BS EN 61386 – 1 Conduit Systems for Cable Management / Testing Equipment

Description

10 Mechanical properties
10.1 Mechanical strength
10.1.1 Conduit systems shall have adequate mechanical strength.

10.1.2 Conduits, according to their classification, when bent or compressed, or exposed to impact or extreme temperature of a specified value in accordance with impact and temperature classification declared for the product, either during, or after, installation according to the manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult, or that the installed insulated conductors or cables are likely to be damaged while being drawn in.
10.1.3 Conduit systems intended as a mounting for other equipment shall have adequate mechanical strength to support such equipment and to withstand the force required to operate the equipment, both during and after installation.

10.1.4 Compliance of 10.1.1 to 10.1.3 is checked by the tests specified in 10.2 to 10.8.

10.2 Compression test
10.2.1 Samples of conduit, each (200 ± 5) mm long, shall be subjected to a compression test at (23 ± 2)ºC, using the apparatus shown in figure 1.
10.2.2 Before the test, the outside diameters of the samples shall be measured.
10.2.3 The samples shall be positioned on a flat steel support, and a steel intermediate piece, as shown in figure 1, shall be placed in the middle of the sample.
10.2.4 A uniformly increasing compression force, reaching the values shown in table 4 within (30 ± 3) s, shall be applied to the intermediate piece.
10.2.5 After the force given in table 4 has been applied for (60 ± 2) s, the outside diameter of the sample shall be measured where flattening has taken place, without removing the force.

Table 4 – Compression force

Classification	Conduits	Compression force Tolerance $^{+4}_{0}$ % N
1	Very light	125
2	Light	320
3	Medium	750
4	Heavy	1250
5	Very heavy	4000

10.2.6 The difference between the initial outside diameter and the diameter of the flattened sample shall not exceed 25 % of the initial outside diameter measured before the test.
10.2.7 The force and the intermediate piece are then removed and, (60 ± 2) s after removal, the outside diameter of the samples, where they have flattened, shall be measured again.
The difference between the initial diameter and the diameter of the flattened samples shall not exceed 10 % of the outside diameter, measured before the test.
10.2.8 After the test, the samples shall show no cracks visible to normal or corrected vision without additional magnification.

10.3 Impact test
10.3.1 Twelve samples of conduit, each (200 ± 5) mm in length, or twelve conduit fittings are subjected to an impact test by means of the apparatus shown in figure 2.
Before the test, the samples are assembled with all the components as for normal use, including conduits required for conducting of the test.

Parts, which are not accessible when mounted in normal use, and small conduit fittings whose maximum dimension is less than 20 mm, are not subjected to this test.
10.3.2 The test apparatus shall be placed on a pad of closed cell expanded sponge (40 ± 1) mm thick when uncompressed, and having a density of (538 ± 22) kg/m3.
The test apparatus, together with the samples, shall be placed in a refrigerator, the temperature within which shall be maintained at the declared temperature as given in table 1 with a tolerance of ±2 °C.
When the samples have attained the temperature specified, or after 2 h, whichever is the longer period, each sample shall be placed in position on the steel base as shown in figure 2. The hammer shall be allowed to fall once on each sample. The mass of the hammer and the fall height shall be as given in table 5.
The test shall be made on the weakest part of the conduit fitting, except that it shall not be applied to within 5 mm of any conduit entry. Samples of conduit are tested at the center of their length.

Table 5 – Impact test values

Classification	Conduit and fittings	Mass of hammer Tolerance $^{+1}_{0}$ % kg	Fall height Tolerance ±1 % mm
1	Very light	0,5	100
2	Light	1,0	100
3	Medium	2,0	100
4	Heavy	2,0	300
5	Very heavy	6,8	300

10.3.3 After the test, when samples have attained (20 ± 5) °C, it shall be possible to pass the appropriate gauge specified in the relevant particular requirements (parts 21, 22, 23, etc.) through the conduit, under its own weight and without any initial speed, with the sample in the vertical position. There shall be no sign of disintegration nor shall there be any crack visible to normal or corrected vision without magnification. At least nine of the twelve samples shall pass the test.

10.4 Bending test
The test is specified in the relevant particular requirements (parts 21, 22, 23, etc.) of this standard.
10.5 Flexing test
The test is specified in the relevant particular requirements (parts 21, 22, 23, etc.) of this standard.
10.6 Collapse test
The test is specified by the relevant particular requirements (parts 21, 22, 23, etc.) of this standard.

10.7 Tensile test
10.7.1 Conduit systems declaring tensile strength shall be tested as follows:
A sample of conduit and two conduit fittings or terminating conduit fittings are assembled in accordance with the manufacturer's instructions so that the overall length is approximately 300 mm. The assembly is subjected to a uniformly increasing tensile force reaching the value given in table 6, at (23 ± 2) °C, in (30 ± 3) s. This tensile force is then applied for 2 min ± 10 s.
10.7.2 Where elongation occurs, the manufacturer shall be responsible for providing guidelines to assist the safe installation of the conduit system.
10.7.3 For conduit systems where tensile strength is not declared, the tensile strength of the joint shall meet the requirements of the relevant tests of the appropriate part 2. 10.7.4 After the test, the conduit fittings or terminating conduit fittings shall remain properly assembled to the conduit, and there shall be no damage visible to normal or corrected vision without magnification.

Table 6 – Tensile force

Classification	Conduit and fittings	Tensile force Tolerance $^{+2}_{0}$ % N
1	Very light	100
2	Light	250
3	Medium	500
4	Heavy	1000
5	Very heavy	2500

10.8 Suspended load test

The conduit fitting, declared by the manufacturer to be suitable for suspended loads, is secured to a rigid structure using a method provided by the manufacturer, with the suspension means pointing downwards. A load, with a time duration in accordance with table 7, is suspended by the means provided, and installed in accordance with the manufacturer's instructions. The fitting shall be deemed to have passed if at the end of the test, there are no cracks visible to normal or corrected vision without magnification, and there is no deformation of the conduit fitting impairing its normal use.

For non-metallic and composite conduit fittings, the test shall be carried out in a heating cabinet, the temperature within which is maintained at the declared maximum temperature given in table 2 with a tolerance of ± 2 o C.

Table 7 – Suspended load

Classification	Fittings	Load Tolerance $^{+2}_{0}$ % N	Duration Tolerance $^{+15}_{0}$ min h
1	Very light	20	48
2	Light	30	48
3	Medium	150	48
4	Heavy	450	48
5	Very heavy	850	48

11 Electrical properties

11.1 Electrical requirements

11.1.1 Conduit systems declaring electrical continuity characteristics shall be checked by the tests in 11.2 immediately after the tests in 14.2.

NOTE – Conduit systems, in some circumstances, may be used in total or in part as a protective conductor in an electrical installation. In that event, the system will be tested after final installation to confirm its suitability for that purpose, in accordance with the installation rules.

11.1.2 Conduit systems of metal or composite materials shall be so constructed that accessible metal parts can be bonded to earth. Compliance is checked by the test in 11.2.

11.1.3 Accessible conductive parts of the metal or composite conduit system, which may become live in the event of a fault, shall be effectively earthed. Compliance is checked by the test in 11.2.

11.1.4 Conduit systems of non-metallic or composite materials, where declared, shall have an

adequate electrical insulating strength and insulating resistance.
Compliance is checked by the test in 11.3.

11.2 Bonding test

An arrangement of conduit and conduit fittings, consisting of 10 pieces of conduit, shall be coupled together, in accordance with the manufacturer's instructions and figure 3, by means of conduit fittings representing, in approximately equal numbers, each type of fitting. The fittings shall be spaced between 100 mm and 150 mm apart. A current of 25 A, having a frequency of 50 Hz to 60 Hz derived from an a.c. source having a no-load voltage not exceeding 12 V, is passed through the assembly for (60 ± 2) s. The voltage drop is then measured and the resistance calculated from the current and that voltage drop. The resistance shall not exceed 0,1 ?. If the numbers of different types of fittings cannot all be accommodated in a single test, the test described above shall be repeated until all such different types of fittings have been tested.

Where special devices are required for the coupling of conduit and conduit fittings, they shall be sufficient to remove the protective coating from the conduit, or the protective finish shall be removed in accordance with the manufacturer's instructions.

11.3 Electrical insulating strength and resistance

11.3.1 Conduits

11.3.1.1 Samples of conduit are immersed over a length of 1 m ± 10 mm in accordance with figure 4 or figure 5 in a salt water solution at (23 ± 2) °C, with a length of 100 mm kept above the level of the solution.

Rigid conduit samples are to be supplied by the manufacturer complete with one end sealed with an appropriate insulating material with high electrical insulation, for example silicon elastomer; see figure 4. Pliable and flexible conduit samples are bent into a "U" shape and then immersed; see figure 5. The salt water solution is made by completely dissolving 1 g/l of sodium chloride. The salt water solution is poured into the open end of the conduit to match the external level. An electrode is placed inside the conduit and another placed into the tank. 11.3.1.2 After 24 h ± 15 min, a voltage is applied across the two electrodes, gradually being increased from 1000 V to 2000 V of substantially sine wave form and having a frequency of 50 Hz to 60 Hz. Having reached 2000 V, the voltage is maintained for a period of 15 min+3s.

The high-voltage transformer used for the test is so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is of at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA. Care is taken that the r.m.s. value of the test voltage applied is measured within ±3 %.

The samples shall be considered to have adequate electrical insulating strength if a 100 mA trip device, incorporated into the circuit, does not trip during the 15 min test.

11.3.1.3 Immediately after the test in 11.3.1.2, the same samples shall be subjected to an electrical insulation resistance test. A direct voltage of 500 V shall be applied across the two electrodes.

11.3.1.4 After (60 ± 2) s from the application of the voltage, the insulation resistance between the electrodes shall be obtained. Conduits shall be considered to have adequate electrical insulation resistance if the measured resistance is greater than 100 M?.

11.3.2 Conduit fittings

11.3.2.1 Samples of conduit fittings shall be immersed for 24 h ± 15 min, in water at (23 ± 2) °C, and

then thoroughly dried at room temperature.

11.3.2.2 Conduit fitting samples shall be assembled in accordance with the manufacturer's instructions with a short length of conduit. All other open ends are sealed with an appropriate insulating material. The inside of the fitting is filled with lead spheres of a diameter between 1,0 mm and 1,5 mm, and an electrode is inserted into the lead shot via the conduit.
An outer electrode of aluminium foil is wrapped around the outside of the fitting and compressed so that it follows the outer contour of the fitting as closely as possible.
11.3.2.3 Conduit fitting samples shall be tested in accordance with 11.3.1.2 within 1 h of removal from the water.
11.3.2.4 Immediately after the test in 11.3.2.3, the same samples are subjected to an electrical insulation resistance test. A d.c. voltage of 500 V is applied across the two electrodes.
11.3.2.5 After (60 ± 2) s from the application of the voltage, the insulation resistance between the electrodes is obtained. Fittings are considered to have adequate electrical insulation resistance if the resistance is greater than 5 M?.

12 Thermal properties
12.1 Non-metallic and composite conduits shall have adequate resistance to heat.
Compliance is checked by the test in 12.2 and verified with 12.3. The load for the heating test shall be the same classification as the declared compression classification.
12.2 Samples of conduit, each (100 ± 5) mm long, together with the test apparatus as shown in figure 8, shall be kept for 4 h ± 5 min in a heating cabinet at the declared temperature given in table 2, with a tolerance of ± 2 o C.
After this period, each sample is loaded for 24 h ± 15 min in an apparatus, as shown in figure 8, with an appropriate mass applied through a steel rod (6,0 ± 0,1) mm in diameter, disposed at right angles to the axis of the conduit.
The sample is subjected to a total mass, including the mass of the rod, as shown in table 9, placed in the middle of the sample. The sample, under load, shall then be allowed to cool to room temperature.

Table 9 – Load for heating test

Classification	Conduits	Mass Tolerance $^{+1}_{0}$ % kg
1	Very light	0,5
2	Light	1,0
3	Medium	2,0
4	Heavy	4,0
5	Very heavy	8,0

12.3 The load is then removed, and immediately after its removal, it shall be possible to pass the appropriate gauge, specified in the relevant part 2, through the conduit, under its own weight and without any initial speed, with the sample in the vertical position.

13 Fire hazard
13.1 Reaction to fire

13.1.1 Initiation of fire
Not applicable.
NOTE Conduit systems are not in direct contact with live parts.
13.1.2 Contribution to fire
Under consideration.
13.1.3 Spread of fire
Non-flame propagating conduit systems shall have adequate resistance to flame propagation. 13.1.3.1 Compliance of non-metallic and composite conduit fittings is checked by using the glow-wire test in IEC 60695-2-1/1:1994.
The glow wire shall be applied once to each sample in the most unfavourable position for its intended use (with the surface tested in a vertical position) at a temperature of 750 °C. The sample is deemed to have passed this test if there is no visible flame or sustained glowing, or if flames or glowing extinguish within 30 s of the removal of the glow wire. 13.1.3.2 Compliance of non-metallic and composite conduits is checked by applying a 1 kW flame, as specified in IEC 60695-2-1/1:1994.
13.1.3.2.1 A sample of length (675 ± 10) mm, is mounted vertically in a rectangular metal enclosure with one open face, as shown in figure 6, in an area substantially free of draughts. The general arrangement is shown in figure 7.
Mounting is by means of two metal clamps approximately 25 mm wide, spaced (550 ± 10) mm apart and approximately equidistant from the ends of the sample.
A steel rod of (2,0 ± 0,1) mm for sizes up to 12 mm, (6,0 ± 0,1) mm for sizes 16 mm to 25 mm and (16,0 ± 0,1) mm for conduits with diameters 32 mm and above is passed through the sample. It is rigidly and independently mounted and clamped at the upper end to maintain the sample in a straight and vertical position. The means of mounting is such as not to obstruct drops from falling onto the tissue paper.
A suitable piece of white pine wood board, approximately 10 mm thick, covered with a single layer of white tissue paper, is positioned on the lower surface of the enclosure.

The assembly of sample, rod and clamping apparatus is mounted vertically in the centre of the enclosure, the upper extremity of the lower clamp being (500 ± 10) mm above the internal lower surface of the enclosure.
13.1.3.2.2 The burner is supported so that its axis is at an angle of (45 ± 2)° to the vertical.
The flame is applied to the sample so that the distance from the top of the burner tube to the sample, measured along the axis of the flame, is (100 ± 10) mm, and the axis of the flame intersects with the surface of the sample at a point (100 ± 5) mm from the upper extremity of the lower clamp, and so that the axis of the flame interacts with the axis of the sample. 13.1.3.2.3 The flame is applied to the samples for the period given in table 11, and is then removed. During the application of the flame, it shall not be moved, except to remove it at the end of the test period. The determination of material thickness of plain conduit, corrugated conduit and combined plain conduit and corrugated conduit is given in annex B. All three samples are measured and the mean material thickness is calculated for each sample. The highest mean value is used to determine the flame application time from table 11.

Table 11 – Times of exposure of the sample to the flame

Mean material thickness mm		Flame application time s
Over	Up to	Tolerance $^{+1}_{0}$ s
–	0,5	15
0,5	1,0	20
1,0	1,5	25
1,5	2,0	35
2,0	2,5	45
2,5	3,0	55
3,0	3,5	65
3,5	4,0	75
4,0	4,5	85
4,5	5,0	130
5,0	5,5	200
5,5	6,0	300
6,0	–	500

13.1.3.2.4 All three samples shall pass the test.
The sample is deemed to have passed the test if it does not ignite.
The sample is deemed to have passed the test if it does ignite but all of the following are met:
– flaming or glowing of the sample is extinguished within 30 s after removal of the test flame,
– the tissue paper does not ignite,
– after extinction of the flaming or glowing of the sample, there is no evidence of burning or charring within 50 mm of the lower extremity of the upper clamp.

14 External influences

14.1 Degree of protection provided by enclosure

Conduit systems, when assembled in accordance with the manufacturer's instructions, shall have adequate resistance to external influences according to the classification declared by themanufacturer, with a minimum requirement of IP30. Compliance is checked by the tests given in 14.1.1and 14.1.2.

14.1.1 Degree of protection – Ingress of foreign solid objects

14.1.1.1 An assembly is made of a conduit fitting with a short length of conduit assembled in each entry. Where necessary, the open ends of the assembly are plugged, or are not part of the test.

14.1.1.2 The assembly shall be tested in accordance with the appropriate test of IEC 529. For numeral 5, category 2 applies.

14.1.1.3 The assembly, tested for numeral 5 or 6, shall be deemed to have passed the test if there isno ingress of dust visible to normal or corrected vision without magnification.

14.1.2 Degree of protection – Ingress of water

14.1.2.1 An assembly is made of a conduit fitting with a short length of conduit assembled in each conduit entry. Where necessary, the open end of the conduit is plugged, or is not part of the test.

14.1.2.2 The assembly shall be tested in accordance with the appropriate test of IEC 529.

For numerals 3 and 4, the oscillating tube shall be used.

14.1.2.3 The assembly, tested for numeral 1 and above, shall be deemed to have passed the test if there is not sufficient ingress of water to form a drop visible to normal or corrected vision without magnification.

14.2 Resistance against corrosion

14.2.1 Metallic and composite conduit systems, excluding screw threads, shall have adequate resistance against corrosion, both inside and outside, in accordance with the classification given in table 10.

Compliance for painted and zinc coated steel and steel composite conduits and conduit fittings is checked by the tests in 14.2.2.

For non-ferrous metallic and composite conduit systems, the manufacturer shall provide information about its protection against corrosion.

14.2.2 Tests for resistance to corrosion for painted and zinc coated steel and steel composite conduits systems

14.2.2.1 Low protection conduit and conduit fittings shall be inspected for completeness of covering by the protective coating, both inside and outside.

14.2.2.2 Medium protection conduit and conduit fittings shall be cleaned with a piece of wadding soaked in white spirit with a kauri-butanol value of 35 + 5.

They shall then be totally immersed in a solution of 0,75 % potassium ferricyanide [K3Fe(CN)6] and 0,25 % ammonium persulphate [(NH4)2S2O8] in water and a quantity of about 0,1 % of a suitable wetting agent, for instance a sodium salt of an alkylnaphthaline sulphonic acid, shall be added.

The solution and the samples shall be maintained at a temperature of (23 ± 2) o C. Each sample shall be tested separately, a fresh solution being used each time.

After immersion for 5 min +5 s, the samples shall be removed from the solution and left to dry at ambient temperature in air. After completion of the test as described above, the samples shall show no more than two blue coloured spots on each square centimetre of the surface, and no blue spot shall have a dimension larger than 1,5 mm. Traces of rust on sharp edges, screw threads and machined

surfaces, also any yellowish film removable by rubbing, shall be ignored.

Table 10 – Resistance to corrosion classification

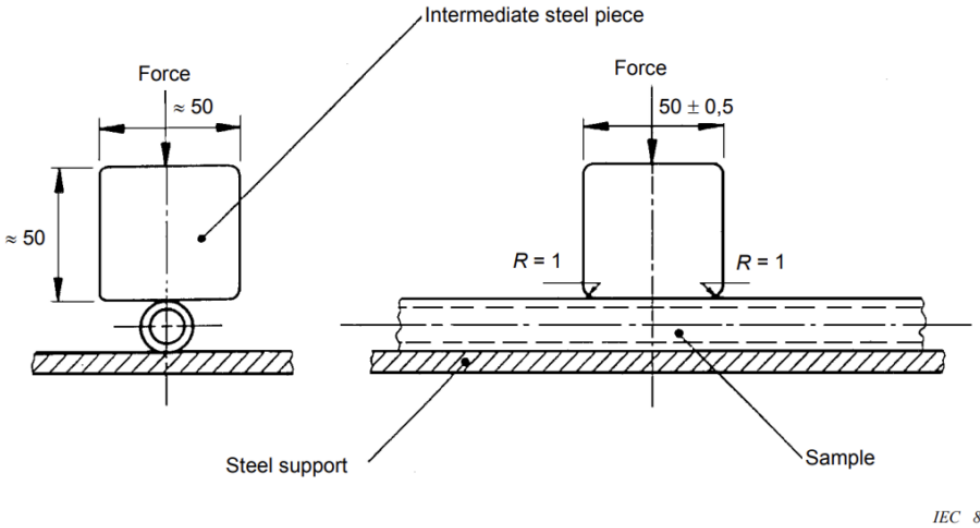
Classification	Protection afforded	Example
1	Low protection, inside and outside	Priming paint
2	Medium protection, inside and outside	Stove enamel/electro zinc plate/air drying paint
3	Medium/High composite protection inside: class 2 outside: class 4	Stove enamel Sherardizing
4	High protection, inside and outside	Hot dip zinc coating Sherardizing Stainless steel

14.2.2.3 High protection conduit and conduit fittings shall be degreased by immersion in white spirit with a kauri-butanol value of 35 + 5 for 10 min+5s and wiped dry with a piece of soft cloth. They shall then be immersed in a 2 % solution of sulphuric acid in water for 15 s, thoroughly cleaned in running water and again wiped dry with a piece of clean soft cloth. Each sample shall then be totally immersed in a solution of copper sulphate ($CuSO_4 5H_2O$) in distilled water, having a specific gravity of 1,186 kg/l at (23 ± 2) o C.

The solution and the samples shall be maintained at a temperature of (23 ± 2) o C, without stirring.
NOTE – The solution is made by dissolving 360 g of crystalline copper sulphate in 1l of distilled water and neutralising with copper carbonate or copper hydroxide (about 1 g/l). The specific gravity is then checked and adjusted as necessary.
The container shall be such that it will not react with the solution and it shall be of such a size as to provide clearance of at least 25 mm between the walls thereof and the sample. Each sample shall be immersed four times in succession in the same solution, each time for 1 min+5s.

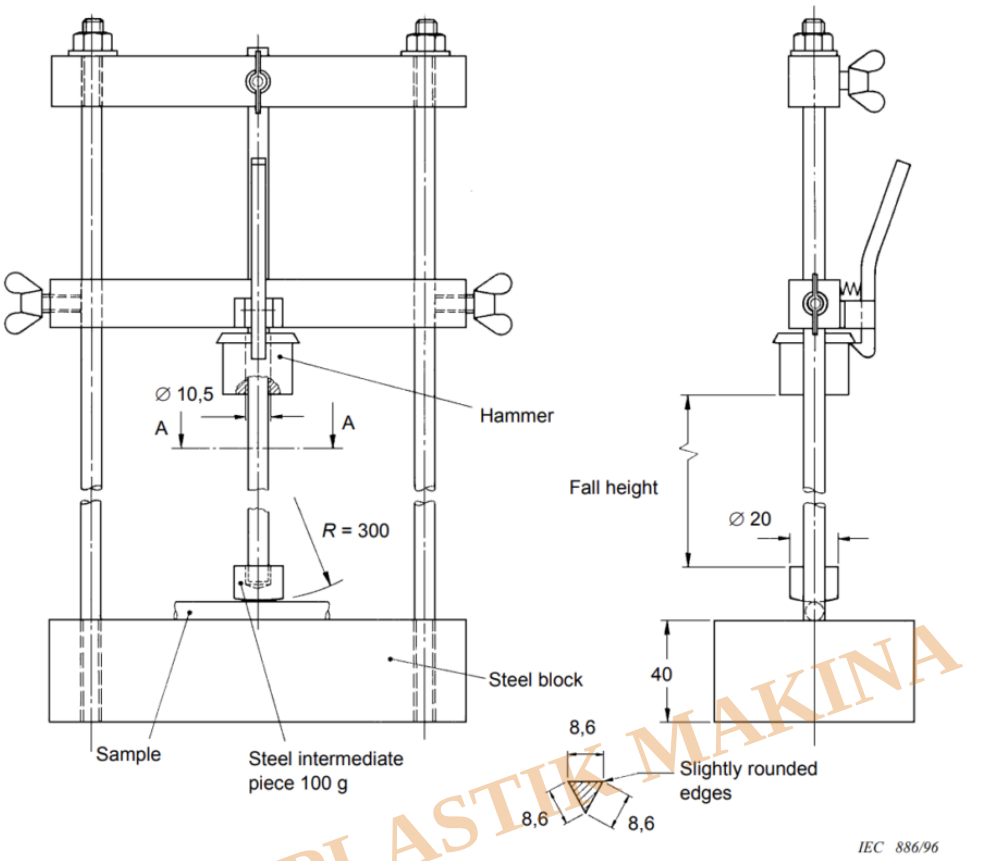
A fresh solution shall be used for each sample. After each immersion, the sample shall immediately be cleaned in running water with a brush to remove any black deposit. The sample shall then be wiped dry with a piece of clean soft cloth, and, except after the fourth immersion, returned to the solution. Care should be taken to clean out all holes and pockets. After the test, the sample shall show no precipitation of copper which cannot be scrubbed off in running water, if necessary after immersion for 15 s in a 10 % solution of hydrochloric acid in water. Traces of copper precipitation on screw threads, sharp edges and machined surfaces may be ignored.

15 Electromagnetic compatibility
Products covered by this standard are, in normal use, passive in respect of electromagnetic influences (emission and immunity).
NOTE – When products covered by this standard are installed as part of a wiring installation, the installation may emit, or may be influenced by, electromagnetic signals. The degree of influence will depend on the nature of the installation within its operating environment and the apparatus connected by the wiring.



Dimensions in millimetres

Figure 1 – Arrangement for compression test



Dimensions in millimetres

NOTE This drawing is not intended to govern design, except as regards the dimensions shown.

Figure 2 – Impact test apparatus

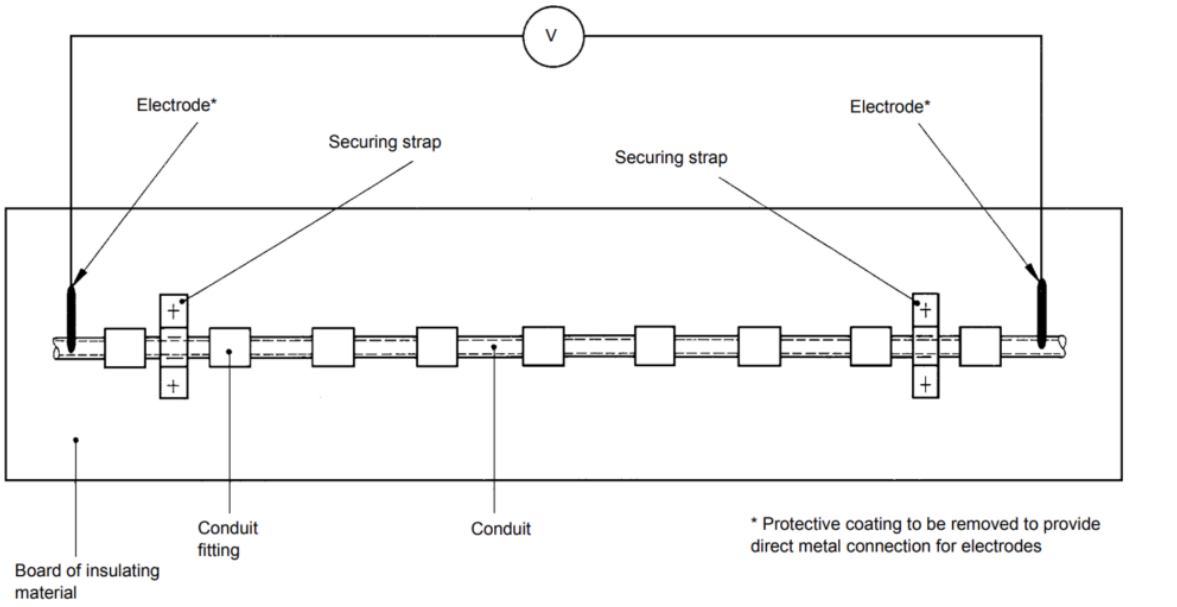


Figure 3 – Assembly of conduit and conduit fitting for bonding test

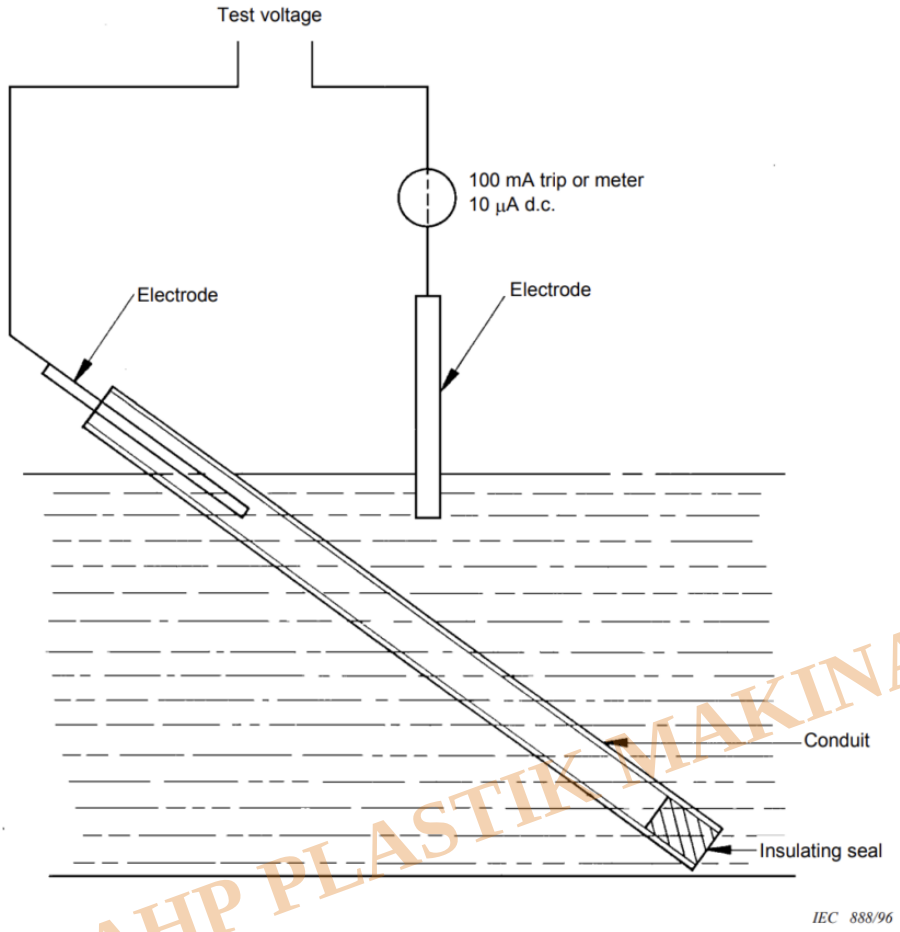
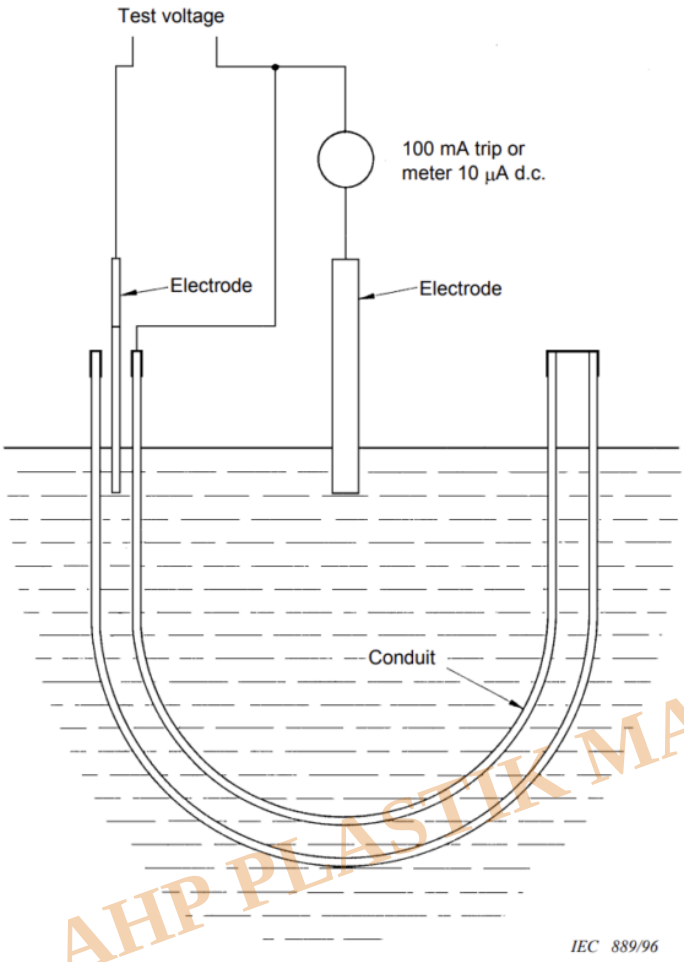
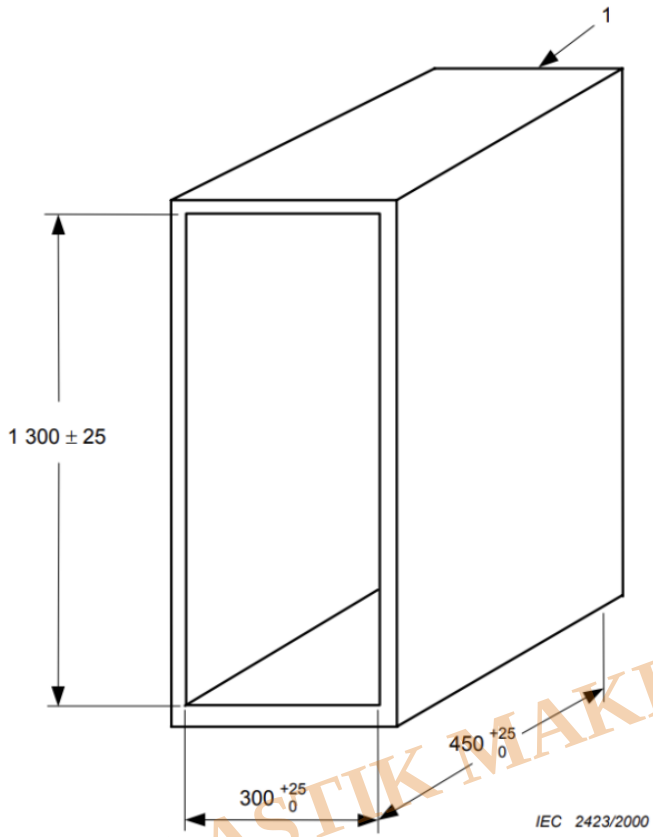


Figure 4 – Arrangement for insulation resistance and electric strength test – Rigid conduit



NOTE – Remove sharp edges and burrs.

Figure 5 – Arrangement for insulation resistance and electric strength test – Pliable and flexible conduit



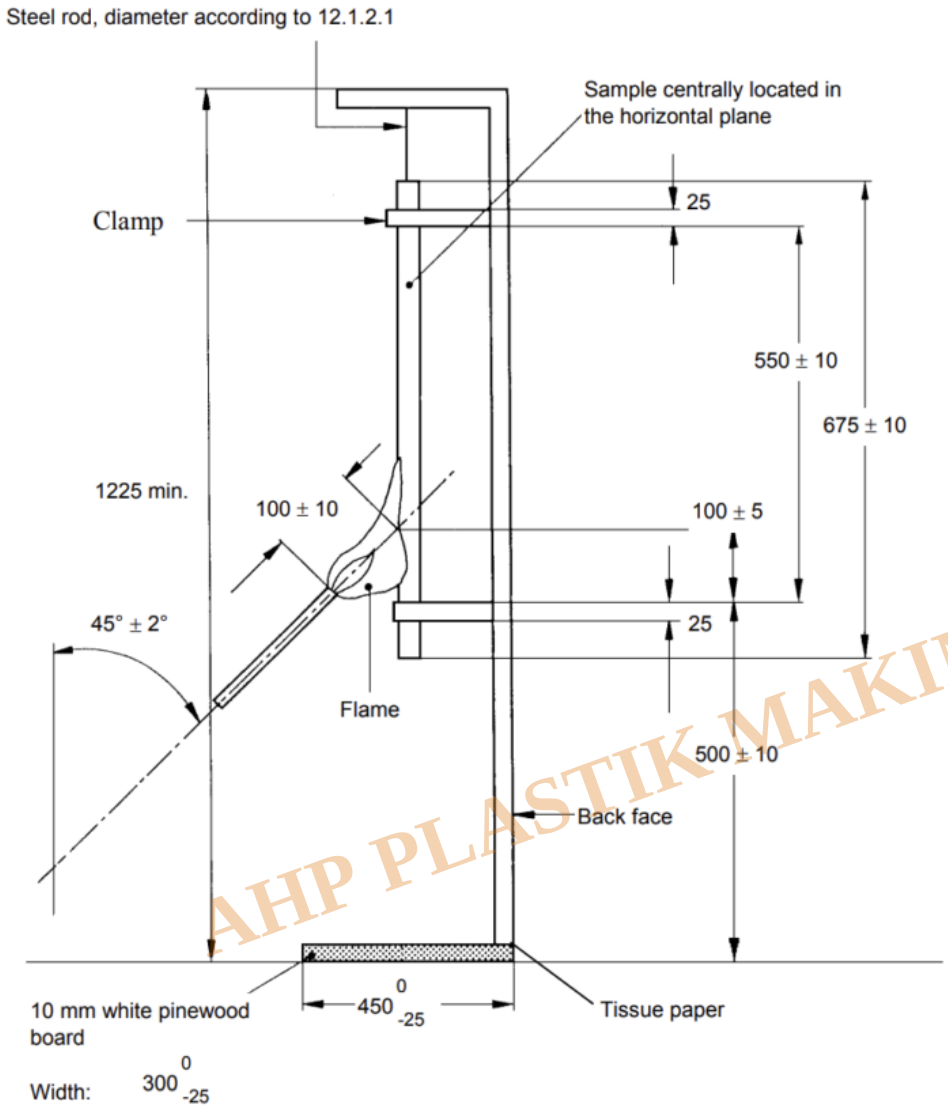
Key

1 Closed back surface

NOTE 1 Material: steel

NOTE 2 Dimensions given are internal and in millimetres

Figure 6 – Enclosure for flame propagation resistance test



Dimensions in millimetres

NOTE – This drawing is not intended to govern design except as regards the dimensions shown.

Figure 7 – Arrangement for flame-propagation resistance test

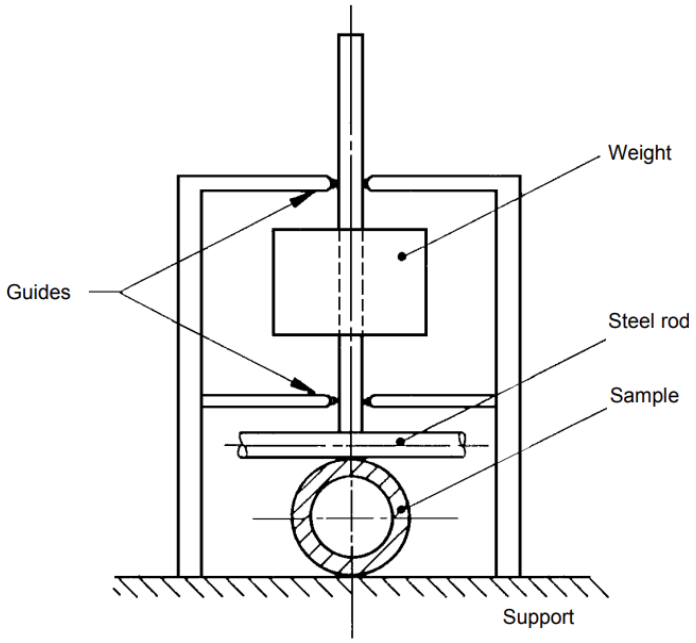


Figure 8 – Test apparatus for resistance to heat

Compression Test Fixture for Conduit Pipes According to BS EN 61386 – 1/10.2

- Can be mounted on a Tensile tester
- Compression block 50*50*50mm
- Corner radius 1mm
- Steel base plate is included

Impact Tester According to BS EN 61386 – 1/10.3

- Manual weight release
- Weights are 0.5, 1, 2, 6.8kg
- Fall heights are 100, 300mm
- Radius of head 300mm
- Chrome-coated shafts
- Diameter of head 20mm
- Easy adjustment of the height of impact

Bending Tester According to BS EN 61386 – 21

- Pneumatic bending tester
- Including rings for pipes of 16,20,25mm
- Easy change of rings
- Grooved rings for 3 pipe sizes

Electrical Insulating Strength and Resistance According to BS EN 61386 – 1/11.3

- Saltwater solution with a depth of 1100mm
- High voltage up to 2000V
- Over current control system as per norm
- Digital timer is included
- Electrical insulation of bath

Thermal Properties According to BS EN 61386 – 1/12

- Test cabin with PID controller and digital timer
- Sample setup assembly
- Masses of 0.5,1,2,4,8 kg

Fire Hazard (Flame Propagation) According to BS EN 61386 – 1/13

- Test cabin with sample assembly
- Automatic flame movement
- Automatic start of timer
- Angle adjustment of flame (45 degrees)
- Vertical sample assembly
- Steel rods of 2, 6, 16mm
- Automatic time control of flame application

Set of Gages for Checking Inside Diameter According to BS EN 61386 – 21

- For sizes 16, 20,25,32 mm

Category

1. Equipment for Standards
2. How to Use
3. Standards