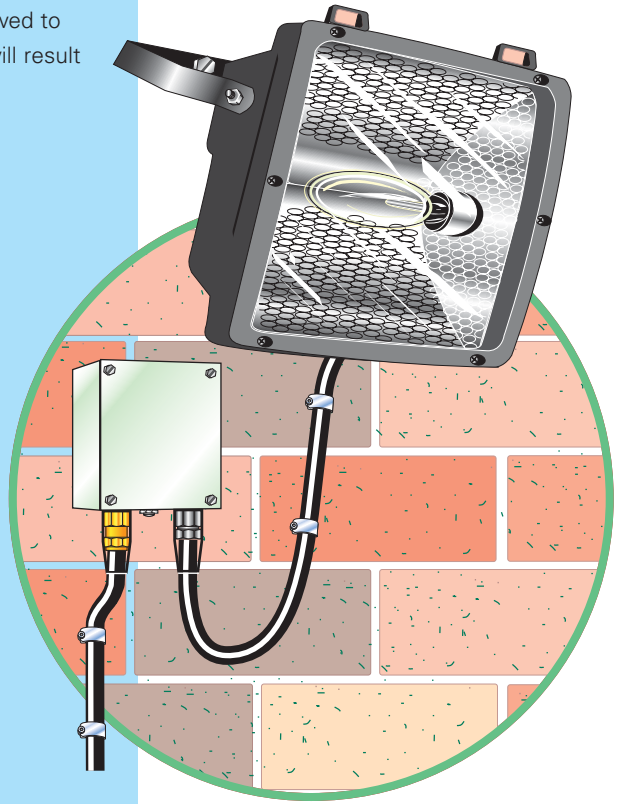
Electrical enclosures outdoors

Electrical enclosures, such as junction boxes and luminaires, located outdoors are susceptible to water entry.

Snag 10

A common defect observed in equipment located outdoors is the entry of water.

In almost all cases, water entry into electrical equipment will cause corrosion of metallic parts and water allowed to accumulate inside equipment will result in an electrical fault.

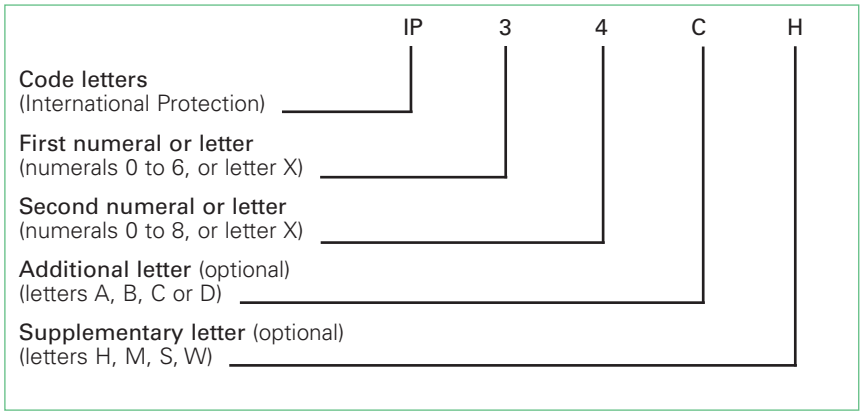


Solution

The likelihood of water penetration must be carefully assessed. The customer should be consulted upon the utilisation of equipment that might influence the assessment. The full performance details of equipment must be written into the specification or summarised on any quotation. Equipment must be specified and selected with a suitable IP (International Protection) rating to be suitable for the external influences and erected in accordance with the manufacturer's instructions. Solid foreign objects and water are both external influences, an assessment of which must be carried out for each installation (Regulation 300-01-01 refers).

Any enclosure mounted outside a building and exposed to the weather needs to be at least 'splash proof' (IPX4). This level of protection will also be required for damp conditions inside. The requirements are even more stringent in places where hoses are used, for example in dairies or pig buildings, where a minimum protection against water entry of IPX5 is required. Note that the terms 'waterproof' or 'weatherproof' should be avoided because they are not specified in the IP code.

The degrees of protection provided by an enclosure are indicated by a designation consisting of the letters 'IP' followed by two characteristic numerals and up to one additional letter and one supplementary letter, as indicated in the following diagram.



The first numeral or letter

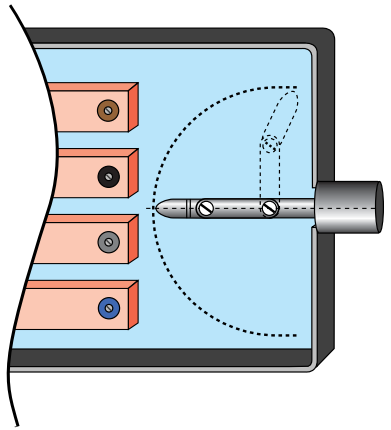
The first numeral or letter of an IP Code designation indicates (a) the degree of protection for persons against access to hazardous parts and (b) the degree of protection of equipment within the enclosure against the ingress of solid foreign objects.

First numeral or letter*	(a)/ (b)	Brief description	Definition
0	(a)	Not protected	
	(b)	Not protected	
1	(a)	Protected against access to hazardous parts with the back of a hand	The access probe, a sphere 50 mm diameter, shall have adequate clearance from hazardous parts
	(b)	Protected against solid foreign objects of 50 mm diameter and greater	The object probe, a sphere 50 mm diameter, shall not fully penetrate†
2	(a)	Protected against access to hazardous parts with a finger	The jointed test finger 12 mm in diameter and 80 mm in length shall have adequate clearance from hazardous parts (see figure)
	(b)	Protected against solid foreign objects of 12.5 mm diameter and greater	The object probe, a sphere 12.5 mm diameter, shall not fully penetrate†
3	(a)	Protected against access to hazardous parts with a tool	The access probe of 2.5 mm in diameter shall not penetrate
	(b)	Protected against solid foreign objects of 2.5 mm diameter and greater	The access probe of 2.5 mm in diameter shall not penetrate at all†
4	(a)	Protected against access to hazardous parts with a wire	The access probe of 1.0 mm in diameter shall not penetrate
	(b)	Protected against solid foreign objects of 1.0 mm diameter and greater	The object probe of 1.0 mm in diameter shall not penetrate at all†
5	(a)	Protected against access to hazardous parts with a wire	The access probe of 1.0 mm in diameter shall not penetrate
	(b)	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity sufficient to interfere with satisfactory operation of the apparatus or to impair safety
6	(a)	Protected against access to hazardous parts with a wire	The access probe of 1.0 mm in diameter shall not penetrate
	(b)	Dust-tight	No ingress of dust

* Where the first characteristic numeral is not required to be specified, it is replaced by the letter 'X'

† The full diameter of the object probe shall not pass through the opening of the enclosure.

Generally, an enclosure providing a specified degree of protection indicated by the first characteristic numeral also provides all lower degrees of protection indicated by that numeral. For example, where the first characteristic numeral is 3, the enclosure also provides degrees of protection of 2, 1 and 0 indicated by that numeral.



Use of the jointed test finger to establish that an enclosure protects persons against access to hazardous parts.

The second numeral or letter

The second numeral or letter denotes protection against the ingress of water given by the IP Code, as summarized in the Table below. The assessment of the extent to which an enclosure will be exposed to water should identify the most onerous conditions likely to occur.

Second numeral	Brief description
0	Not protected
1	Protected against vertically falling water drops
2	Protected against vertically falling drops when the enclosure is tilted at any angle up to 15 degrees
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water
8	Protected against the effects of continuous immersion in water

Generally, an enclosure having a specified degree of protection indicated by the second numeral also provides all lesser degrees of protection. For example, where the second characteristic numeral is 4, the enclosure also provides degrees of protection of 3, 2, 1 and 0. However, where the second characteristic numeral is 7 or 8, the enclosure should, in the absence of better information, be considered unsuitable for exposure to water jets (designated by a second characteristic numeral of 5 or 6).

It is important to note that, in some of the locations of increased electric shock risk covered by Chapter 6 of BS 7671 (Special installations and locations), minimum degrees of protection against external influences are specified for electrical equipment enclosures. For example, in an installation at agricultural or horticultural premises, enclosures must provide protection to at least IP 44. Higher degrees of protection may be required as appropriate to the external influences (Regulation 605-11-01 refers).

Water may be permitted to enter an enclosure provided it is not in such quantity to cause damage to the enclosed equipment. It is therefore permissible to have suitably located drainage points in, say, an IPX3 enclosure in a wiring system where water may collect or condensation may form to permit its harmless escape (Regulation 522-03-02).

Additional letters

These are optional and they indicate the degree of protection of persons against access to hazardous parts. Additional letters are used where:

- the actual protection against access to hazardous parts is greater than that indicated by the first numeral or letter (for example, where greater protection is provided by barriers, suitable shape of openings or distances inside the enclosure), or
- only protection against access to hazardous parts is indicated, the first characteristic numeral then being replaced by the letter 'X'.

The Table gives the meaning of each additional letter.

Additional letter	Brief description	Definition
A	Protected against access with the back of the hand	The access probe, a sphere of 50 mm diameter, is required to have adequate clearance from hazardous parts
B	Protected against access with a finger	The jointed test finger of 12 mm diameter and 80 mm length is required to have adequate clearance from hazardous parts
C	Protected against access with a tool	The access probe of 2.5 mm diameter and 100 mm in length is required to have adequate clearance from hazardous parts
D	Protected against access with a wire	The access probe of 1.0 mm diameter and 100 mm in length is required to have adequate clearance from hazardous parts

Supplementary letters

The Table gives the most commonly used supplementary letters but further letters may be introduced by future product specifications.

Supplementary letter	Significance
H	High-voltage apparatus
M	Tested for harmful effects due to the ingress of water when the movable parts of the equipment (e.g. the rotor of a rotating machine) are in motion
S	Tested for harmful effects due to the ingress of water when the movable parts of the equipment (e.g. the rotor of a rotating machine) are stationary
W*	Suitable for use under specified weather conditions and provided with additional protective features and processes

*. In the first edition of international standard IEC 529 the letter 'W' with the same meaning was placed immediately after the code letters 'IP'.

Where more than one supplementary letter is to be used, such letters should appear in alphabetical order.

In summary

Equipment and wiring systems outdoors should be erected and located to minimize the possibility of water entry. For example, enclosures may be able to be sited under cover. Cables should, normally, be arranged to enter an enclosure from below and a sealing washer may need to be fitted to ensure the required IP rating is achieved. The manufacturer's instructions should provide further details.

Regulation 300-01-01 (part of)

An assessment shall be made of the following characteristics of the installation in accordance with the chapters indicated

(ii) the external influences to which it is to be exposed (Chapter 32)

Regulation 512-06-01

Every item of equipment shall be of a design appropriate to the situation in which it is to be used or its mode of installation shall take account of the conditions likely to be encountered, including the test requirements of Part 7.

If the equipment does not, by its construction, have the characteristics relevant to the external influences of its location, it shall be provided with appropriate additional protection in the erection of the installation. Such protection shall not adversely affect the operation of the equipment thus protected.

Regulation 522-03-01

A wiring system shall be selected and erected so that no damage is caused by condensation or ingress of water during installation, use and maintenance.

Regulation 522-03-02

Where water may collect or condensation may form in a wiring system provision shall be made for its harmless escape through suitably located drainage points.