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## **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  
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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 20653 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

## Introduction

The IP-codes used in this International Standard are in accordance with IEC 60529 except specific codes “K” describing special requirements for road vehicles 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 International Standard 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-Code) for the:
  - protection of electrical equipment within the enclosure against ingress of foreign objects, including dust (protection against foreign objects);
  - protection of electrical equipment inside the enclosure against effects due to ingress of water (protection against water);
  - protection of persons against access to hazardous parts inside the enclosure (protection against access).
- b) Requirements for each degree of protection.
- c) Tests to be carried out in order to confirm that the enclosure complies with requirements of the relevant degree of protection.

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

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

IEC 60529, *Degrees of protection by enclosures (IP-Code)*

## 3 Terms and definitions

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

### 3.1

#### enclosure

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

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**3.2 degree of protection**

protection provided by an enclosure against access, foreign objects and/or water and verified by standardized test methods

[IEC 60529]

**3.3 International Protection code IP-code**

coding system to indicate the degree of protection provided by an enclosure against access, foreign objects and/or water and to give additional information in connection with such parts

[IEC 60529]

**3.4 hazardous part**

part that is hazardous to approach or touch

[IEC 60529]

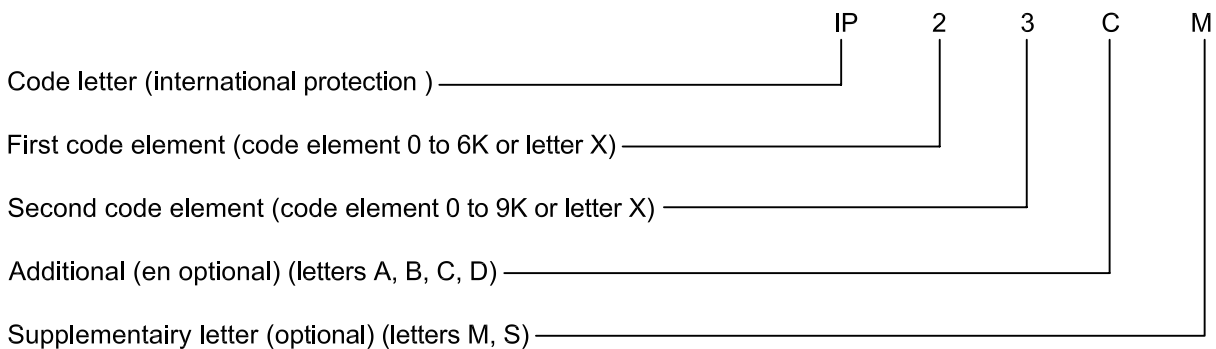
**3.5 opening**

gap or aperture in an enclosure which exists or may be formed by the application of a test probe at the specified force

[IEC 60529]

**4 Structure and significance of the IP-code**

**4.1 Structure of the IP-code**



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.

Letters following each other directly shall be arranged 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 Significance of IP-code

Table 1 contains an overview of the IP-code elements.

**Table 1 — Overview of all IP-Code elements and significance**

Element	IP	Significance for the protection of electrical equipment	Significance for the protection of persons
First code element	0	— not protected	Against access: — not protected
	1	— with diameter $\geq$ 50 mm	— with back of hand
	2	— with diameter $\geq$ 12,5 mm	— with finger
	3	— with diameter $\geq$ 2,5 mm	— with tool
	4	— with diameter $\geq$ 1,0 mm	— with wire
	5K	— dust-protected	— with wire
	6K	— dust-tight	— with wire
Second code element	0	Against water: — 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)	A		Against access (unless described by first letter) — with back of hand
	B		— with finger
	C		— with tool
	D		— with wire
Supplementary letter (optional)	M	Movement of movable parts <sup>a</sup> during water test	
	S	Standstill of movable parts <sup>a</sup> during water test	
<sup>a</sup> e.g. of the rotor of an electrical machine			

**ISO 20653:2006(E)****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.

IP 44	no letters, no options;
IPX5	omitting first characteristic numeral;
IP2X	omitting second characteristic numeral;
IP20C	using additional letter;
IPXXC	omitting both characteristic numerals, using additional letter;
IPX1C	omitting first characteristic numeral, using additional letter;
IP3XD	omitting second characteristic numeral, 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.

The same degree of protection (identical code element) for protection against foreign objects and access shall be provided. In this case, both are only indicated by the first code element.

Different degrees of protection for both protection types may be defined by adding the additional letter, whereby in this case the first code element only defines the protection against foreign objects and the additional letter only 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 $\geq 50$ mm	Test probe with diameter 50 mm shall not penetrate completely.
2	Foreign objects diameter $\geq 12,5$ mm	Test probe with diameter 12,5 mm shall not penetrate completely.
3	Foreign objects diameter $\geq 2,5$ mm	Test probe with diameter 2,5 mm shall not penetrate completely.
4	Foreign objects diameter $\geq 1,0$ mm	Test probe with diameter 1,0 mm shall not penetrate completely.
5K	Dust	Dust shall only penetrate in quantities which do not impair performance and safety.
6K	Dust	Dust shall not penetrate.
“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 diameter 50 mm shall not penetrate completely and maintain sufficient distance from hazardous parts.
2	B	Finger	Jointed test finger with diameter 12 mm may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
3	C	Tool (e.g. screwdriver)	Test probe with diameter 2,5 mm, 100 mm long, may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
4	D	Wire	Test probe with diameter 1,0 mm, 100 mm long, may penetrate completely, but shall maintain a sufficient distance from hazardous parts.
5K	D	Wire	
6K	D	Wire	
“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.

The degrees of protection 1 to 6K for the protection against water always include the preceding degrees of protection. Due to different physical effects, this does not apply automatically for the degrees of protection against water 7, 8 and 9K.

Should this apply nevertheless, the included lower degree of protection shall be indicated separately, e.g. IPX4K/IPX7, IPX5/IPX7, IPX6K/IPX8 or IPX6K//IPX9K.