SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J383 JUN1995

(R) Motor Vehicle Seat Belt Anchorages - Design Recommendations

RATIONALE

This standard has been updated to be compatible with FMVSS requirements.

1. SCOPE

This SAE Recommended Practice specifies design recommendations for the location of seat belt assembly anchorages which will promote proper transfer of occupant restraint forces on the strongest parts of the human anatomy to the vehicle or seat structure. Test procedures are specified in SAE J384.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications.

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J384 Motor Vehicle Seat Belt Anchorages - Performance Requirements and Test Procedure

SAE J826 Devices for use in Defining and Measuring Vehicle Seating Accommodation, May 1987

SAE J1100 Motor Vehicle Dimensions, June 1984

Federal Motor Vehicle Safety Standard 208 - Occupant Performance

Federal Motor Vehicle Safety Standard 209 - Seat Belt Assemblies.

Federal Motor Vehicle Safety Standard 210 - Seat Belt Assembly Anchorages

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3. DEFINITIONS

3.1 ACROMION

The outer end of the scapula (shoulder blade). See Figure 1.

3.2 ANCHORAGE

Structural attachments that transfer occupant restraint forces of the seat belt assembly to the vehicle or seat structure.

3.3 ANTERIOR SUPERIOR ILIAC SPINE (ASIS)

Anterior extremity of the iliac crest of the pelvis. See Figure 1.

3.4 ATTACHMENT HARDWARE

Attachment hardware means any or all hardware designed for securing the webbing of a seat belt assembly to a motor vehicle.

3.5 BELT ANGLE REFERENCE POINT

The point 64 mm (2.5 in) forward of and 10 mm (0.375 in) above the Seating Reference Point. Also known as the FMVSS 210 “X-Point”.

3.6 BELT CONTACT POINT (BCP)

The point used to determine the angle of the safety belt anchorages in relation to the SAE two-dimensional drafting or CAD template. It is the nearest rigid contact point of the seat belt with the hardware attaching it to the anchorage. The component on which the belt contact is located must be capable of sustaining a force that might be imposed by the webbing of a seat belt assembly. It may or may not be the actual belt anchorage depending on the configuration of the belt hardware and routing of the webbing.

3.7 CLAVICLE

The bone that connects the scapula to the sternum. Also known as the collarbone. See Figure 1.

3.8 DESIGNATED SEATING POSITION (DSP)

A seat location that has a seating surface width of at least 330 mm (13 in) as described and further defined in FMVSS 208.

H- Point (Hip-Point)The mechanically hinged hip point of a manikin which simulates the actual pivot center of the human torso and thigh, described in SAE Recommended Practice J826, “Manikins for Use in Defining Vehicle Seating Accommodations,” November 1962.

3.9 SEATING REFERENCE POINT (SgRP) as defined in the Federal Register, 9/13/90.

The unique design H-point, as defined in SAE J1100 June 1984, which:

(1) Establishes the rearmost normal design driving or riding position of each designated seating position, which includes consideration of all modes of adjustment, horizontal, vertical and tilt in a vehicle;

(2) Has X, Y, and Z coordinates, as defined in SAE J1100 JUN 1984, established relative to the designed vehicle structure;

(3) Simulates the position of the pivot center of the human torso and thigh; and

(4) Is the reference point employed to position the two-dimensional drafting template with the 95th percentile leg described in SAE J826 May 1987, or if the drafting template with the 95th percentile leg cannot be positioned in the seating position, is the most rearward adjustment position of the seating position.

3.10 SEAT BELT ASSEMBLY

Any strap, webbing, or similar device designed to restrain an occupant in a motor vehicle during a crash. Includes all necessary buckles, fasteners, and hardware designed for installing the seat belt assembly in a motor vehicle.

3.11 SHOULDER REFERENCE POINT (SHRP)

A point 563 mm (22.16 in) above the design H-Point along the torso centerline of the SAE two-dimensional drafting template described in SAE J826 and shown in Figure 6. This dimension, added to the dimension of 97.5 mm (3.84 in) from the H-Point to the buttocks flesh line at an angular relationship of 90 degrees between the torso and thigh segment of the two-dimensional drafting template, has been found to be representative of the shoulder height of the 99th percentile of the adult male driver population

3.12 STERNUM

A flat bone that lies in the middle part of the rib cage. Also known as the breastbone. See Figure 1.

3.13 TORSO LINE

Line connecting the H-Point and the Shoulder Reference Point (SHRP).

3.14 TYPE 1 SEAT BELT ASSEMBLY

A lap belt for pelvic restraint as defined in FMVSS 209.

3.15 TYPE 2 SEAT BELT ASSEMBLY

A combination of pelvic and upper torso restraints as defined in FMVSS 209.

3.16 SUBMARINING

The phenomena where the Anterior Superior Iliac Spine (ASIS) of the pelvis slides beneath the lap portion of a properly worn seat belt during a crash. This can result in compression of the soft portion of the occupant's abdomen. Improper initial placement of the lap belt over the pelvis is not submarining.

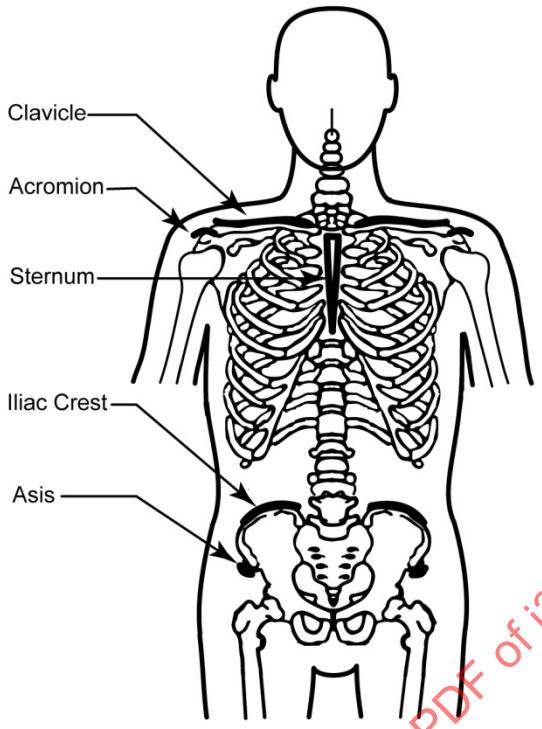

FIGURE 1 - KEY ANATOMICAL LANDMARKS

4. INSTALLATION CONSIDERATIONS

Seat belt anchorages for a Type 1 or a Type 2 seat belt assembly shall be installed for each designated seating position in passenger cars for which a Type 1 or Type 2 seat belt assembly is required by FMVSS 208.

4.1 General Considerations for Seat Belt Pelvic Restraint Anchorage Location

Many factors influence the selection of particular seat belt system hardware geometry. No one choice will be appropriate for all vehicles. Each vehicle generally has its own unique geometry that has been designed specifically for that vehicle. The decision on where to locate anchorages involves the balancing of sometimes competing requirements such as comfort, ease of use, fit, and performance in a wide variety of crash types. A particular geometry cannot be solely designed to any one requirement, but must instead appropriately balance all requirements

The final pelvic restraint belt angles are ultimately a balance between occupant performance in many types of reasonably foreseeable crashes, overall vehicle design considerations and occupant kinematics. Such considerations may be influenced by any or all of the following:

- Occupant size;
- Type of crash;
- Overall vehicle dimensions, interior accommodations, and crash pulse;
- Seat cushion compression and/or seat deflection;
- Seat ramps and other equivalent structure beneath the cushion;
- Seat cushion angle, seat back angle, and seat cushion height above the heel point;
- Proximity of knee bolsters or similar structures in front of the knees of the occupant;
- Initial length and elongation characteristics of belt webbing;

- Type of restraint system and restraint system features (air bags, pretensioners, etc.);
- Height of the buckle;
- Location of upper torso restraint anchorage;
- Stiffness of components which are belt contact points;
- Location of the belt contact points;
- Manner in which the belt is worn and how the occupant is seated;

4.2 Lap belt angle alone is not a reliable indicator whether an occupant will submarine. However, good occupant lower torso kinematics is generally promoted with a more vertical pelvic belt angle. Particular attention should be placed to smaller size occupants and older children who have outgrown child restraints because the ASIS is generally lower relative to the seat on smaller occupants and the potential for submarining is increased.

4.3 Vehicle crash tests, sled tests, or computer simulations should be conducted during vehicle development to assess the tendency of occupants to submarine. One effective evaluation method used to assess submarining risk in a dynamic environment is an ATD with iliac spine load cells. The load cell data can be used to assess the occurrence and risk of submarining. Lap belt load data and film analysis of occupant kinematics can also be used to assess the risk of submarining.

5. LOCATION CONSIDERATIONS FOR SEAT BELT PELVIC RESTRAINT ANCHORAGES

The lap portion of the belt must be capable of being worn low and snug on the hips, just touching the thighs as pictured in Figure 2.

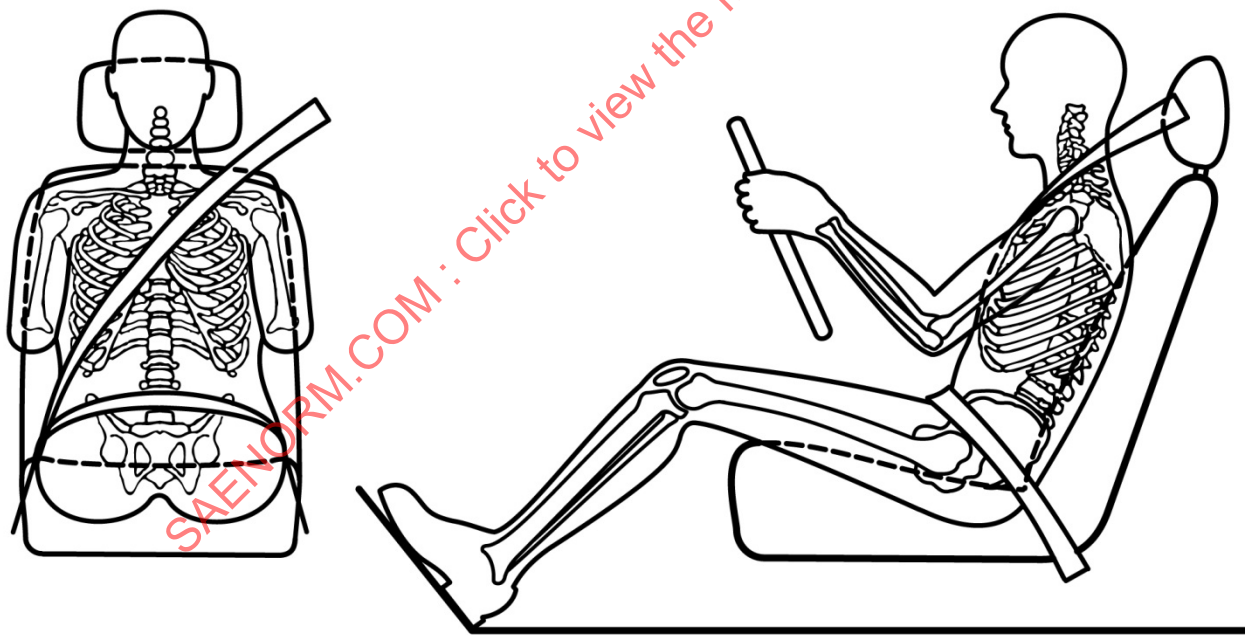

FIGURE 2 - SEAT BELT SHOULDER AND LAP BELT ROUTING

5.1 Each anchorage must be examined independently for proper location (inboard lap anchorage, outboard lap anchorage, and upper torso anchorage).

5.2 Seat belt anchorages for occupants of seats where the belt does not bear upon the seat frame (passes outside the seat or through the seat cushion), and are not attached to the seat.

5.2.1 Non-Adjustable Seats:

A line from the Seating Reference Point to the nearest belt contact point shall form an angle with the horizontal of not less than 30 degrees and not more than 75 degrees. See Figure 5.

5.2.2 Adjustable Seats (movable in the fore and aft direction):

A line from the belt angle reference point 64 mm (2.5 in) forward of and 10 mm (0.375 in) above the Seating Reference Point to the nearest belt contact point shall form an angle with the horizontal of not less than 30 degrees and not more than 75 degrees. See Figure 6.

5.3 Seat belt anchorages for occupants of seats where the belt does not bear upon the seat frame, and are attached to the seat (regardless whether or not if the seat is adjustable).

A line from the seating reference reference point to the nearest belt contact point on the seat frame shall form an angle with the horizontal of not less than 30 degrees and not more than 75 degrees. See Figure 4.

5.4 Seat belt anchorages for occupants of seats where the belt does bear upon the seat frame (regardless of whether or not it is attached to the seat, or whether or not the seat is adjustable).

A line from the Seating Reference Point to the nearest belt contact point on the belt with the hardware attaching it to the seat structure shall form an angle with the horizontal of not less than 30 degrees and not more than 75 degrees. And;

In the side view where a direct belt routing is interrupted by an intervening load-bearing member and is not located on the seat - the anchorage shall be located rearward of the rearmost point over which the webbing passes on the intervening member. That determination should be made for movable seats when placed in the rearmost normal position. See Figure 7.

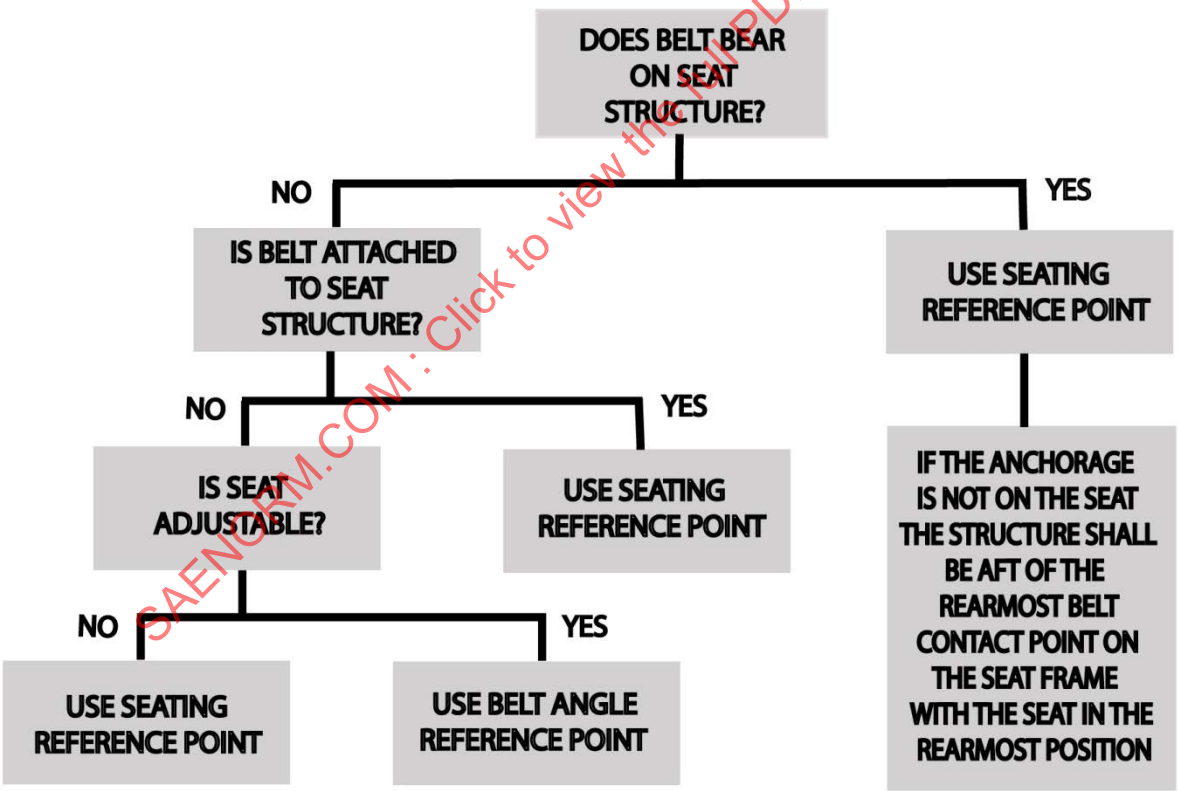

FIGURE 3 - LOWER ANCHOR ZONE DETERMINATION AND RANGE

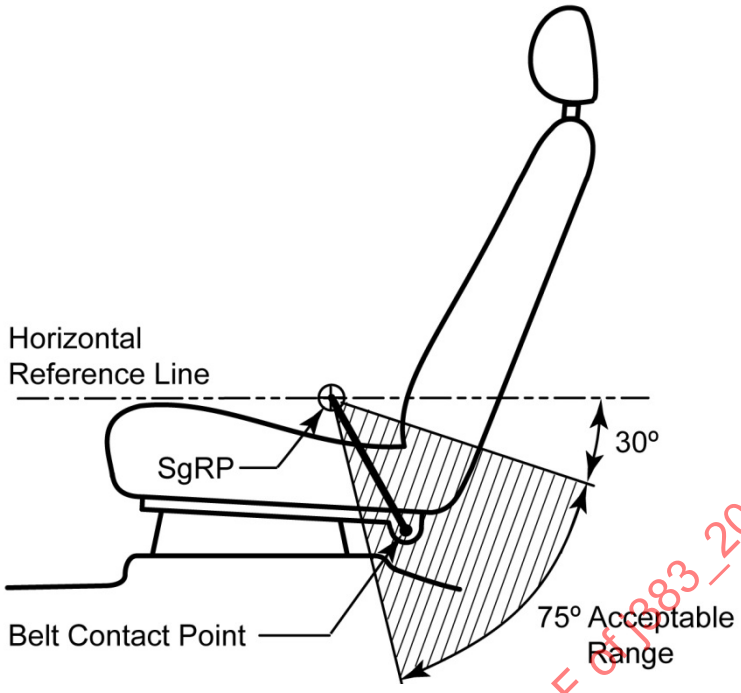

FIGURE 4 - BELT DOES NOT BEAR ON SEAT FRAME AND IS ATTACHED TO SEAT

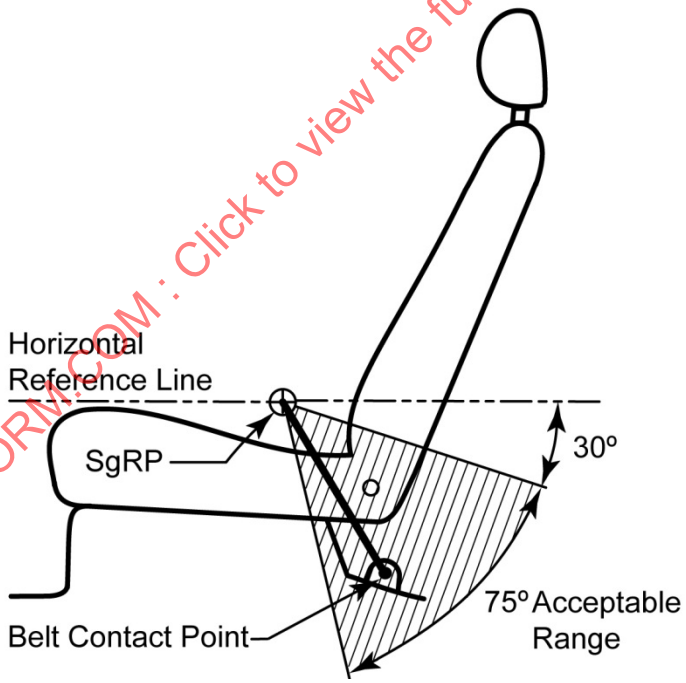

FIGURE 5 - BELT DOES NOT BEAR ON SEAT FRAME AND IS NOT ATTACHED TO SEAT
NON-ADJUSTABLE SEAT

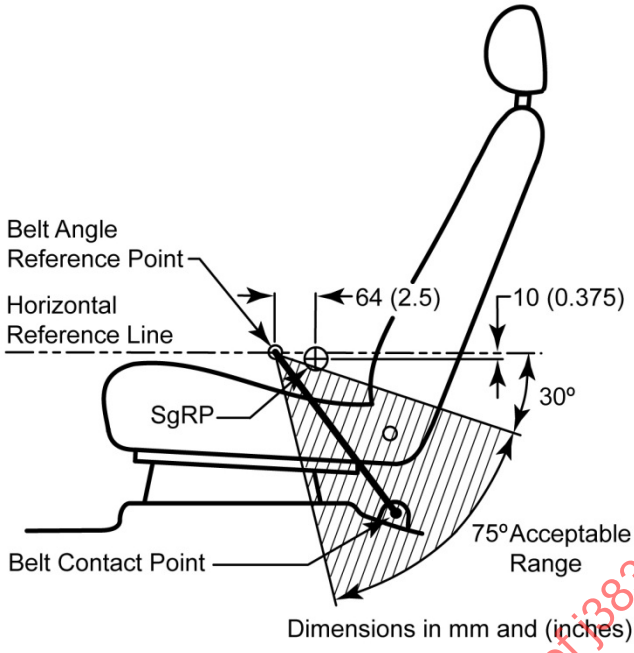

FIGURE 6 - BELT DOES NOT BEAR ON SEAT FRAME AND IS NOT ATTACHED TO SEAT ADJUSTABLE SEAT

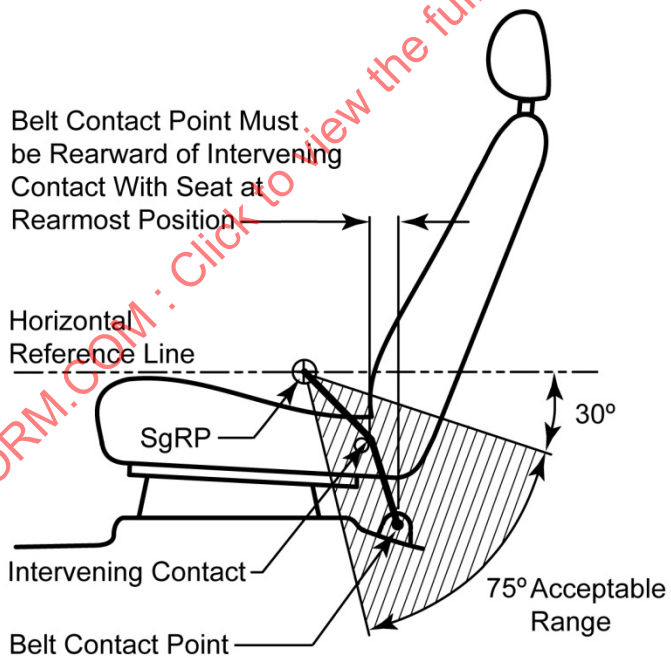

FIGURE 7 - BELT BEARS ON SEAT FRAME
REGARDLESS IF THE SEAT IS ADJUSTABLE OR ANCHORAGE IS ATTACHED TO THE SEAT

5.5 Lateral Location for all Pelvic Restraint Belts

5.5.1 Anchorages for any individual pelvic restraint belt assembly shall be located at least 165 mm apart (measured between the centerline of the attachment holes, or the centroid of the attachment means).

6. LOCATION OF SEAT BELT UPPER TORSO RESTRAINT ANCHORAGES

6.1 The shoulder belt should be designed to go over the shoulder and across the chest as pictured in Figure 1. The belt should be away from the face and neck, but not falling off the shoulder. Generally it is preferable that the shoulder