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**Road vehicles — Ergonomic  
requirements for the driver's workplace in  
line-service buses —**

Part 1:  
**General description, basic requirements**

*Véhicules routiers — Exigences ergonomiques du poste de conduite  
dans les bus de ville —*

*Partie 1: Description générale, exigences de base*



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## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 16121-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

ISO 16121 consists of the following parts, under the general title *Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses*:

- *Part 1: General description, basic requirements*
- *Part 2: Visibility*
- *Part 3: Information devices and controls*
- *Part 4: Cabin environment*

## Introduction

Poor ergonomics in the driver's workplace in buses designed to provide scheduled urban and interurban services increase the already high physical and mental strains on the drivers.

It is the aim of this part of ISO 16121 to supply the designer of line-service buses with information about how to develop an overall ergonomic concept for the driver's workplace. The recommended requirements on the driver's workplace for line-service buses made in this part of ISO 16121 are based on the scientific conclusions of the research project "Driver's workplace in the line-service bus". This was conducted in Germany and summarized in the recommendation VDV 234 [3]. Further comprehensive ergonomic studies related to the design of an enhanced driver workplace conducted in the United States, Canada, the Netherlands, Sweden and the United Kingdom [4, 5, 6, 7, 8] have been considered and found to provide recommendations covering similar areas.

This part of ISO 16121 sets out to consider the practical implications for all ranges of driver, but particularly those with heights from 1,58 m (small female) to 2,0 m (large male).

It is also essential that the designer refer to the specifications and requirements of all parts of ISO 16121 (1 to 4) before completing his design of a driver's workplace.

It should be noted that where there is also national legislation covering any of the subjects contained herein, then both should be complied with. However, if a contradiction between the two should arise in any specific area, then the legislation shall prevail for that specific point only.



# Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses —

## Part 1: General description, basic requirements

### 1 Scope

This part of ISO 16121 applies to the driver's workplace in low-floor line-service buses designed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum weight exceeding five metric tonnes and an overall width exceeding 2,30 m.

It contains basic requirements for an ergonomic and comfortable seating position, which is essential to keep drivers in a good state of health. The dimensions and mounting positions of driver's seat, pedals and steering have to be carefully chosen, to enable drivers to sit in an ergonomic seating position, i.e. sitting at angles which comply with the given ranges of comfort and to allow some variation when seated.

### 2 Normative references

The following referenced documents are indispensable for the application 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 2575, *Road vehicles — Symbols for controls, indicators and tell-tales*

ISO 6549, *Road vehicles — Procedure for H- and R-point determination*

ISO 10326-1, *Mechanical vibration — Laboratory method for evaluating vehicle seat vibration — Part 1: Basic requirements*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1 low-floor

a vehicle in which at least 35 % of the area available for standing passengers (or of its forward section in the case of an articulated vehicle) forms a single area without steps, reached through at least one service door by a single step from the ground

#### 3.2 required

values representing present state of the art that, when applied, achieve an acceptable level of ergonomic design

**3.3 recommended**  
values representing the preferred ergonomic conditions that are desirable for the future development of the driver's workplace

**3.4 zero-X-plane**  
vertical transverse plane through the OHP, vertical to the longitudinal median plane of the bus

**3.5 zero-Y-plane**  
median plane of driver (in driving posture), parallel to the longitudinal median plane of the bus

**3.6 zero-Z-plane**  
horizontal plane through the OHP

**3.7 Operator Heel Point OHP**  
intersection of the driver's right heel with the surface of the depressed floor covering or other heel support

**3.8 Heel Point Line**  
intersection line of the zero-X-plane with the zero-Z-plane

## 4 Basic requirements

### 4.1 Dimensions

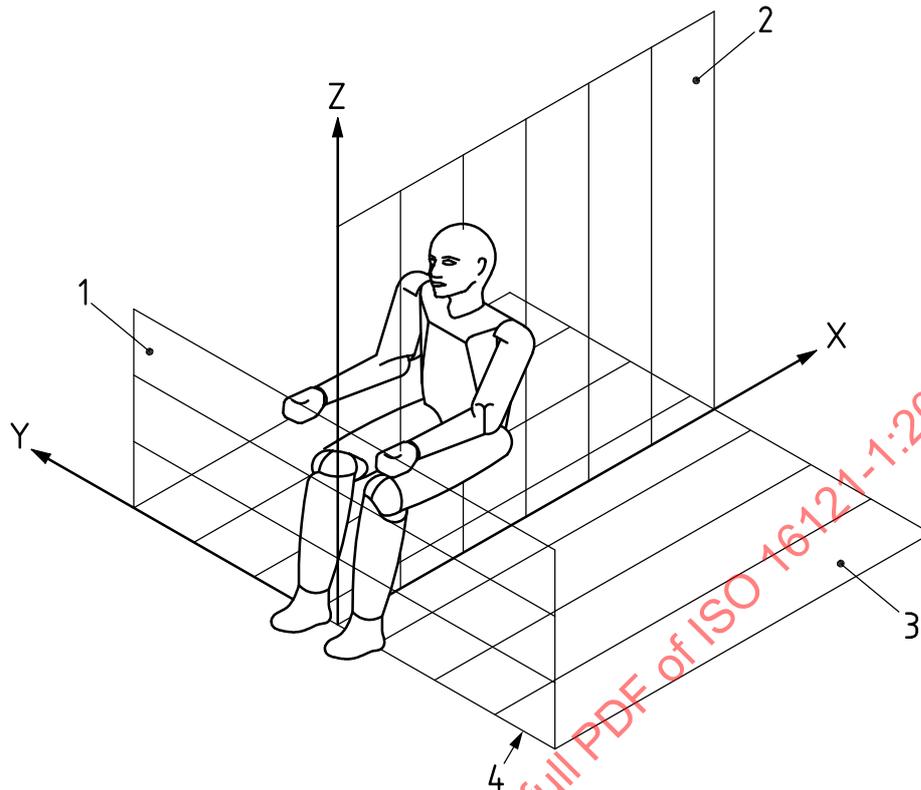
#### 4.1.1 Reference system

All dimensions at the driver's workplace refer to a driver-based system of coordinates (see Figure 1).

The reference system is formed by the zero-X-plane, zero-Y-plane and zero-Z-plane, which are perpendicular to each other.

The intersection point (coordinate origin) of all three planes corresponds to the OHP on the zero-Y-plane. The intersection line of the zero-X-plane with the zero-Z-plane is referred to below as Heel Point Line.

The X, Y and Z axes are so oriented that the negative coordinate range lies in front of the zero-X-plane, on the left of the zero-Y-plane and below the zero-Z-plane, when one is looking in the direction of driving forward.

**Key**

- 1 zero-X-plane
- 2 zero-Y-plane
- 3 zero-Z-plane
- 4 OHP line

**Figure 1 — Driver-based system of coordinates**

**4.1.2 Tolerances**

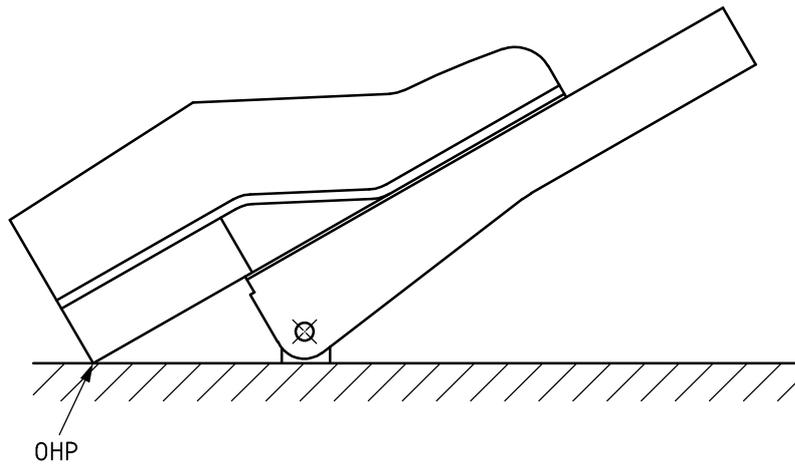
For linear measures a tolerance of  $\pm 10$  mm shall be valid, unless otherwise specified. This tolerance, however, is not applicable when dimensions are specified as a range of values (e.g.  $x = 10$  mm to 30 mm).

**4.1.3 OHP**

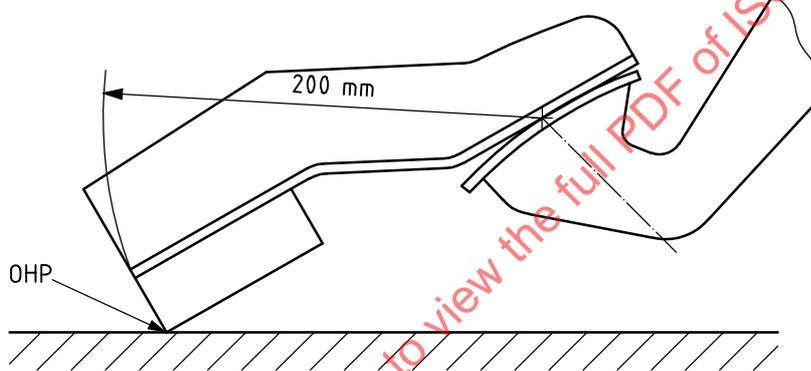
The OHP is defined for three basic types of throttle pedal design as follows:

- For treadle (organ) type pedals (see Figure 2a), the OHP is the intersection of the depressed floor or other heel support with a line projected from the upper surface of the throttle pedal.
- For hanging (pendulum) type pedals (see Figure 2b), the OHP is the point which intersects with the depressed floor or other heel support when an arc 200 mm in length is taken from the centre of the pedal surface.
- For treadle (organ) type pedals with a fixed heel stop (see Figure 2c), the OHP shall be taken as the intersection between the heel stop and the pedal surface.

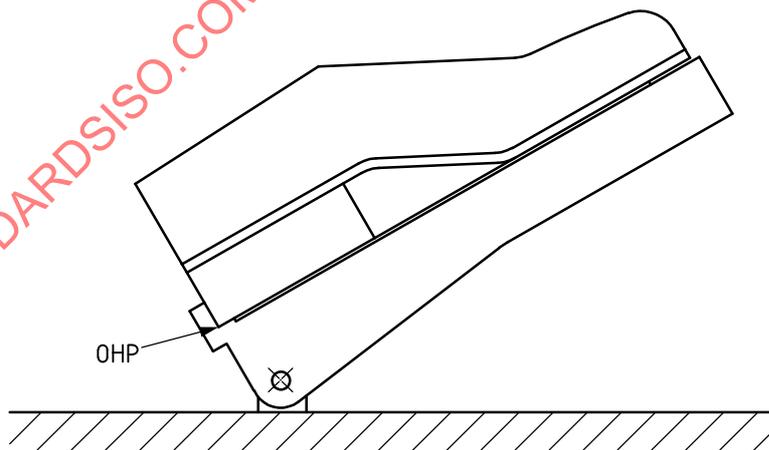
In all cases, the OHP shall lie on the vertical centreline of the pedal.



a) Treadle type pedal with no heel stop



b) Pendulum type pedal



c) Treadle type pedal with heel stop

Figure 2 — Determination of operator heel point, OHP

## 4.2 Driver's workplace in general

It is recommended to provide a wall behind the driver.

### 4.2.1 Size of driver's workplace

#### 4.2.1.1 Driver's workplace length

The length of the driver's workplace (inside dimension) must be such that the driver can attain the full range of adjustment (see Table 1), including swivel (where such a mechanism is fitted) without restriction. The depth of the footwell shall be at least 350 mm (see Figure 3) forward of OHP.

#### 4.2.1.2 Driver's workplace width

The width of the driver's workplace must be chosen in such a way that sufficient distance to the cab covers and sufficient leg freedom are available, included space for seat swivel. For the protection of the fingers a clearance distance of 25 mm from the outer extremities of the seat shall be kept.

The minimum elbow room ( $z_{\min}$ ) in the shoulder range must be 800 mm in a vertical distance of up to  $z_{\min}$  of  $\leq 900$  mm to the heel point line.

### 4.2.2 Access to the driver's workplace

In low-floor buses, the driver's workplace should be arranged on a platform. It is recommended that this platform be at a height of  $200 \pm 50$  mm above the floor and be reached by a single step. If the platform height is greater than 250 mm, steps with equal height shall be provided with a maximum height of 250 mm and a minimum height of 125 mm.

Clear and unrestricted access to the driver's workplace shall be ensured, with a passage width of at least 500 mm.

These requirements are for the normal entrance to the driver's workplace and do not necessarily apply to additional emergency exit doors.

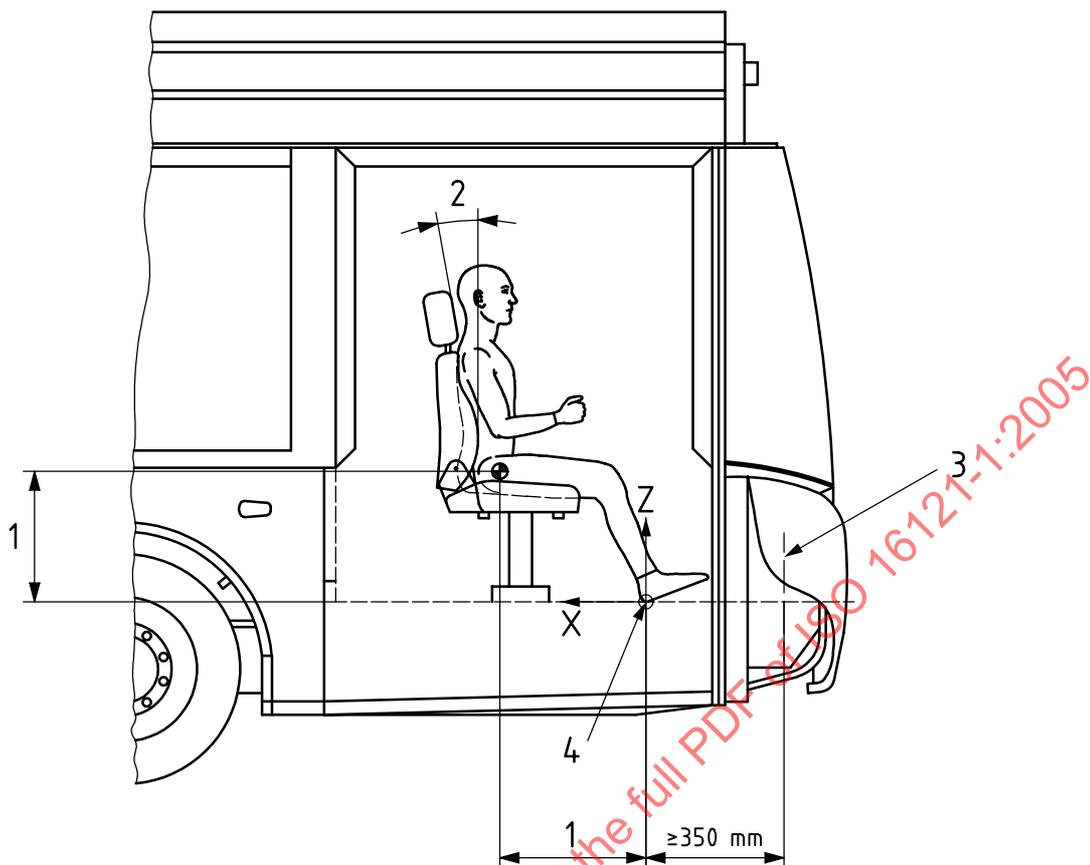
### 4.2.3 Stowage space

In the driver's workplace, a space for the driver's bag should be provided, e.g. in the cabin door. The stowage dimensions (length  $\times$  height  $\times$  width) for the driver's bag should be at least 480 mm  $\times$  330 mm  $\times$  170 mm (240 mm preferred, where possible).

It shall be possible to open the bag for the withdrawal of objects in the compartment. For personal objects needed during the drive (e.g. sunglasses) additional, easy-to-reach, non-slip stowage space should be available.

A coat hook should be provided inside the driver's cabin. A coat hung on the coat hook shall not interfere with the operation of controls nor obstruct the driver's view. Optionally, a hanger may be provided.

A lockable compartment for valuables shall be available.



**Key**

- 1 Table 1, item 1
- 2 Table 1, item 10
- 3 bulk head
- 4 OHP

**Figure 3 — Side view of driver's cab**

**4.3 Driver's seat**

**4.3.1 Positioning, seat dimensions and adjustment ranges**

The centreline of the steering wheel should be positioned in line with the centreline of the driver. However, an offset of up to 25 mm is permitted.

For a healthy and comfortable seat posture, the seat dimensions and adjustment ranges listed in the column titled "Required" in Table 1 shall be provided (see also Figure 4). The H-point referred to is the design H-point according to ISO 6549.

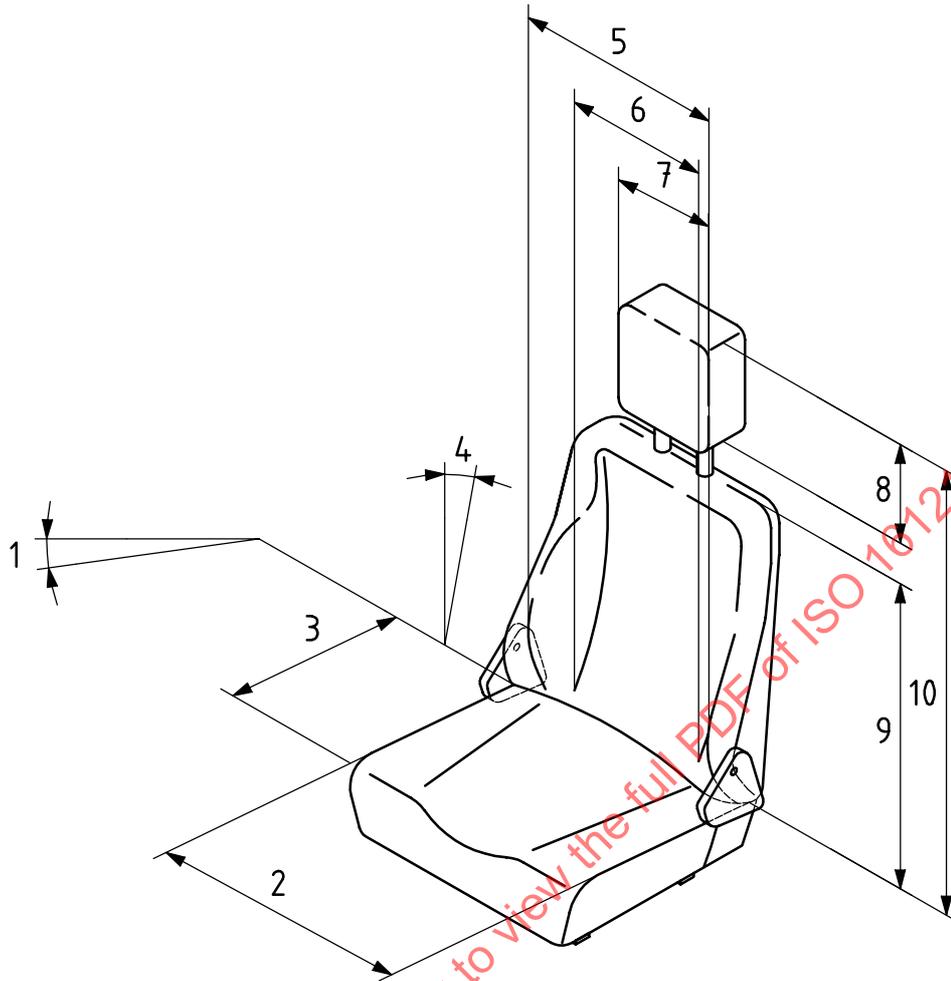
Table 1 — Seat dimensions and adjustment ranges

Dimensions in millimetres

Subject		Required	Recommended	Remarks
1	position of seat (H-point according to ISO 6549)		X = 650 Y = 0 Z = 510	a
2	adjustment range horizontal	≥ 200	≥ 230	≥ 100 fore and aft
3	adjustment range vertical	≥ 100	≥ 130	≥ 50 up and down
4	depth of seat area	400 – 450	390 – 500 adjustable	
5	width of seat area (total)	≥ 450	≥ 480	
6	inclination of seat area	5° ± 5°	5° ± 10° adjustable	b
7	height of seat back	≥ 500	≥ 600	
8	seat back width (total)	≥ 475	—	
9	seat back width (lumbar region)	≥ 270	300 – 340	
10	inclination range of back-rest (to vertical)	+10° to +25° adjustable	0 to 30° adjustable	
11	height of head-restraint's top edge (above seat squab)	≥ 840	—	c
12	height of head restraint	≥ 120	—	c
13	width of head restraint	≥ 250	—	c
14	weight adjustment for damping of the seat		45 – 130 kg	
<p><sup>a</sup> For the purpose of this part of ISO 16121, which is to provide equally good ergonomics for tall and small drivers, the H-point shall be regarded in a medium position with respect to its longitudinal position. Medium position means the middle of the fore/aft and vertical adjustment range.</p> <p><sup>b</sup> Positive angle = front of seat cushion upward.</p> <p><sup>c</sup> If head restraint is provided.</p>				

#### 4.3.2 Seat control

The seat shall be capable of manual adjustment – without the use of tools – from the driver's seated position. The adjustment functions shall be: seat longitudinal and height adjustment. Capability of adjustment of seat back inclination, seat cushion inclination, seat cushion depth, lumbar support in height and curvature and head-restraint (where fitted) in height and inclination is recommended. As an option, a power-driven seat, with memory for basic settings, is permitted.



- Key**
- 1 Table 1, item 6
  - 2 Table 1, item 5
  - 3 Table 1, item 4
  - 4 Table 1, item 10
  - 5 Table 1, item 8
  - 6 Table 1, item 13
  - 7 Table 1, item 9
  - 8 Table 1, item 12
  - 9 Table 1, item 7
  - 10 Table 1, item 11

**Figure 4 — Driver's seat**

**4.3.3 Swivel mechanism (optional)**

If seat swivel is required due to the type and positioning of the ticketing equipment, sufficient leg room shall be provided for the driver. The swivelling range shall be limited by integrated end stops. The seat shall automatically lock itself in the driving position. Controls for unlocking shall be easily accessible.

#### 4.3.4 Suspension

The seat shall be equipped with a suspension. The natural frequency of that suspension shall take into account the natural frequency of the complete vehicle. The system shall be tuned in such a way that a transfer ratio of  $< 1$  is maintained under typical operation.

NOTE For a definition of "Transfer ratio" see ISO 10326-1.

#### 4.3.5 Seat upholstery

The seat shall have a breathable upholstery. Optionally, a seat with heating and/or inside ventilation may be provided.

#### 4.3.6 Operating manual

Seat controls shall be clearly marked according to ISO 2575; additional instruction for the correct adjustment of the seat shall be provided.

### 4.4 Pedals

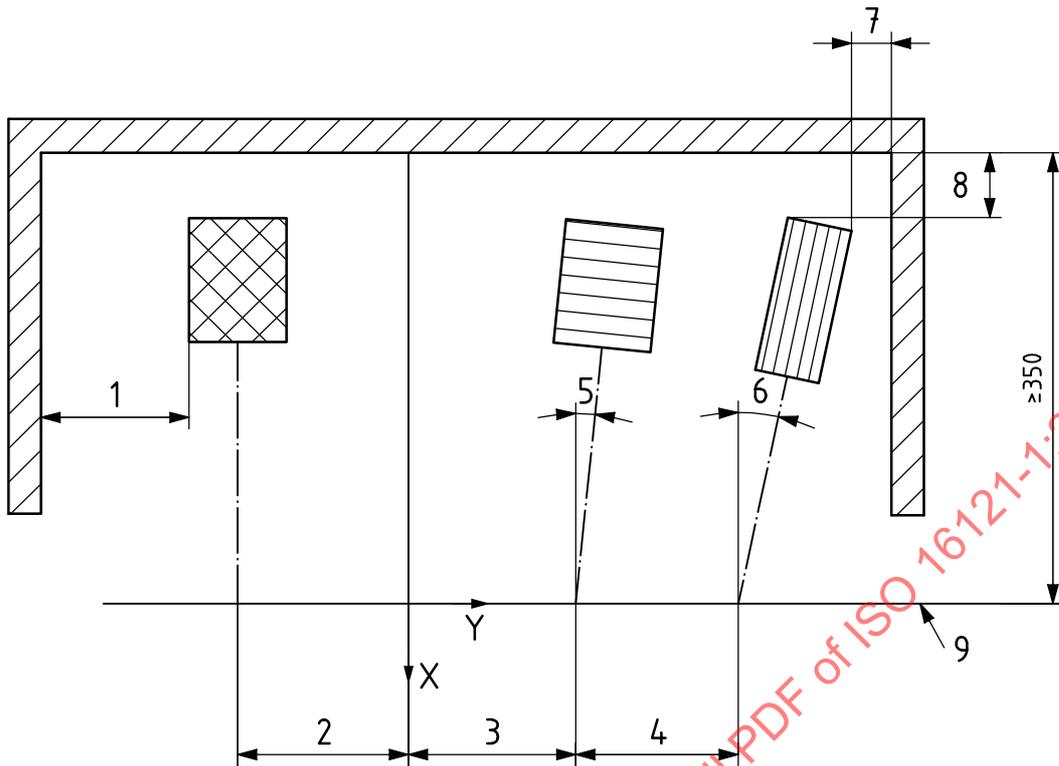
#### 4.4.1 Design of the pedals

The accelerator pedal and brake pedal should be arranged in such a way that the foot movement is rotational during operation.

#### 4.4.2 Position and arrangement

As regards the position, arrangement and operating forces of the pedals, the values quoted in Table 2 shall be met (see Figure 5).

The operating forces refer to a lever arm of 200 mm (distance from heel point to the centre of the pedal surface).



**Key**

- 1 Table 2, item 3.6
  - 2 Table 2, item 3.1
  - 3 Table 2, item 2.1
  - 4 Table 2, item 1.1
  - 5 Table 2, item 2.2
  - 6 Table 2, item 1.2
  - 7 Table 2, item 1.7
  - 8 Table 2, item 1.6
  - 9 OHP line
- <sup>a</sup> Minimum 350 mm.

**Figure 5 — Arrangement of foot controls**