

Technical Brief - IP (Ingress Protection) Ratings

You may have noticed that some enclosed electrical components have an IP rating-for example, "IP67". Sometimes, a brief explanation of the rating is provided-for example, "IP67, Temporary Immersion". This technical brief provides an explanation of the IP rating system.

(Don't confuse IP rating with the IP designation indicating that a device, such as a switch or circuit breaker, is ignition protected.)

IP stands for Ingress Protection and indicates the degree of protection provided by an enclosure. The numbers following IP represent levels of sealing and can range from none at all (IP00) to protection against dust and continuous immersion in water (IP68). The table provides a description of the protection at each level.

First number: Protection against solid objects		Second number: Protection against liquids	
0	No special protection	0	No special protection
1	Protected against solid objects greater than 50 mm in diameter or thickness such as a hand	1	Protection against vertically falling drops of water
2	Protected against solid objects greater than 12 mm in diameter or thickness such as fingers or other objects not exceeding 80 mm in length	2	Protection against direct sprays of water up to 15 degrees from the vertical for three minutes
3	Protected against solid objects greater than 2.5 mm in diameter or thickness such as tools or wires	3	Protection against direct sprays of water up to 60 degrees from the vertical for three minutes
4	Protected against solid objects greater than 1.0 mm in diameter or thickness such as wires or strips	4	Water splashed against the enclosure from any direction for three minutes. The enclosure is tilted at any angle up to 15° from its normal position
5	Ingress of dust is not totally prevented but dust does not enter in sufficient quantity to interfere with satisfactory operation of the equipment. Two to eight hours	5	Water projected from a nozzle against the enclosure for three minutes from any direction shall have no harmful effect
6	No ingress of dust. Two to eight hours	6	Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities.
		7	Protection against the effects of immersion in water between 15cm and 1m for 30 minutes
		8	Protection against long periods of immersion in water under pressure

For example, consider an IP65 rating:

- The rating's first digit, e.g. IP6_, means that the enclosure is dust tight
- The second digit, e.g. IP_5, relates to the ingress protection against water

Solids ingress protection Levels 5 and 6 are concerned with dust protection. Level 5 allows some dust to enter, but not enough to affect equipment operation. Level 6 is fully dust-tight. These tests are conducted in a dust chamber using fine talcum powder recirculated by a blower. Depending on the test requirements, a partial vacuum may be drawn through the enclosure. The vacuum tests are performed for a period of between two and eight hours, depending on how much air volume is drawn through the cabinet. The duration of the non-vacuum tests is eight hours.

IP water resistance varies from mild drip resistance, through sprays, jets, and total immersion. For spray Levels 3 and 4, the water is delivered by either an oscillating tube which looks like a garden sprinkler, or manually, by a handheld showerhead. The spray head passes 12.5 liters per minute. The enclosure being tested is exposed for at least three minutes, or in the case of a large unit, at least one minute for each square meter of surface as the spray head is slowly moved around.

For Levels 5 and 6, hose nozzles are used. The Level 5 exposure is at 12.5 liters/minute through a 6.3 mm (1/4 inch) nozzle. Level 6 is a higher pressure and flow test, using a 12.5 mm (1/2 inch) nozzle at a flow rate of 100 liters/minute. For both Levels 5 and 6, the hosing is conducted from a distance of 2.5 to 3 meters. Exposure time is three minutes.

For Levels 7 and 8 the enclosure is submerged in water. Level 7 tests water submersion for 30 minutes. The enclosure is dunked so that its bottom is 1 meter below the water surface, and its top is 0.15 meters below the surface. Level 8 is a special test where the performance level-in terms of duration and external water pressure (which is proportional to depth)-are agreed on by the vendor and the user.

The IP rating system was established by the International Electromechanical Commission (IEC), a worldwide organization for standardization. The object of the IEC is to promote International cooperation on all questions concerning standardization in the electrical and electronic fields. The IEC collaborates closely with the International Organization for Standards (ISO). IEC documents have the form of recommendations and are published in the form of standards, technical specifications, technical reports or guidelines.

A complete description of the IP ratings and associated tests is found in IEC Publication 529. Although these ratings were initially developed as a way to classify enclosures, they now provide engineers with a convenient, practical way to compare levels of sealing. This standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. The adoption of this classification system promotes uniformity in methods of describing the protection provided by the enclosure and in the tests to prove the various degrees of protection.

Look for a product's IP rating when making a purchase. The product's IP rating is your way of knowing that the product is protected from particles or dust or water that may be present in the environment where you install the product