

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES

(IP Code)

INTRODUCTION

This standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. Whilst this system is suitable for use with most types of electrical equipment, it should not be assumed that all the listed degrees of protection are applicable to a particular type of equipment. The manufacturer of the equipment should be consulted to determine the degrees of protection available and the parts of equipment to which the stated degree of protection applies.

The adoption of this classification system, wherever possible, will promote uniformity in methods of describing the protection provided by the enclosure and in the tests to prove the various degrees of protection. It should also reduce the number of types of test devices necessary to test a wide range of products.

This second edition of IEC 529 takes account of experiences with the first edition, and clarifies the requirements. It provides for an optional extension of the IP Code by an additional letter A, B, C, or D if the actual protection of persons against access to hazardous parts is higher than that indicated by the first characteristic numeral.

In general, enclosures with an IP coding to the first edition would be eligible for the same code according to this edition.

1. Scope

This standard applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72,5 kV.

2. Object

The object of this standard is to give:

- a) *Definitions* for degrees of protection provided by enclosures of electrical equipment as regards:
 - 1) protection of persons against access to hazardous parts inside the enclosure;
 - 2) protection of the equipment inside the enclosure against ingress of solid foreign objects;
 - 3) protection of the equipment inside the enclosure against harmful effects due to the ingress of water.
- b) *Designations* for these degrees of protection.
- c) *Requirements* for each designation.

3.8 Access probe

A test probe simulating in a conventional manner a part of a person or a tool, or the like, held by a person to verify adequate clearance from hazardous parts.

3.9 Object probe

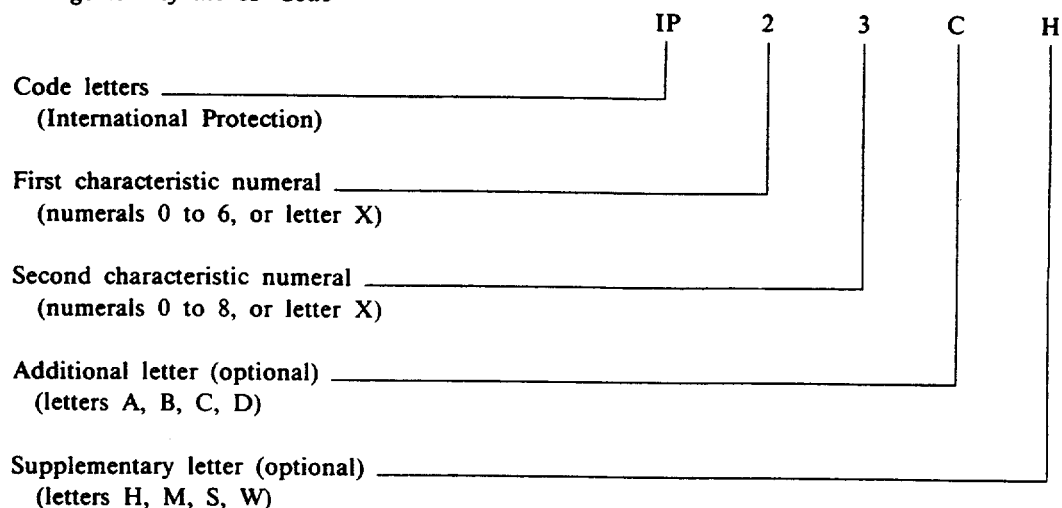
A test probe simulating a solid foreign object to verify the possibility of ingress into an enclosure.

3.10 Opening

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

4. Designations

The degree of protection provided by an enclosure is indicated by the IP Code in the following way:

4.1 Arrangement of the IP Code

Where a characteristic numeral is not required to be specified, it shall be replaced by the letter "X" ("XX" if both numerals are omitted).

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

Where more than one supplementary letter is used, the alphabetic sequence shall apply.

If an enclosure provides different degrees of protection for different intended mounting arrangements, the relevant degrees of protection shall be indicated by the manufacturer in the instructions related to the respective mounting arrangements.

Details for the marking of an enclosure are given in Clause 10.

TABLE II
Degrees of protection against solid foreign objects indicated by the first characteristic numeral

First characteristic numeral	Degree of protection		Test conditions, sec
	Brief description	Definition	
0	Non-protected	—	—
1	Protected against solid foreign objects of 50 mm Ø and greater	The object probe, sphere of 50 mm Ø, shall not fully penetrate ¹⁾	13.2
2	Protected against solid foreign objects of 12,5 mm Ø and greater	The object probe, sphere of 12,5 mm Ø, shall not fully penetrate ¹⁾	13.2
3	Protected against solid foreign objects of 2,5 mm Ø and greater	The object probe of 2,5 mm Ø shall not penetrate at all ¹⁾	13.2
4	Protected against solid foreign objects of 1,0 mm Ø and greater	The object probe of 1,0 mm Ø shall not penetrate at all ¹⁾	13.2
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety	13.4 13.5
6	Dust-tight	No ingress of dust	13.4 13.5

¹⁾ The full diameter of the object probe shall not pass through an opening of the enclosure.

6. Degrees of protection against ingress of water indicated by the second characteristic numeral

The second characteristic numeral indicates the degree of protection provided by enclosures with respect to harmful effects on the equipment due to the ingress of water.

The tests for the second characteristic numeral are carried out with fresh water. The actual protection may not be satisfactory if cleaning operations with high pressure and/or solvents are used.

Table III gives brief descriptions and definitions of the protection for the degrees represented by the second characteristic numeral.

Degrees of protection listed in this table shall be specified only by the second characteristic numeral and not by reference to the brief description or definition.

The tests are specified in Clause 14.

Up to and including second characteristic numeral 6, the designation implies compliance also with the requirements for all lower characteristic numerals. However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests obviously would be met if applied.

TABLE III (continued)

Second characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
7	Protected against the effects of temporary immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time	14.2.7
8	Protected against the effects of continuous immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more severe than for numeral 7	14.2.8

7. Degrees of protection against access to hazardous parts indicated by the additional letter

The additional letter indicates the degree of protection of persons against access to hazardous parts.

Additional letters are only used

- if the actual protection against access to hazardous parts is higher than that indicated by the first characteristic numeral
- or if only the protection against access to hazardous parts is indicated, the first characteristic numeral being then replaced by an X.

For example, such higher protection may be provided by barriers, suitable shape of openings or distances inside the enclosure.

Table IV gives access probes considered by convention as representative of parts of the human body or objects held by a person and the definitions for the degrees of protection against access to hazardous parts, indicated by additional letters.

An enclosure shall only be designated with a stated degree of protection indicated by the additional letter if the enclosure also complies with all lower degrees of protection. However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests obviously would be met if applied.

The tests are specified in Clause 15.

See Annex A for examples of the IP Coding.

TABLE VIII (continued)

Second characteristic numeral	Test means	Water flow rate	Duration of test	Test conditions, see
5	Water jet hose nozzle Figure 6 Nozzle 6,3 mm diameter, distance 2,5 m to 3 m	12.5 l/min \pm 5%	1 min/m ² at least 3 min	14.2.5
6	Water jet hose nozzle Figure 6 Nozzle 12.5 mm diameter, distance 2,5 m to 3 m	100 l/min \pm 5%	1 min/m ² at least 3 min	14.2.6
7	Immersion tank Water-level on enclosure: 0.15 m above top 1 m above bottom	-	30 min	14.2.7
8	Immersion tank Water-level: by agreement	-	by agreement	14.2.8

14.2 Test conditions

Test means and main test conditions are given in Table VIII.

Details concerning compliance of degrees of protection – in particular for second characteristic numerals 5/6 (water jets) and numerals 7/8 (immersion) – are given in Clause 6.

The tests are conducted with fresh water.

During the tests for IPX1 to IPX6 the water temperature should not differ by more than 5 K from the temperature of the specimen under test. If the water temperature is more than 5 K below the temperature of the specimen a pressure balance shall be provided for the enclosure. For IPX7 details of the water temperature are given in 14.2.7.

During the test, the moisture contained inside the enclosure may partly condense. The dew which may thus deposit shall not be mistaken for an ingress of water.

For the purpose of the tests, the surface area of the enclosure is calculated with a tolerance of 10%.

Adequate safety precautions should be taken when testing the equipment in the energized condition.

14.2.1 Test for second characteristic numeral 1 with the drip box

The test is made with a device which produces a uniform flow of water drops over the whole area of the enclosure.

An example of such a device is shown in Figure 3a).

The turntable on which the enclosure is placed has a rotation speed of 1 r/min and the eccentricity (distance between turntable axis and specimen axis) is approximately 100 mm.

The conditions to be observed are as follows:

- internal diameter of the nozzle: 6,3 mm;
- delivery rate: 12,5 l/min \pm 5%;
- water pressure: to be adjusted to achieve the specified delivery rate;
- core of the substantial stream: circle of approximately 40 mm diameter at 2,5 m distance from nozzle;
- test duration per square metre of enclosure surface area likely to be sprayed: 1 min;

- minimum test duration: 3 min;
- distance from nozzle to enclosure surface: between 2,5 m and 3 m.

14.2.6 *Test for second characteristic numeral 6 with the 12,5 mm nozzle*

The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle as shown in Figure 6.

The conditions to be observed are as follows:

- internal diameter of the nozzle: 12,5 mm;
- delivery rate: 100 l/min \pm 5%;
- water pressure: to be adjusted to achieve the specified delivery rate;
- core of the substantial stream: circle of approximately 120 mm diameter at 2,5 m distance from nozzle;
- test duration per square metre of enclosure surface area likely to be sprayed: 1 min;

- minimum test duration: 3 min;
- distance from nozzle to enclosure surface: between 2,5 m and 3 m.

14.2.7 *Test for second characteristic numeral 7: temporary immersion between 0,15 m and 1 m*

The test is made by completely immersing the enclosure in water in its service position as specified by the manufacturer so that the following conditions are satisfied:

- a) the lowest point of enclosures with a height less than 850 mm is located 1 000 mm below the surface of the water;
- b) the highest point of enclosures with a height equal to or greater than 850 mm is located 150 mm below the surface of the water;
- c) the duration of the test is 30 min;
- d) the water temperature does not differ from that of the equipment by more than 5 K. However, a modified requirement may be specified in the relevant product standard if the tests are to be made when the equipment is energized and/or its parts in motion.

14.2.8 *Test for second characteristic numeral 8: continuous immersion subject to agreement*

Unless there is a relevant product standard, the test conditions are subject to agreement between manufacturer and user, but they shall be more severe than those prescribed in 14.2.7 and they shall take account of the condition that the enclosure will be continuously immersed in actual use.