

INGRESS PROTECTION RATIO (IP)

The intent of this technical note is to provide a brief explanation of the meaning and utilisation of the IP classification system in general, as well specific recommendations for the application of various IP codes in weighing applications.

Definitions

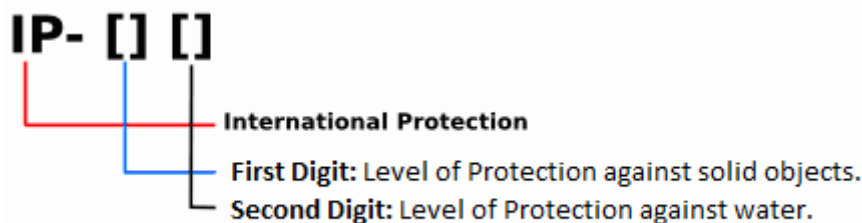
The following definitions were taken from the document IEC 60050, International Electrotechnical Vocabulary (section IEV 826-03-12):

Ingress Protection Ratio: *The level of protection provided by an enclosure against access to hazardous parts, against the penetration of solid foreign bodies, against the penetration of water or against external mechanical impacts, determined using standardized test methods.*

Enclosure: *An element that provides protection against the effects of external material in any direction and protects against direct contact.*

The IP protection rating is described in the European Standard EN 60529 as well as in other equivalent and/or complementary standards, such as ISO 29653, IEC 529, DIN 40050-9 and UNE 20324.

IPXX CODE



This code consists of 2 numbers placed immediately after the letters IP, called first and second digits, and sometimes features an third character, which provides additional information on the degree of protection.

Explanation of the first characteristic digit IPXX

The first characteristic digit indicates the protection of equipment against the penetration of **solid** foreign objects.

First Digit	IP Degree of Protection	
	Brief Description	Brief indication of the objects that should not enter the enclosure
1	Protected against bodies 50mm in size and greater	Solid objects with 50mm diameter or greater, for example a human hand.
2	Protected against bodies 12mm in size and greater	Solid objects with 12mm diameter or greater, for example human fingers.
3	Protected against bodies 2.5mm in size and greater	Solid objects with 2.5mm diameter or greater, for example tools etc.
4	Protected against bodies 1mm in size and greater	Solid objects with 1mm diameter or greater, for example wires.
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity that would interfere with the satisfactory operation of the apparatus or impair safety.
6	Completely dust-protected	No ingress of dust at all.

Explanation of the second characteristic digit IPXX

The second characteristic digit indicates the protection of equipment against the penetration of **water**.

Second Digit	IP Degree of Protection	
	Brief Description	Type of protection provided by the enclosure
0	Non-Protected	No particular protection.
1	Protected against vertically falling water drops	Water droplets falling vertically from a height of 200mm above the device (at a rate of 3-5 mm ³ per minute) over a 10 minute period shall have no adverse effects.
2	Protected against vertically falling water droplets when the enclosure is tilted by up to 15°	When the enclosure is tilted by up to 15° water droplets falling vertically from a height of 200mm above the device (at a rate of 3-5 mm ³ per minute) over a 10 minute period shall have no adverse effects.
3	Protected against spraying water	Water sprayed at an angle of up to 60° on either side of the vertical, at an average rate of 10 litres/min and a pressure of 80-100 kN/m ² , over a period of 5 minutes, shall have no adverse effects.
4	Protected against splashing water	Water splashed against the enclosure from any direction, at an average rate of 10 litres/min and a pressure of 80-100 kN/m ² , over a period of 5 minutes, shall have no adverse effects.
5	Protected against water jets	Water jets, projected by a 6.3mm diameter nozzle directed at the enclosure from any direction, at an average rate of 12.5 litres/min and a pressure of 30 kN/m ² , over a period of 5 minutes, shall have no adverse effects.

Table continued on following page

Page 2 of 5

Second Digit	IP Degree of Protection	
	Brief Description	Type of protection provided by the enclosure
6	Protected against powerful water jets	Water jets projected by a 12.5mm diameter nozzle directed at the enclosure from any direction, from a distance no less than 3 metres, at an average rate of 10 litres/min and a pressure of 100kN/m ² , over a period no less than 3 minutes, shall have no adverse effects.
7	Protected against the effects of temporary immersion in water	Immersion of the object in water, at a depth up to 1 metre and for no longer than 30 minutes, shall have no adverse effects.
8	Protected against the effects of continuous immersion in water	Total and continuous immersion to a depth and for a time that are specified by the manufacturer (but always worse than the conditions for value 7) shall have no adverse effects. The most common specification is a depth of 1 metre and a time period of 100 hours.
9K	Protected against high-pressure jets	High pressure jets, from any direction, having a pressure of 100 bar, a temperature of 80°C, a flow rate of 15 litres/min and from a distance no less than 10cm, shall have no adverse effects.

Special recommendations for weighing system applications

- Solid bodies and/or dust:** Although the components within most load cells and associated electronic equipment are well protected against dust and solid body ingress, a weighing system must remain free of dirt and dust to be able to move, in the vertical and horizontal axes, with sufficient freedom to measure with high repeatability and accuracy.

At the same time, it is recommended that external motion-limiting devices are used to offer a level of stability and safety suitable for the application. To achieve this objective, the designers of weighing systems must consider the use of barriers, enclosures and shields etc., and leave sufficient space between these items and the moving parts of a weighing system – to avoid the effects of dust and dirt on the weight measurements.

It is also important to adopt a maintenance plan with provision for regular verification and cleaning, for example yearly, or at whatever intervals are necessary according to the specifications of the installation and any governing standards or directives.

- Water and moisture/humidity:** In general, weighing equipment and particularly load cells are very sensitive to the effects of moisture, because the typical range of signals processed is of the order of only a few microvolts. These signals are produced by very small changes in the resistance of the strain gauges as a load is applied to a load cell. Therefore, when load cells will be used in an environment with a high moisture content, the maximum available ingress protection (IP rating) should be selected for the load cells and great care should be taken during the installation to ensure good drainage and water evacuation. Special attention should be paid to the installation of cables and junction boxes, to avoid adverse

effects during floods and to encourage drainage and ventilation. It is also essential to establish a maintenance plan to remove any dirt can that accumulate due to humidity and inhibit proper drainage. In all cases, prolonged immersions must be avoided, whatever degree of ingress protection the chosen equipment has.

- **IP selection guide to choose the appropriate load cell according to its application and environment:** Despite the presence of the above IP codes and because their classification is based on a relatively short term test, when selecting equipment a conservative approach should always be taken. The protection against water ingress should be maximised in order to ensure reliable and durable long-term use of the equipment. For this reason the following recommendations, as an absolute minimum, are good practice:
 - **Indoor applications, always in a dry location, with low ambient humidity and no condensation** (heated/air conditioned offices, stores, warehouses, etc.): no specific protection.
 - **Indoor applications with occasional water presence** (workshops, factories with normal cleaning processes using water, but not at high pressure, in and around machinery with no moisture or condensation inside, etc.): IP65 or higher.
 - **Outdoor applications; under cover but potential splashes of water and/or rain** (outdoor machinery with load cells protected under covers or housings, installations in buildings/floors with open sides exposed to rain, etc.): IP66 or higher.
 - **Outdoor applications; open to the weather conditions, directly exposure to rain without protective covers** (outdoor tanks and silos, chemical or food industry applications with good drainage and without direct high pressure cleaning, etc.): IP67 or higher.
 - **Applications in pits and/or locations with high moisture content and/or highly probable presence of water and/or sporadic, short-lived floods** (in-pit pallet scales, in-pit truck scales/weighbridges, etc.): IP68.
 - **Applications with direct high pressure and high temperature water jet cleaning** (food/chemical/pharmaceutical hoppers and scales, etc.): IP69K.

Key points and general recommendations

- The IP protection tests only consider the detrimental effect of the ingress of solids and water into the enclosures of the equipment; however they do not guarantee anything in terms of the level of corrosion protection of the device, either internally or externally. Along with the level of IP protection suitable for the application, as per the above recommendations, it is important to select:
 - the correct construction materials and/or other applicable recommendations for the

particular environment in which the equipment will be used.

- The most important factor in the protection of load cells against moisture ingress is the preservation of the internal electrical circuit; for this reason the preferred load cells are those fully made from stainless steel and hermetically sealed by the welding of metallic covers. Some manufacturers specify cells as having IP68 protection; however they are only protected with a silicone potting and a metal enclosure that has not been hermetically welded; the sealing on such load cells will probably fail during the medium or long term under high moisture conditions.
- The end of the external load cell cable and its individual wires should be always protected against contact with water; for this reason they should always be connected to a junction box of good quality.
- All “good practice” within the industry and application of usage should be adhered to.
- The general quality and reliability of weighing equipment is mainly due to the smallest details in the design and manufacturing of the products. The quality of installation is also very influential.

This technical note serves only as guidance and not as a contractual specification. The individual product specifications should be taken from the relevant product data sheets and the standards to which reference has been made in this technical note. Thames Side Sensors Limited reserves the right to change to the content of this technical note at any time without prior notice.

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