SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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Recommended Design and Performance Standard for Seats with Integrated Lap and Shoulder Restraints

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Seat Belt Systems Standards Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. ***Scope***—This SAE Recommended Practice defines minimum performance standards, qualification requirements, and minimum documentation requirements for Integrated Lap and Shoulder Restraint (to) equipped Seats (IL&SRTS). The goal is to achieve comfort, durability, and occupant protection under expected and foreseeable normal operation loads. The document attempts to define test and evaluation criteria to demonstrate performance at peak operational loads, while attempting to maintain the seat's ability to meet loads set forth in FMVSS 207, 210, and ECE 14, 16, and 17.

This document also provides guidance for design by enumerating certain design goals to enhance comfort, serviceability, and safety. Guidance for test procedures, measurements, equipment, and interpretation of results may be presented to promote uniform techniques and to achieve acceptable data.

While this document addresses system performance, responsibility for the seating systems is divided between the seat supplier and the vehicle OEM. The seat suppliers' responsibility consists of meeting all the established system performance requirements and obtaining and supplying to the vehicle OEM all the data prescribed by this document. The vehicle OEM has the ultimate system responsibility in assuring that all requirements for safe seat applications have been met.

1.1 Applicability—This document addresses the static performance criteria for IL&SRTS systems applied to licensed motor vehicles for purposes of transportation.

2. ***References***

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J140—Seat Belt Hardware Test Procedures
SAE J141—Seat Belt Hardware Performance Requirements
SAE J369 1994—Flammability of Polymeric Interior Materials—Horizontal Test Method
SAE J383—Motor Vehicle Seat Belt Anchorage's—Design Recommendations
SAE J384—Motor Vehicle Seat Belt Anchorage's—Test Procedure
SAE J385—Motor Vehicle Seat Belt Anchorage's Performance Requirements
SAE J782b—Motor Vehicle Seating Manual
SAE J826—Devices for Use in Defining and Measuring Vehicle Seating Accommodation

SAE J879—Motor Vehicle Seating Systems
SAE J885—Human Tolerance to Impact Conditions as Related to Motor Vehicle Design
SAE J1100—Motor Vehicle Dimensions

2.1.2 DIN PUBLICATION—Available from DIN, Beuth Verlag GmbH, D-10772, Berlin.

DIN 75410-Part 2

2.1.3 ECE PUBLICATIONS—Available from United Nations Economic Commission for Europe, Palais Des Nations, CH-1211, Geneva 10, Switzerland.

ECE R 14
ECE R 16
ECE R 17

2.1.4 FMVSS PUBLICATIONS—Available from the Superintendent of Documents, U. S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

FMVSS 207
FMVSS 210

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J114-1986—Seat Belt Assembly Webbing Abrasion Performance Requirements
SAE J787b-1966—Motor Vehicle Seat Belt Anchorage
SAE J800-1986—Motor Vehicle Seat Belt Assembly Installation
SAE AS 8049-1990—Performance Standard for Seats in Civil Rotorcraft and Transport Aircraft

2.2.2 ECE PUBLICATIONS—Available from United Nations Economic Commission for Europe, Palais Des Nations, CH-1211, Geneva 10, Switzerland.

ECE R 32
ECE R 94
ECE R 95

2.2.3 FMVSS PUBLICATIONS—Available from the Superintendent of Documents, U. S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

FMVSS 201
FMVSS 202
FMVSS 208
FMVSS 209
FMVSS 302

2.2.4 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 1417—Automobiles—Anchorages for seat belts

2.3 Order of Precedence—In the event of a conflict between the text of this document and the references cited herein, the text of this document should take precedence.

3. General Description

3.1 Guidance—This section provides the designer with information, which experience has shown, enhances comfort, serviceability, and safety. Satisfactory design may include features that differ from this guidance manual.

3.1.1 Attention should be given to ergonomic, utility, and comfort aspects of seats.

3.1.2 Comfortable support and protective retention of the occupant under all belted driving conditions is the primary consideration in IL&SRTS design.

3.1.3 Front passenger seats and restraints should accommodate occupants encompassing the 5th female Hybrid III through the 95th male Hybrid III. The restraint attachments and lengths should be adjustable to function properly in safely retaining this range of occupant sizes. In such cases as front passenger seats where the passenger airbag may be disabled, the IL&SRTS should accommodate forward and rearward facing childseats. Childseat two point ISOFIX attachments with upper tether attachments are recommended designed into the seat. Rear or rows of seats rearward of the front seating positions should accommodate occupants in child seats up through the 95th percentile male occupant in restraint design.

3.1.4 The seat system should be designed to absorb energy with minimal rebound where practical. Separation of joints and attachments should not occur first in the primary load path of the structure.

3.1.5 If the seat design incorporates energy-absorbing (EA) features (i.e., deformation initiators) and the structure absorbs energy through deformation or stroking, shields, or other means should be provided in the seat design to maintain clearances for the deformation or stroking to allow for occupant egress and minimize potential hazardous sharp edges or crushing structures to be exposed to occupants in or surrounding the seat.

3.1.6 Restraint systems, while fastened, should not impede access to vehicle controls.

3.1.7 The seat system should incorporate at least one or more visual cues and optionally, an auditory cue so those primary structural elements could be inspected to detect consumption of EA or deterioration of structural performance that would impact safety.

3.1.8 Restraint system anchorage's including belt, head restraint, and seat backs, should provide self-aligning or follow type features to optimize these restraint systems. If self-aligning features are not incorporated, designs minimizing impediments to the alignment or stroking of restraint features should be considered and tested in the most adverse seat adjustment. The anchorage system should minimize the possibility of incorrect installation or inadvertent disconnection of the restraint system.

3.1.9 Environmental design considerations noted in SAE belt restraint recommended practices J140, J141, J383, J384, and J385, as well as seat design recommended practice SAE J782b should be incorporated.

3.1.10 Materials should be selected that minimize smoke and toxic emissions in the presence of fire. SAE J369 JAN94. (Other current examples: See MSJZ 8-20 (Ford), GM2726M (GM), and M9H72A (Chrysler).)

3.1.11 On seats which may be user detached from the vehicle floor, such as on removable or adjustable in the floor architectures, the attachment design, and fittings for the attachment of the seat to underbody should be the strongest element and structural link to vehicle structure in the seat system. Attachments should be positive attachment design with high reliability providing the highest integrity of the fastening system. See 3.2.3.

3.1.12 All exposed portions of the seat, and those hidden/trimmed structure radii above the seat's 'R' point should have projection radii >5.0 mm and meet the energy absorption criteria noted in 3.2.1.

3.1.13 Electrical or electronic devices incorporated in a seat should be provided with appropriate shielding and provisions to minimize electrical interference with diagnostic or deployment electronics on or adjacent the seat system.

3.2 Requirements—This section provides additional requirements for seat and restraint system designs that are not described elsewhere in this document.

3.2.1 Seats should be designed to provide impact protection for the occupant. This protection should be provided at all seat positions that may be occupied. All portions of seats above the vehicle belt-line, or above a radius of 736 mm from the SgRP of a seating position behind the seat should meet an energy absorption criteria of $a \leq 80g$ for $t \geq 3$ ms. Re: SAE J885.

3.2.2 Seat elements should be designed so that, when evaluated under the test conditions of this document, they do not leave hazardous projections that could contribute to occupant injury or impede egress of the occupant from the vehicle.

3.2.3 Seat equipped quick-release type fittings, adjustment handles, and buttons should be designed, installed, and protected such that their positions can be visually and witness mark verified, making incorrect installation or inadvertent actuation unlikely.

Positive, or preferably continuously engaged seat adjustment features, such as fore-aft seat adjuster tracks, seat back recliners and seat back fold locks for entry/egress should be provided. Visual warning signals or visual tell-tales indicating non-positive locking should be provided, and seat back deformation use indication could be incorporated into such signals. Vehicle lock-out provisions should be considered when seat is not positively engaged.

Removable seats should have positive locking devices that provide visual and auditory warning signals or tell-tales indicating there is not seat to underbody positive locking. Again, vehicle lock-out provisions should be considered when seat is not positively engaged.

Adjustment handles and controls should be designed to protect against inadvertent actuation or adjustment, and apply cognitive intuitive design where applicable to heighten conscience adjustment or release of seat related systems.

3.2.4 Electrical or electronic devices incorporated in a seat should be supplied with grounding.

3.2.5 Adjustable features (seat swivel, storable armrests, storage pockets) should be designed so that they can be adjusted by the seated occupant without the release of the belt restraint system. In addition, these items should not dislodge or open under the test conditions of this document in a manner that could contribute to occupant injury or impede egress.

3.2.6 When a storage pocket is incorporated in the seat back, the seat will be tested assuming a 20 g restrained inertia mass of 9 kg (1.8 kN) at the seat back cg. On those seats that may be exposed to cargo, such as vans, wagons, or passenger cars with second row folding seats or trunk accessibility through the rear seat, an additional inertial load of 36 kg (7.20 kN) will be applied, tested per Section 5.

3.2.7 The seat cushion should be designed so that only a positive inclination angle is possible between the occupants depressed 'D' point and an anti-submarining reactionary surface forward of this 'D' point. (The 'D' point is the lowest point on the 2D manikin buttocks region drawn between the manikin and the seat cushion on the vehicle architecture drawing. Re: SAE J826 and J1100.)

3.2.8 The seat structure, trim, and occupant restraint system should be considered to act as a total system. Substitution of subsystems or components of the seat should be made only on the basis of additional tests or rational analysis based on tests.

3.2.9 Rearward facing seats should meet all other seat requirements of such seats with the additional requirements set forth in this document for forward-facing seats.

3.3 Fire Protection Requirements

3.3.1 All materials and assemblies should be tested in accordance with SAE J369.

3.3.2 If ashtrays are installed in or attached to the seat, they should be self-contained, completely removable types. The ashtray housing should be fire-resistant and sealed to prevent burning materials from falling into the seat should the housing be missing.

3.3.3 Electrical components in a seat should have provisions to precluded initiation of a fire should overheating occur.

4. Seat Deformation Performance Requirements

4.1 Deformation is defined in the seat system only. Requirements are described to isolate the seat system from the vehicle, insuring integrity of seat system components prior to vehicle applications. Tuning of the seat or the vehicle with the seat in the vehicle environment is still necessary for optimization.

4.2 Testing should occur on a rigid fixture representing the appropriate seat to vehicle geometrical interface of the vehicle on a horizontal plane. The seat adjuster is to be positioned at its weakest longitudinal performance stance, normally full rearward and full up if such adjustments are available. All dimensions and angles necessary for seat set-up would be translated longitudinally and vertically from the seat's design position (SgRP, 'H' point) to the seat's weakest adjustment stance (SRP and full up).

4.3 Seat attachment to the rigid fixture should be, as the seat would be attached in the vehicle. A safety link may be added to the seat for test purposes, however, the link should remain slack throughout testing for testing to remain valid.

4.4 Deformation within the document's recommendation criteria is acceptable so long as there is no separation of the seat between the fixture or between the seat cushion and seat back. There must be no separation, free flight translations, or release of engagement of the seat-adjuster mechanism or other seat-adjusting device. Latches providing seat back release for egress would need to be operable; however, other adjustments do not need to be functional after testing.

4.5 Seat deformation should be measured as the difference in x, y, and z plane positions between the initial and final location of the effective shoulder belt anchorage point on the seat back. Measurement and path trace of elastic deformation should be recorded and reviewed to insure elastic deformation does not exceed limits. Re: DIN 75410-Part 2.

4.6 Allowable longitudinal deformation is defined as follows in Figure 1.

a. The longitudinal location of the effective shoulder restraint anchor point ("X") is determined from the vehicle packaging drawing. (See Figure 1.)
b. A lateral, vertical plane is drawn 150 mm forward of the corresponding seat location SgRP.
c. The shortest longitudinal dimension between these two entities is the allowable longitudinal displacement prescribed.

4.7 Allowable vertical deformation is defined as follows:

a. The vertical displacement of the effective shoulder anchor point should maintain the geometry defined in SAE J383, J384, J385, and J141.

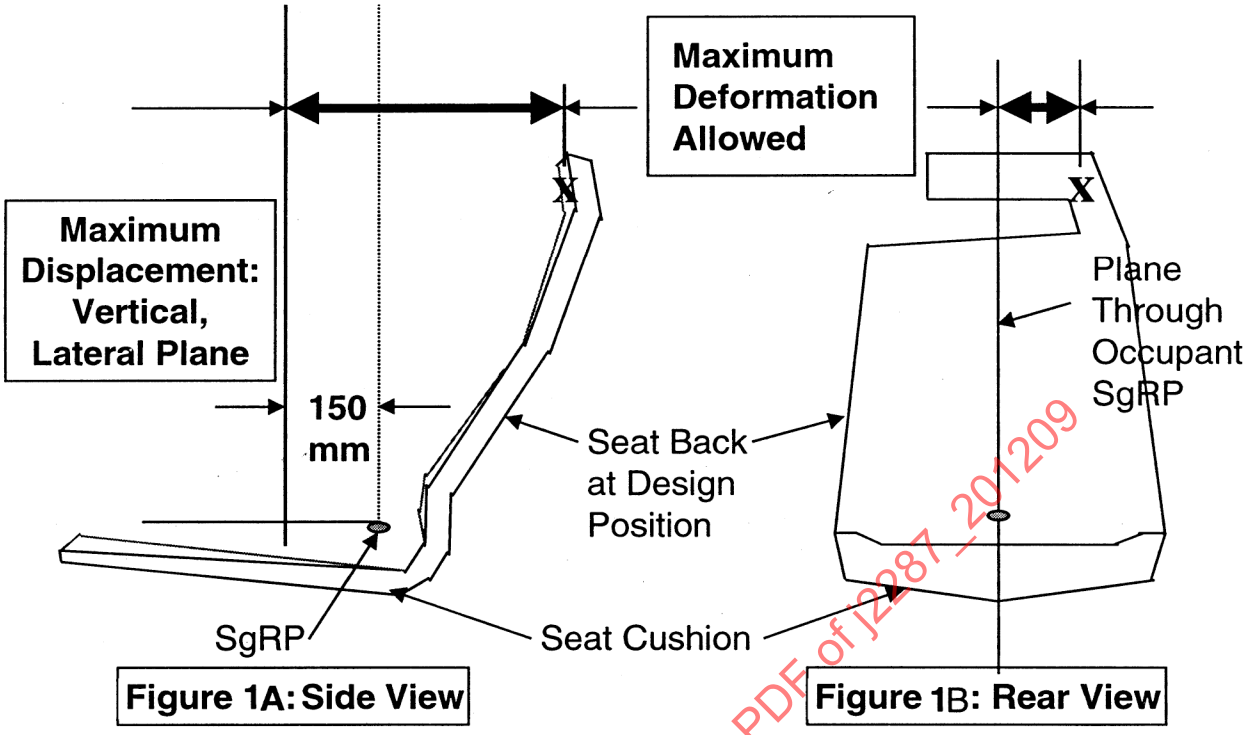

FIGURE 1—SIDE/REAR VIEWS—SEAT

4.8 Lateral deformation is defined as follows:

a. The lateral location of the effective shoulder restraint anchor point ("X") is determined from the vehicle packaging drawing. (See Figure 1B.)
b. A longitudinal, vertical plane through the centerline of the seat is drawn.
c. The shortest lateral dimension between these two entities is the allowable lateral displacement prescribed.

5. Strength Testing

5.1 The document applies a quasi-static test procedure to standardize both test procedure and comparison of data between test sources.

NOTE—Quasi-static is used to denote the potential that visual displacement velocity may be observed in the testing.

5.2 Seats should be designed and demonstrated by test that they will withstand, without primary load path failure or deformations exceeding limits defined in the following sections.

5.3 It is assumed that the IL&SRTS apply a type 2 belt restraint. The force applied to the test belt webbing around the pelvic and torso blocks should be 13.3 kN. Where laterally adjacent designated seating position occurs, (i.e., a center lap belt shares the inboard lap anchor of the tested seat) an additional 6.7 kN is applied to the pelvis block test webbing.

5.3.1 The force through the seat cg should be 20 times the seat total mass; SAE J879b loads.

NOTE—Because the moment of the recliner is being tested with the seat back structure to determine deformation, the seat back must not be gusseted as in SAE J879b.

5.3.2 Seat backs of seats, which constitute the limits of a cargo area, (i.e., either exposed to the vehicle's trunk or the seats at the truck can be folded down to expose the seat to cargo) are subjected to the additional equivalent force of two 18 kg masses undergoing a 20 g deceleration. This force, assumed coupled in this test, is approximated by 36 kg x 20 g = 7.20 kN. If the seat back contains a storage pocket, an additional 1.80 kN load is applied, corresponding to a 9 kg related inertial force. Each of these forces are pulled through the seat's cg location with the seat mass loads. (This is to minimize potential interference of independent load paths applied in the test.)

5.3.3 The loads are applied by the load profile shown in Figure 2, with each load element applied simultaneously as shown in Figure 3.

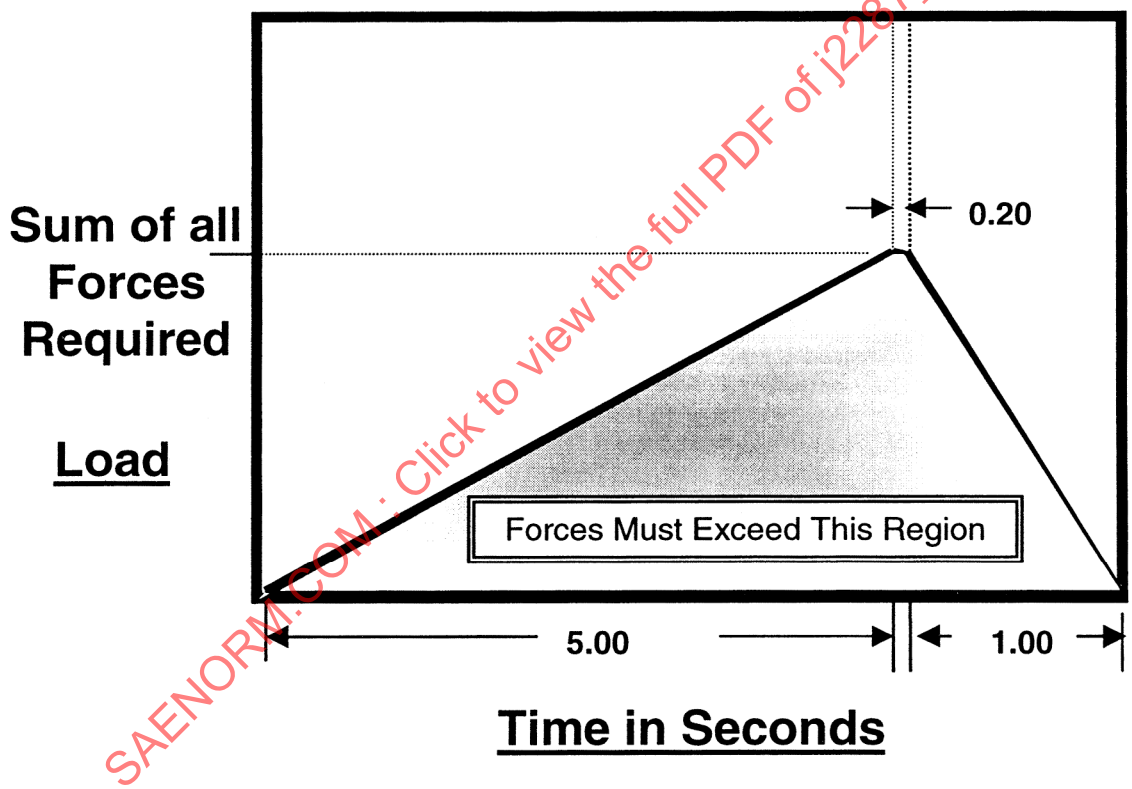

FIGURE 2—IL&SRTS SEAT AND BELT LOADING