INTERNATIONAL STANDARD

ISO 20653

Third edition
2023-08

Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access

Véhicules routiers — Degrés de protection (codes IP) — Protection des équipements électriques contre les corps étrangers, l'eau et les contacts

Reference number
ISO 20653:2023(E)

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

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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 32, *Electrical and electronic components and general system aspects*.

This third edition cancels and replaces the second edition (ISO 20653:2013), which has been technically revised.

The main changes are as follows:

— test conditions for IPX9K test were extended, the method for measuring of the impact forced was described and tolerances were added, the visualization method for impact force with foam was added;

— details to test setup for degrees of protection against water 3, 4 and 4K were added.

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 IP codes used in this document are in accordance with IEC 60529, except in the case of codes “K”, which describe special requirements for road vehicles that are not covered by IEC 60529.

Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access

1 Scope

This document applies to degrees of protection (IP code) provided by enclosures of the electrical equipment of road vehicles. It specifies the following:

a) designations and definitions of types and degrees of protection provided by enclosures of electrical equipment (IP codes) for the:

   — protection of electrical equipment within the enclosure against ingress of foreign objects, including dust (protection against foreign objects);

   — protection of persons against access to hazardous parts inside the enclosure (protection against access);

   — protection of electrical equipment inside the enclosure against effects due to ingress of water (protection against water);

b) requirements for each degree of protection;

c) tests carried out in order to confirm that the enclosure complies with requirements of the relevant degree of protection.

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 12103-1, *Road vehicles — Test contaminants for filter evaluation — Part 1: Arizona test dust*

IEC 60068-2-68, *Environmental testing — Part 2: Tests — Test L: Dust and sand*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
enclosure
part providing protection of equipment against certain external influences and in any direction against access

3.2
degree of protection
protection provided by an *enclosure* (3.1) against access, foreign objects and/or water and verified by standardized test methods

3.3
IP code
international protection code
coding system used to indicate the *degree of protection* (3.2) provided by an *enclosure* (3.1) against access, foreign objects and/or water and to give additional information in connection with such parts

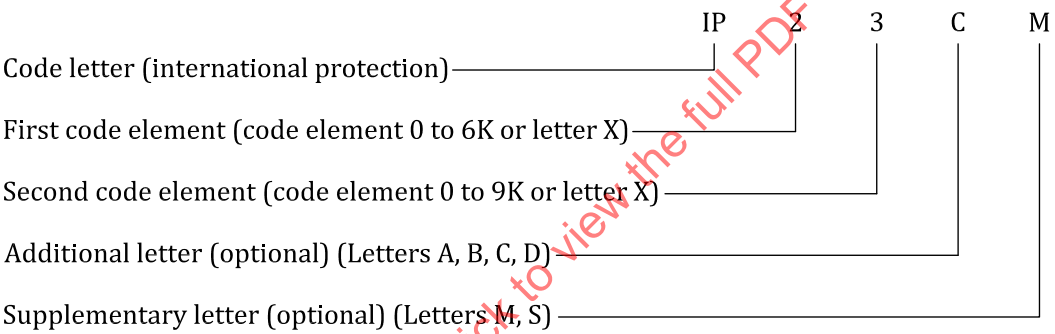
3.4
hazardous part
part that is hazardous to approach or touch

3.5
opening
gap or aperture in an *enclosure* (3.1) which exists or may be formed by the application of a test probe at the specified force

4 Structure and meaning of the IP code

4.1 Structure of the IP code

The structure of the IP code is as follows.



Where no code element is given, the letter "X" shall be substituted (or "XX", if none of the two code elements have been indicated).

Additional and/or supplementary letters may be omitted without substitute.

Additional letters following each other directly shall be in alphabetical order.

Wherever the degree of protection of a part of the enclosure or the electrical equipment deviates from the degree of protection of the remaining part, both degrees of protection shall be indicated.

4.2 Meaning of IP code

Table 1 contains an overview of the IP code elements.

Table 1 — Overview of all IP code elements and meaning

Element	IP	Meaning for the protection of electrical equipment	Meaning for the protection of persons
First code element		Against foreign objects (including dust):	Against access:
	0	— not protected	— not protected
	1	— with diameter ≥ 50 mm	— with back of hand
	2	— with diameter ≥ 12,5 mm	— with finger
	3	— with diameter ≥ 2,5 mm	— with tool
	4	— with diameter ≥ 1,0 mm	— with wire
	5K	— dust-protected	— with wire
	6K	— dust-tight	— with wire
Second code element		Against water:	Not applicable
	0	— not protected	
	1	— vertical water drips	
	2	— water drips (15° inclination)	
	3	— water spray	
	4	— splash water	
	4K	— splash water with increased pressure	
	5	— high-velocity water	
	6	— strong high-velocity water	
	6K	— strong high-velocity water with increased pressure	
	7	— temporary immersion	
	8	— continuous submersion	
	9K	— high-pressure/steam-jet cleaning	
Additional letter (optional)		Not applicable	Against access (unless described by first letter)
	A		— with back of hand
	B		— with finger
	C		— with tool
	D		— with wire
Supplementary letter (optional)	M	Movement of moveable parts during water test	Not applicable
	S	Standstill of moveable parts during water test	

4.3 Examples for the use of letters in the IP code

The following examples explain the use and arrangements of letters in the IP code. For more comprehensive examples, see Clause 7.

IP44 no letters, no options;

IPX5 omitting first code element;

IP2X omitting second code element;

IP20C using additional letter;

IPXXC omitting both code elements, using additional letter;

IPX1C omitting first code element, using additional letter;

IP3XD omitting second code element, using additional letter;

IP23S using supplementary letter;

IP21CM using additional letter and supplementary letter;

IPX5/IPX7 giving two different degrees of protection by an enclosure against both water jets and temporary immersion for “versatile” application.

5 Degrees of protection against foreign objects and against access

Tables 2 and 3 contain short descriptions of the degrees of protection with the relevant requirements.

If the same degree of protection (identical code element) for protection against foreign objects and access is required, then both requirements are indicated by the first code element.

If different degrees of protection for both protection types are required, then an additional letter shall be used. In this case the first code element only defines the protection against foreign objects and the additional letter indicates the protection against access.

Additional letters may only be used if:

— the degree of protection against access is higher than indicated by the first code element, or

— only the degree of protection against access is to be indicated (first code element substituted by X).

The indication of a degree of protection against access and foreign objects always includes the preceding degrees of protection.

Table 2 — Degrees of protection against foreign objects

First code element	Degree of protection	
	Brief description	Requirements
0	Not protected	None
1	Foreign objects diameter ≥ 50 mm	Test probe with a diameter of 50 mm shall not penetrate completely[a].
2	Foreign objects diameter ≥ 12,5 mm	Test probe with a diameter of 12,5 mm shall not penetrate completely[a].
3	Foreign objects diameter ≥ 2,5 mm	Test probe with a diameter of 2,5 mm shall not penetrate completely[a].
4	Foreign objects diameter ≥ 1,0 mm	Test probe with a diameter of 1,0 mm shall not penetrate completely[a].
5K	Dust	Dust shall only penetrate in quantities which do not impair performance and safety.
6K	Dust	Dust shall not penetrate.

[a] “Shall not penetrate completely” indicates that the full diameter shall not pass through an opening of the enclosure.

Table 3 — Degrees of protection against access

First code element	Additional letter	Degree of protection	
		Brief description	Requirements
0	–	Not protected	None
1	A	Back of hand (no protection against intentional contact)	Test probe with a diameter of 50 mm shall not penetrate completely[a] and maintain sufficient distance from hazardous parts.

[a] “Shall not penetrate completely” indicates that the full diameter shall not pass through an opening of the enclosure.

Table 3 *(continued)*

First code element	Additional letter	Degree of protection	
		Brief description	Requirements
2	B	Finger	Jointed test finger with a diameter of 12 mm may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
3	C	Tool (e.g. screwdriver)	Test probe with a diameter of 2,5 mm, 100 mm long, may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
4	D	Wire	Test probe with a diameter of 1,0 mm, 100 mm long, may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
5K	D	Wire	
6K	D	Wire	

[a] "Shall not penetrate completely" indicates that the full diameter shall not pass through an opening of the enclosure.

6 Degrees of protection against water

Table 4 contains short descriptions of the degrees of protection with the relevant requirements.

Up to and including degree of protection 6K for the protection against water, the designation implies compliance also with the requirements for all lower degrees of protection.

For degrees of protection against water 7, 8 and 9K, lower degrees of protection up to and including 6K are not covered by the designation. In such cases where a lower degree of protection up to and including 6K is required in addition to protection against water 7, 8 or 9K, it shall be indicated separately, e.g. IPX4K/IPX7, IPX5/IPX7, IPX6K/IPX8, IPX6K/IPX9K and IPX8/IPX9K.

Table 4 — Degrees of protection against water

Second code element	Degree of protection	
	Brief description	Requirements
0	Not protected	None
1	Water drips vertically	Vertical drips shall not have any harmful effects or impair performance.
2	Water drips with enclosure inclined by 15°	Vertical drips shall not have any harmful effects or impair performance when the enclosure is tilted at any angle up to 15° on either side of the vertical.
3	Water spray	Water spray at an angle up to 60° on either side of the vertical shall have no harmful effects or impair performance.
4	Splash water	Water which splashes against the enclosure from any direction shall not have any harmful effects or impair performance.
4K	Splash water with increased pressure	Water which splashes against the enclosure from any direction with increased pressure shall not have any harmful effects or impair performance.
5	High-velocity water	Water which is directed against the enclosure from any direction as a jet shall not have any harmful effects or impair performance.
6	Strong high-velocity water	Water which is directed against the enclosure from any direction as a strong jet shall not have any harmful effects or impair performance.
6K	Strong high-velocity water with increased pressure	Water which is directed against the enclosure from any direction as a strong jet with increased pressure shall not have any harmful effects or impair performance.

Table 4 *(continued)*

Second code element	Degree of protection	
	Brief description	Requirements
7	Temporary immersion in water	Water shall not penetrate in a quantity causing harmful effects or impairing performance if the enclosure is immersed in water temporarily under specified pressure and time conditions.
8	Continuous immersion in water	Water shall not penetrate in a quantity causing harmful effects if the enclosure is continuously immersed in water under conditions which shall be agreed between supplier and car manufacturer, but which are more severe than code 7.
9K	Water during high-pressure/ steam-jet cleaning	Water which is directed against the enclosure from any direction shall not have any harmful effects or impair performance.

7 Designation examples

7.1 General

The degree of protection shall be indicated using the IP code.

7.2 Example IP34K

The marking of an enclosure with the IP code IP34K means:

(3) protection of the electrical equipment access to the enclosure against foreign objects with a diameter of ≥ 2,5 mm (protection against foreign objects), and

protection of persons handling rods of 2,5 mm diameter or more against access within the enclosure (protection against access);

(4K) protection of electrical equipment within the enclosure against harmful effects resulting from water splashing against the enclosure with increased pressure from any direction (protection against water).

7.3 Example IP16KB

The marking of an enclosure with the IP code IP16KB means:

(1) protection of the electrical equipment within the enclosure against foreign objects with a diameter of ≥ 50 mm (protection against foreign objects);

(6K) protection of electrical equipment within the enclosure against harmful effects resulting from water directed against the enclosure from any direction as a strong jet with increased pressure (protection against water);

(B) protection of persons against finger contact with hazardous parts within the enclosure (protection against access).

7.4 Example IP2X/IP5KX

The designation

— IP2X for the complete enclosure, and

— IP5KX for the cover of a part inside the complete enclosure

mean:

(2) protection of the electrical equipment within the complete enclosure against foreign objects with a diameter of ≥ 12,5 mm (protection against foreign objects), and

protection of persons against finger contact with hazardous parts within the complete enclosure (protection against access);

(X) no statement on the degree of protection against water for the complete enclosure, and additionally

(5K) protection of the part against harmful effects resulting from ingress of dust (protection against foreign objects), and

protection of persons handling wires of 1 mm diameter or more against contact with hazardous parts within the cover of this part (protection against access);

(X) no statement on the degree of protection against ingress of water for the cover of this part.

NOTE 1 If all other parts are also not harmed by the penetrated dust, apart from protection against foreign objects degree 2, insensitivity to dust within the complete enclosure is also achieved.

NOTE 2 This higher degree of protection of the cover of the part located within the complete enclosure does not influence the complete enclosure surrounding it, whose lower degree of protection 2 applies.

8 Requirements and testing

8.1 Atmospheric conditions

Unless otherwise specified, tests shall be carried out under the following ambient atmospheric conditions:

— temperature range: (23 ± 5) °C;

— relative humidity: 25 % to 75 %;

— atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar).

8.2 Device under test (DUT)

Unless otherwise agreed, the DUT shall be unused and clean. Further specifications regarding DUT may be made.

NOTE If field loads have an impact on fulfilment of IPX requirements, pre-aging/preconditioning can be added. This can be decided on the specific design and the usage of the component.

8.3 Requirements and tests for degrees of protection against foreign objects and access

8.3.1 Test set-up

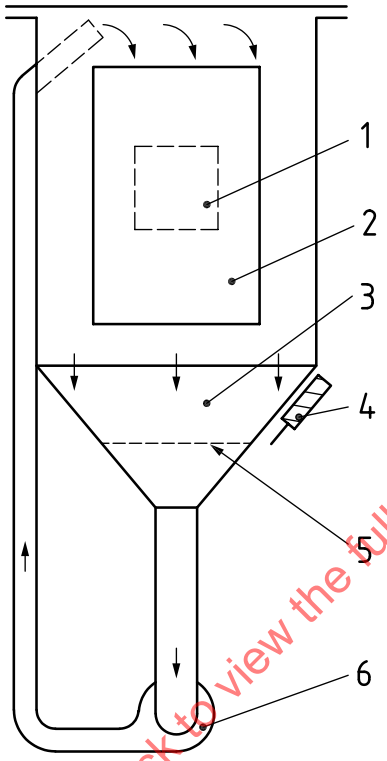
Probes for determining the degrees of protection against access and foreign objects are shown in Table 5. If the guard and handle impede practical testing, the test shall be carried out with the rigid test sphere only.

A principle test set-up for determining degrees of protection against foreign objects 5K and 6K (dust-protected or dust-tight) with vertical flow of the air–dust mixture is depicted in Figure 1. Alternatively, a principle dust chamber with horizontal dust flow (see Figure 2) can be agreed upon, based on IEC 60068-2-68.

Unless otherwise agreed, test dust A2 (Arizona dust) according to ISO 12103-1 shall be used. Where a dust chamber in accordance with Figure 1 is used, approximately 2 kg of test dust per m^3 chamber

volume shall be filled in and kept in suspension during the test. If another dust is used, the volume should be similar to the A2 dust according to ISO 12103-1. And the particle size distributions shall be the same as A2.

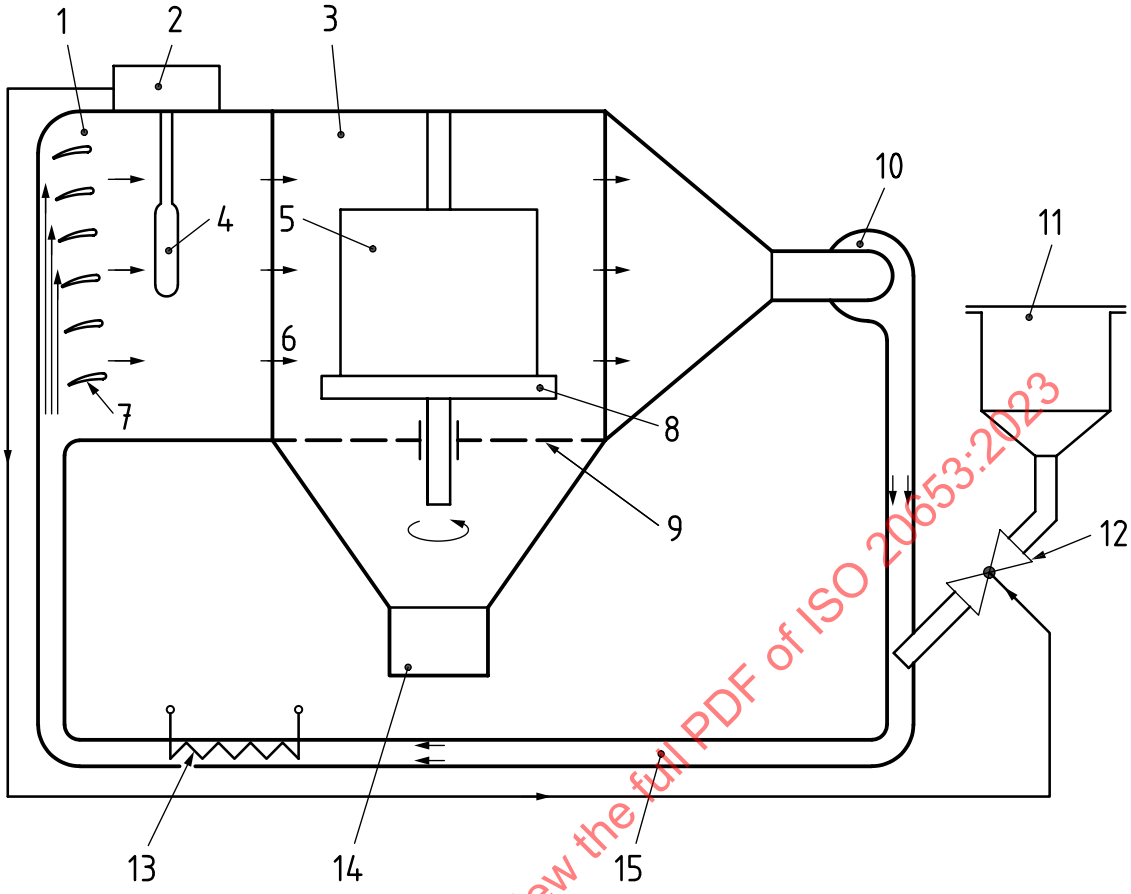
Where dust chambers according to Figure 2 are used, the density of the air–dust mixture shall be (5 ± 2) g/m^3 and the flow rate shall be maintained in accordance with IEC 60068-2-68 (unless otherwise agreed).



Key

1 DUT
2 glass window
3 dust
4 vibrator
5 protective grating
6 circulating pump or other equipment for suspending the dust

Figure 1 — Principle test set-up for determining the protection against dust in vertical orientation; degree of protection against foreign objects 5K and 6K



Key

1 pre-chamber
2 dust density controller (control unit)
3 test chamber
4 probe
5 DUT
6 laminar air flow
7 air baffles
8 test bench
9 protective grating
10 dust circulating pump (radial fan)
11 reservoir for test dust
12 solenoid valve (proportioning valve)
13 heating
14 collecting tank for test dust
15 air duct

Figure 2 — Principle test set-up for determining the degree of protection against dust in horizontal orientation; protection against foreign objects 5K and 6K

8.3.2 Requirements for tests using probes

The requirements for tests using the probes according to Table 5 are specified in Table 6.

Table 5 — Probes for the testing of degrees of protection against foreign objects and access

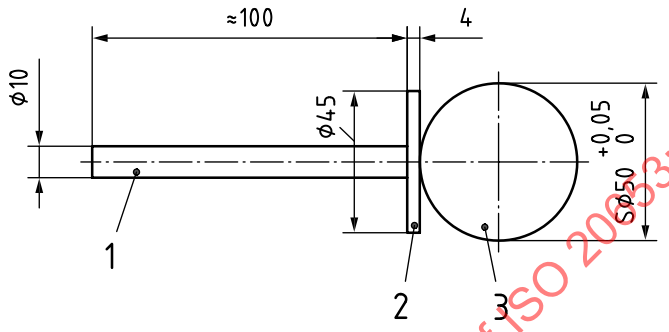
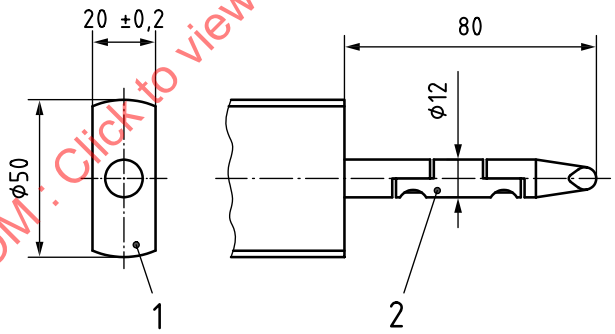
Degree of protection against access of foreign objects		Test probe designation and dimension
First code element	Additional letter	
1	A	Sphere diameter 50 mm Dimensions in millimetres  **Key** 1 handle (insulating material) 2 guard (insulating material) 3 rigid test sphere (metal)
–	B	Jointed test finger diameter 12 mm; length 80 mm Dimensions in millimetres  **Key** 1 stop face (insulating material) 2 jointed test finger (metal) NOTE For structural details of the finger, refer to Figure 2, test probe B in IEC 61032.

Table 5 *(continued)*

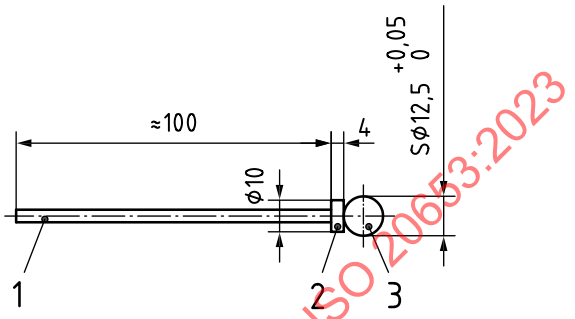
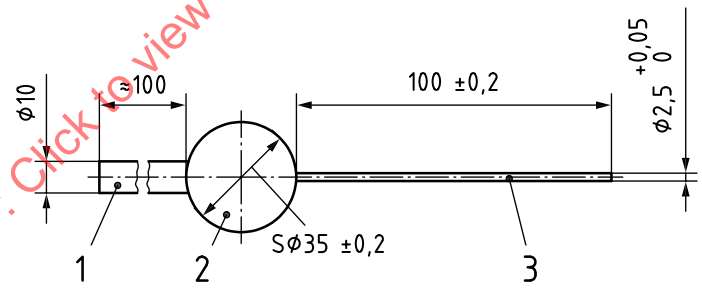
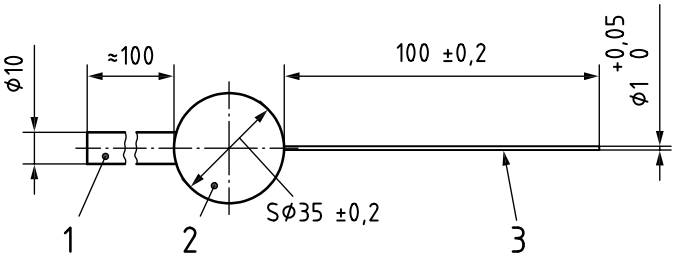
Degree of protection against access of foreign objects		Test probe designation and dimension
First code element	Additional letter	
2	–	Sphere diameter 12,5 mm Dimensions in millimetres  **Key** 1 handle (insulating material) 2 guard (insulating material) 3 rigid test sphere (metal)
3	C	Test rod diameter 2,5 mm; length 100 mm Dimensions in millimetres  **Key** 1 handle (insulating material) 2 stop face (insulating material) 3 rigid test rod (metal) (edges free from burrs)
4/5K/6K	D	Test rod diameter 1,0 mm; length 100 mm Dimensions in millimetres  **Key** 1 handle (insulating material) 2 stop face (insulating material) 3 rigid test wire (metal) (edges free from burrs)

Table 6 — Test conditions and requirements for testing degrees of protection against foreign objects and access using probes

Degree of protection against foreign objects First code element	Degree of protection against access First code element or additional letter	Test force N ±10 %	Requirements
or			
0	0	–	None
–	1 or A	50	The sphere (diameter 50 mm) shall not penetrate fully through any openings and shall be sufficiently distant from hazardous parts.
1	–		The sphere (diameter 50 mm) shall not penetrate fully through any opening.
–	2 or B	10	The jointed test finger may penetrate over its full length of 80 mm but shall be sufficiently distant from hazardous parts, even when its joints are bent at any optional angle (up to 90° from its axis) and are brought into any possible position. The stop face (Ø50 mm × 20 mm) shall not pass through the opening.
2	–	30	The sphere (diameter 12,5 mm) shall not penetrate fully through any opening.
–	C	3	The rigid test rod (diameter 2,5 mm, 100 mm long) may penetrate over its full length of 100 mm, but shall be sufficiently distant from hazardous parts[a] in any possible angular position. The stop face (sphere Ø35 mm) shall not pass through the opening.
3			The rigid test rod (diameter 2,5 mm) shall not penetrate.
–	D	1	The rigid test wire (diameter 1,0 mm, 100 mm long) may penetrate over its full length of 100 mm, but shall be sufficiently distant from hazardous parts in any possible angular position. The stop face (sphere Ø35 mm) shall not pass through the opening.
4	4/5K/6K		The rigid test wire (diameter 1,0 mm) shall not penetrate.

[a] "Sufficiently distant from hazardous parts" has the following meaning in this context: the probes shall not contact hazardous parts while hazardous parts are being moved.

8.3.3 Requirements for testing with dust

8.3.3.1 Execution of the test for protection against ingress of dust

The enclosure to be tested shall be placed in the test chamber in its normal operating position, with all its shrouds, covers and open drain holes, and exposed to the following conditions.

a) Test chamber according to Figure 1:

— 6 s movement of the air–dust mixture,

— 15 min break.

Unless otherwise agreed, 20 such cycles shall be performed.

b) Test chamber according to Figure 2:

— subject to agreement: exposure time 0,5 h to 24 h and speed (0 to 3) min^{-1}.

8.3.3.2 Requirements

For requirements, refer to Table 2, which generally stipulates successful completion of an agreed performance test for degree of protection against foreign objects 5K and 6K. In special cases, a permissible degree of dust or another test criterion may be agreed upon.

8.4 Requirements and test for degrees of protection against water

8.4.1 Test set-up

The test set-up and the special arrangement with reference to the DUT are illustrated in Figures 3 to 9.

8.4.2 Execution of the tests for protection against ingress of water

The test conditions are specified in Table 7.

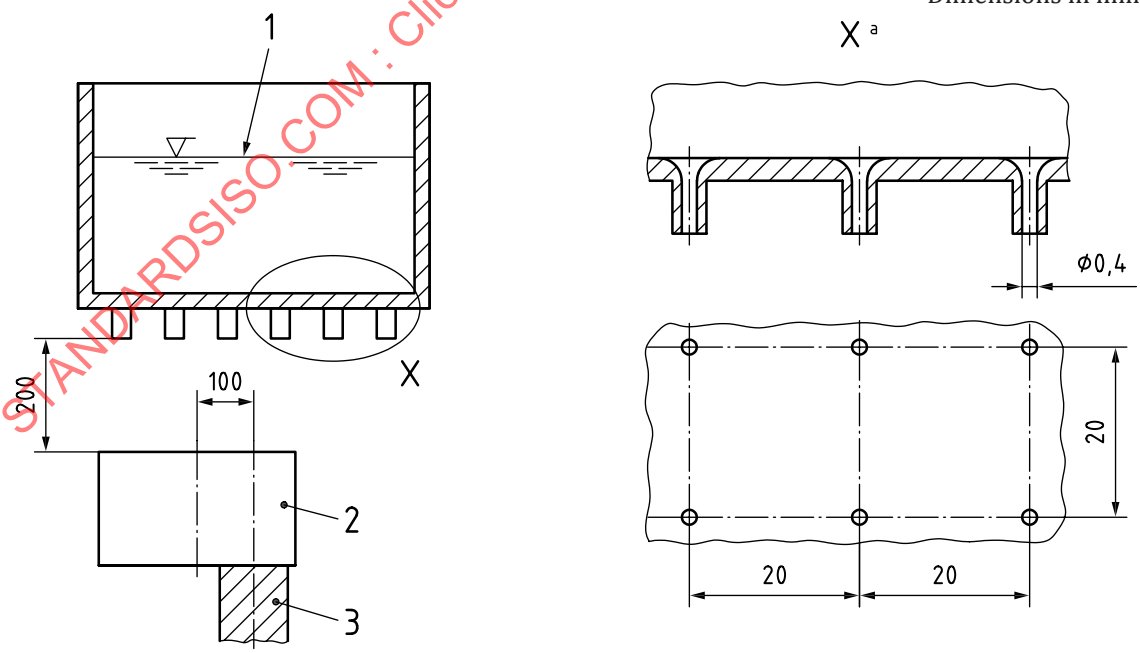
8.4.3 Requirements

The requirements are contained in Table 4, whereby the acceptable quantity of penetrated water or another test criterion (e.g. passing a performance test to be specified) shall be agreed.

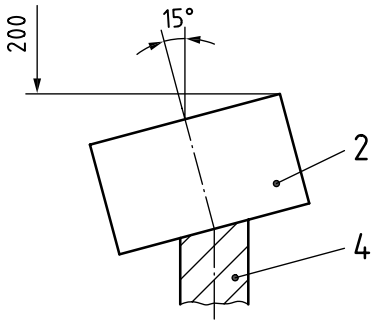
The requirements are contained in Table 4, whereby the test criteria, the acceptable harmful effects and impaired performance shall be agreed between customer and supplier.

NOTE Test criteria could be an acceptable quantity of penetrated water, passing a specified performance test and no signs of corrosion after a specified time.

Dimensions in millimetres



a) degree of protection against water 1



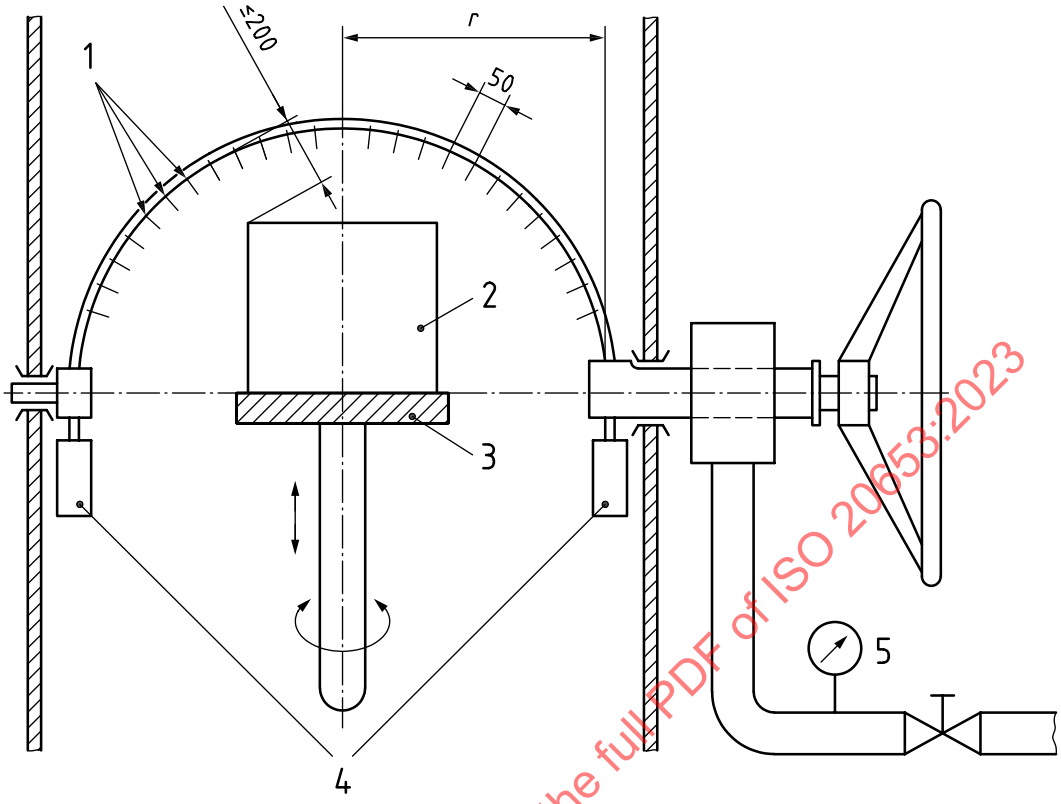
b) degree of protection against water 2

Key

1 adjustable water level
2 DUT
3 turntable / holder
4 holder
[a] Hole pattern (sectional drawing).

Figure 3 — Test set-up for determining the protection against vertical water drips (drip apparatus); degrees of protection against water 1 and 2

Dimensions in millimetres



Key

1 holes with diameter *D*
2 DUT
3 turntable / holder
4 counterweights
5 flow rate indicator and pressure gauge

r = (200, 400, 600, 800 or 1 600) mm; select the smallest radius depending on the size of DUT.

D = 0,4 mm for tests regarding degrees of protection against water 3 and 4.

D = 0,8 mm for tests regarding degrees of protection against water 4K.

Speed of DUT from (1 to 3) r/min.

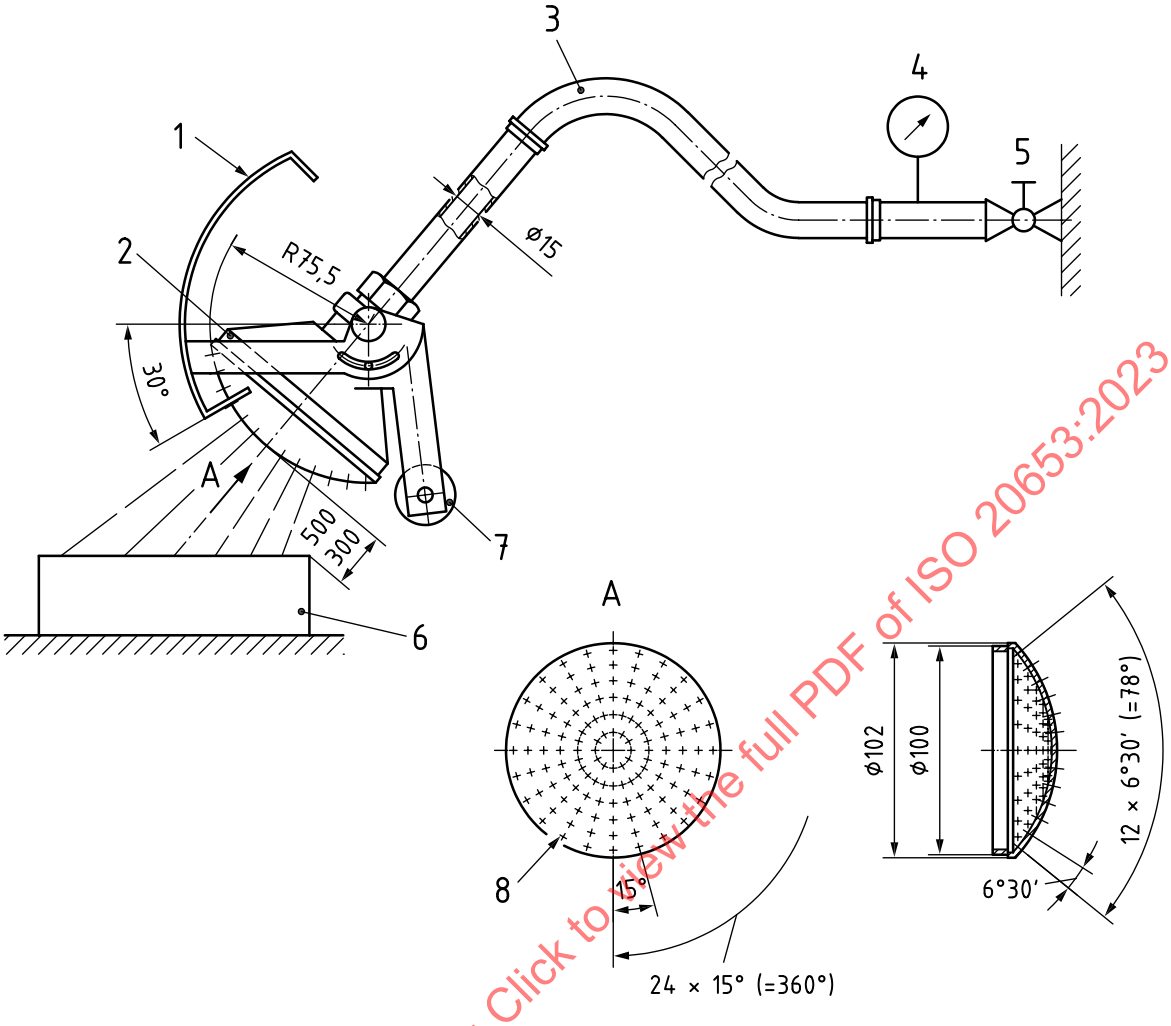
Figure 4 — Test set-up for determining the protection against splash water and water spray (swivel tube); degrees of protection against water 3, 4 and 4K

All water jets shall meet in a circle of 5 % of the swivel tube diameter. For example, *r* = 200 mm: diameter of the circle is 10 mm.

If the DUT is not fully symmetric, it is recommended to set the horizontal position of the DUT in a product specific agreement between customer and supplier to increase reproducibility, e.g. define the centre point of the DUT.

The bottom of the DUT is placed at the centre point of the semicircle. The height adjustment is used, e.g. if a holder is needed for the DUT to fulfil the previous the requirement.

Dimensions in millimetres



Key

1 moveable cover
2 shower tube
3 hose
4 flow rate indicator and pressure gauge
5 stop-cock
6 DUT
7 counterweight
8 diameter of apertures

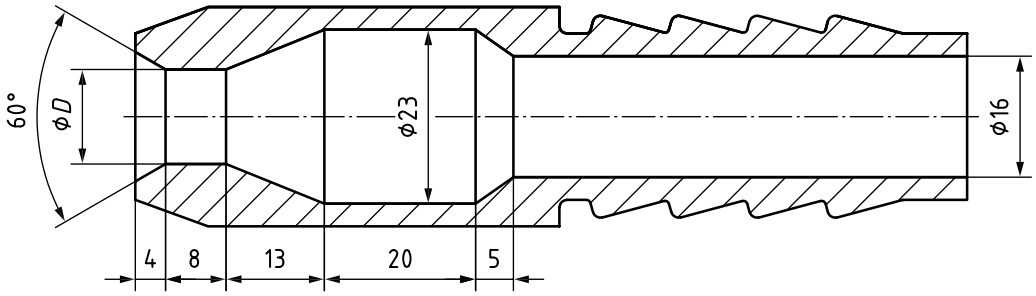
NOTE The shower tube contains 121 apertures with diameter 0,5 mm:

— 1 centre aperture,
— 2 inner circles (12 apertures at 30° pitch),
— 4 outer circles (24 openings at 15° pitch), and
— a moveable cover made from aluminium.

The shower tube shall be made from copper–zinc alloy (brass).

Figure 5 — Manual test set-up for determining the protection against splash water and water spray (shower tube); degrees of protection against water 3 and 4

Dimensions in millimetres

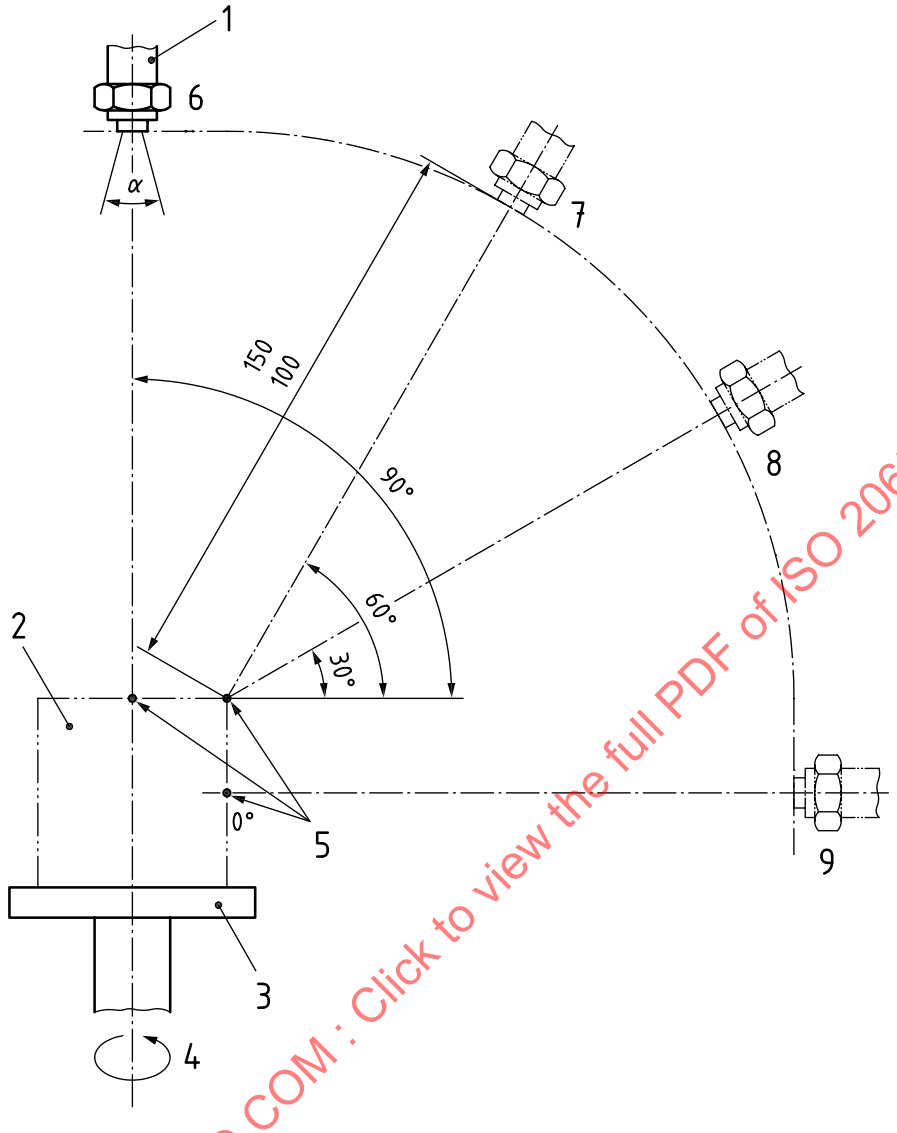


D = 6,3 mm for tests regarding degrees of protection against water 5 and 6K

D = 12,5 mm for tests regarding degree of protection against water 6

Figure 6 — Nozzle for determining the protection against high-velocity water; degrees of protection against water 5, 6 and 6K

Dimensions in millimetres



Key

1 fan jet nozzle
2 DUT
3 turntable / holder
4 swivel axis
5 reference points (0°, 30°, 60°, 90°) endorsing cylinder for DUT
6 position 1
7 position 2
8 position 3
9 position 4

α = (30 ± 10)°

Speed of DUT (5 ± 1) r/min.

Figure 7 — Test set-up for determining the protection against high-pressure/steam-jet cleaning; degree of protection against water 9K

Table 7 — Test set-ups and conditions for testing degrees of protection against water

2nd code element	Test equipment Test conditions	Water flow rate	Water pressure	Water temperature	Exposure time
0	–	–	–	–	–
1	Drip apparatus Figure 3 Enclosure on turntable Speed (1 ± 0,5) r/min	(1,0 + 0,5) mm/min (precipitation height)	–	Difference of the temperature of the equipment under test no more than 5 °C. For water temperatures which are more than 5 °C lower, measures shall be agreed between the users of the standard to prevent the formation of condensed water.	10 min
2	Drip apparatus Figure 3 Enclosure in 4 fixed positions, inclined by 15°	(3,0 + 0,5) mm/min (precipitation height)	–		2,5 min for each of the four positions
3	Swivel tube Figure 4 with apertures diameter 0,4 mm to ±60° from the vertical plane spray while swivelling the swivel tube by ±60° with reference to the vertical plane at a rate of approx. 1 s/60° The max. distance is 200 mm. The holder shall be not perforated.	0,1 l/min ± 5 % per aperture (medium value), or	approx. 80 kPa		10 min (speed of DUT from (1 to 3) r/min)
	or shower tube Figure 5 spray while swivelling the shower tube by ±60° with reference to the vertical plane The max. distance is 500 mm.	10 l/min ± 5 %	50 kPa to 150 kPa		5 min
4	Swivel tube Figure 4 as under 3, but with apertures diameter 0,4 mm ± 90° from the vertical plane; spray while swivelling the swivel tube by ± (180° to 20°) with reference to the vertical plane at a rate of approx. 1 s/60° The max. distance is 200 mm. The holder shall be perforated.	as under 3	as under 3		as under 3
	or shower tube Figure 5, but with removed cover, spray while swivelling the shower tube by ±90° with reference to the vertical plane The max. distance is 500 mm.				
4K	Swivel tube Figure 4 as under 3, but with apertures diameter 0,8 mm ± 90° from the vertical plane, spray while swivelling the swivel tube by ± (180° to 20°) with reference to the vertical plane at a rate of approx. 1 s/60° The max. distance is 200 mm. The holder shall be perforated.	0,6 l/min ± 5 % per aperture (medium value)	approx. 400 kPa		10 min (Speed of DUT from (1 to 3) r/min)
5	Water jet, nozzle 6,3 mm diameter according to Figure 6 Distance 2,5 m to 3 m	12,5 l/min ± 5 %	approx. 30 kPa		3 min
6	Water jet, nozzle 12,5 mm diameter according to Figure 6 Distance 2,5 m to 3 m	100 l/min ± 5 %	approx. 100 kPa	Difference of the temperature of the equipment under test shall be no more than 5 °C. For water temperatures which are more than 5 °C lower, measures shall be agreed between the users of this document to prevent the formation of condensed water.	3 min
6K	Water jet, nozzle 6,3 mm diameter according to Figure 6 Distance 2,5 m to 3 m	75 l/min ± 5 %	approx. 1 000 kPa		min. 3 min
7	Immersion basin immersion depth: 1 m (deepest housing location) 0,15 m water above highest housing location, if housing is larger than 0,85 m	–	–		30 min