch junction should demonstrate a minimum dynamic impact of 18 kN when mounted at 30° inboard and 30° forward over a break edge located along the buckle strap.

3.7.3.2.2.1 The buckle assembly includes but is not limited to webbing, steel cable or rigid bracket junction or fixtures. The test must demonstrate that the whole buckle subsystem is able to withstand the specified load.

3.7.3.2.2.2 Reference GMW14311.

3.7.3.2.3 Acceleration Sensitivity. The buckle shall remain locked during and after any combination of vertical and lateral accelerations created by the tensioner used in the system. An evaluation is to be done before and after the common environmental conditioning and durability cycling.

3.7.3.2.3.1 Reference GMW14232.

3.7.3.2.4 Static Load Cam Out. The latch plate should have a statistically demonstrated ability to withstand an in-plane load of 4.45 kN applied at an angle of 30° without disengaging from the buckle.

3.7.3.2.4.1 Reference GMW14311.

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3.7.3.2.5 Side Impact Loading. End release buckles shall withstand a side impact of 40G without release or ejection of the latch plate.

3.7.3.2.5.1 Reference GMW14311.

3.7.3.2.6 Buckle Engagement Force. The engagement force required to insert the latch plate into the buckle should be 25 N maximum, (buckles may cycle up to ten times prior to insertion effort check).

3.7.3.2.6.1 Evaluation to be done before and after the common environmental conditioning and durability cycling.

3.7.3.2.7 Belt Buckle Release Force. The release force required to disengage the latch plate from the buckle should be between 10 N and 25 N (the release force is measured along the axis of button travel), with 13 N of pull force applied to the latch plate.

3.7.3.2.7.1 Evaluation to be done before and after the common environmental conditioning and durability cycling.

3.7.3.2.7.2 Reference GMW14311.

3.7.3.2.8 Post Loading Release. The maximum push button effort to release the latch plate from the buckle shall be 60 N in the following condition. After the buckle is subjected to a 15 kN load, the tensile load is then reduced to 300 N, and then checked for release force.

3.7.3.2.8.1 Evaluation to be done after the common environmental conditioning and durability cycling.

3.7.3.2.8.2 Reference GMW14311.

3.7.3.2.9 Buckle/Latch Engagement Function. The buckle design should guide the latch into the receiving channel, allowing for blind operation.

3.7.3.2.10 Buckle Release Function. The buckle release button should not require the user to position or move the hand or fingers in an unnatural way. Finger access areas should be free of all sharp edges and pinch areas.

3.7.3.2.11 Latch Plate Ejection. The latch plate shall be ejected beyond the buckle opening when the push button is activated. The buckle shall be positioned so that the latch plate is ejected upwards for this evaluation.

3.7.3.2.12 Inadvertent Release. The latch plate shall not eject from the buckle when a 40 mm diameter ball is used against the release button. The latch plate shall **not** eject from the buckle before the push button is depressed 3 mm.

3.7.3.2.12.1 Reference GMW14311.

3.7.3.2.13 Buckle/Latch Compatibility. When more than one source is supplying seat belt buckles and latch plates to a common design, the buckles and latch plates shall be interchangeable between these sources. Certification of the common buckles and latch plates will be required for interchangeability. Certification will be performed by all suppliers through an independent lab source.

3.7.3.2.14 Vibration.

3.7.3.2.14.1 Buckle/latch and Anchor Connection Vibration Noise. All buckle/latch and Anchor Connection assemblies should have an Instationary Zwicker Loudness of ≤ 1.5 sones N10. Evaluations to be completed in the vertical, fore/aft and lateral direction per test procedure GMW14011 Component Squeak and Rattle Testing using the vibration input frequencies and amplitudes are defined in Appendix D. A 10 N webbing load may be applied through the latch plate.

3.7.3.2.14.1.1 The requirement must be fulfilled with and without its intended latch plate inserted.

3.7.3.2.14.2 Vibration Tolerance. All buckles should be functional (latch, unlatch, switch function if applicable) after being subjected to 8 h of vibration from (5 to 20) Hz. Evaluation shall be done with the buckle in the expected installed position for 8 h and in the expected shipping position for 8h.

3.7.3.2.14.2.1 The latch plate should remain engaged during the full vibration test in the installed position.

3.7.3.2.14.3 Audible Buckle Latch. Audible feedback shall be provided to the user to indicate that the belt latch has engaged with the buckle. The loudness of this audible "click" shall be at least 2 and should not be > 46 sones when measured in accordance with procedures GMW14154 and GMW14155. This audible click shall **not** occur before the latch is fully engaged in the buckle.

3.7.3.2.15 Buckle/Latch Cycle Life. The buckle and latch shall have a minimum cycle life of 50 000 latch and unlatch cycles. The buckle and latch should meet tensile strength, cam out, buckle release force, push button binding, engagement force, side impact loading, minimum buckle housing separation force, latch ejection, post-loading release effort, buckle switch operation, latch operation immunity (buckle switch).

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3.7.3.2.15.1 Buckle/Latch Duty Cycle.

a. Test Condition: Ambient Temperature.

b. Insertion Force: 250 N.

c. Duty Cycles: 2000 Cycles.

d. Cycle/Minute: (10 – 20) cycles per minute.

e. Buckle shall be rigidly mounted.

f. Requirement: No fractured or broken components.

3.7.3.2.15.1.1 Reference GMW14311.

3.7.3.2.16 Preventing Disassembly. It shall **not** be possible to disassemble the buckle or latch plate assembly without the use of tools. Disassembly with the use of tools shall leave witness marks that would remain visible if the parts are reassembled.

3.7.3.2.17 Buckle Function. The buckle shall maintain its function with the cover removed, or displaced from design position when tested according to 3.7.3.2.19.1. The buckle shall **not** automatically release and the push button shall still operate properly. The cover shall **not** be used to retain any parts necessary to maintain integrity of the buckle.

3.7.3.2.17.1 Function at Full Attachment Torque. Buckles shall meet all specified functional requirements as defined in this technical specification and the SOR. Satisfying these requirements must be demonstrated as the buckle is installed under production conditions (seat structure, body structure, underbody interfaces, etc.) including to the specified fastener torque range (nominal, minimum and maximum).

3.7.3.2.18 Maintaining Function After Drop Testing. The buckle and switch shall meet all functional requirements after being dropped once each on each of its six sides from a height of 1 m on a hard, flat surface. The drop test should not cause any invisible damage that could affect function, or internal damage to the buckle or switch.

3.7.3.2.18.1 Reference GMW14309.

3.7.3.2.19 Buckle Housing Separation Force.

3.7.3.2.19.1 The minimum separation force of an end release buckle housing from the assembly in the longitudinal direction should be 750 N minimum. If the cover is displaced, then the buckle function must operate properly (see 3.7.3.2.17).

3.7.3.2.19.2 The minimum separation force of an end release buckle housing from the assembly in the lateral direction, (e.g., split cover open) should be 250 N minimum.

3.7.3.2.19.3 Reference GMW14311.

3.7.3.2.20 Shielding from Foreign Matter (Buckle). The buckle mechanism should be designed to minimize the entry of foreign matter that could affect the normal function of the buckle.

3.7.3.2.21 Finger Entrapment. It shall **not** be possible for a 9.5 mm spherical tool to bind in the buckle when operating the push button at any location and in any direction.

3.7.3.2.21.1 Reference GMW14311.

3.7.3.2.22 Finger Friendly Design. The buckle should be designed so that it does not pinch the operator's skin. The design should be finger and fingernail friendly and defined in the supplier's DFMEA.

3.7.3.2.23 Buckle Push Button Binding. When operating the buckle, the push button shall always return to its initial position. This should also be defined in the supplier's DFMEA.

3.7.3.2.24 Rattles. Buckles should not rattle against each other or against other hardware attached to the same anchor location when the belt system is not occupied. Engaged latch plates should not rattle in the buckle.

3.7.3.2.24.1 Reference GMW14793.

3.7.3.2.25 Buckle Switch Location. The buckle switch should be located within the buckle or retractor, be fully protected, and not removable without the use of tools. Switch lead wires should not be visible between the buckle and the point at which the switch lead wire enters the webbing sleeve.

3.7.3.2.26 Buckle Switch Electrical. The buckle switch state shall be normally closed when the latch is not inserted in the buckle.

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3.7.3.2.26.1 The buckle switch shall meet the applicable electrical requirements from GMW3431. The buckle switch rate of actuation shall be a minimum of 10 mm/s latch plate velocity and a maximum of 60 mm/s latch plate velocity.

3.7.3.2.26.2 Webbing and Cable Mounted Buckle Switch/Wire Durability.

a. **Test Condition:** Ambient temperature.

b. **Cycles:** 3000 cycles of both torsion and axial displacement of the buckle assembly.

c. One cycle for torsion displacement consists of rotating the buckle head ±60° about an axis through the center line of the buckle parallel to the webbing or cable. The webbing or cable is to be controlled by a holding plate. See, Figure R1.

d. One cycle for axial displacement consists of translating the buckle head 50 mm toward the anchor and returning to its initial position. This displacement should be measured from the bottom of the buckle head. The webbing or cable is to be controlled by a holding plate. See Appendix R, Figure R2.

e. **Cycle/Minute:** (10 – 20) cycles per minute.

f. **Requirement:** The buckle switch and wire shall demonstrate full function after cycling per Table 1 or Table 2, as applicable.

3.7.3.2.26.3 Reference Appendix R.

3.7.3.2.27 Locking Latch Webbing Slip. Webbing should be statistically demonstrated to not slip through the locking adjustable latch more than 25 mm when the adjustable latch is loaded to 22.24 kN loop load (where locking latch required by the Design Release Engineer).

3.7.3.2.27.1 Reference GMW14312.

3.7.3.2.28 Locking Latch Adjustment Effort. The effort to adjust the locking latch should be statistically demonstrated to be between 1.0 N and 13.4 N where locking latch required by the Design Release Engineer.

3.7.3.2.28.1 Reference GMW14312.

3.7.3.2.29 Semi-Locking/Cinching (Child Restraint System) Latch Webbing Slip. All cinching latches should be statistically demonstrated to hold a 267 N straight tensile load with < 25 mm of webbing slip through the latch.

Note: The latch must ultimately pass FMVSS 208 in the vehicle.

3.7.3.2.29.1 Reference GMW14312.

3.7.3.2.30 Free Falling Latch (Three Point Systems) Requirement. The latch shall fall on vertically suspended webbing at a minimum rate of 1 m in 2 s.

3.7.3.2.31 Buckle Switch Malfunction. Buckle switch malfunction shall **not** affect buckle operation.

3.7.3.2.32 Buckle Switch Operation. The buckle switch shall operate when the buckle is latched. The push button shall **not** operate the switch. Latch plate movement shall **not** affect switch operation.

3.7.3.2.32.1 Evaluation to be done before and after the common environmental conditioning and durability cycling.

3.7.3.2.33 Buckle Sticking Test. The buckle shall fulfill the following requirements. Pour 0.2 l cola (carbonated beverage with sugar) into the latch plate slot of a vertically mounted buckle. Let it dry in room temperature for 48 h. Insert a latch plate and check for partial locking. The buckle should fully lock and fully eject the latch plate when released by the push button (effort to release 2 times FMVSS 209) or shall **not** lock or retain the latch plate.

3.7.3.2.33.1 Reference GMW3431 for spillage immunity.

3.7.3.2.34 Buckle/Latch Load Durability Test. The buckle/latch mechanism or anchor connection shall sustain no damage, loss of function or eject the latch plate when submitted to the 50 000 load/unload cycles of 500 N in the direction of the latch pull out.

3.7.3.2.34.1 After the test, the buckle/latch mechanism or anchor connection (when applicable) should meet requirements such as tensile strength, cam out, buckle release force, push button binding, engagement force, side impact loading, minimum buckle housing separation force, latch ejection, post-loading release effort, buckle switch operation, latch operation immunity.

3.7.3.2.34.2 Reference GMW14311 for test procedure.

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3.7.3.2.35 Buckle Anti-Rotation Pin Strength. The anti-rotation pin should not break at an applied torque of 70 Nm but it should break at 150 Nm torque.

3.7.3.2.35.1 This requirement applies only for front buckles to the seat structure.

3.7.3.2.36 Pivot Joint.

3.7.3.2.36.1 Angles and Forces. The pivot joint between the buckle head and the attachment to the seat or to the floor shall fulfill the stated tilt angles and forces from Table E1 (see Appendix E) before and after the endurance testing.

3.7.3.2.36.1.1 The force shall be measured perpendicular to the webbing slot of the latch plate when engaged in the buckle. The force shall be measured over the whole tilt angle range required and shall be within required levels as stated in this Appendix E, Table E1.

3.7.3.2.36.1.2 The joints shall, when tested in its normal installation in vehicle, not be a source for disturbing rattle or squeak under various riding and handling conditions for buckles with engaged latch plates as well as for buckles without engaged latch plate.

3.7.3.2.36.2 Pivot Joint Endurance. All tests according to the following 3.7.3.2.36.2.1 and 3.7.3.2.36.2.2 shall be made in the as received condition and after the environmental conditioning as specified in Appendix G.

3.7.3.2.36.2.1 Spring Loaded Pivot Joint Cycle Life Test. Buckle assemblies with spring loaded pivot joint between Buckle and Attachment Bracket shall manage to be tilted to an angle of 5° towards the occupant for 50 000 cycles cross-car with a speed of (10 ± 1) cycles/minute. There shall be no rattling or squeaking noise when moving the buckle in any pivot direction during or after the test and the spring forces as specified in Table E1 (see Appendix E), shall be met. Evaluation to be done before and after the common environmental conditioning and durability cycling (Appendix G).

3.7.3.2.36.2.2 Buckle Strap Pivot Joint (Friction Element). Buckle assemblies attached to the seat or body structure including a pivoting friction element shall meet the forces as specified in 3.7.3.2.34 before and after 10 000 cycles back and forth motions in fore and aft directions ±15° around nominal installation angle with a speed of (10 ± 1) cycles/minute. There shall be no rattling or squeaking noise when pivoting the buckle after the test. Evaluation to be done before and after the common environmental conditioning and durability cycling (Appendix G).

3.7.3.2.37 Cable Attachment.

3.7.3.2.37.1 Bending Cycle Life Test. This requirement is applicable to buckles with steel cable only.

3.7.3.2.37.1.1 Buckle or anchor connection assemblies attached to the seat or body structure by a flexible cable shall be able to withstand 10 000 bending cycles in fore and aft directions followed by 10 000 bending cycles in cross-car direction ±25° around nominal installation angle with a speed of (30 ± 3) cycles/minute. There shall be no cable breakage or rattling/squeaking noise after the test.

3.7.3.2.37.2 Torsion Cycle Life Test. This requirement is applicable to buckles with steel cable only.

3.7.3.2.37.2.1 The cable shall be able to withstand 500 torsion cycles ±50° around nominal position with no cable breakage or damage. There shall be no rattling or squeaking noise when twisting the buckle after the test.

3.7.3.2.38 Dynamic Locking Latch Plate (DLLP). The DLLP must fulfill the requirements stated for free falling latch plates (see 3.7.3.2.30) and the following.

3.7.3.2.38.1 Activation of the DLLP. The DLLP must not lock with < 40 N of tension in the lap and shoulder belt.

3.7.3.2.38.2 Locking Performance. After activation the DLLP shall lock the seat belt to prevent belt slip (< 5 mm) from shoulder to lap belt up to a minimum delta force between lap and shoulder belt of 6 kN when tested dynamically according to Appendix L.

The DLLP should not prevent the belt slip from lap to shoulder belt, if the shoulder belt force is higher than the lap belt.

3.7.3.2.38.3 DLLP Activation Cycles. The DLLP must withstand 10 000 full activation cycles, and 100 000 partial activation cycles without spring failure (cycled in 1000 full activation and 10 000 partial activation increments). Partial stroke is considered 70% of full stroke, or alternate as agreed to by GM engineering.

3.7.3.2.38.4 Activation Noise. There shall be no rattling or squeaking noise when stowed (internal), worn, or adjusted.

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