International Protection (IP)

IEC 60529 : Degree of protection provided By enclosures (IP Codes)

MAKMAL PENYELIDIKAN ELEKTRIK

BAHAGIAN INOVASI , PENYELIDIKAN DAN PEMBANGUNAN KEJURUTERAAN

PUSAT KECEMERLANGAN KEJURUTERAAN & TEKNOLOGI JKR (CREaTE)

Introduction

To test Degree of Protection provided by enclosure as below

- Protection of **persons** against access **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**

SECOND CHARACTERISTICS NUMERICAL :
Againts ingress of water with harmful effects
Numerals :

0 : non protected

1 : vertical dripping

2 : dripping 15 º

3: spraying

4: splashing

5 : jetting

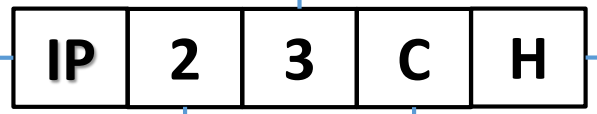
6 : powerful Jetting

7 : Temporary immersion

8 : Continuos Immersion

9 : High Pressure and temperature water jet

CODE LETTERS
(INTERNATIONAL PROTECTION)



Supplementary letter(optional) :
Supplementary Information
H: High Voltage Apparatus
M : Motion During water Test
S :Stationary during water test
W : Weather conditions

FIRST CHARACTERISTICS NUMERICAL :
Againts Ingress of solid foreign objects/Againts Hazardous Parts
Numerals :

0 : not protected
1 : ≥50mm diameter
2 :≥12.5mm diametet
3 : ≥2.5 mm diamter
4 : ≥1.0 mm diameter
5 : dust protected
6 : dust tight

Additional letter(optional) : protection against access to hazardous parts

A : back of hand
B : finger
C: tool
D: wire

SOURCE IEx

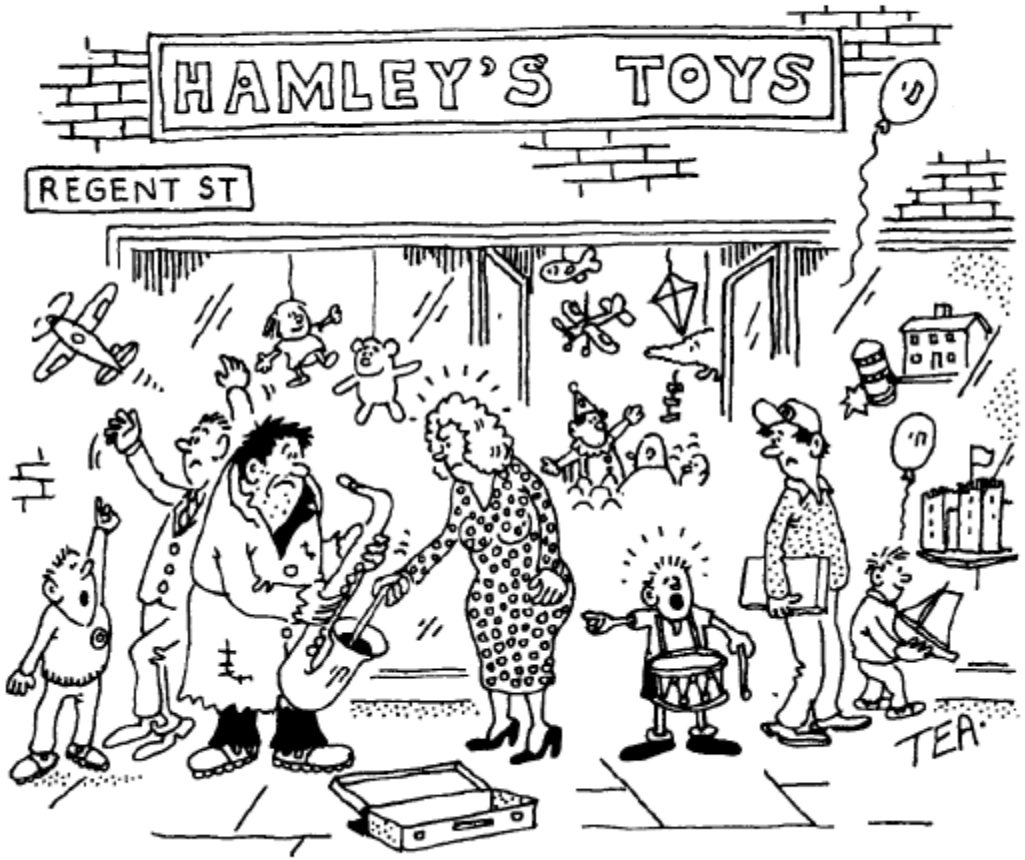
Real World Examples of IP Codes...

IP1X – 50mm diameter sphere – no penetration

SOURCE IEx

Real World Examples of IP Codes...

IP2X – Test Finger



SOURCE IEx

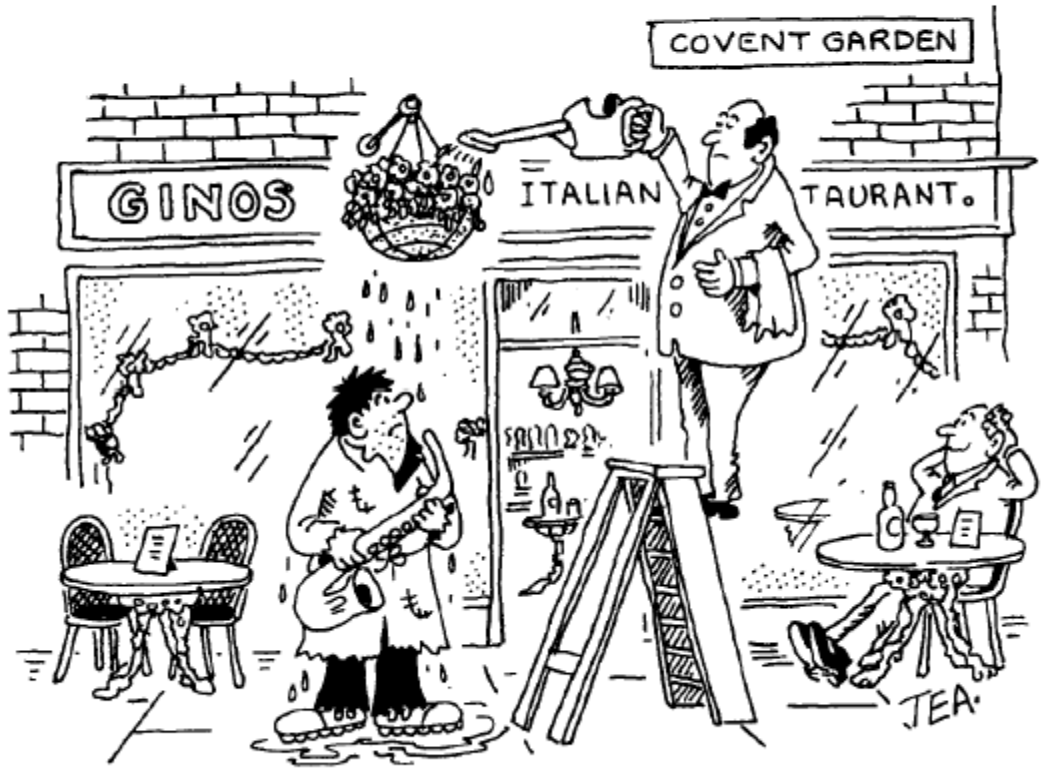
Real World Examples of IP Codes...

IP3X – 2.5mm probe

SOURCE IEx

Real World Examples of IP Codes...

IPX1 – Vertically dripping



SOURCE IEx

Real World Examples of IP Codes...

IPX2 – Dripping 15° From the vertical

SOURCE IEx

Real World Examples of IP Codes...

IPX3 – Limited spraying

SOURCE IEx

Real World Examples of IP Codes...

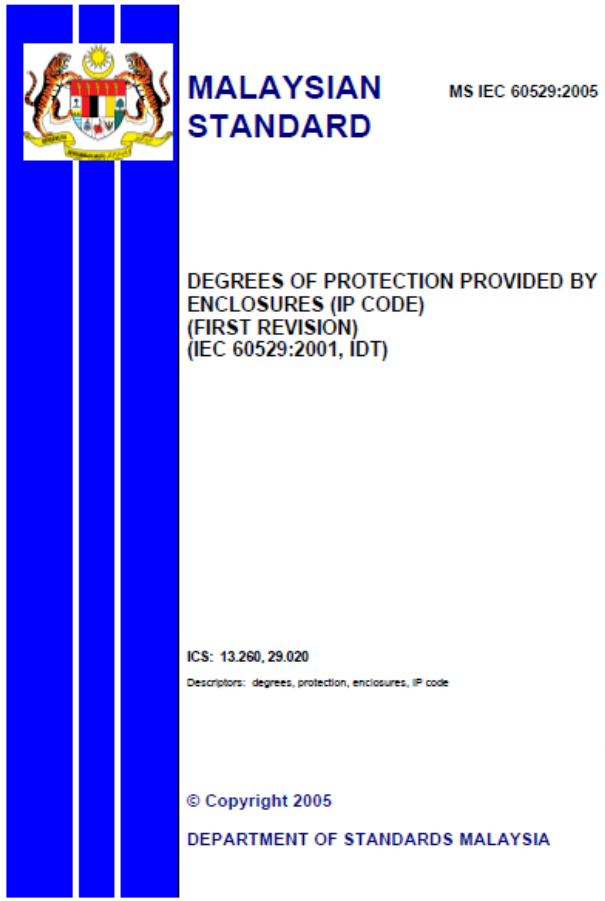
IPX4 – Splashing from all directions

SOURCE IEx

Real World Examples of IP Codes...

Completely protected!!!

IP CODE – TESTING PROCEDURE



MALAYSIAN STANDARD

MS IEC 60529:2005

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
(FIRST REVISION)
(IEC 60529:2001, IDT)

ICS: 13.260, 29.020

Descriptors: degrees, protection, enclosures, IP code

DEPARTMENT OF STANDARDS MALAYSIA

MALAYSIAN STANDARD

MS IEC 60529:2005

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
(FIRST REVISION)
(IEC 60529:2001, IDT)

TERMS AND DEFINITION

3.1
enclosure
a part providing protection of equipment against certain external influences and, in any direction, protection against direct contact [IEV 826-03-12]*.

NOTE This definition taken from the existing International Electrotechnical Vocabulary (IEV) needs the following explanations under the scope of this standard:

1) Enclosures provide protection of persons or livestock against access to hazardous parts.
2) Barriers, shapes of openings or any other means – whether attached to the enclosure or formed by the enclosed equipment – suitable to prevent or limit the penetration of the specified test probes are considered as a part of the enclosure, except when they can be removed without the use of a key or tool.

TERMS AND DEFINITION

3.2
direct contact
contact of persons or livestock with live parts [IEV 826-03-05]

NOTE This IEV definition is given for information. In this standard "direct contact" is replaced by "access to hazardous parts".

3.3
degree of protection
the extent of protection provided by an enclosure against access to hazardous parts, against. ingress of solid foreign objects and/or against ingress of water and verified by standardized test methods

TERMS AND DEFINITION

3.4
IP Code
a coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

TERMS AND DEFINITION

3.5.1
hazardous live part
a live part which, under certain conditions of external influences, can give an electric shock (see IEC 60050-195, 195-06-05)

3.5.2
hazardous mechanical part
a moving part, other than a smooth rotating shaft, that is hazardous to touch

TERMS AND DEFINITION

3.6
protection provided by an enclosure against access to hazardous parts
the protection of persons against

- contact with hazardous low-voltage live parts
- contact with hazardous mechanical parts
- approach to hazardous high-voltage live parts below adequate clearance inside an enclosure

NOTE This protection may be provided

- by means of the enclosure itself,
- by means of barriers as part of the enclosure or distances inside the enclosure.

TERMS AND DEFINITION

3.7
adequate clearance for protection against access to hazardous parts
a distance to prevent contact or approach of an access probe to a hazardous part

3.8
access probe
a test probe simulating in a conventional manner a part of a person or a tool, or the like, held by a person to verify adequate clearance from hazardous parts

3.9
object probe
a test probe simulating a solid foreign object to verify the possibility of ingress into an enclosure

3.10
opening
a gap or aperture in an enclosure which exists or may be formed by the application of a test probe at the specified force

GENERAL TEST REQUIREMENTS

TESTING ACCORDING TO RELEVANT PRODUCT STANDARD

Eg. LUMINAIRES – MS IEC 60598-1

MINIATURE CIRCUIT BREAKER – MS IEC 60898-1

TEST REQUIREMENTS :

- Number of sample(s).
- Condition of mounting
- Pre-conditioning
- Tested energized/not energized.
- Tested in motion/not in motion

.

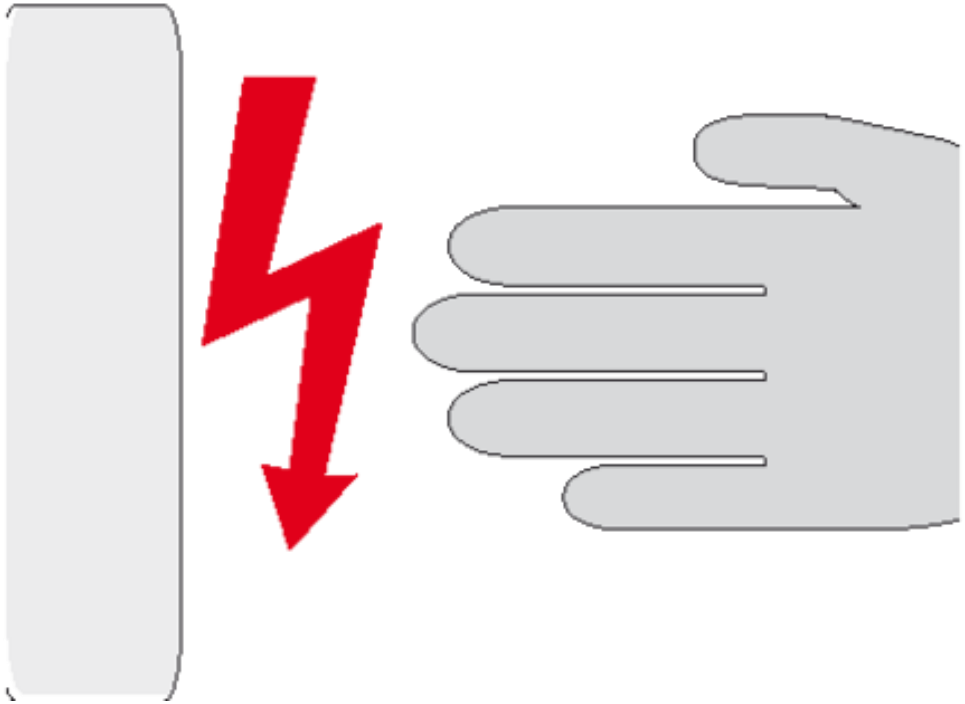
GENERAL TEST REQUIREMENTS

ATMOSPHERIC CONDITIONS :

Temperature :	**15ºC to 35ºC**
Relative Humidity :	25 % to 75 %
Air Pressure :	86 kPa to 106kPa

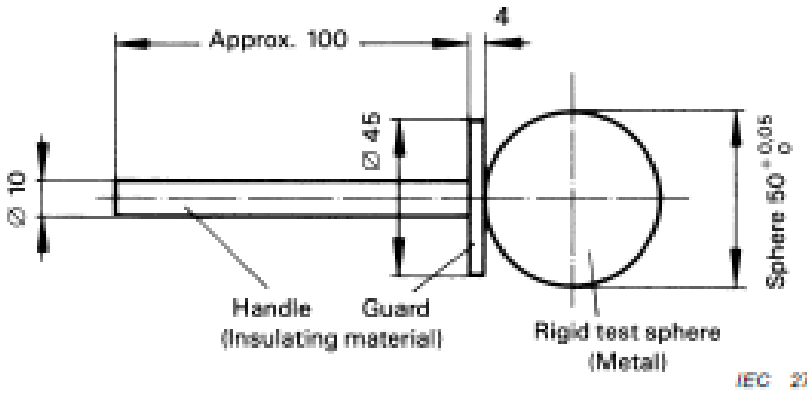
Tests for protection against access to hazardous parts indicated by the first characteristic numeral

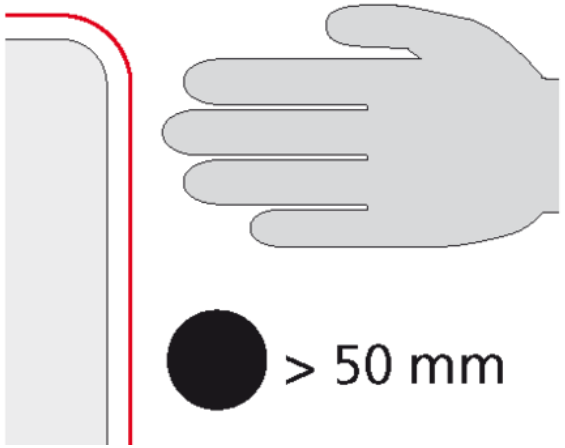
IP 0X



Tests for protection against access to hazardous parts indicated by the first characteristic numeral

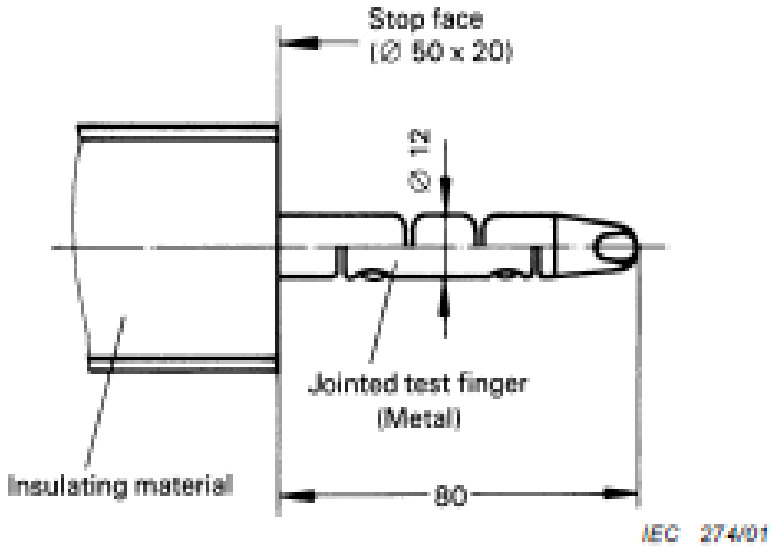
Access Probe – IP 1X

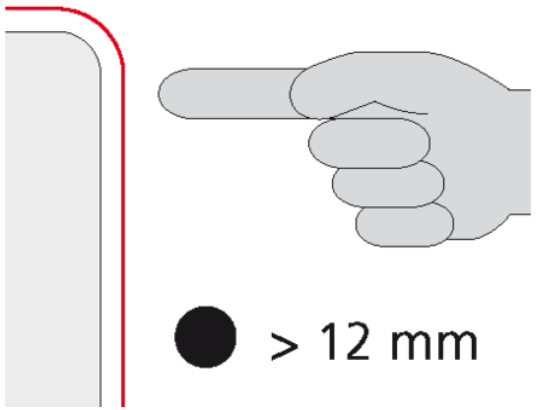
First numeral	Addit. letter	Access probe	Test force
1	A	Sphere 50 mm diameter 	50 N ± 10 %



TESTING APPARATUS

Access Probe – IP 2X

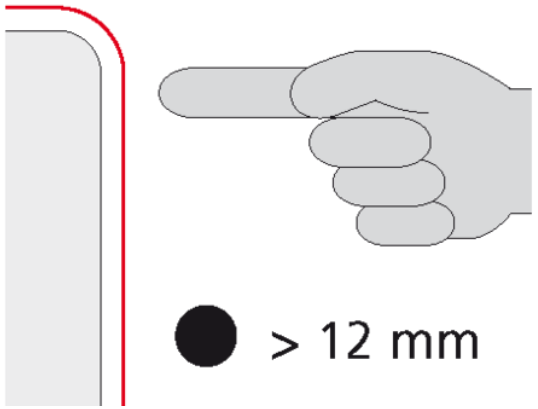
2	B	Jointed test finger See figure 1 for full dimensions  	10 N ± 10 %

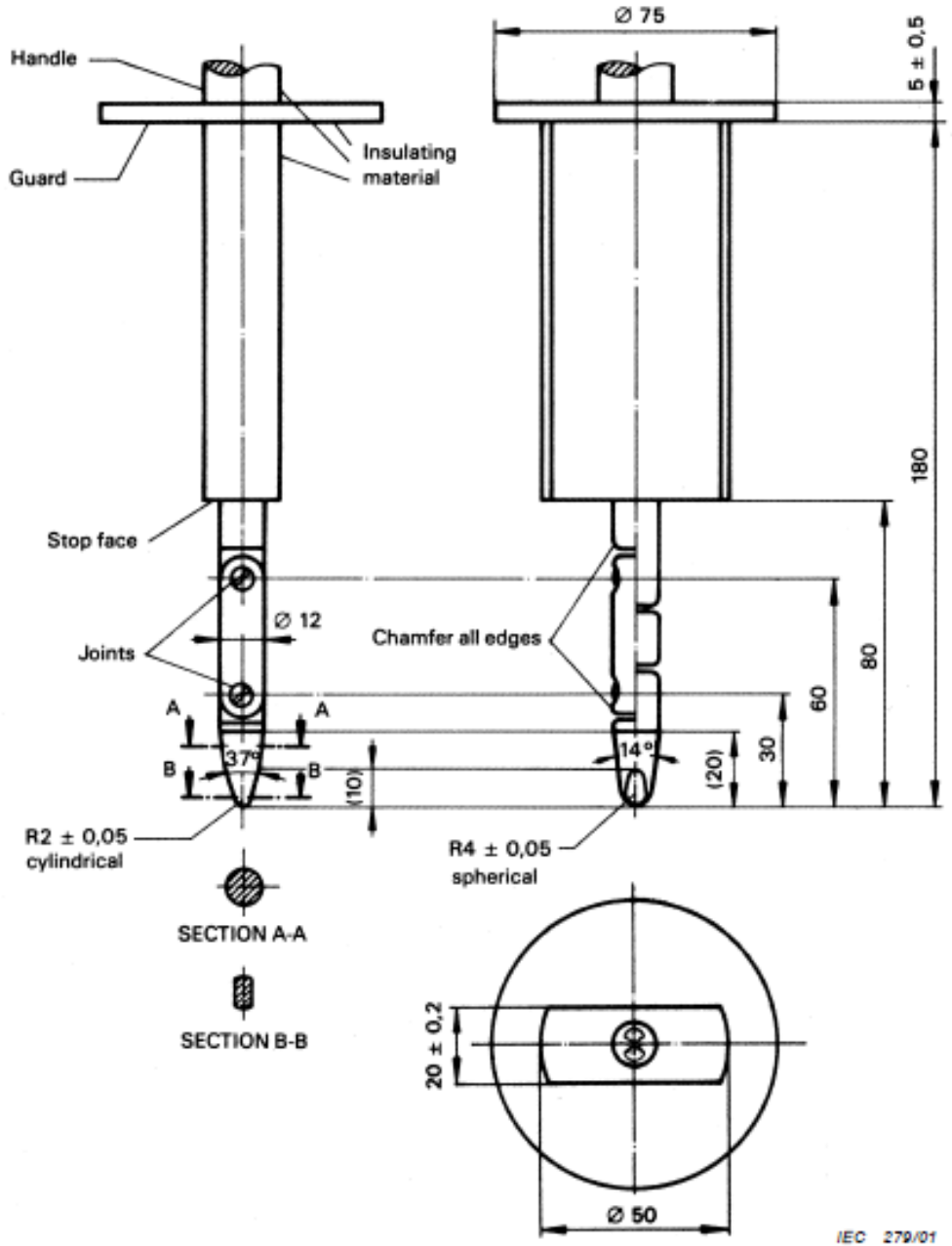


TESTING APPARATUS

Access Probe – IP 2X

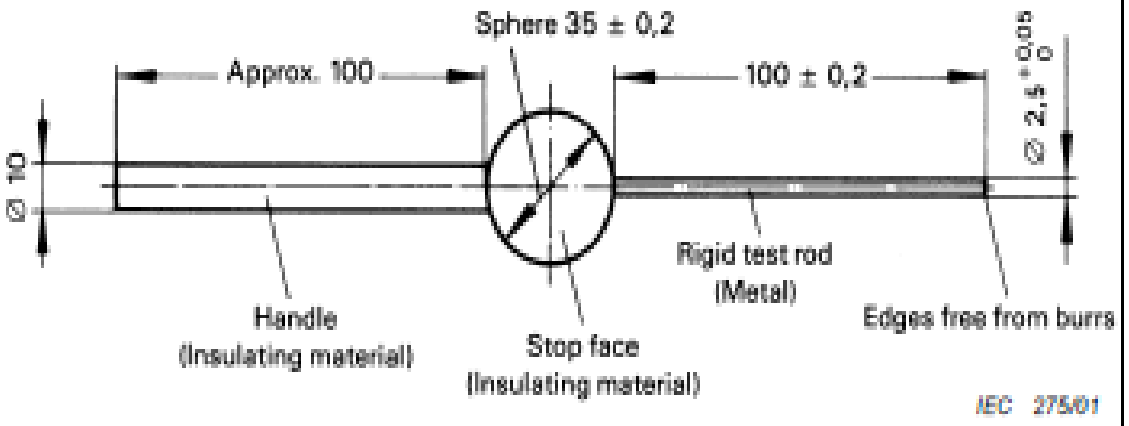
Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to +10° tolerance.

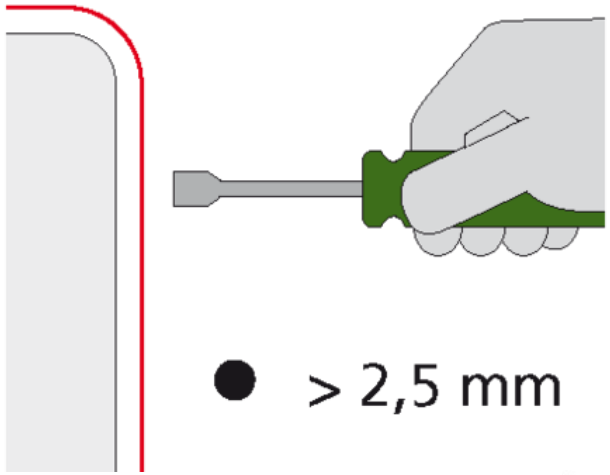




TESTING APPARATUS

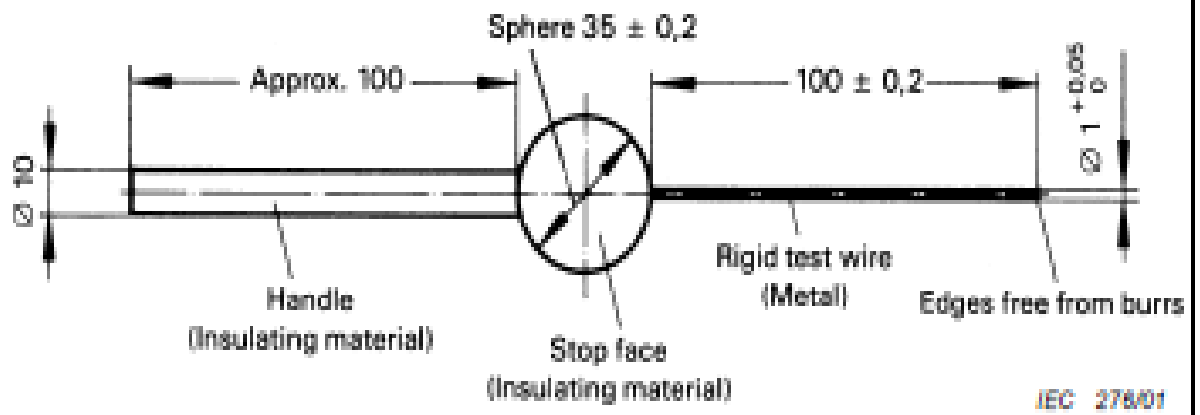
Access Probe – IP 3X

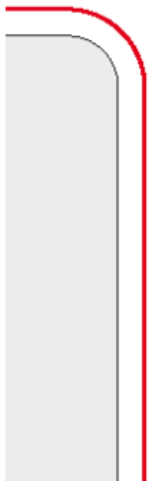
3	C	Test rod 2,5 mm diameter, 100 mm long 	3 N ± 10 %

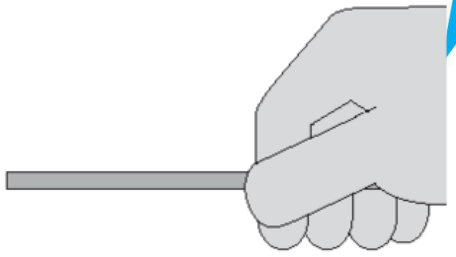


TESTING APPARATUS

Access Probe – IP 4X

4, 5, 6	D	Test wire 1,0 mm diameter, 100 mm long  	1 N ± 10 %

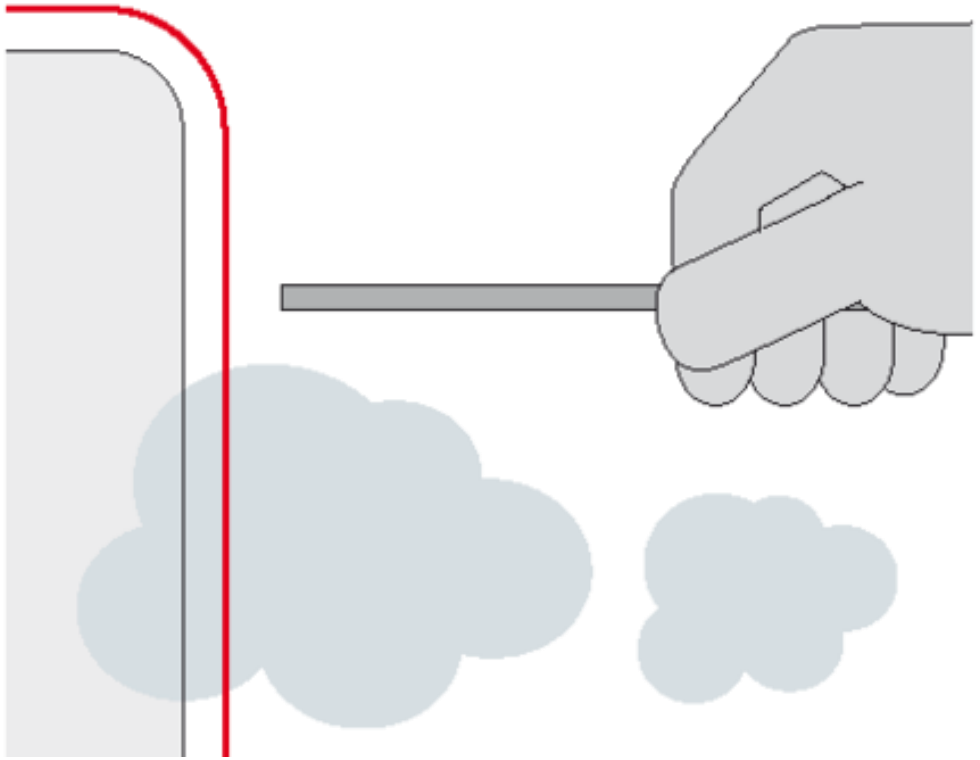




- > 1 mm

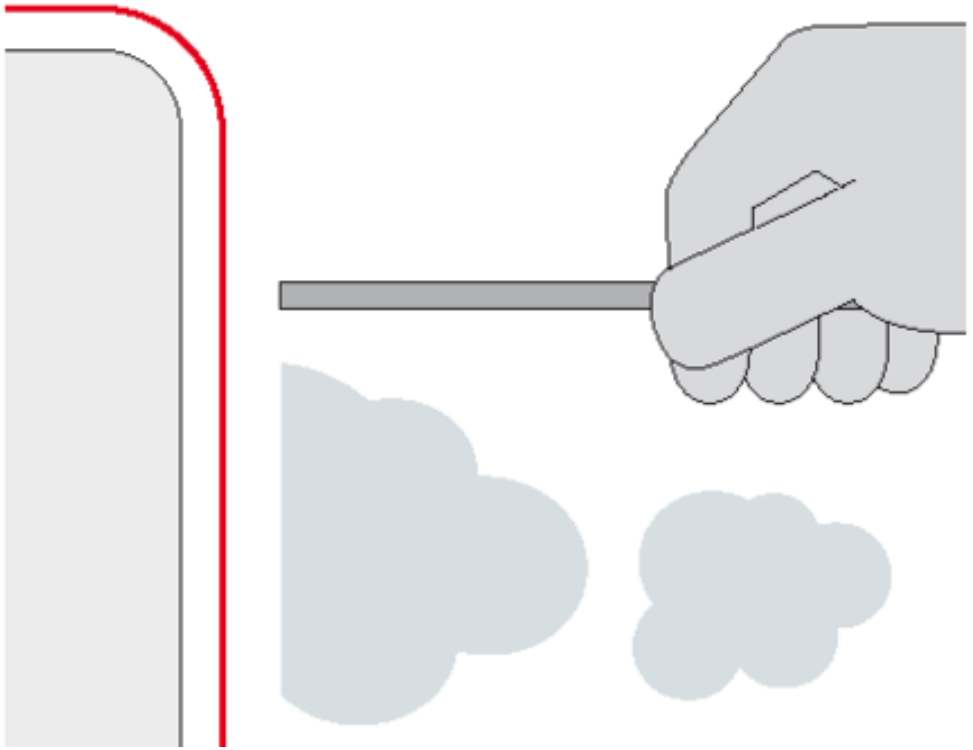
TESTING APPARATUS

Dust proof– IP 5X



TESTING APPARATUS

Dust tight– IP 6X

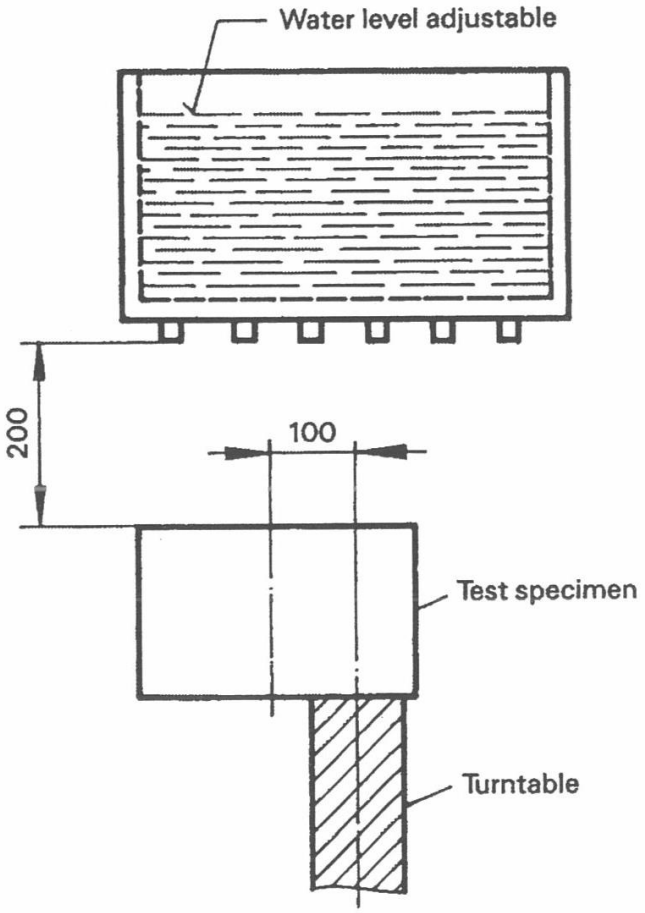


Tests for protection against access to hazardous parts indicated by the first characteristic numeral

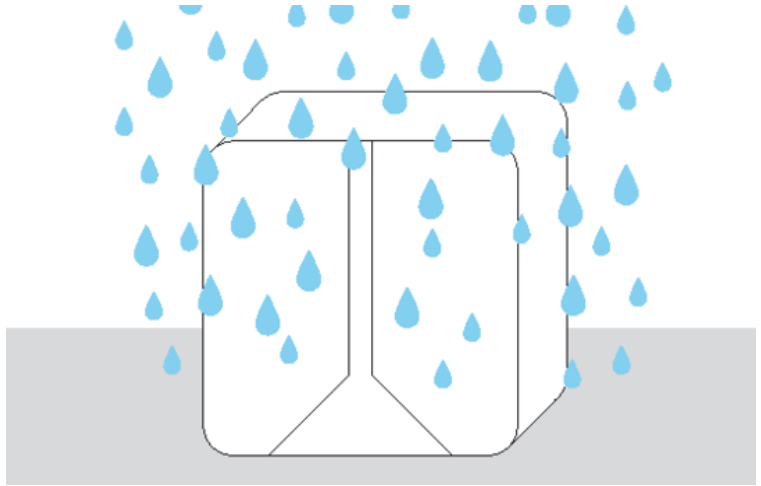
Acceptance conditions

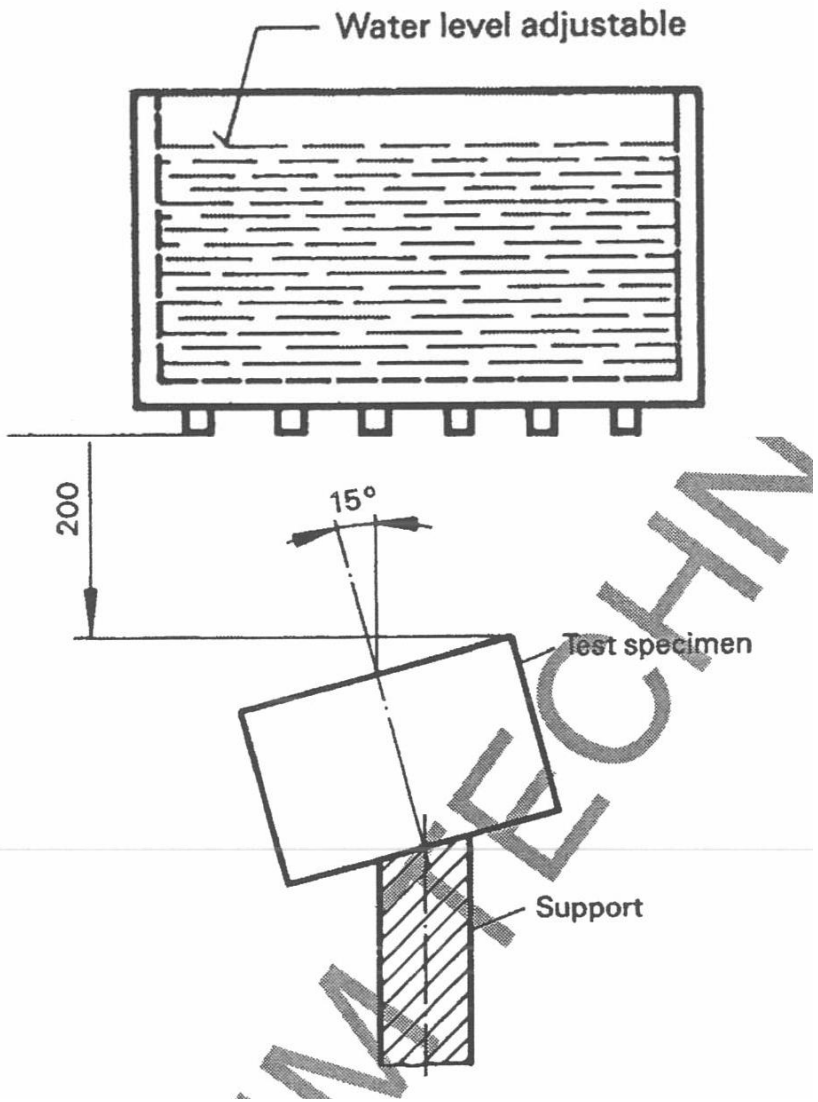
The protection is satisfactory if adequate clearance is kept between the access probe and hazardous parts.
For the test of first characteristic numeral 1, the access probe 50 mm diameter shall not completely pass through the opening.
For the test of first characteristic numeral 2, the jointed test finger may penetrate to its 80 mm length, but the stop face (50 mm . 20 mm) shall not pass through the opening.
Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90° with respect to

Tests for protection against water indicated by the second characteristic numeral

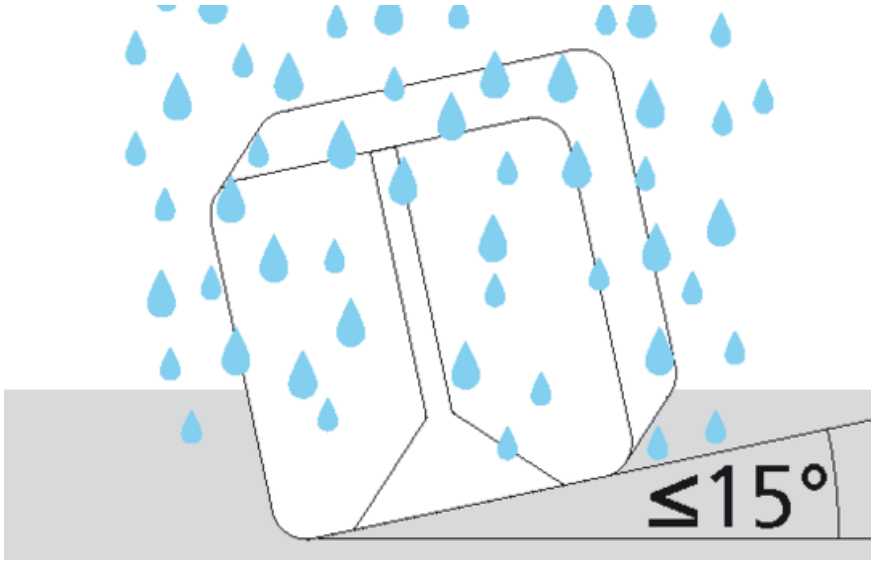


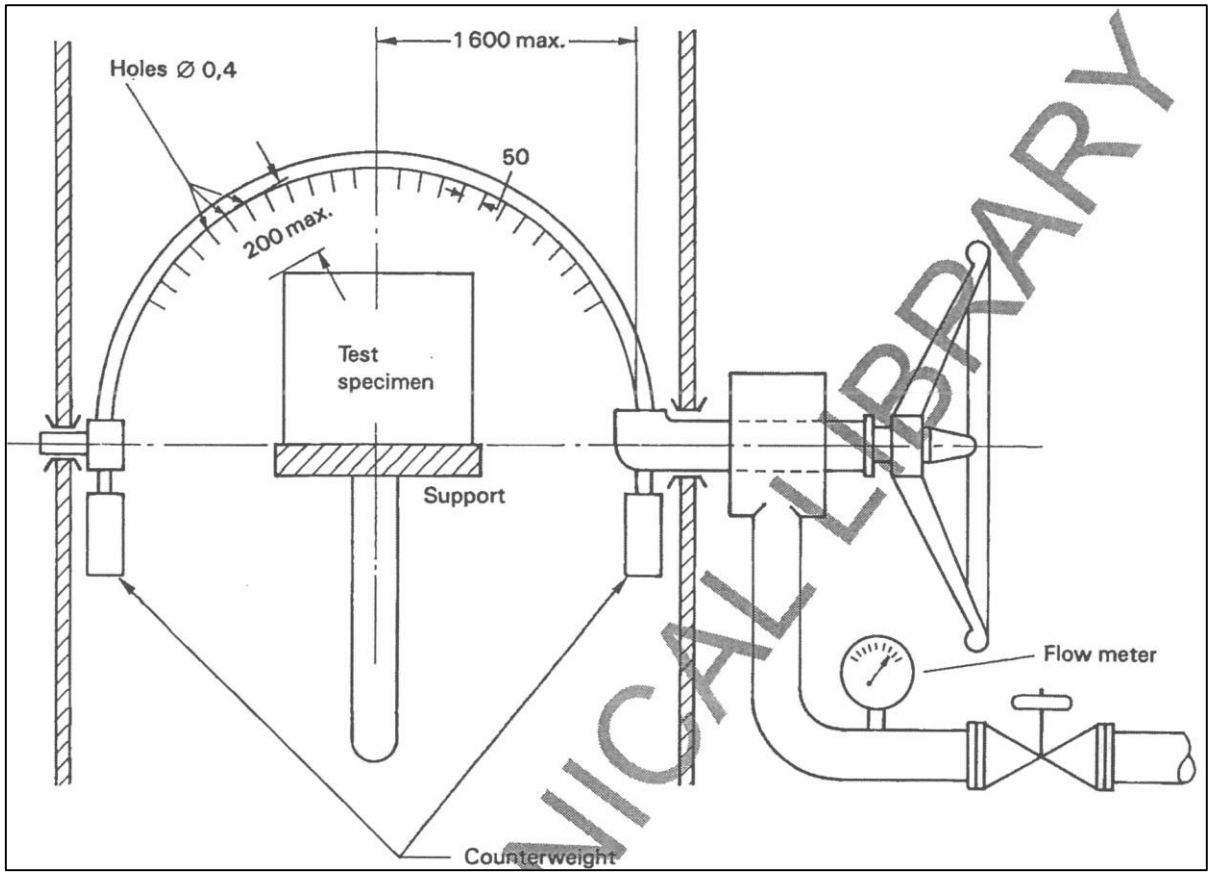
- Drip Box
- IPX1
- Sample placement: Vertical

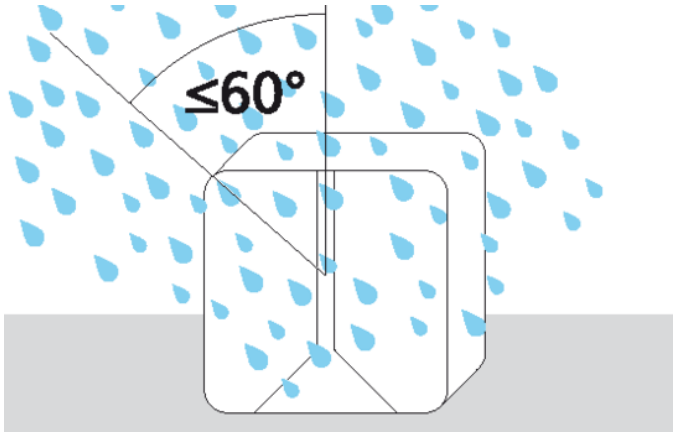




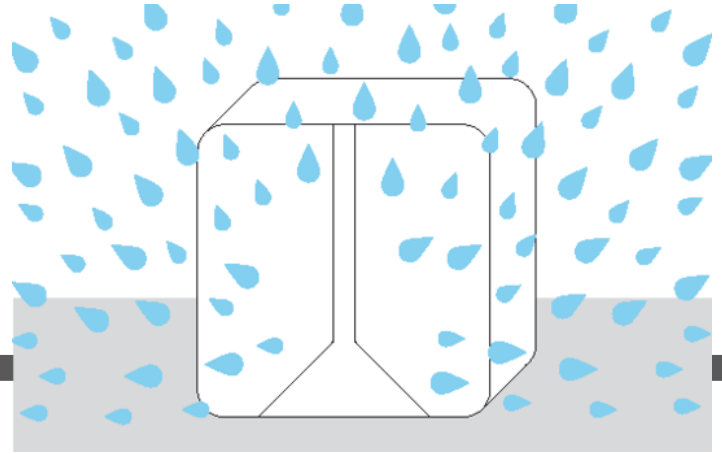
- Drip Box
- IPX2
- Sample placement: 15° tilt



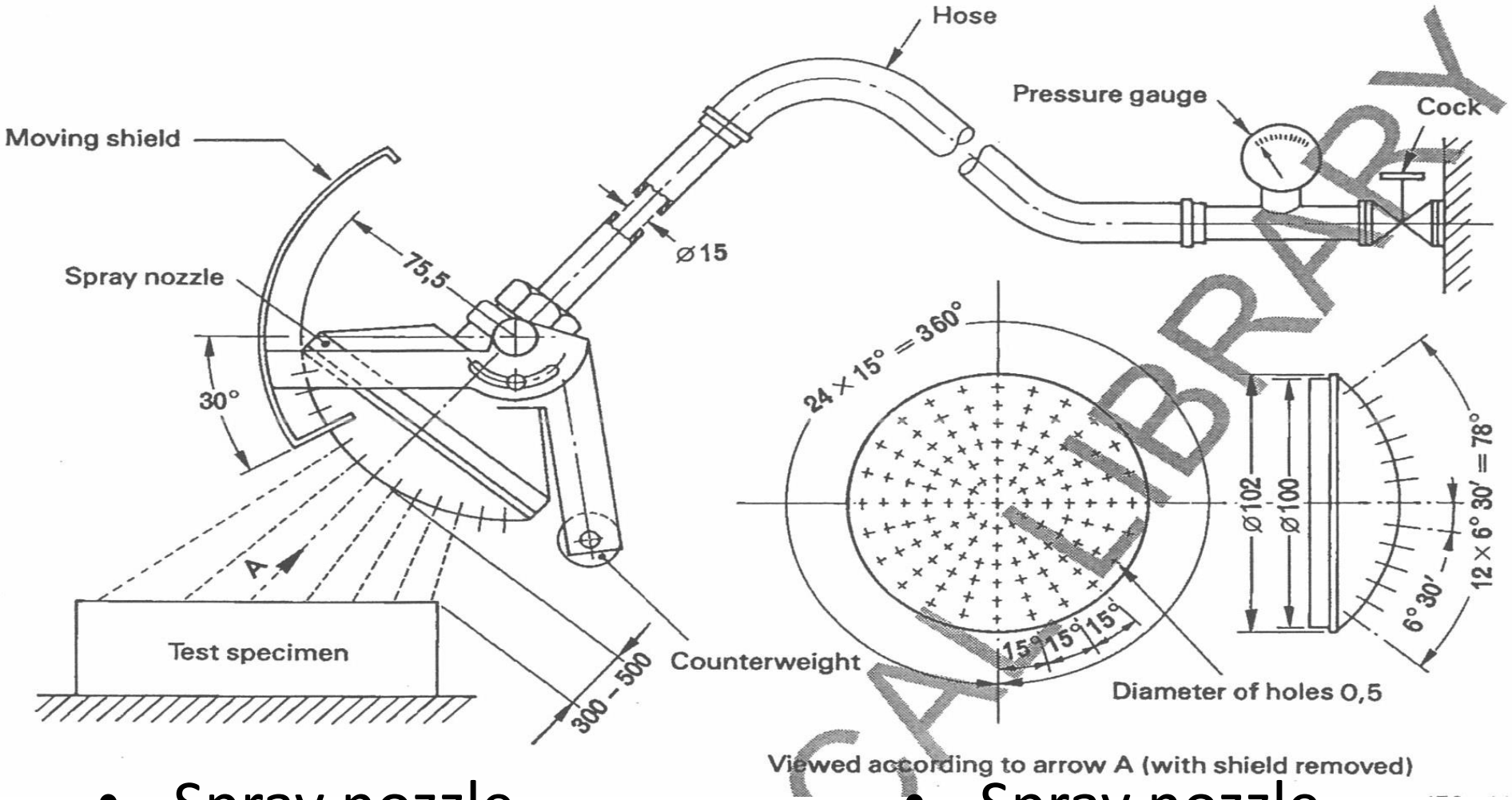




- Oscillating tube
- IPX3
- Spray ± 60 °

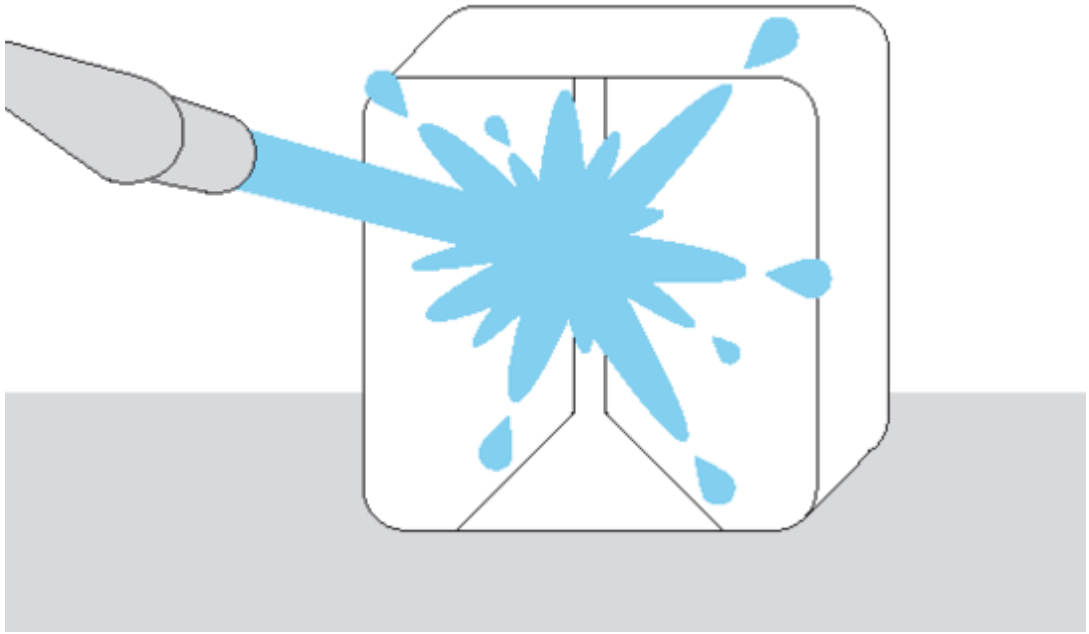


- Oscillating tube
- IPX4
- Spray ± 180 °

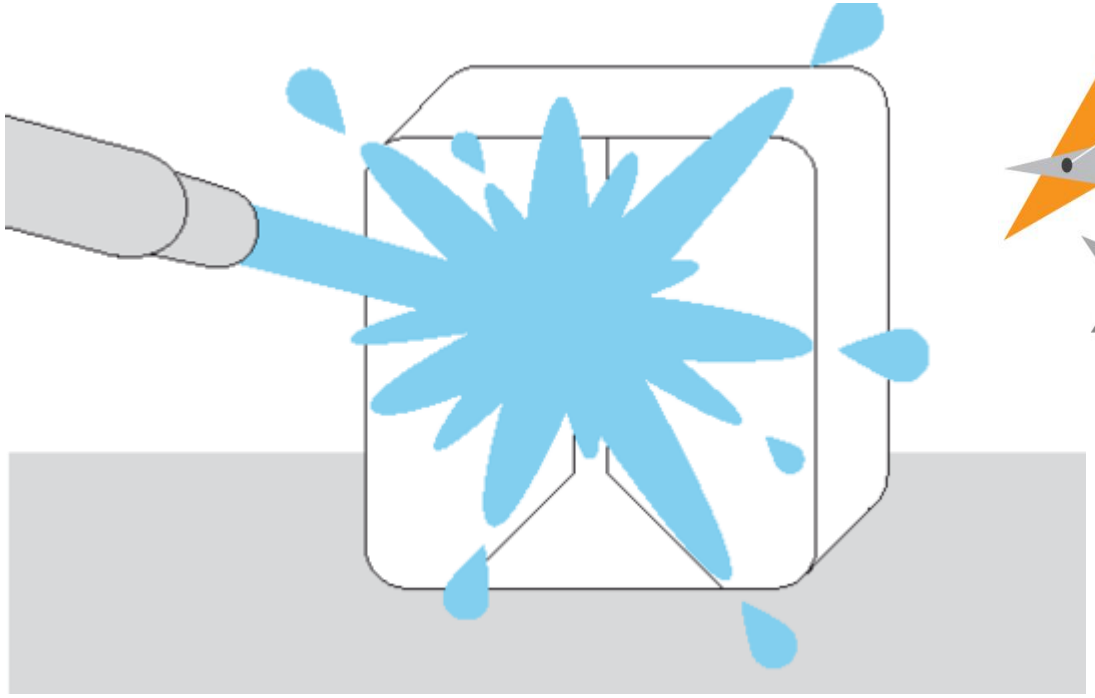


- Spray nozzle
- IPX3
- Spray ± 60 °

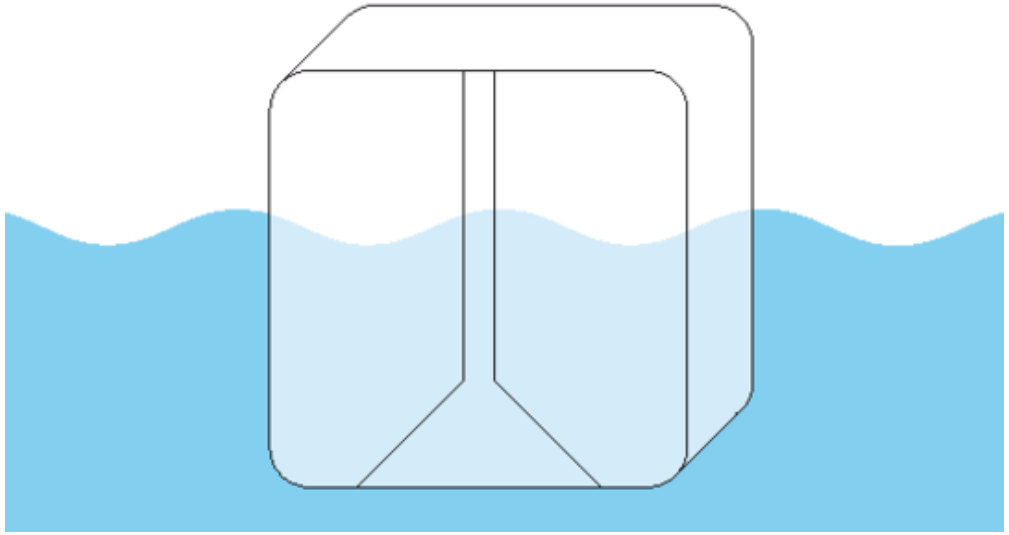
- Spray nozzle
- IPX4
- Spray ± 180 °



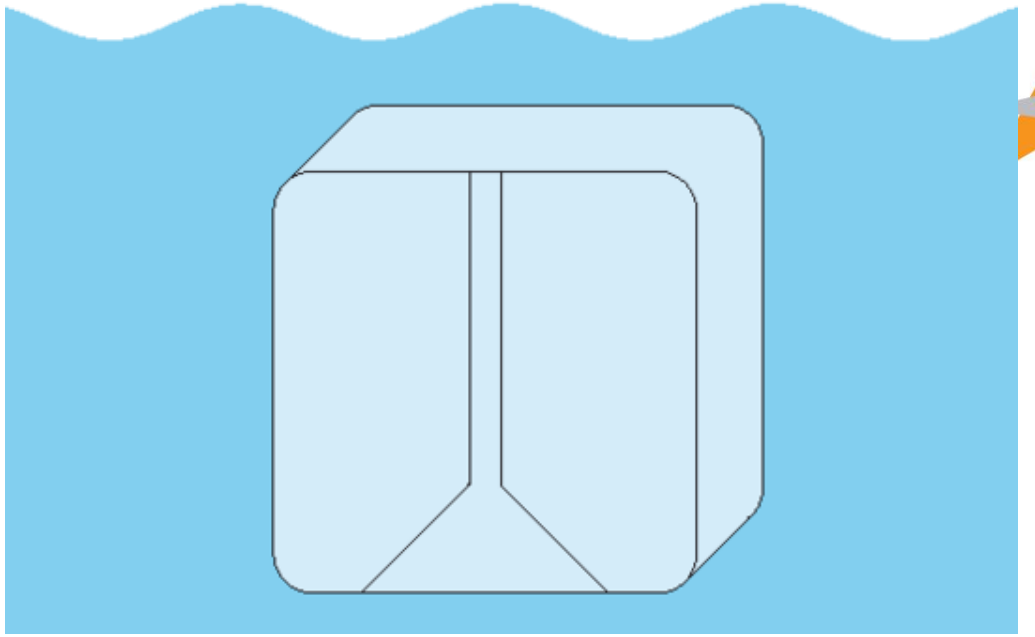
- Water jet
- IPX5
- Nozzle Ø =6.3 mm
- Delivery rate=12.5 l / min



- Water jet
- IPX6
- Nozzle Ø =12.5 mm
- Delivery rate=100 l / min



- Temporary immersion in water
- IPX7
- 30 min
- Between 0.15 m to 1 m



- Continuous immersion in water
- IPX8
- Subject to agreement with manufacturer (depend on actual use)

Tests for protection against water indicated by the second characteristic numeral

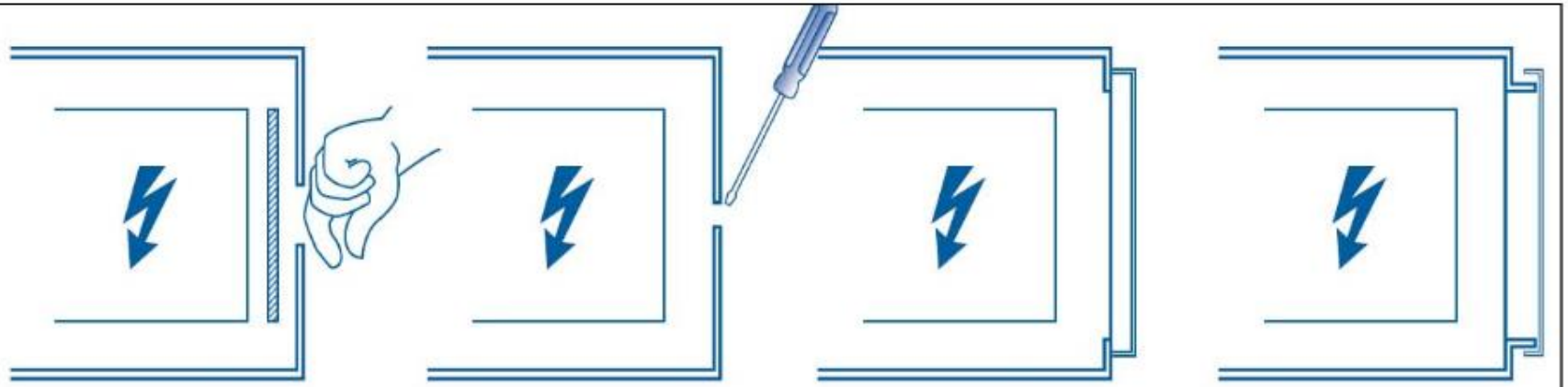
Acceptance conditions

In general, if any water has entered, it shall not;

- Interfere with correct operation of the products or impair safety.
- Deposit on insulation part where it could lead to tracking along the creepage.
- Reach live parts
- Accumulate near the cable

However the amount of water penetration is subjected to the relevant product standard.

IP Codes – The Basic..



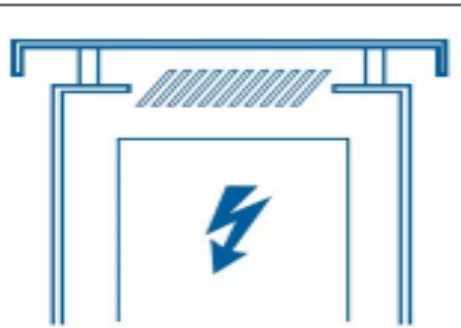
The IP code for this example without the barrier is IP1X, but with the internal barrier fitted as shown it can become IP1XC or even IP1XD.

Smaller aperture to prevent access of small tools etc, therefore IP3X, but also needs an internal barrier if wire strands need to be excluded.

Hinged or removeable door type suitable for IP ratings generally up to IP42, and would require good quality gasket to achieve higher values.

Door overlaps the enclosure aperture and when gasketted, this type of design can achieve the highest IP ratings

IP Codes – Ventilation Equipment

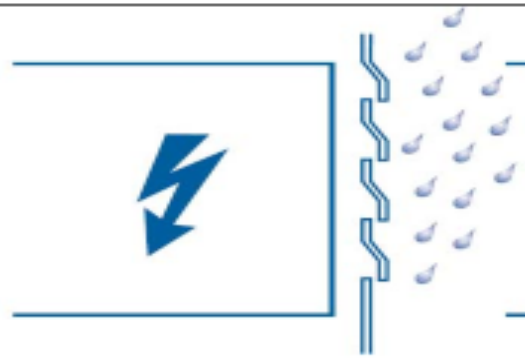


This example provides:

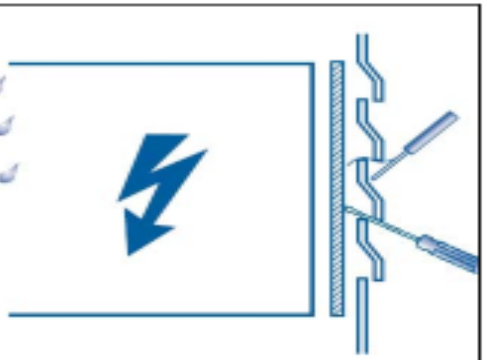
1 Basic protection against solid objects to IP2X/3X, and due to the tortuous path, complies with IP2XD/3XD.

2 Protection against water ingress to IPX2.

3 Allows for ventilation of the equipment.

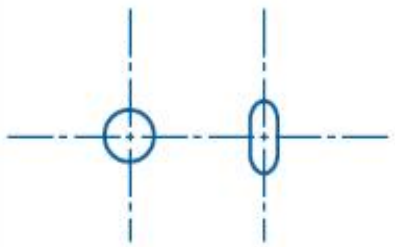


Similarly, side louvres can be engineered to provide the same protection.

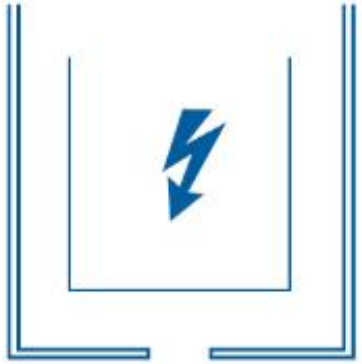


Additional internal barriers can be used to enhance the protection against small tools and individual wire strands, although this may well affect the efficiency of the ventilation. The test probe is not deemed to have entered the enclosure until the final barrier has been penetrated.

IP Codes – Drainage Holes

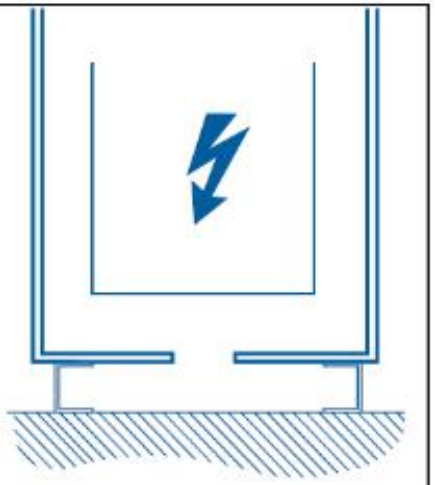


The minimum recommended aperture sizes to allow for drainage and overcome the surface tension of water are 5.0mm diameter, or a 3.0mm width slot of 20.0mm² area.



The basic protection with drainage holes would then be IP2X.

This can be improved by the use of internal barriers, and a rating of IP2XD can be achieved



The IP rating can be affected by the installation position; here the mounting surface acts as an external barrier and limits accessibility.

Do not assume that higher the IP number, the better the protection (IP66 vs IP67)