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SURFACE VEHICLE INFORMATION REPORT

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Combination Pelvic/Upper Torso (Type 2) Operator Restraint Systems for Off-Road Work Machines

***Foreword*—**This SAE information Report includes requirements for combination pelvic and upper torso restraint systems and testing of seat belt anchorages on off-road work machines and the testing of seat belt assemblies.

***1. Scope*—**This SAE Information Report provides performance and test requirements for combination pelvic/upper torso operator restraint systems provided for off-road self-propelled work machines.

1.1 Purpose—This document applies to 3-point and 4-point operator restraint systems (Type 2 and Type 2A) for off-road, self-propelled work machines fitted with ROPS.

1.2 Field of Application

1.2.1 This document applies to operator restraint systems that include seat systems of 70 kg mass or less.

1.2.2 For machines with seat systems of greater than 70 kg mass, such as those that include add-on control modules, it is necessary that the seat support be designed to withstand an additional force of ten times the mass of the seat system which exceeds the 70 kg mass. This force should be added to the test forces for the pelvic restraint portion of combined system.

1.2.3 A Type 2 belt is optional and may be used where upper torso restraint is desired. This document provides guidelines for, but does not imply in any way, that an upper torso (Type 2) operator restraint system is required for off-road work machines.

2. References

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

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

SAE J141—Seat Belt Hardware Performance Requirements
SAE J386—Operator Restraint Systems for Off-Road Work Machines
SAE J826—Devices for Use in Defining and Measuring Vehicle Seating Accommodation
SAE J833—Human Physical Dimensions
SAE J899—Operator's Seat Dimensions for Off-Road Self-Propelled Work Machines
SAE J1163—Determining Operator Seat Location on Off-Road Work Machines

TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

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

ISO 6683—Earth-moving machinery—Seat belts and seat belt anchorages

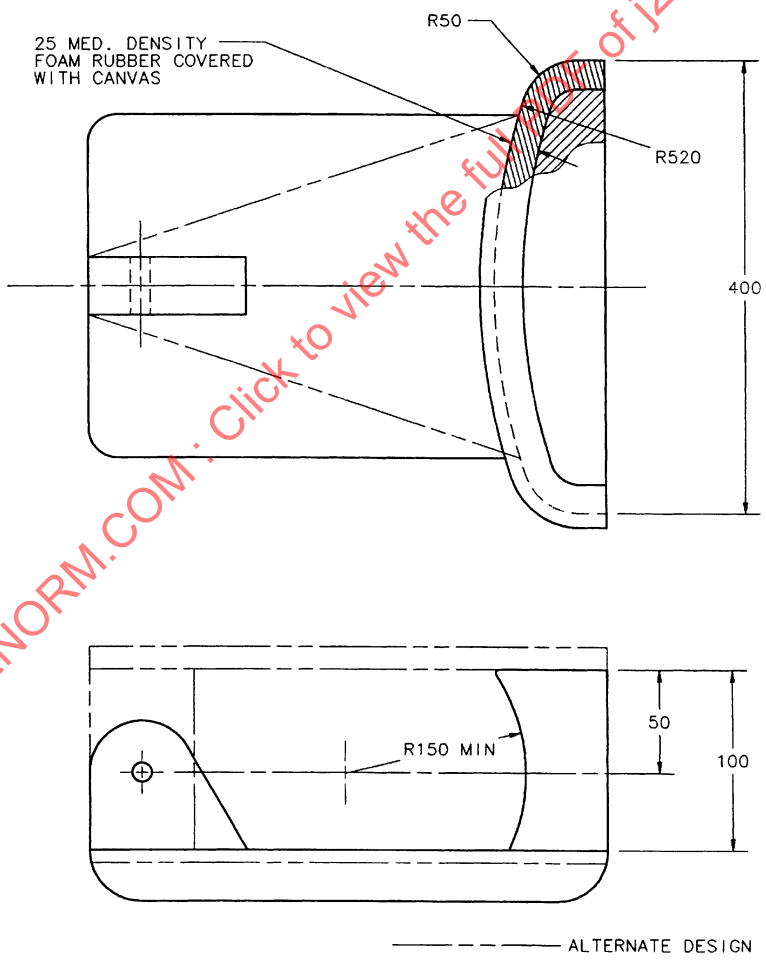
3. Definitions

3.1 Adjustment Hardware—Hardware designed for adjusting the belt assembly to fit the user, including such hardware that may be integral with buckle, attachment hardware, or retractor.

3.2 Anchorage—The point where the seat belt assembly and/or extension (tether) belt is mechanically attached to the seat system and/or machine.

3.3 Attachment Hardware—Hardware for securing a seat belt assembly to an anchorage on a seat system or on a machine.

3.4 Body Block—The test device used to apply the seat belt force to the seat system (Reference Figures 1 and 2.)



DIMENSIONS NOT SHOWN ARE OPTIONAL TO SATISFY THE TEST FACILITY AND DO NOT INFLUENCE THE TEST RESULTS.

FIGURE 1—PELVIC BODY BLOCK

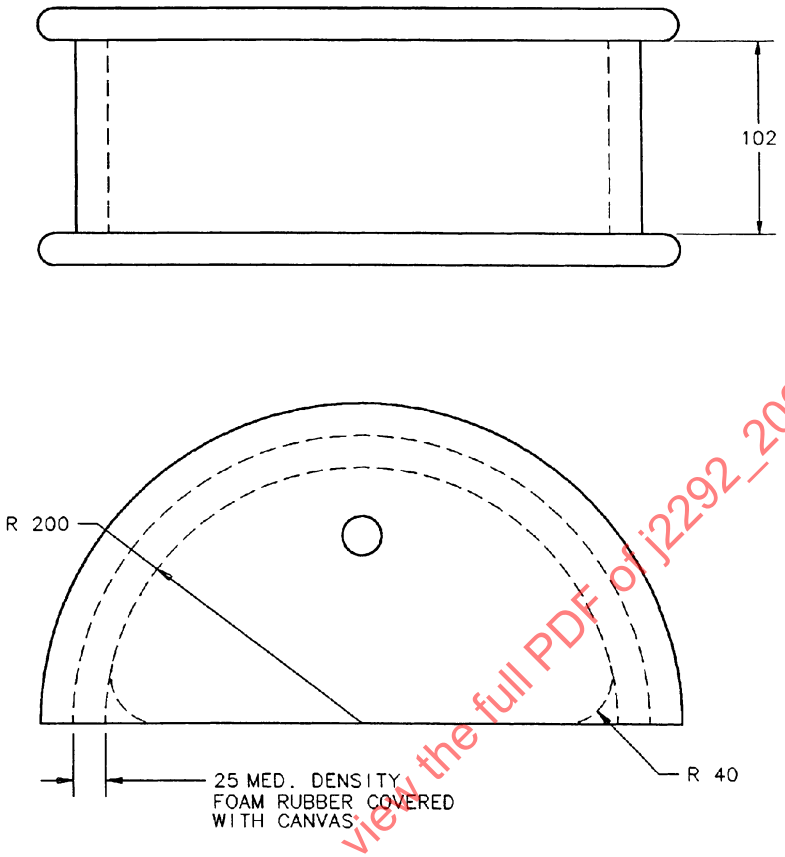


FIGURE 2—TORSO BODY BLOCK

3.5 Buckle and Latchplate—A quick-release connector which fastens the belt assembly into a loop.

3.6 Creep—The amount of unintentional lengthening of the seat belt assembly loop during use that is caused by motion of the machine, the seat, and the seat belted occupant.

3.7 Extension (Tether) Belt—Any strap, belt, or similar device (webbing, wire cable, solid link, etc.) that aids in the transfer of seat belt forces.

3.8 Hardware—Any metal or rigid plastic part of the restraint system.

3.9 H-Point—The pivot axis between a human torso and thigh as defined by the H-point template and H-point machine in SAE J826.

3.10 Loop—The complete seat belt assembly as it would be installed around the seat occupant.

3.11 Operator Restraint System—The total system composed of the seat belt assembly, seat system, anchorages, and extension (tether) belts, if applicable, which transfers the seat belt force to a machine.

3.12 Polyester Yarn—Yarns spun from polyethylene terephthalate.

3.13 Retractors—Devices for storing all or part of the strap material of a seat belt assembly.

3.14 Roping—The tendency of a piece of material to twist upon itself or roll up transversely, remaining in the form of a rope instead of staying in its original strap form.

3.15 Seat Belt Assembly—Any strap, webbing, or similar device designed to provide operator restraint in a machine. It includes buckles or other features, and may include the attachment hardware for installing the seat belt assembly to an anchorage.

3.15.1 TYPE 1 SEAT BELT ASSEMBLY—A seat belt assembly which provides pelvic restraint.

3.15.2 TYPE 2 SEAT BELT ASSEMBLY—A seat belt assembly which provides both pelvic and upper torso restraint. This includes what is commonly referred to as 3-point and 4-point belt systems.

3.15.3 TYPE 2A SEAT BELT ASSEMBLY—A seat belt assembly consisting of a separate upper torso restraint intended for use only in conjunction with a Type 1 seat belt assembly and when combined make up a Type 2 seat belt assembly.

3.16 Shoulder Reference Point—A point 563 mm (22.16 in) above the H-point along the torso centerline of the two-dimensional drafting template described in SAE J826.

3.17 Upper Torso Restraint—Upper torso restraint means a portion of a seat belt assembly intended to restrain movement of the chest and shoulder regions.

3.18 Pelvic Restraint—Pelvic restraint means a seat belt assembly or portion thereof intended to restrain movement of the pelvis.

3.19 Seat Index Point (SIP)—The point in the central, vertical plane of the SIP measuring device when installed in the operator's seat as defined in SAE J1163.

3.20 Seat System—The total support mechanism between the machine and the operator interface. This could include the seat assembly, fixed seat support, or seat suspension (flexible seat support).

4. Technical Requirements, Testing, and Performance of Seat Belts

4.1 Seat Belt Assembly General Requirements

4.1.1 SINGLE OCCUPANCY—A seat belt assembly shall be designed for use by one, and only one, person at any time.

4.1.2 RELEASE—The seat belt assembly shall be provided with a buckle or latch readily accessible to the occupant, and designed to provide easy and rapid release of the assembly with a single motion. It shall also be capable of being released with either hand, bare or mittened. The buckle shall be designed to minimize the possibility of accidental release due to operator movement, inertia, or external forces. The buckle shall meet all the requirements described in 4.3.

4.1.3 ADJUSTMENT—The seat belt shall be self-adjusting or readily adjustable by a means within easy reach of the occupant. In all operating positions, adjustment to a snug condition shall at least accommodate the 5th percentile United States female through the 95th percentile United States winter-clothed male, reference SAE J833. To meet the previous requirements, overall length of belt may vary depending upon anchorage locations.

4.1.4 CREEP—If manual belt adjusters are used in the 3-point or 4-point systems, they must meet the creep requirements outlined in SAE J386.

4.1.5 BREAKING STRENGTH—The components of a seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements.

4.1.5.1 The pelvic portion of Type 2 seat belt assembly shall withstand a loop force of not less than 22 000 N applied at the center of the loop by a loop force testing machine as described in Figure 3 of SAE J386.

4.1.5.2 The components of the upper torso restraint of a Type 2 or Type 2A seat belt assembly shall withstand a tensile force of not less than 6 500 N when tested by the procedure specified in SAE J141.

4.1.5.3 The components common to the pelvic and upper torso restraints shall withstand a tensile force of not less than 13 400 N when tested by the procedure specified in SAE J141.

4.1.6 MARKING (LABELING)—Each seat belt assembly and/or each section of belt assembly shall be permanently and legibly labeled with year of manufacture, model or style number, and name or trademark of manufacturer or importer, and shall state compliance with SAE J386/J2292.

4.1.7 USAGE AND MAINTENANCE INSTRUCTIONS—Seat belt assemblies when packaged separately, shall be accompanied by written instructions for:

a. Proper installation, including the proper manner of threading the strap into the attachment hardware when threadable hardware is supplied.
b. Proper wearing of the installed assembly.
c. Proper maintenance (including cleaning procedures) and periodic inspection for wear or damage.

4.2 Strap Material Requirements

4.2.1 MATERIAL—Strap material requirements are the same as defined in SAE J386.

4.3 Buckle Requirements

4.3.1 Buckle requirements are the same as defined in SAE J386.

4.4 Hardware Requirements

4.4.1 GENERAL—Hardware shall meet the requirements of SAE J386.

4.4.2 RETRACTORS—Retractors shall meet the seat belt assembly strength requirements of 4.1.5. When a locking retractor is included in a seat belt assembly, it shall be locked at the start of the seat belt assembly strength test. Retractors sensitive to webbing withdrawal only shall not be used unless lap potion of belt meets Type 1 or 2A load requirements. Emergency locking retractors should have a vehicle sensitivity which provides comfort in rough riding conditions while providing adequate locking in machine rollover conditions. Retractors should meet the environmental test requirements and cycle life requirements consistent with the environments in which they are used.

5. Technical Requirements, Machine Related

5.1 Anchorages

5.1.1 Anchorages on the seat system or machine shall be such that the belt assembly can be readily installed or replaced and shall comply with the force requirement of 5.2.2.

5.1.2 If the seat does not swivel or have a suspension system, the seat belt assembly may be anchored to the seat or to the machine at any point within the cross-hatched zone shown in Figure 3.

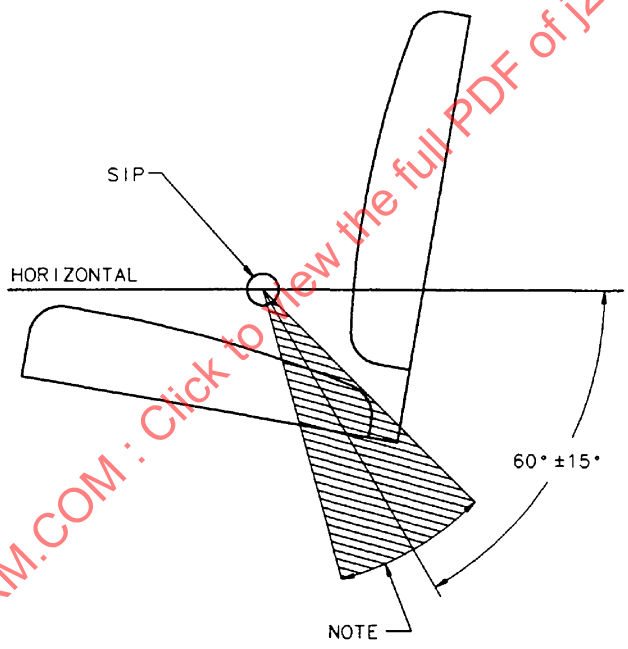
5.1.3 If the seat is supported by a suspension system, the Type 1 seat belt assembly or pelvic portion of a Type 2 seat belt assembly shall be attached in such a way that the loop size of the belt does not change as the seat oscillates through its suspension's travel. The loop size of the upper torso restraint of a Type 2 or Type 2A seat belt assembly can change as the seat is adjusted or oscillates.

5.1.4 EXTENSION (TETHER) BELTS—Belts, cables, or similar flexible devices may be used to transfer the seat belt assembly forces from the seat anchorages to the machine. The extension belt length may be adjustable.

5.1.5 Extension belts shall meet the seat belt assembly force requirements of 5.2.2 in all operating positions.

5.1.6 SEAT BELT ASSEMBLY INSTALLATION

5.1.6.1 The pelvic portion of the seat belt assembly shall be located such that when the seat belts are in a straight line through the SIP, the angle formed from the horizontal will be in the range of 60 degrees ± 15 degrees as shown in Figure 3 for all operating positions. Where practical, the preferred angle through the SIP is toward the more vertical.



NOTE: RANGE OF SEAT BELT ANCHORAGE MOUNTINGS THROUGH THE SIP TO THE HORIZONTAL THROUGHOUT ALL OPERATING POSITIONS (FORE AND AFT, VERTICAL, TILT AND SUSPENSION TRAVEL).

FIGURE 3—LOCATION OF SEAT BELT ANCHORAGE FOR PELVIC PORTION OF A TYPE 2 SEAT BELT SYSTEM

5.1.6.2 The lower anchorage of the upper torso restraint may be common with the pelvic restraint anchorage.

5.1.6.3 When the seat is in the rearmost and lowest position, the suspension, if present, in it's mid-ride position, and the seat back is in it's most upright work position, the upper anchorage(s) of the upper torso restraint shall be located within the acceptable range shown in Figure 4.

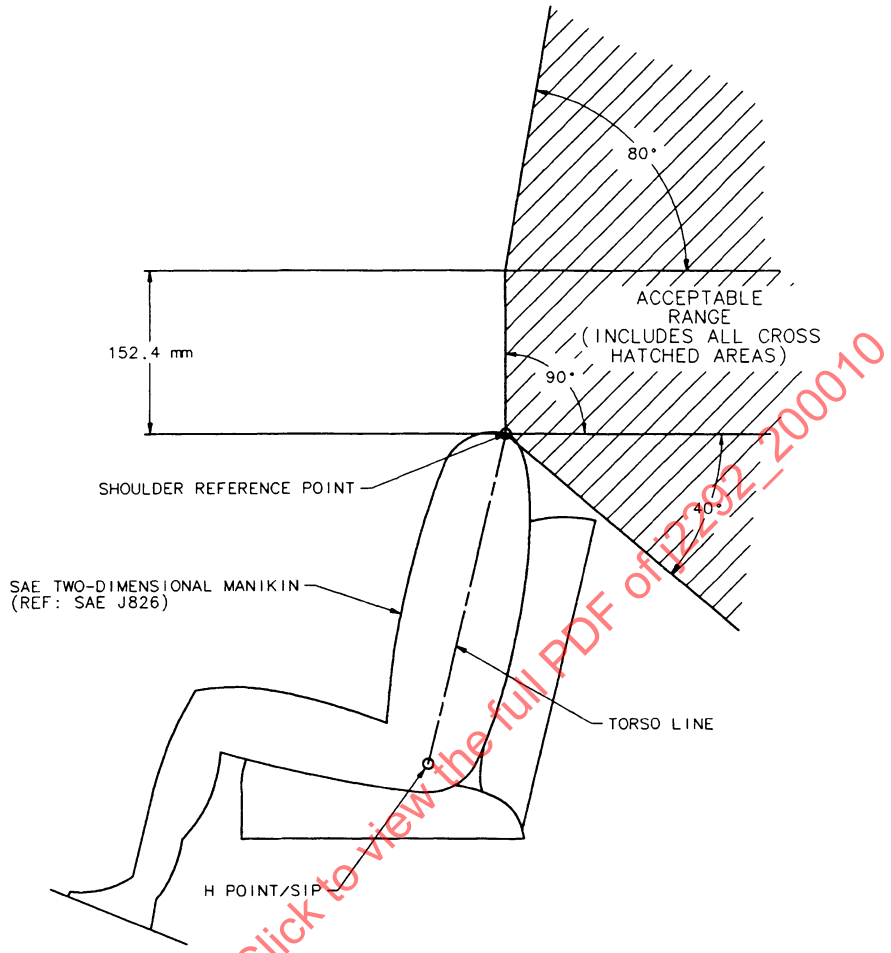


FIGURE 4—ACCEPTABLE RANGE FOR LOCATION OF UPPER ANCHORAGE FOR TYPE 2 SEAT BELT SYSTEM

5.1.6.4 The upper torso restraint shall be positioned to minimize the contact of the seat belt assembly with the neck and avoid its sliding off the shoulders of the operator when the seat back, if adjustable, is at a maximum reclined position of 15 degrees as measured per SAE J899.

5.1.6.5 The Type 1 seat belt assembly or pelvic portion of a Type 2 seat belt assembly is intended to remain in the pelvic girdle area under operating, collision, and rollover conditions, thereby restraining the operator's hips and lower torso to the seat assembly.

5.1.6.6 Seat belt assemblies should be inspected by the user regularly. Replace the seat belt assembly immediately if damage such as worn or damaged hardware, nicked or frayed strap, buckle or retractor malfunction, or loose stitching is found.

5.2 Machine Related Testing and Performance

5.2.1 TEST SET-UP

5.2.1.1 The seat system shall be tested on-machine or in a manner equivalent to an on-machine condition.

5.2.1.2 The seat system shall be adjusted to the operating position which produces the most severe loading condition to the operator restraint system, prior to any subsequent structural deflection. The seat back, if adjustable, shall be positioned in its most upright work position.

5.2.1.3 After the force is applied to the seat system, the force application device shall not be repositioned to compensate for any changes that may occur to the force application angle.

5.2.1.4 The Type 1 seat belt assembly or pelvic portion of Type 2 seat belt assembly force shall be applied using a body block similar to that shown in Figure 1. (If a retractor is included in the assembly, refer to 4.4.2.) The upper torso restraint of a Type 2 or Type 2A seat belt assembly shall be loaded using a torso body block similar to that shown in Figure 2.

NOTE—Additional width of the upper body block may be provided to simultaneously load 4-point upper torso belts.

5.2.2 TEST PROCEDURE FOR CONSTRUCTION AND INDUSTRIAL MACHINES—Anchorages for a Type 1 seat belt assembly (or pelvic portion of a Type 2 where the upper shoulder harness is detachable) shall be tested as outlined in SAE J386 and shown here for reference in Figure 5. The test force is 15 000 N.

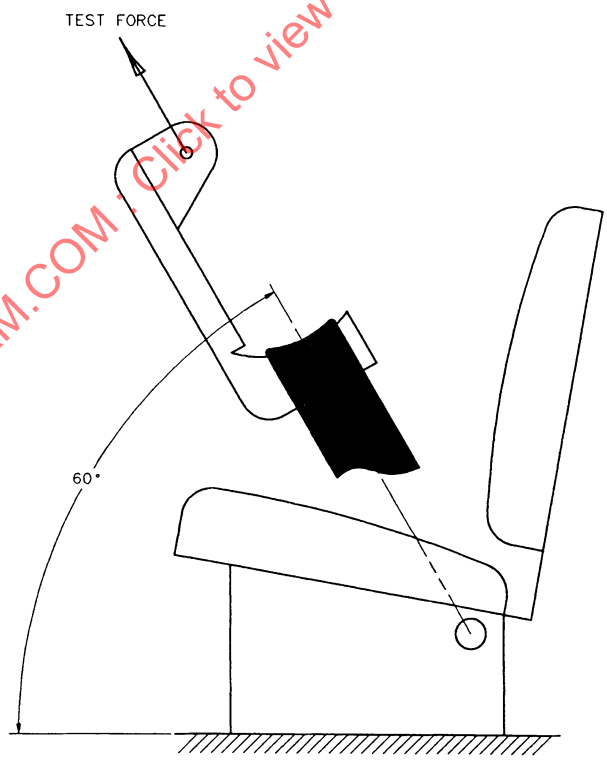


FIGURE 5—CONSTRUCTION AND GENERAL—PURPOSE INDUSTRIAL MACHINES TEST PROCEDURE FOR PELVIC PORTION OF A DETACHABLE UPPER TORSO BELT (TYPE 2 SYSTEM)