



English version



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Technology of components used in heating.

Chapter 10

IP protection classification (Ingress protection)



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The first 2 characters of IP codification (upon IEC 60259)

The IP rating defined by the IEC 60529 specifies the degree of protection against ingress of solid bodies (first digit) and against the ingress of water (second digit). Third and fourth characters, optional, provide information on the level of protection. The classification is done by increasing efficiency. There are 7 levels against solid (0: no protection, 6 fully protected) and 9 levels against water (0: no protection, 8: protected against immersion under pressure).

For example, "IP21" means protected against solid objects greater than 12.5 mm (e.g. a finger) and resistant to condensation. **Caution:** Some IP Protection grades can be given for a specified enclosure position.

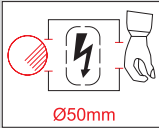
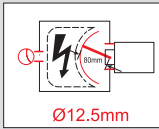
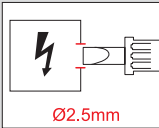
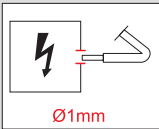
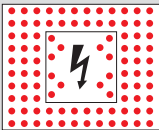
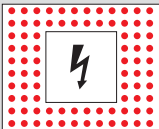
X letter in the codification:

The letter X is used in any place in the code where specifying a digit is meant to be avoided. There may be various reasons for choosing this coding variant, such as marketing considerations. Thus, e.g. an IPX7 rating for a consumer device specifies that the device has water protection up to limited immersion, but gives deliberately no information as to whether the device has any protection against mechanical ingress or dust. Among other common IP ratings using the letter X are IPX4. IP2X is frequently used on electrical items to specify the item must prevent finger access to live terminals i.e. plug sockets are IP2X.

First digit (Solid particle protection)

The first digit indicates the level of protection that the enclosure provides against access to hazardous parts (e.g., electrical conductors, moving parts) and the ingress of solid foreign objects

Note: The first digit of the IP marking is not required by EN 60335-1.

First digit	IP	Pic	Protection type	Features
0	IP0X		No protection	No protection against contact and ingress of objects
1	IP1X		Protected against solid particles >50 mm	Protected against any large surface of the body, such as the back of a hand, but no protection against deliberate contact with a body part.
2	IP2X		Protected against solid particles >12.5 mm	Protected against fingers or similar objects.
3	IP3X		Protected against solid particles >2.5 mm	Protected against tools, thick wires, etc.
4	IP4X		Protected against solid particles >1 mm	Protected against most wires, screws, etc.
5	IP5X		Dust protected	Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment. Completely protected against contact.
6	IP6X		Dust tight	Completely protected against ingress of dust. Completely protected against contact.

IP protection classification (Ingress protection)

Second digit (Liquid ingress protection)

The second digit indicates the level of protection that the enclosure provides against harmful ingress of water.			
IPX1	IPX2	IPX3	IPX4
10min 1mm/min	10min 3mm/min	5min 0.7L/min 80-100kPa	5min 10L/min 80-100kPa
Second digit	Protection type	Effective protection	Test description
0	Not protected		
1	Dripping water	Dripping water (vertically falling drops) shall have no harmful effect.	- Water equivalent to 1 mm rainfall per minute. - Test duration: 10 minutes
2	Dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from its normal position.	- Water equivalent to 3 mm rainfall per minute. - Test duration: 10 minutes
3	Spraying water	Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect.	- Water volume: 0.7 liters per minute - Pressure: 80–100 kPa - Test duration: 5 minutes
4	Splashing water	Water splashing against the enclosure from any direction shall have no harmful effect.	Test duration: 5 minutes Water volume: 10 liters per minute Pressure: 80–100 kPa
IPX5	IPX6	IPX7	IPX8
12.5L/min, 30kPa	30min 100L/min 100kPa	30min 0.15m	xx min, xx m
Second digit	Protection type	Effective protection	Test description
5	Water jets	Water projected by a 6.3 mm dia. nozzle against enclosure from any direction shall have no harmful effects.	- Water volume: 12.5 litres per minute - Pressure: 30 kPa - Distance: 3 m - Test duration: 3 minutes
6	Powerful water jets	Water projected in powerful jets (12.5 mm nozzle) against the enclosure from any direction shall have no harmful effects.	- Water volume: 100 litres per minute - Pressure: 100 kPa - Distance: 3 m - Test duration: 3 minutes
7	Immersion up to 1 m	Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1 m of submersion).	- Immersion at depth of at least 1 m measured at bottom of device, and at least 15 cm measured at top of device - Test duration: 30 minutes
8	Immersion beyond 1 m	The equipment is suitable for continuous immersion in water under conditions which shall be specified by the manufacturer. Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment, it can mean that water can enter but only in such a manner that it produces no harmful effects.	Test duration: continuous immersion in water. Depth is specified by manufacturer

IP protection classification (Ingress protection)

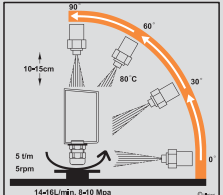
First additional letter

Additional letters that can be appended to classify only the level of protection against access to hazardous parts by persons	
Letter	Protected against access to hazardous parts with
A	Back of hand
B	Fingers
C	Tools
D	Wires

Second additional letter

Further letters can be appended to provide additional information related to the protection of the device	
Letter	Meaning
H	High voltage device
M	Device moving during water test
S	Device standing still during water test
W	Weather conditions

IP69K (DIN 40050-9)

Description	Test description
 <p>Specific ingress protection rating for high-pressure, high-temperature washing applications. Such enclosures must not only be dust tight (IP6X), but also able to withstand high-pressure and steam cleaning</p>	<ul style="list-style-type: none"> - Water volume: 14-16L liters per minute - Water temperature: 80°C - Pressure: 8-10 Mpa (80-100 bar) - Distance: 10 to 15cm from the tested device at angles of 0°, 30°, 60° and 90° for 30s each. The test device sits on a turntable that rotates once every 12s

Examples of ingress protection requested by standard and applications

Examples of standards which we recommend you refer to define technical needs for domestic appliances: Room heaters (IEC60335-2-30), Heaters that are built into air conditioners (IEC 60335-2-40); Clothes dryers and towel rails (IEC 60335-2-43); Heaters for saunas (IEC 60335-2-53); Thermal-storage room heaters (IEC 60335-2-61); Heating appliances for breeding and rearing animals (IEC 60335-2-71); Foot warmers and heating mats (IEC 60335-2-81); Flexible sheet heating elements for room heating (IEC 60335-2-96); Heating cables (IEC 60800).






Areas	Minimal IP requirements	Electrical protection
Bath rooms, swimming pools and assimilated	These rooms are divided in 4 area volumes: 0,1,2,3. These volumes and installation rules are described in the French standard NFC15100, International standard Cenelec HD384 and European standard IEC6.364	
0	All electric heaters are prohibited. Other equipments: <u>Bathrooms:</u> IPX7 <u>Pools and similar:</u> IPX8	SELV limited to 12V DC or 30V AC
1	All electric heaters are prohibited. Other equipments: <u>Bathrooms:</u> IPX4, but IPX5 if this volume can be subjected to water jets for cleaning in public baths. <u>Pools and similar:</u> IPX5	SELV limited to 12V DC or 30V AC
2	<u>Bathrooms:</u> IP24 mini heaters are authorized Other equipments: IPX3, but IPX5 if this volume can be subjected to water jets for cleaning in public baths. <u>Indoors Pools:</u> IP24 mini heaters authorized Other equipment: IPX2, but IPX5 if this volume can be subjected to water jets for cleaning. <u>Outdoors Pools:</u> IPX5	<ul style="list-style-type: none"> - Class 2 devices - Controls should not be accessible from the shower or bath. - Heaters must not be powered by a wall mounted socket. - Line must be protected by a 30 mA residual current circuit breaker
3	<u>Bathrooms:</u> IP21 mini heaters are authorized Other equipments: IPX1 <u>Pools:</u> Heaters authorized IP21 mini Other equipments: IPX1, but IPX5 if this volume can be subjected to water jets for cleaning. <u>Outdoors Pools:</u> IPX5	<ul style="list-style-type: none"> - Class 1 or Class 2 devices - Heaters must not be powered by a wall mounted socket. - Line must be protected by a 30 mA residual current circuit breaker
Saunas	Electrical equipment must have a minimum degree of protection IP24.	
Underfloor heating	The heating elements intended to be embedded in a concrete or other similar material must be IPX7	

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Electrical devices that are permanently outdoor	The degree of protection shall be at least IPX4.
Residential, Offices, Schools	Generally clean, dry and free from harmful deposits of dust, but some condensate may be present due to atmospheric conditions. Minimum protection is typically IP2X for dry conditions.
Control rooms/ Sub-Stations	Generally dry and free from harmful deposits of dust, but some condensate may be present due to atmospheric conditions. Where access is restricted to skilled or instructed persons, IP2X is the typical minimum requirement for dry conditions.
Commercial, Light industrial premises	It may not be clean, but normally dry and free from harmful deposits of dust. Suitable minimum protection: - Where condensate is not present: IP2X - Where condensate may be present: IP21. - Equipment installed within range of fire sprinkler systems: IP22.
Machine control equipment	Where fluids may be present, e.g. lathes, millers etc., minimum protection typically requested is IP54. Consideration should also be given to the corrosive properties of certain fluids.
Heavy Industrial, Chemical.	These environments are not usually totally clean, with possible presence of corrosive elements and harmful deposits of dust. Protection to IP54 will be typically required, with special consideration given to the corrosion resisting properties of the enclosure. When risk of explosion exists, enclosures and equipment should meet the specifications of these environments.
Food Processing	Will vary depending on the type of food being processed and the possible requirement for washing down. Where fine powders are present, a minimum of IP53 should be used. This should be increased to IP54/65 if the equipment needs to be washed or hosed down. If the equipment is to be washed with hot or cold water under high pressure, the degree of protection IP65 may be insufficient and IP69K may be necessary.
Dump trucks, cement mixers, food industry, car wash	In these high-pressure, high-temperature wash-down applications, enclosures must not only be dust tight (IP6X), but also able to withstand high-pressure and steam cleaning. The recommended protection rating is IP69K. (DIN40050-9)
Weatherproof equipment	If subjected to exposure to any specific weather condition, an agreement between the User and Manufacturer is necessary, with consideration given to specific testing conditions, including the corrosion resisting properties of the enclosure, fittings and cable glands.

Other classifications

NFC 15100 standard also refers to a "water drop" marking that household appliances and lightings can wear depending on their degree of protection. This marking is different from the IP marking. Double marking, the water drops and the IP code, is not allowed because the tests are different.

Description	Protected against vertical water drops	Protected against rainfall	Protected against splashing water	Protected against water jets	Protected against immersion up to 1 m
IP equivalent	IPX1	IPX3	IPX4	IPX5	IPX7
Standard logo					

NEMA (USA) rating equivalences with IP

The United States National Electrical Manufacturers Association (NEMA) also publishes protection ratings for enclosures similar to the IP rating system published by the International Electro-technical Commission (IEC). However, it also dictates other product features not addressed by IP codes, such as corrosion resistance, gasket aging, and construction practices. Thus, while it is possible to map IP Codes to NEMA ratings that satisfy or exceed the IP Code criteria, it is not possible to map NEMA ratings to IP codes, as the IP Code does not mandate the additional requirements. The table above indicates the minimum NEMA rating that satisfies a given IP code, but can only be used in that way, not to map IP to NEMA. North American enclosure rating systems are defined in NEMA 250, UL 50, UL 508, and CSA C22.2 N°. 94.

Equivalent IP Code	Min. NEMA Enclosure rating to satisfy IP Code.
IP20	NEMA-1
IP54	NEMA-3

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Equivalent IP Code	Min. NEMA Enclosure rating to satisfy IP Code.
IP66	NEMA-4, NEMA-4X
IP67	NEMA-6
IP68	NEMA-6P

IPx5 and IPx6 testing of enclosures in our laboratory



IPx4 test



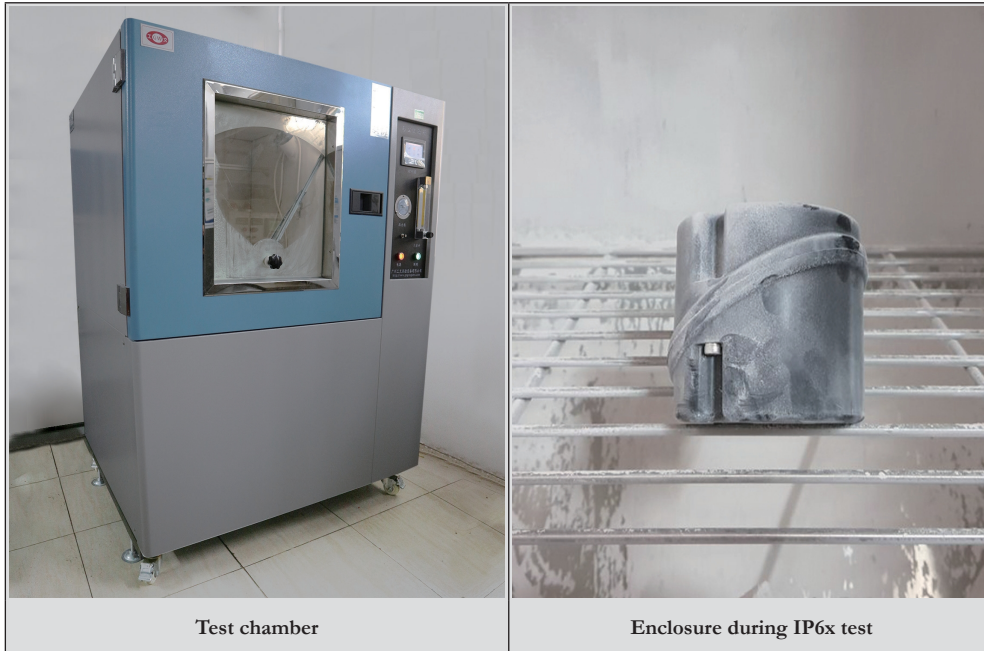
IPx5 test



IPx6 test

IP protection classification (Ingress protection)

IP5x and IP6x (Protection against dust) testing of enclosures in our laboratory



IPx9K testing of enclosures in our laboratory
(water jets at High pressure and high temperature)

