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Road vehicles — Procedure for H- and R-point determination

Véhicules routiers — Procédure de détermination des points H et R



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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6549 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

This second edition cancels and replaces the first edition (ISO 6549:1980), which has been technically revised.

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Road vehicles — Procedure for H- and R-point determination

1 Scope

This International Standard defines a three-dimensional H-point machine for use in the determination of the actual H-point and torso angle of a seat, for the purpose of comparing these measurements to the manufacturer's seating reference point and design torso angle. The three-dimensional H-point machine is intended to be used as a checking device for one designated seat position at a time and is not a device which measures or indicates an occupant's capabilities or comfort.

This International Standard is applicable to any motor vehicle where:

- a) the distance, vertically measured, between the operator heel point and the seating reference point is less than 550 mm,
- b) the torso angle is greater than 5° rearward of vertical or where the attitude of the thigh centreline as indicated by the thigh bar is greater than 5° above the horizontal.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3833, *Road vehicles — Types — Terms and definitions*.

ISO 4130, *Road vehicles — Three-dimensional reference system and fiducial marks — Definitions*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 3833 and the following apply.

3.1

three-dimensional H-point machine

device used for the determination of the actual H-point and actual torso angle in a vehicle

3.2

H-point

pivot centre of the torso and thigh of the three-dimensional H-point machine which simulates the pivot centre of the human torso and thigh and is used for actual H-point determination

NOTE It is located on the centreplane of the device which is midway between the H-point sight buttons on either side of the H-point machine.

3.2.1**seating reference point****R-point****SgRP****design H-point**

manufacturer's intended location for a design H-point, which is specifically designated as R-point or SgRP, and which:

- a) is the fundamental reference point used to establish occupant accommodation tools and dimensions;
- b) simulates the position of the pivot centre of the human torso and thigh;
- c) has coordinates established with respect to the designed vehicle structure;
- d) establishes the rearmost normal design driving or riding H-point location of each designated seating position, which accounts for all modes of adjustment: horizontal, vertical and tilt that are available for the seat, but does not include seat travel used for purposes other than normal driving and riding

3.2.2**actual H-point**

H-point measured at the pivot centre of the torso line and thigh bar centreline of the three-dimensional H-point machine using one of the appropriate leg lengths shown in Figure 1, with the seat positioned at the seating reference point as specified by the manufacturer

3.3**torso angle**

angle from vertical in side view of the lower flat portion of the torso pan of the H-point machine

3.3.1**torso line**

centreline of the headroom probe in its fully rearward position against the torso pan of the three-dimensional H-point machine

See Figure 2.

NOTE The torso line intersects the H-point and is parallel to the flat portion of the torso pan that defines torso angle.

3.3.2**actual torso angle**

angle measured between a true vertical line through the actual H-point and the torso line of the three-dimensional H-point machine installed in accordance with clause 5

NOTE Torso angle is read from an indicator, called the hip angle quadrant, located just below the torso angle level on the H-point machine.

3.3.3**design torso angle**

angle measured between a true vertical line through the seating reference point and the torso line

NOTE This angle is specified by the manufacturer.

3.4**centreplane of occupant (C/LO)**

Y-coordinate of the R-point, in each designated seating position

NOTE In vehicles with individual seats, the centreplane of the seat represents the centreplane of the occupant. On bench seats, the centreplane of the occupant is specified by the manufacturer.

3.5**operator heel point**

intersection of the right heel of the three-dimensional H-point machine with the surface of the depressed floor covering or other heel support, when the driver's seat is positioned at the seating reference point

3.6

foot angle

angle measured between the lower leg centreline and a line tangential to the bottom of the bare right foot

NOTE A scale on the foot assembly of the three-dimensional H-point machine indicates the foot angle. The angle to the bottom of the device's shoe is $6,5^\circ$ less than the bare foot angle because of the shoe sole and heel thickness.

4 Description of the three-dimensional H-point machine

The torso and seat pans of the three-dimensional H-point machine (see Figure 2) are representations of average torso and seat contours of an adult male.¹⁾

Constructed of reinforced plastic and metal, these separate torso and seat pans simulate the human torso and thigh and are mechanically hinged at the actual H-point to measure the actual torso angle. An adjustable-length thigh bar, attached to the seat pan, establishes the thigh centreline and serves as a baseline for the hip angle quadrant.

Lower leg segments, also adjustable in length, are connected to the seat pan assembly at the T-bar joining the knees. The T-bar is a lateral extension of the adjustable thigh bar. Quadrants are incorporated in the lower leg segments to measure knee angles. Shoe and foot assemblies are calibrated to measure the foot angle. Positive stops are provided in the thigh and lower leg segments for the 50th and 95th percentile of adult male dimensions (see Figure 1). Two spirit levels orient the device in space. Body element weights are placed at the corresponding centres of gravity to provide seat penetration equivalent to a 76 kg male. All joints of the H-point machine shall be checked for free movement without encountering noticeable friction.²⁾

5 Installation procedure for the three-dimensional H-point machine

5.1 The vehicle shall be preconditioned at the manufacturer's discretion, at a temperature of $(20 \pm 10)^\circ\text{C}$ to ensure that the seat material reaches room temperature. If the seat to be checked has never been sat upon, a 70 kg to 80 kg person or device shall sit on the seat to flex the cushion and back. At the manufacturer's request, all seat assemblies shall remain unloaded for a minimum period of 30 min prior to installation of the three-dimensional H-point machine.

5.2 Dimensions are measured relative to the vehicle three-dimensional reference system by setting up the vehicle relative to the fiducial marks (see ISO 4130) as specified by the manufacturer. The seat is positioned at the seating reference point with all seat adjustments set as specified by the manufacturer. For seats with an independent vertical adjustment or suspension, the vertical position shall be rigidly fixed in a position specified by the manufacturer.

5.3 Place muslin cotton cloth over the seat area to be checked. The muslin shall be a plain cotton, knitted or non-woven fabric having 18,9 threads per cm^2 and weighing $0,228 \text{ kg/m}^2$, and shall be of sufficient size to prevent the machine from contacting the seat. If the test is run in an installation for the seat, suitable pieces of floor covering, or their equivalent, shall be placed under the feet of the three-dimensional H-point machine.

5.4 Place the seat and torso assembly of the three-dimensional H-point machine so that the centreplane of the occupant (C/LO) coincides with the centreplane of the H-point machine. At the manufacturer's request, the centreplane of the H-point machine may be moved inboard with respect to the C/LO if the H-point machine is located so far outboard that the seat edge will not permit levelling of the H-point machine. When the H-point machine has been moved inboard the necessary distance to permit its levelling, the distance from the centreplane of the vehicle to the centreplane of the H-point machine shall be noted in the recorded measurements.

1) Derived from data based on the driving population in the USA.

2) Drawings and videotape are available from SAE, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096, USA. For seats which are highly contoured to give special support for the driver during cornering at high lateral forces, the three-dimensional H-point machine may give unrealistic H-point results.

5.5 Adjust the leg elements to one of the appropriate lengths shown in Figure 1.

5.6 Attach the foot and lower leg assemblies to the seat pan assembly, either individually or by using the T-bar and lower leg assembly. A line through the H-point sight buttons shall be parallel to the ground and perpendicular to the longitudinal centreplane of the seat.

5.7 The foot and leg positions of the three-dimensional H-point machine shall be as specified in 5.7.1 and 5.7.2.

5.7.1 Designated seat position: driver

5.7.1.1 For 50th percentile leg lengths: both foot and leg assemblies shall be moved forward in such a way that the feet take up natural positions. If the right shoe sole of the device does not reach the accelerator pedal, both feet may take natural positions on the floor, with the legs extended between the operating pedals if necessary. In this case the operator heel point shall be specified by the manufacturer. The spirit level verifying the transverse orientation of the device is brought to horizontal, if necessary, by re-adjustment of the seat pan, or by adjusting the leg and foot assemblies towards the rear.

5.7.1.1.1 The left foot is positioned on the floor or toe-rest and located approximately the same distance to the left of the centreplane of the H-point machine as the right foot is to the right. A line passing through the H-point sight buttons shall be maintained parallel to ground, and perpendicular to the longitudinal centreplane of the seat.

5.7.1.1.2 If the left leg cannot be kept parallel to the right leg and the left foot cannot be supported by the structure, adjust the left lower leg length and/or the left foot angle and move the left foot until it is supported. The alignment of the sight buttons shall be maintained. Retighten the leg element setting.

5.7.1.1.3 In cases where the right heel point of the device would be on the toe-rest instead of the floor when the foot is at the minimum angle of 87°, the foot shall be moved until the heel touches the intersection of the toe-rest and the floor covering. Then the foot shall be pivoted until it is in contact with the accelerator pedal.

5.7.1.2 For 95th percentile leg lengths: the right foot and leg assembly is placed on the accelerator pedal and the heel on the floor as far forward as specified by the manufacturer. However, the foot angle shall never be less than 87°. This is accomplished by inserting the positive stop pin of the H-point machine into the foot assembly. The shoe sole of the device shall touch, and, if specified by the manufacturer, is allowed to depress the accelerator pedal through some portion of its travel.

5.7.1.2.1 The left foot is positioned on the floor or toe-rest and located approximately the same distance to the left of the centreplane of the H-point machine as the right foot is to the right. A line passing through the H-point sight buttons shall be maintained parallel to ground, and perpendicular to the longitudinal centreplane of the seat.

5.7.1.2.2 If the left leg cannot be kept parallel to the right leg and the left foot cannot be supported by the structure, adjust the left lower leg length and/or the left foot angle and move the left foot until it is supported. The alignment of the sight buttons shall be maintained. Retighten the leg element setting.

5.7.1.2.3 In cases where the right heel point of the device would be on the toe-rest instead of the floor when the foot is at the minimum angle of 87°, the foot shall be moved until the heel touches the intersection of the toe-rest and the floor covering. Then the foot shall be pivoted until it is in contact with the accelerator pedal.

5.7.2 Designated seat position: passenger

5.7.2.1 In all passenger seat positions set the feet 254 mm apart, centre-to-centre, and equidistant from the centreplane of the H-point machine, unless otherwise specified by the manufacturer. The left and right foot angles may be at 87° or greater, and need not be equal.

5.7.2.2 Outside front seat: For both 50th or 95th percentile leg lengths, refer to the procedure in 5.7.1.1.

5.7.2.3 Outside rear seat: If the feet rest on parts of the floor which are at different levels, the foot which first comes into contact with the front seat shall serve as a reference. The other foot shall be so arranged that the spirit level giving the transverse orientation of the seat of the device indicates the horizontal.

5.7.2.4 Centre seat, front or rear: If the H-point is being determined for a centre seat, the feet shall be placed one on each side of the tunnel if there is one.

5.8 Apply lower leg and thigh weights and level the H-point machine.

5.9 Tilt the torso pan forward against the forward stop and draw the three-dimensional H-point machine away from the seat back using the T-bar. Reposition the H-point machine on the seat by one of the following methods:

5.9.1 If the three-dimensional H-point machine tends to slide rearward, use the following procedure. Allow the three-dimensional H-point machine to slide rearward until a forward horizontal restraining load on the T-bar is no longer required, i.e. until the seat pan contacts the seat back. If necessary, reposition the lower leg.

5.9.2 If the three-dimensional H-point machine does not tend to slide rearward, use the following procedure. Slide the H-point machine rearward by applying a horizontal rearward load to the T-bar until the seat pan contacts the seat back (see Figure 2).

5.10 Apply a (100 ± 10) N load to the H-point machine at the intersection of the hip angle quadrant and the T-bar housing. The direction of load application shall be maintained along a line passing by the above intersection to a point just above the thigh bar housing. Then carefully return the torso pan to the seat back. Care shall be exercised through the remainder of the procedure to prevent the three-dimensional device from sliding forward.

5.11 Install the right and left buttock weights and then alternately the eight torso weights. Maintain the H-point machine's level.

5.12 Tilt the torso pan forward to release the tension on the seat back. If desired by the manufacturer, rock the three-dimensional H-point machine from side to side over a 10° arc (5° to each side of the vertical centreplane) for three complete cycles to release any accumulated friction between the H-point machine and the seat.

During the rocking action, the T-bar of the H-point machine may tend to diverge from the specified horizontal and vertical alignment. The T-bar shall therefore be restrained by applying an appropriate lateral load during the rocking motions. Care shall be exercised in holding the T-bar and rocking the H-point machine to ensure that no inadvertent exterior loads are applied in a vertical or fore and aft direction.

The feet of the H-point machine shall not be restrained or held during this step. If the feet change position, they shall be allowed to remain in that attitude for the moment.

5.12.1 Carefully return the torso pan to the seat back and check that the device is level. Due to the movement of the feet during the rocking operation of the H-point machine, the feet are repositioned as follows:

Alternately lift each foot off the floor the minimum necessary amount until no additional foot movement is obtained. During this lifting, the feet are to be free to rotate, and no forward or lateral loads are to be applied. When each foot is placed back in the down position, the heel is to be in contact with the floor.

5.12.2 If the seat pan is not level at the completion of this step, apply a lateral load to the top of the torso pan sufficient to level the H-point machine's seat pan on the seat.

5.13 Holding the T-bar to prevent the H-point machine from sliding forward on the seat cushion, proceed as follows:

5.13.1 Return the torso pan to the seat back.

5.13.2 Alternately apply and release a horizontal rearward load, not to exceed 25 N, to the headroom probe at a height approximately at the centre of the torso weights until the hip angle quadrant indicates that a stable position has been reached after load release. Care shall be exercised to ensure that no exterior downward or lateral loads are applied to the H-point machine. If another level adjustment of the H-point machine is necessary, rotate the torso pan forward, re-level, and repeat the procedure given in 5.12.

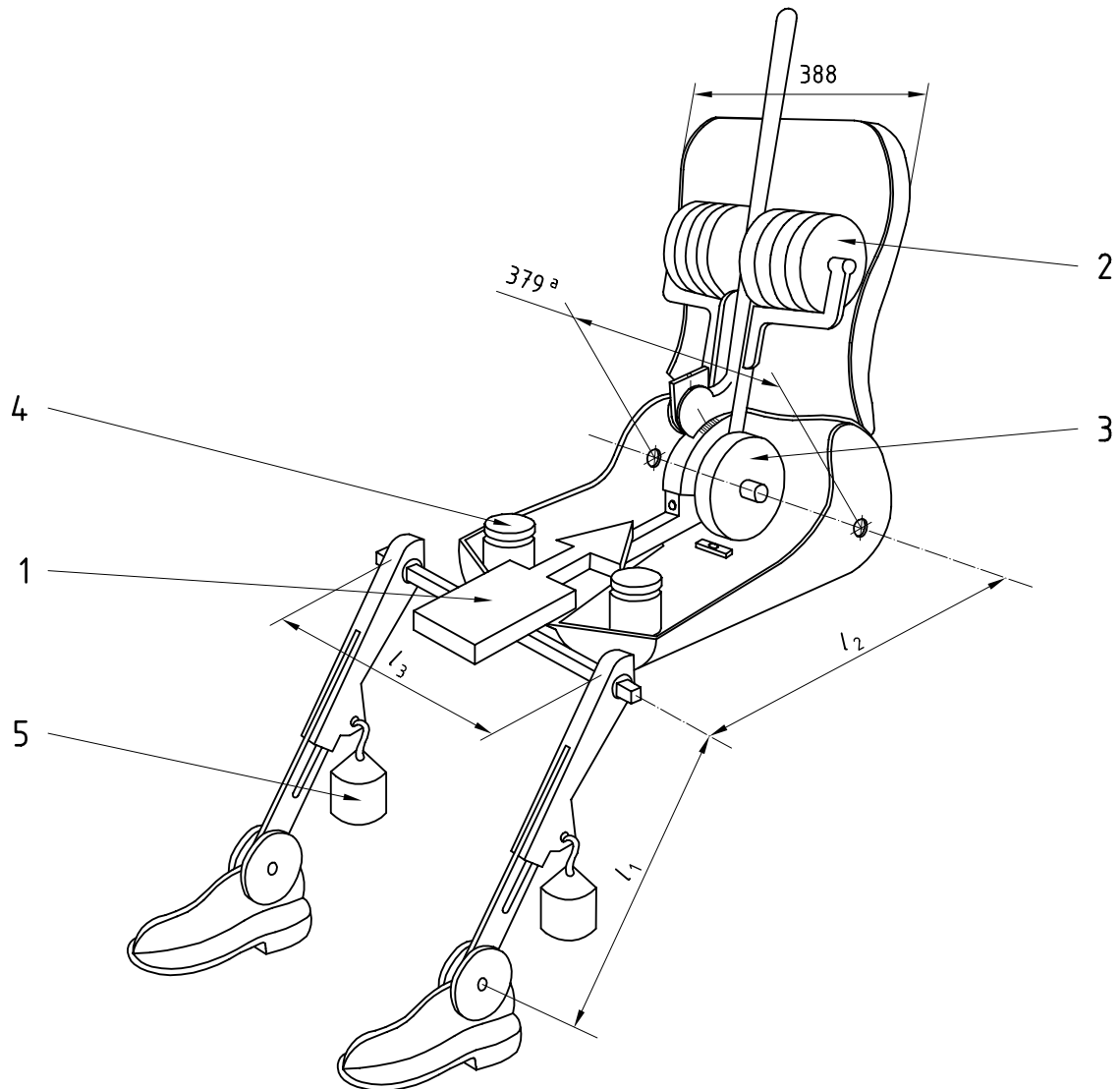
5.14 Record all measurements and the leg lengths used for each designated seat position.

5.14.1 The coordinates of the actual H-point are measured with respect to a three-dimensional reference system. The actual H-point is measured to the H-point sight buttons on either side of the H-point machine, and is midway between them.

5.14.2 If a measurement of the actual torso angle is desired, rotate the headroom probe to its fully rearward position and level the torso angle level. The actual torso angle can be read from the hip angle quadrant.

5.15 If a re-run of the installation of the H-point machine is desired, the seat assembly shall remain unloaded for a minimum period of 30 min prior to the re-run. The H-point machine shall not be left loaded on the seat longer than the time required to perform the test.

Dimensions in millimetres

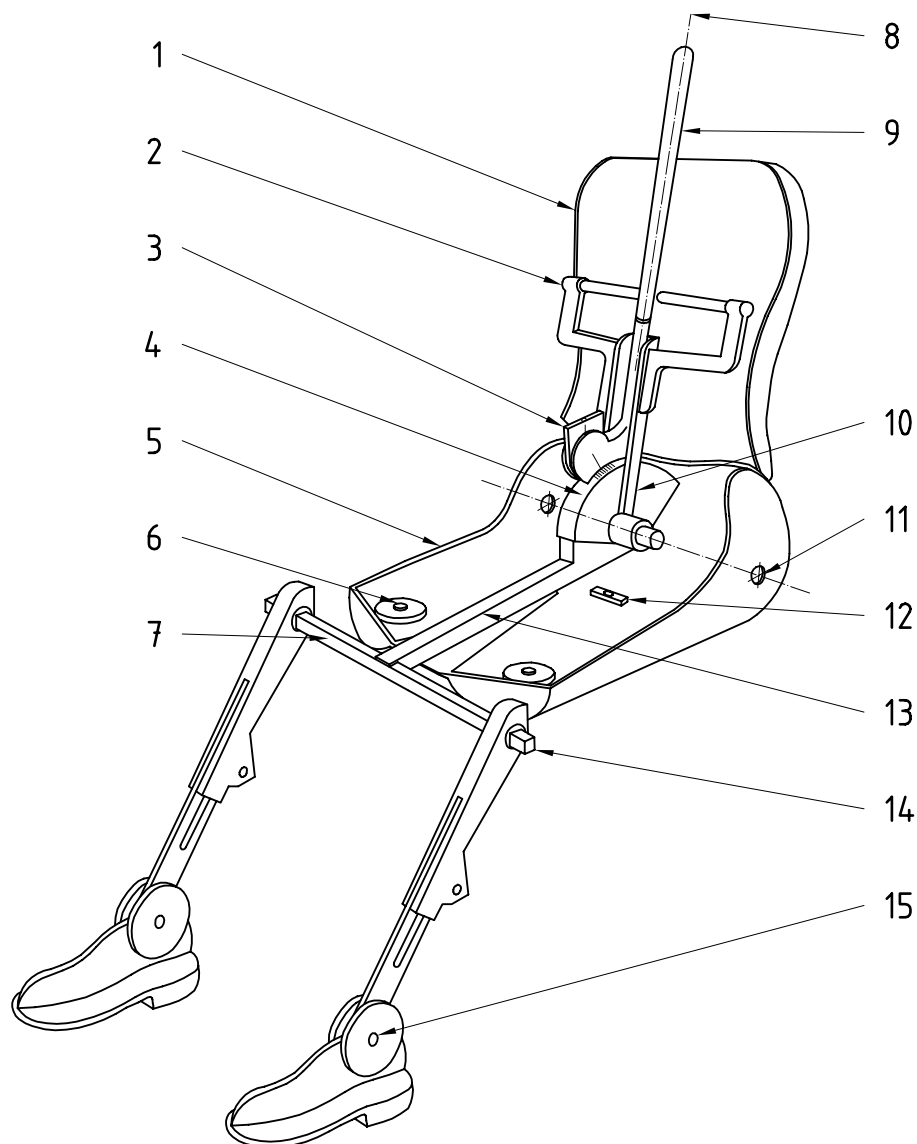


Dimension	50th percentile	95th percentile
l_1	417,5	459
l_2	431,5	456
l_3	variable from 108 to 424	

Key

- 1 Direction and point of load application
- 2 Torso weights
- 3 Buttock weights
- 4 Thigh weights
- 5 Leg weights
- a Excludes H-point buttons

Figure 1 — Dimensions of the H-point machine elements and load distributions



Key

- 1 Torso pan
- 2 Torso weight hanger
- 3 Torso angle level
- 4 Hip angle quadrant
- 5 Seat pan
- 6 Thigh weight pad
- 7 T-bar joining the knees
- 8 Torso line
- 9 Head room probe
- 10 Torso angle quadrant
- 11 H-point pivot
- 12 Lateral level
- 13 Thigh bar
- 14 Knee angle quadrant
- 15 Foot angle quadrant

Figure 2 — H-point machine elements designation

Bibliography

- [1] ISO 4131:1979, *Road vehicles — Dimensional codes for passenger cars.*

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