
**Road vehicles — H-point machine
(HPM-II) — Specifications and
procedure for H-point determination**

*Véhicules routiers — Machine point H (HPM-II) — Spécifications et
procédure pour la détermination du point H*



This document is a preview generated by EKO



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	v
Introduction.....	vi
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Measurement procedure for the three-dimensional H-point machine.....	3
4.1 General.....	3
4.2 Summary of installation procedure.....	4
4.2.1 Summary.....	4
4.2.2 Measured versus design values.....	4
4.3 Prepare vehicle and seat.....	4
4.3.1 Vehicle.....	4
4.3.2 Seat.....	5
4.4 Determine the H-point travel path (optional).....	5
4.5 Adjust seat to design intent.....	6
4.5.1 Move seat to design intent position.....	6
4.5.2 Torso angle and cushion angle.....	6
4.5.3 Seat in front of test seat.....	7
4.6 Install HPM cushion and back pan assembly.....	8
4.6.1 Install the cushion pan.....	8
4.6.2 Install the back pan.....	8
4.6.3 Level the HPM.....	9
4.7 Load the HPM.....	9
4.7.1 Procedure.....	9
4.7.2 Summary table.....	9
4.7.3 Load the cushion pan.....	10
4.7.4 Load the back pan.....	10
4.8 Soak time.....	11
4.9 Record measurements — digitize HPM points.....	11
4.9.1 General.....	11
4.9.2 H-point.....	11
4.9.3 Torso angle and cushion angle.....	12
4.9.4 Lumbar support prominence.....	12
4.9.5 Summary of driver measurements.....	12
5 Optional measurements for driver seat.....	12
5.1 Leg and shoe installations.....	12
5.1.1 General.....	12
5.1.2 Mark accelerator pedal centreline.....	13
5.1.3 Install the shoe fixture.....	13
5.1.4 Install the shoe tool.....	13
5.1.5 Install leg segments.....	14
5.2 Record measurements.....	15
5.2.1 General.....	15
5.2.2 Shoe plane angle.....	16
5.2.3 Ball of foot reference point.....	16
5.2.4 Accelerator heel point.....	16
5.2.5 Accelerator heel point to ball of foot reference point lateral offset.....	18
5.2.6 Knee angle and ankle angle.....	18
5.2.7 Thigh angle and hip angle.....	18
6 Optional measurements for the 2nd or succeeding row passenger seats.....	18
6.1 Leg and shoe installation.....	18
6.1.1 General.....	18

6.1.2	Install the shoe tool	18
6.1.3	Install leg segments	20
6.2	Record measurements for rear passengers	22
6.2.1	Summary of measurements	22
6.2.2	Floor reference point	23
6.2.3	Floor plane angle	23
6.2.4	Knee clearance and legroom	23
7	Additional optional measurements	24
7.1	Effective headroom	24
7.1.1	When to install headroom fixture	24
7.1.2	Install the headroom fixture	24
7.1.3	Measure effective headroom	24
8	Remove the HPM	24
Annex A	(normative) Description of the three-dimensional H-point machine (HPM)	26
Annex B	(informative) HPM specification and tolerances	39
Annex C	(informative) HPM field checking procedures	46
Annex D	(informative) H-point design (HPD) tool description	63
Bibliography	67

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 39, *Ergonomics*.

This third edition cancels and replaces the second edition (ISO 20176:2011), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

- minor editorial changes;
- removal of reference to the cancellation and replacement of ISO 6549:1999.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The tools and procedures for H-point determination given in this document are based on SAE J4002.

H-point devices are used during vehicle design and development to establish interior reference points and dimensions for occupant packaging, and to validate the location of these key reference points and dimensions on physical properties during audits.

H-point devices are also used for the design and validation of seats. However, in these instances, the reference points and dimensions are defined relative to the seat structure or surface, rather than the vehicle's interior. The procedures for positioning the H-point devices in seats do not require the use of the shoe tool or leg segments.

For convenience and simplicity, many terms associated with H-point devices use human body parts in their name. However, they should not be construed as measures that indicate occupant accommodation, human capabilities, or comfort. H-point devices do not represent the size or posture of any category of occupant.

Key differences from ISO 6549

Compared to the H-point machine (HPM) specified in ISO 6549, the HPM specified in this document provides improved repeatability, greater ease of use, as well as additional features and measurement capabilities. All efforts were made to achieve these improvements while minimizing their impact on the location of reference points and measurements. Several of the changes are discussed below.

1) **Separate components**

For this HPM, the legs (upper and lower), shoe, cushion pan and back pan are all separate pieces. This greatly improves the ease of installation.

2) **“Legless” manikin**

The H-point location is defined without having to attach the legs. This is a major advantage. The procedure specified in this document is based on installing the HPM without legs. Use of legs is optional.

3) **Shoe tool**

Several improvements were made to the shoe tool and how it is positioned in the vehicle, including:

- i) replacing the pedal reference point (PRP) with a new ball of foot reference point (BOFRP);
- ii) specifying a new procedure for positioning the shoe on the pedal.

4) **Cushion angle**

The cushion angle is now measured independently of thigh angle, and at the same time the other measurements are made. With the ISO 6549 HPM, cushion angle was measured from the thigh line, and required a separate installation of the HPM.

5) **Lumbar support**

The articulation of the back pan assembly allows the HPM specified in this document to be better seated in contoured seats. It also provides a measurement of lumbar support prominence (LSP). This measurement provides an indication of the amount the seat back is contoured to provide support for the lumbar spine. The contour of the back pan assembly is most similar to the ISO 6549 H-point machine when the HPM is in a neutral posture (LSP equals zero).

Changes from ISO 20176:2011

The procedures for auditing the seat are unchanged from the second edition.

In the second edition, the most significant change was that the ball of foot (BOF) of the shoe does not have to be on the pedal surface. The HPM shoe can contact the pedal at any point(s) on the bottom of the shoe. The term pedal reference point (PRP) was deleted (since the BOF may not be on the pedal) and replaced by a new term called the ball of foot reference point (BOFRP). The accelerator heel point (AHP) to BOF distance was changed from 200 mm to 203 mm to be consistent with ISO 6549, SAE J1100, and vehicle manufacturers around the world.

In addition, the following physical modifications were made to the HPM. The flat part of the shoe bottom was extended from 200 mm to 203 mm. A new scale was added to the top of the shoe to aid in determining the pedal contact point (PCP). A new H-point divot was added to allow coordinate measuring machine (CMM) point taking from above. The knee angle scale was recessed to improve its durability and reoriented to improve its readability. Several figures were revised to illustrate these changes.

Finally, the terms pedal plane and pedal plane angle (PPA) were replaced by shoe plane and shoe plane angle (SPA). These new terms more accurately convey the meaning. SPA is a side view angle that is provided by the vehicle manufacturer.

Road vehicles — H-point machine (HPM-II) — Specifications and procedure for H-point determination

1 Scope

This document provides the specifications and procedures for using the H-point machine (HPM)¹⁾ to audit vehicle seating positions. The HPM is a physical tool used to establish key reference points and measurements in a vehicle. The H-point design tool (HPD) is a simplified computer-aided design (CAD)²⁾ version of the HPM, which can be used in conjunction with the HPM to take the optional measurements specified in this document, or used independently during product design.

These H-point devices provide a method for reliable layout and measurement of occupant seating compartments or seats. This document specifies the procedures for installing the H-point machine (HPM) and using the HPM to audit (verify) key reference points and measurements in a vehicle.

The devices are intended for application at designated seating positions. They are not to be construed as tools that measure or indicate occupant capabilities or comfort. They are not intended for use in defining or assessing temporary seating, such as folding jump seats.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

SAE J1100, *Motor vehicle dimensions*

SAE J4002, *H-point machine (HPM-II) specifications and procedure for H-point determination — Auditing vehicle seats*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in SAE J1100 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

H-point

point at the pivot centre of the back pan and cushion pan assemblies, located on the lateral centreline of the H-point device

Note 1 to entry: The H-point device can be the H-point machine (HPM) or the H-point design tool (HPD).

1) All references to H-point machine or HPM in this document refer to the SAE J4002 H-point machine (HPM-II), unless otherwise noted.

2) CAD has come to encompass any software system or approach to automotive design and development, and is often used to refer to CAE (computer-assisted engineering) and CAM (computer-assisted manufacturing) software systems as well.