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Motor Vehicle Seat Belt Anchorages - Design Recommendations

RATIONALE

The technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. ***Scope***—This SAE Recommended Practice specifies design recommendations for location of seat belt assembly anchorages. It applies to seat belt anchorages attached to vehicle structure or to seat assemblies in the vehicle. (This SAE Recommended Practice supersedes the Design Section of SAE J787b.) Performance requirements and test procedures are specified in SAE J385 and SAE J384, respectively.

2. ***References***

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

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

SAE J385—Motor Vehicle Seat Belt Anchorages—Performance Requirements
SAE J384—Motor Vehicle Seat Belt Anchorages—Test Procedure

3. ***Definitions***

3.1 Anchorage—The final point of attachment for transferring seat belt assembly loads to the vehicle structure or seat structure.

3.2 Seating Reference Point—The design H-Point with the seat in the rearmost normal design driving or riding position, as defined in detail in SAE J1100. (The "design H-Point" has coordinates relative to the design vehicle structure. It is located at the H-Point of the two-dimensional drafting template placed in any designated seating position.)

3.3 Shoulder Reference Point—A point 563 mm (22.16 in) above the Design H-Point along the torso centerline of the two-dimensional drafting template described in SAE J826. This dimension, added to the dimension of 97.5 mm (3.84 in) from the H-Point to the buttocks fleshline 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.

3.4 Attachment Hardware—All load-bearing hardware designed for securing the webbing portion of a seat belt assembly to a motor vehicle structure or intermediate structural component including but not limited to retractors, end fittings, bolts, studs, nuts or other attachment means but not including those components permanently fixed to the vehicle.

NOTE—If the seat belt is attached to a seat, the seat is not attachment hardware.

3.5 Seat Belt Assembly—Any strap, webbing, or similar device designed to secure a person in a motor vehicle with the intention of minimizing the risk of bodily harm in a collision (other than a system designed solely to accommodate children), including all buckles, adjusting mechanisms, fasteners, and related hardware.

3.6 Type 1 Seat Belt Assembly—A seat belt assembly which provides pelvic restraint.

3.7 Type 2 Seat Belt Assembly—A seat belt assembly which provides both pelvic and upper torso restraint.

3.8 Type 2a Seat Belt Assembly—A seat belt assembly consisting of either a separate upper torso restraint intended for use only with a Type 1 seat belt assembly or knee bolster or an upper torso restraint which may be connected to a Type 1 seat belt assembly for use as a Type 2 seat belt assembly.

3.9 Type 4 Seat Belt Assembly—An automatic seat belt system.

3.10 Belt Contact Point—The point where the seat belt webbing longitudinal centerline would make contact with the load-bearing member of the seat structure, body structure, retractor hardware (or webbing wound on the spool of a retractor), or attachment hardware such as a swivel plate which may be bolted to the seat belt 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. If the webbing or seat belt buckle is attached to the anchorage by a cable, pivoting metal strap, or other flexible or readily movable component, the belt contact point is the point at which the attaching hardware becomes flexible or movable. For example, the contact point for a cable-attached buckle is the end of the flexible portion of the cable nearest the vehicle structure. For a metal strap that is free to pivot throughout the range of likely usage, the belt contact point is the center of the pivot of the strap.

3.11 Belt Angle Reference Point—The point 63.5 mm (2.5 in) forward of and 9.5 mm (0.38 in) above the Seating Reference Point.

4. General

4.1 Installation and Replacement—Anchorages shall permit seat belt assemblies to be readily installed or replaced, and shall comply with the strength requirements of SAE J385.

4.2 Common Anchorage(s)—A common anchorage point may be used for more than one belt end, provided it meets the pertinent requirements of 5.4 and SAE J385. The location of the lower anchorage(s) of the upper torso restraint may be common with the pelvic restraint anchorages.

5. Location of Pelvic Restraint Anchorages

5.1 Pelvic Restraint Angle Guidelines—Many factors affect the preferred, more vertical pelvic restraint belt angle which is intended to prevent the anterior-superior iliac spine from sliding under the lap belt during the forward and downward movement of the restrained occupant.

Ideally, component tests, computer simulations, sled tests, or vehicle crash tests should be conducted, utilizing an anthropomorphic test device containing a humanlike ilium with appropriate "soft tissue," to determine the preferred pelvic restraint angle, which is influenced by any or all of the following:

a. Seat cushion compression and/or seat deflection
b. Seat cushion angle, seat back angle, and seat cushion height above the heel point
c. Proximity of knee bolsters or "hard" vehicle structures in front of the knees of the restrained occupant
d. Initial length and elongation characteristics of belt webbing
e. Type of restraint system
f. Presence or absence of upper torso restraint belt
g. Location of upper torso restraint anchorage
h. Stiffness of components on which are found the belt contact points
i. Lateral location of the belt contact points

In the absence of component tests, computer simulations, sled tests, or vehicle crash tests, a more vertical pelvic belt angle is preferred and should be selected from the upper end of the range of 30 to 75 degrees from the horizontal.

For pelvic restraint belts that are intended solely to secure a child restraint system (for example, anchorages for a lap belt supplied with an automatic belt that cannot be used to secure a child seat), a more horizontal belt angle is preferred and should be selected from the lower end of the range of 30 to 75 degrees from the horizontal.

5.2 Anchorages on Vehicle Structure for Pelvic Restraint Belts

5.2.1 MOVABLE SEATS

5.2.1.1 *Movable Front Seats*—The location of anchorages for belts for occupants of front row seats which are adjustable or movable in the fore and aft direction, and where the belt passes outside of the seat or through the seat cushions shall be as follows: A line from the belt contact point to the belt angle reference point 63.5 mm (2.50 in) forward of and 9.5 mm (0.38 in) above the Seating Reference Point shall form an angle with the horizontal as determined from the guidelines in 5.1 and as shown in Figure 1.

5.2.1.2 *Movable Rear Seats*—The location of anchorages for belts for occupants of seats in rows other than the front row of seats in a vehicle, which seats are adjustable or movable in the fore and aft direction for seated occupant space or comfort, and where the belt passes outside of the seat or through the seat cushions shall be as follows: A line from the belt contact point to the Design H-Point of the seat when located at the midpoint of its range of normal design seating positions shall form an angle with the horizontal as determined from the guidelines in 5.1 and as shown in Figure 1.

5.2.2 FIXED SEATS—The location of anchorages for belts for occupants of fixed seats where the belt passes outside the seat or through the seat cushions shall be as follows: A line from the belt contact point to the Seating Reference Point shall form an angle with the horizontal as determined from the guidelines in 5.1 and as shown in Figure 2.

5.2.3 SEAT BELT ROUTING TO ANCHORAGE—In the side view where a direct belt routing is interrupted by an intervening load-bearing member (refer to the Belt Contact Point definition in 3.10), the anchorage shall not be located forward 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. Figure 3.

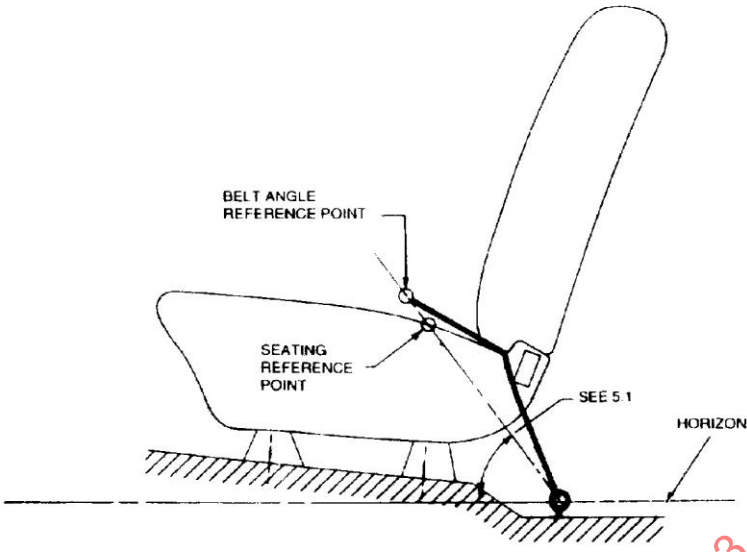

FIGURE 1—BELT OUTSIDE SEAT OR THROUGH SEAT SPRINGS

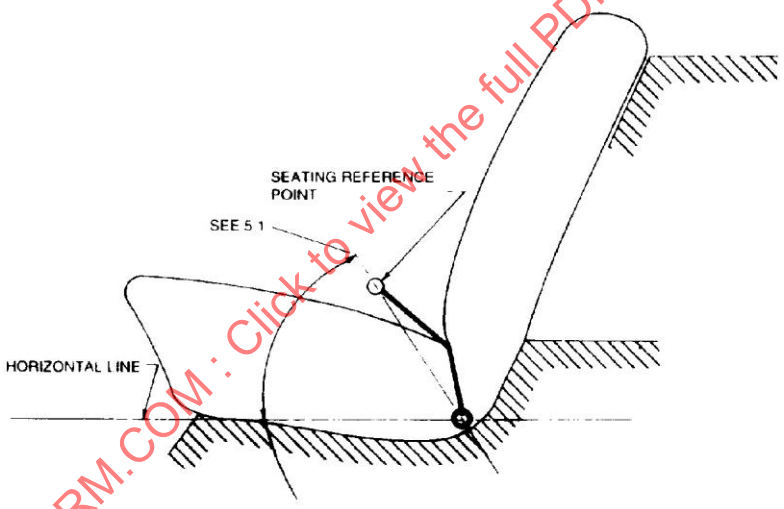

FIGURE 2—REAR SEAT BELT INSTALLATION

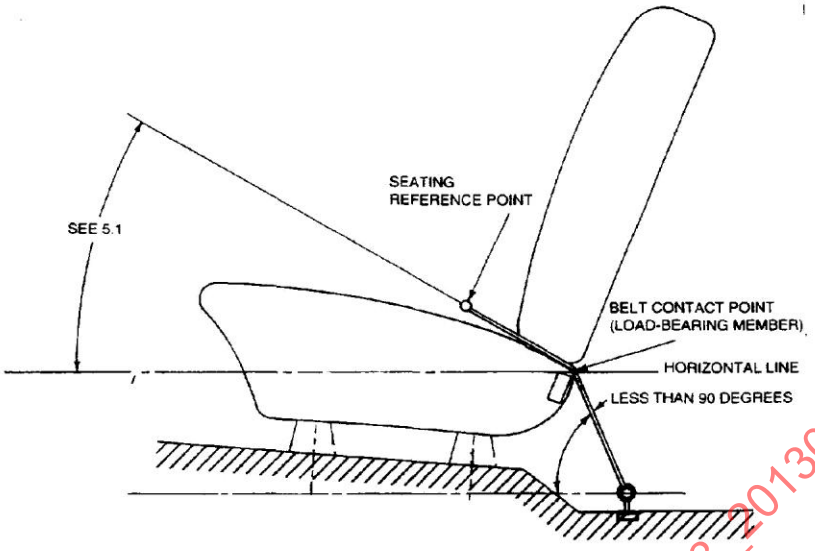

FIGURE 3—BELT OVER SEAT CROSS BAR

5.3 Anchorages on Seat Structure for Pelvic Restraint Belts—The location of anchorages for belts for occupants of seats where the belts are anchored to seat structure, or for occupants of movable seats where the belt contact point moves fore and aft in direct relation to the fore and aft movement of the seat, shall be as follows: A line from the belt contact point to the Seating Reference Point shall form an angle with the horizontal as determined from the guidelines in 5.1 and as shown in Figure 4.

5.4 Lateral Location for all Pelvic Restraint Belts—Anchorages for any individual pelvic restraint belt assembly shall be located at least 165 mm (6.5 in) apart, and preferably shall be placed equidistant from the longitudinal centerline of the designated seating position unless intervening load-bearing members provide the spacing desired. The farther that anchorages are located from the side of the occupant, the less effective they are likely to be in preventing the anterior-superior iliac spine from sliding under the lap belt during the forward and downward movement of the restrained occupant. This is particularly true on the buckle side of a Type 2 belt, because a widely spaced anchorage is less effective in preventing the upper torso belt from lifting the pelvic belt.

6. Location of Upper Torso Restraint Anchorages

6.1 Side View Location—With the seat in its most rearward and downward position and the seatback in its nominal design upright riding position, the upper anchorage(s) shall be longitudinally in line with, or rearward of a line extending 152 mm (6.0 in) vertically upward from the shoulder reference point, and then extending rearward at an angle of 80 degrees above the horizontal Figure 5. The anchorage shall be on or above a line extending rearward and downward 40 degrees below the horizontal from the shoulder reference point.