Degrees of Protection

IEC 60529

IP-Code system

Simon Bakker

09-03-2016

Specifications

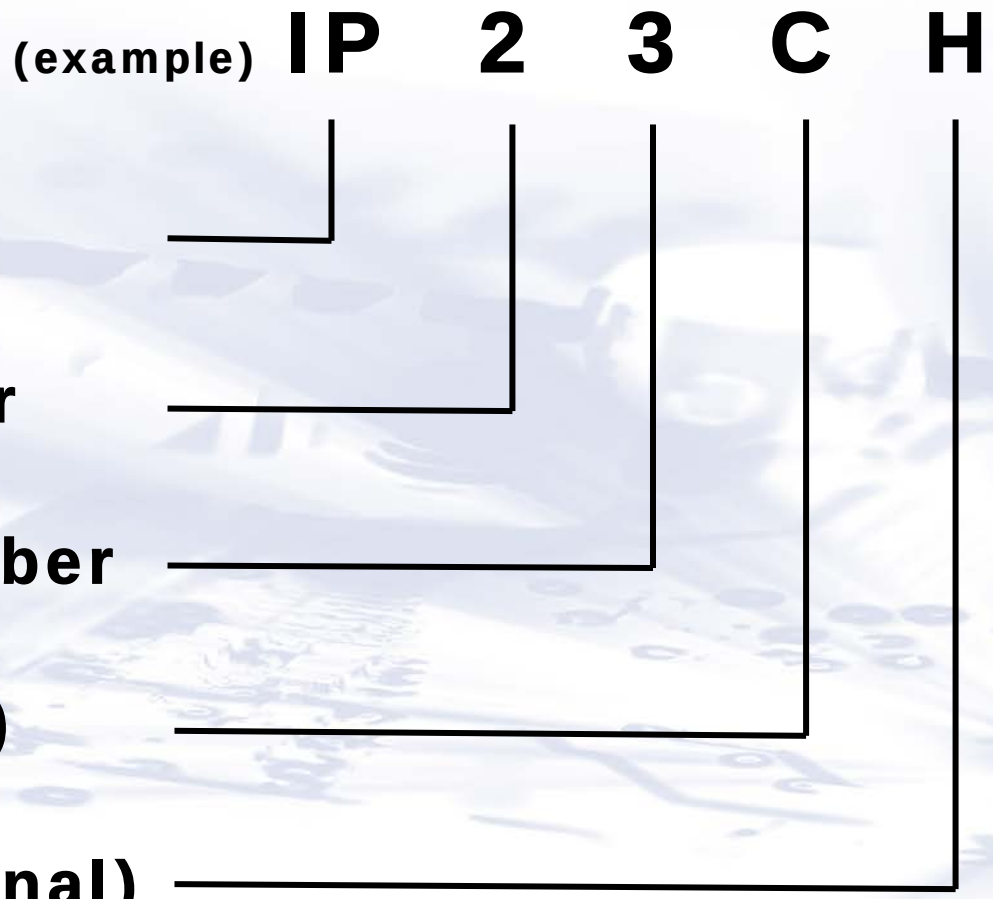
- IEC 60529
- NEN-EN-ISO 20653
- DIN 40050
- MIL-STD 810, Method 506 + 510
- NEMA 250
- ...

Definition (IEC 60529)

- Protection of persons against access to hazardous parts inside the enclosure.
- Protection of the equipment inside the enclosure against ingress of solid foreign objects.
- Protection of the equipment inside the enclosure against harmful effects due to the ingress of water.

- Enclosure:
  - A part providing protection of equipment against certain external influences and, in any direction, protection against direct contact.

The IP Code

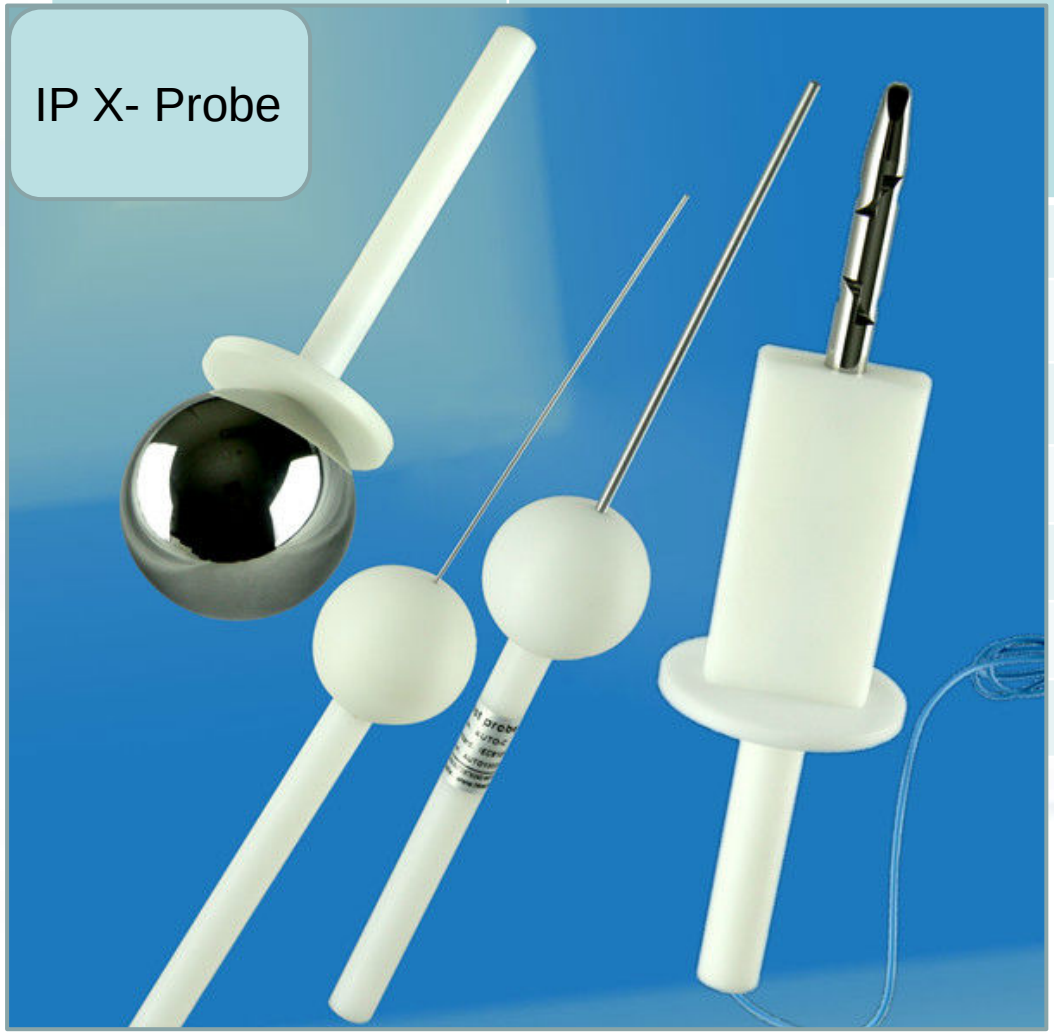


- **Code letter**
  - (**I**nternational **P**rotection)
- **First characteristic number**
  - (0 to 6, or X)
- **Second characteristic number**
  - (0 to 9, or X)
- **Additional letter (optional)**
  - (A, B, C, D)
- **Supplemental letter (optional)**
  - (H, M, S, W)

IPX- : Acces to hazardous parts

First Characteristic Number	Description of Protection Against...	Definition
0	No Protection	---
1	Access to hazardous parts with the back of a hand	The access probe, sphere of 50 mm ø, shall have adequate clearance from hazardous parts
2	Access to hazardous parts with a finger	The jointed test finger of 12 mm ø, 80 mm length, shall have adequate clearance form hazardous parts
3	Access to hazardous parts with a tool	The access probe of 2,5 mm ø shall not penetrate
4	Access to hazardous parts with a wire	The access probe of 1,0 mm ø shall not penetrate
5	Access to hazardous parts with a wire	The access probe of 1,0 mm ø shall not penetrate
6	Access to hazardous parts with a wire	The access probe of 1,0 mm ø shall not penetrate

IPX- : Acces to hazardous parts



Definition
The access probe, sphere of 50 mm ø, shall have adequate clearance from hazardous parts
The jointed test finger of 12 mm ø, 80 mm length, shall have adequate clearance form hazardous parts
The access probe of 2,5 mm ø shall not penetrate
The access probe of 1,0 mm ø shall not penetrate
The access probe of 1,0 mm ø shall not penetrate
The access probe of 1,0 mm ø shall not penetrate

IPX- : Ingress of Solide foreign objects

First Number	Description of Protection Against...	Definition
0	No Protection	---
1	Solid foreign objects of 50 mm ø and greater (50 N)	The object probe, sphere, shall not fully penetrate
2	Solid foreign objects of 12,5 mm ø and greater (30 N)	The object probe, sphere, shall not fully penetrate
3	Solid foreign objects of 2,5 mm ø and greater (3 N)	The object probe, sphere, shall not penetrate at all
4	Solid foreign objects of 1,0 mm ø and greater (1 N)	The object probe of 1,0 mm ø, shall not penetrate at all
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
6	Dust-tight	No ingress of dust

IPX- : Acceptance

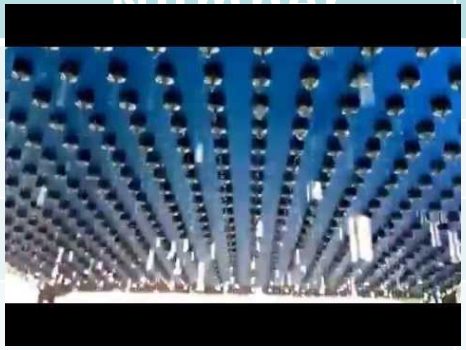
First Number	Access To Hazardous Parts	Solid Foreign Object
0	No test required	
1	The sphere of 50 mm ø shall not fully penetrate and adequate clearance shall be kept	
2	The jointed test finger may penetrate up to its 80 mm length, but adequate clearance shall be kept	The sphere of 12,5 mm ø shall not fully penetrate
3	The test rod of 2,5 mm ø shall not penetrate and adequate clearance shall be kept	
4	The test wire of 1,0 mm ø shall not penetrate and adequate clearance shall be kept	
5	The test wire of 1,0 mm ø shall not penetrate and adequate clearance shall be kept	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
6	The test wire of 1,0 mm ø shall not penetrate and adequate clearance shall be kept	No ingress of dust

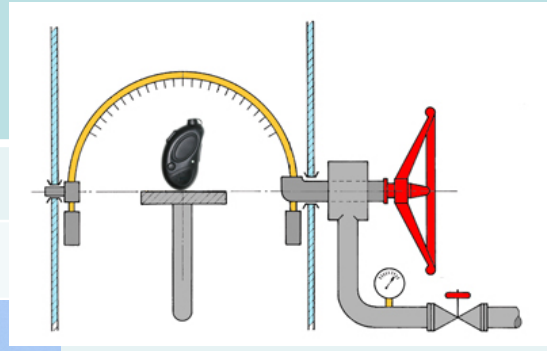
IP-X : Ingress of Water

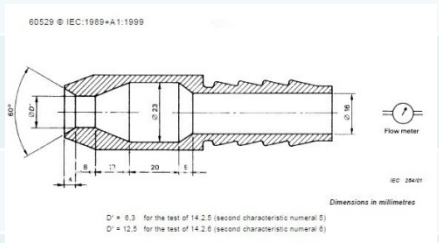
Second Number	Test means	Duration of test
0	No test required	---
1	Drip box, enclosure on turntable	1 mm/min, 10 min
2	Drip box, enclosure in 4 fixed positions of 15° tilt	3 mm/min, 2.5 min for each position of tilt
3	Oscillating tube, ±60° from vertical max. 200 mm distance Or spray nozzle 'showerhead' ±60° from vertical	0.07 l/min per hole by number of holes, 10 min 10 l/min, 1 min/m^2, at least 5 min
4	Oscillating tube, ±180° from vertical max. 200 mm distance Or spray nozzle 'showerhead' all sides	0.07 l/min per hole by number of holes, 10 min 10 l/min, 1 min/m^2, at least 5 min
5	Water jet hose nozzle 6.3 mm, 2.5m to 3 m distance	12.5 l/min, 1 min/m^2, at least 3 min
6	Water jet hose nozzle 12.5 mm, 2.5m to 3 m distance	100 l/min, 1 min/m^2, at least 3 min
7	Immersion tank Water 0.15m above top of enclosure, water 1m above bottom of enclosure	30 min
8	Immersion tank Waterlevel by agreement	By agreement
9	Fan jet nozzle, enclosure on turntable, 0°/30°/60°/90°	15 l/min, 80°C, 30 s per position(small units), 1 min/m^2, at least 3 min (large units)

IP-X : Ingress of Water

Second Number	Test means	
	No test required	---
	Drip box, enclosure on turntable	1 mm/min, 10 min
	Drip box, enclosure in 4 fixed positions of 15° tilt	
	Oscillating tube, ±60° from vertical max. 200 mm distance Or spray nozzle 'showerhead' ±60° from vertical	umber of holes, 10 min east 5 min
	Oscillating tube, ±180° from vertical max. 200 mm distance Or spray nozzle 'showerhead' all sides	umber of holes, 10 min east 5 min
	Water jet hose nozzle 6.3 mm, 2.5m to 3 m distance	12.5 l/min, 1 min/m², at least 3 min
6	Water jet hose nozzle 12.5 mm, 2.5m to 3 m distance	st 3 min
7	Immersion tank Water 0.15m above top of enclosure, water 1m above bottom of enclosure	
8	Immersion tank Waterlevel by agreement	
9	Fan jet nozzle, enclosure on turntable, 0°/30°/60°/90°	s), 1 min/m², at least 3 min (large units)







IP Code Considerations

- IP Code applies only to new enclosures
- IP Code applies to electrical equipment rated voltage not exceeding 72.5kV
- In the IEC 60529 impact tests are no longer defined (replaced by IK code in IEC 62262)
- Code IPX9 added to IEC 60529
- Still no K coding in IEC 60529, though described in IEC 20653; road vehicles
- Checkability of ingress...Avoid wrong conclusions due to inspection sequence

- **Use common sense, it is your best help!**

Additional Letters

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

Additional Letter	Description of Protection Against...	Definition
A	Access with back of the hand	The access probe, sphere of 50 mm ø, shall have adequate clearance from hazardous parts
B	With finger	The jointed test finger of 12 mm ø, 80 mm length, shall have adequate clearance form hazardous parts
C	With tool	The access probe of 2,5 mm ø, 100 mm length, shall have adequate clearance from hazardous parts
D	With wire	The access probe of 1,0 mm ø, 100 mm length, shall have adequate clearance from hazardous parts

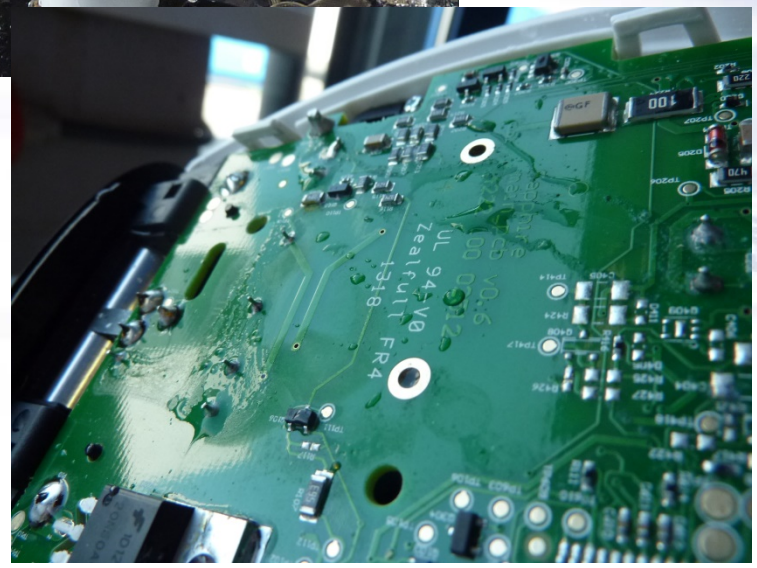
Supplementary Letters

- **Supplementary information describes exceptional cases**

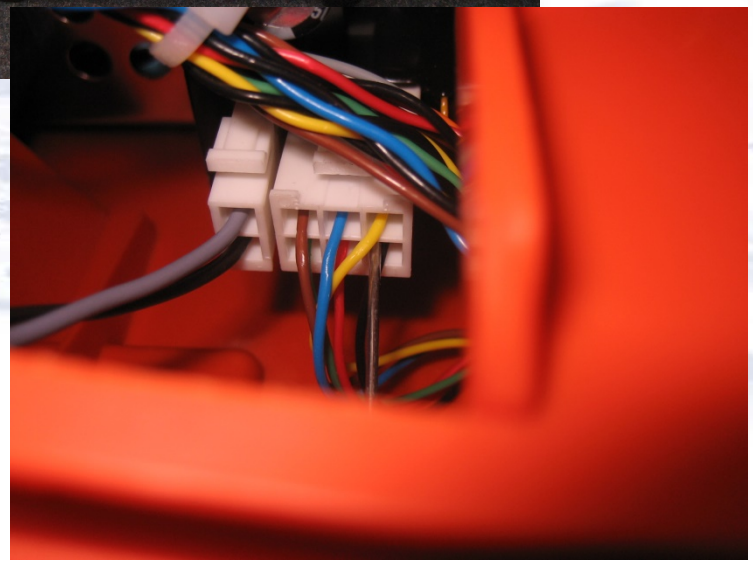
Additional Letter	Definition
H	High-voltage apparatus
M	Tested for harmful effects due to the ingress of water when the movable parts of the equipment (for example, the rotor of a rotating machine) are in motion
S	Tested for harmful effects due to the ingress of water when the movable parts of the equipment (for example, the rotor of a rotating machine) are stationary
W	Suitable for use under specified weather conditions and provided with additional protective features or processes

Examples: Systems Level

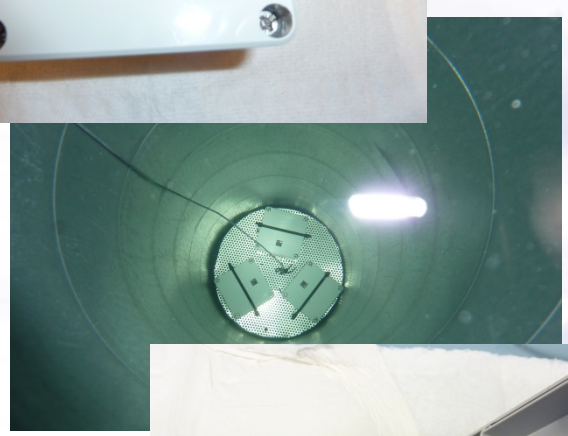
IPX2



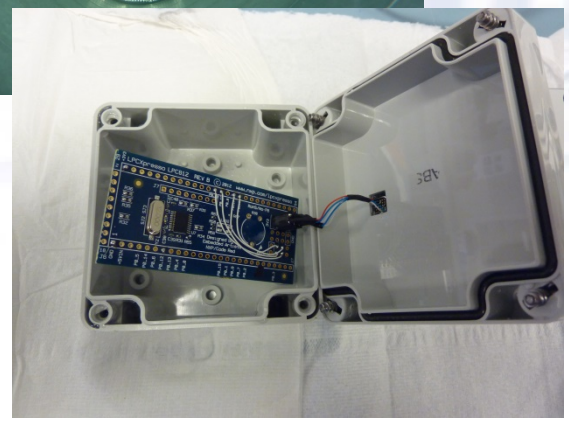
IP4X

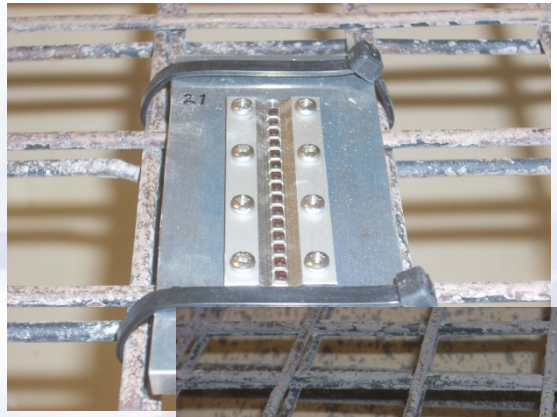


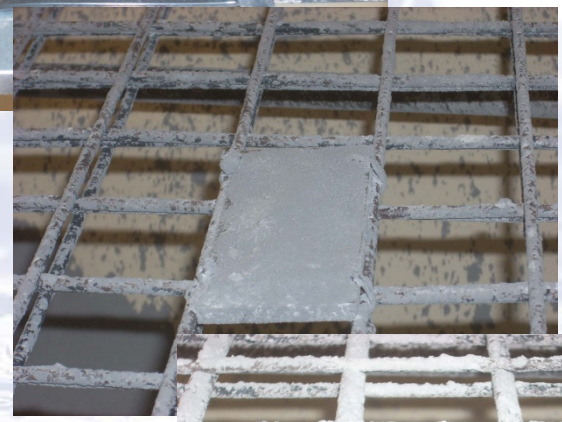
Examples: Component Level



IPX7







IP5X