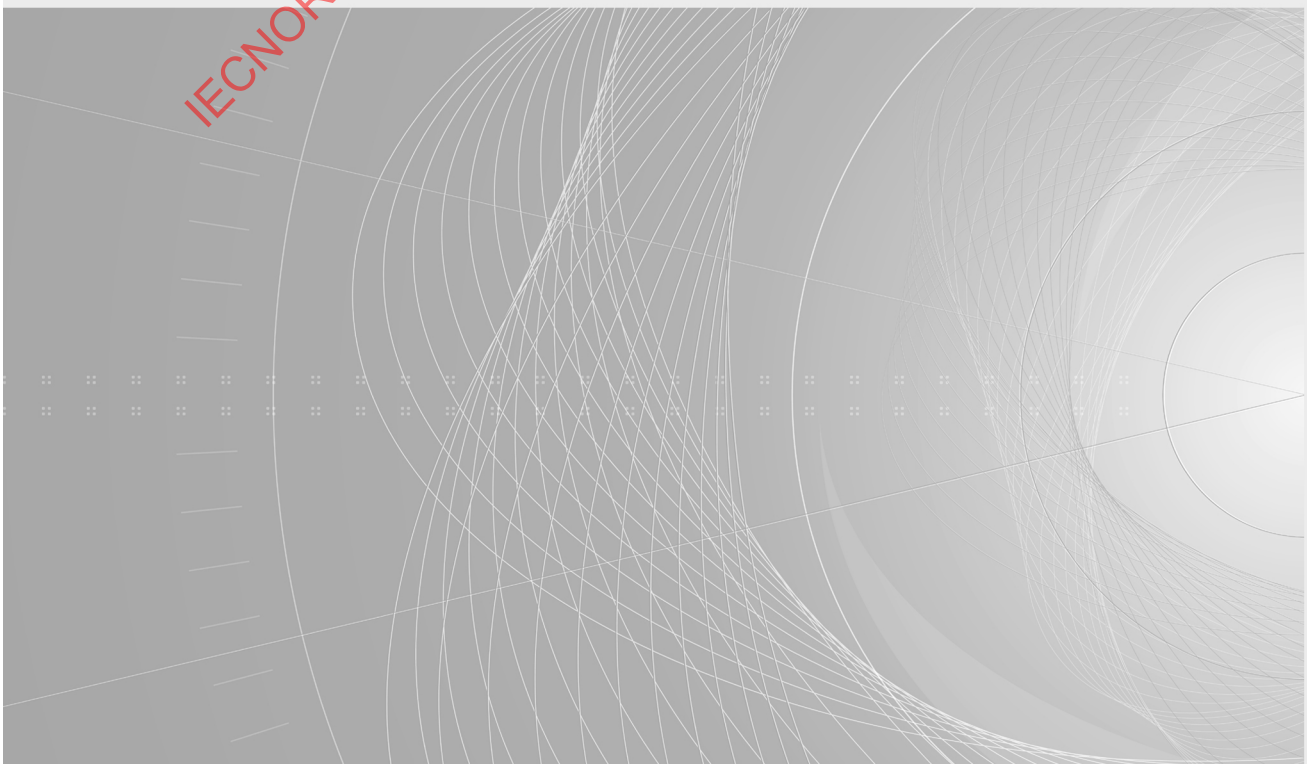
IEC 61950

Edition 3.0 2019-09

INTERNATIONAL STANDARD

Cable management systems – Specifications for extra-heavy-duty electrical steel conduit fittings and accessories



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CONTENTS

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CABLE MANAGEMENT SYSTEMS – SPECIFICATIONS FOR EXTRA-HEAVY-DUTY ELECTRICAL STEEL CONDUIT FITTINGS AND ACCESSORIES

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International Standard IEC 61950 has been prepared by subcommittee 23A: Cable management systems, of IEC technical committee 23: Electrical accessories.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– change in title and scope to cover only fittings and accessories for use with extra-heavy-duty electrical rigid steel (EHDERS) conduits;
– new and updated definitions of terms;
– addition of requirements for expansion, expansion-deflection and deflection fittings;
– deletion of requirements for cast metal boxes.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
23A/887/FDIS	23A/890/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

In this standard, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

CABLE MANAGEMENT SYSTEMS – SPECIFICATIONS FOR EXTRA-HEAVY-DUTY ELECTRICAL STEEL CONDUIT FITTINGS AND ACCESSORIES

1 Scope

This document specifies requirements for conduit fittings, including conduit bodies used with extra-heavy-duty electrical rigid steel (EHDERS) conduit conforming to IEC 60981.

This document does not include requirements for fittings intended for installation in potentially explosive atmospheres.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60981:2019, *Extra heavy-duty electrical rigid steel conduits*

ISO 68-2, *ISO general purpose screw threads – Basic profile – Part 2: Inch screw threads*

ISO 263, *ISO inch screw threads – General plan and selection for screws, bolts and nuts – Diameter range 0,06 to 6 in*

ISO 301, *Zinc alloy ingots intended for castings*

ISO 5864, *ISO inch screw threads – Allowances and tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
angle fitting
fitting with or without a cover (or cap) intended to change the direction of the conduit entering a box or an enclosure

3.2
box
enclosure without a cover but with means for mounting a cover, and provision for the entrance of conduit and cable fittings

3.3
box fitting
connector whose primary function is to join threadless or threaded metal conduit to knockout openings or threaded openings in a box or enclosure

3.4
bushing
discrete or integral fitting provided to protect conductors from abrasion and intended for use where they enter or leave the conduit system

3.4.1
insulating bushing
fitting consisting of a polymeric insulator provided to protect wires from abrasion and intended for use where conductors enter or leave the conduit

3.4.2
insulated bushing
bushing having a metallic collar with an insulated shoulder

3.4.3
insulating liner bushing
bushing used in the portion of a fitting where the conductors exit the conduit

3.4.4
bushing outlet
metallic or non-metallic collar with an insulating material cover having holes for the individual conductors

3.4.5
non-insulating bushing
bushing made of metallic material

3.5
capped elbow
elbow with a removable cover that provides access to interior of the conduit system during conductor pulling

3.6
compression-type fitting
style of fitting that is provided with a gland nut that, when wrench tightened, uniformly compresses a split ring that secures the fitting to the conduit

3.7
concrete-tight
so constructed that when embedded in freshly mixed concrete there is no ingress of concrete aggregate (Portland-type cement and sand) under specified test conditions

3.8
conduit body
means that provides access through (a) removable cover(s) to the interior of the system at a junction of two or more conduit sections or at a termination point

Note 1 to entry: Cast, sheet metal, non-metallic, and other boxes such as FS and FD or larger boxes and fittings such as capped elbows and service entrance elbows are not classified as conduit bodies.

3.9
connector
fitting intended to terminate conduit to a box or enclosure and capable of providing other functions such as sealing and earthing

3.10
coupling
fitting intended to join two lengths of EHDERS conduit

3.11
deflection fitting
fitting intended to compensate only for lateral or angular deflection in a span of conduit

3.12
elastomer
rubber or any thermosetting polymer having properties similar to those of rubber

3.13
elbow
conduit bend that changes the direction of the axis of a conduit system

3.14
enclosure
box with a cover, so constructed to provide a defined degree of protection for personnel against accidental contact with live parts, and also for the enclosed equipment against specified environmental conditions

3.15
expansion fitting
fitting that compensates only for linear expansion and contraction of a span of conduit

3.16
expansion-deflection fitting
fitting that compensates for linear expansion and contraction, and compensates for lateral or angular deflection in a span of conduit

3.17
EHDERS conduit
extra-heavy-duty rigid steel conduit
part of a closed wiring system of circular cross-section, made of steel of welded construction, capable of providing extra-heavy mechanical protection to conductors or cables and for use as an equipment earthing conductor when installed utilizing appropriate fittings

3.18
fitting
means for securing conduit to a box or enclosure, or conduit system

3.19
hub
fitting intended for use with threaded conduit for connection to an enclosure

3.20
junction box
box with a cover joining different runs of conduit and cable and providing space for the connection and branching of the conductors enclosed

Note 1 to entry: There are no openings in the cover.

3.21
knockout
portion of the wall of a box or enclosure that may be removed readily at the time of installation in order to provide an unthreaded opening for the attachment of conduit, or conduit and cable fittings

3.22
liquid-tight
intended for use in wet industrial environments which contain machine oils and coolants

3.23
fitting locknut
component provided with a fitting that attaches an externally threaded connector to an unthreaded opening in a box or enclosure and is capable of providing electrical continuity

3.24
conduit locknut
internally threaded fitting for use on threaded conduit intended to inhibit turning and to provide a secure joint, and is capable of providing electrical continuity

3.25
nipple
externally threaded fitting that serves as a short conduit between closely spaced enclosures

3.26
offset fitting
connector or coupling that offsets the axis of a conduit

3.27
outlet box
box that provides access to a wiring system and has provision for the entrance of conduit, or conduit and cable fittings and means for the mounting of a cover

3.28
pull box
box with a cover that is installed in one or more runs of conduit to facilitate pulling the conductors through the conduit system

3.29
pull fitting
fitting that permits conductors to be pulled at locations other than a box

3.30
wet location type fitting
fitting so constructed or protected as to exclude beating rain under specified test conditions

3.31
reducing coupling
fitting intended to join lengths of two different sizes of conduit

3.32
service-entrance head
enclosed fitting intended for use at service entrances where a service drop is connected to a service-entrance conduit

3.33
threadless fitting
fitting intended for use with unthreaded rigid conduit

3.34
type test
test made on a specimen for the conformity of the design of a given product to the requirements of the relevant standard

4 General requirements

4.1 Tests

Tests according to this document shall be type tests.

4.2 Metallic materials

4.2.1 General

4.2.1.1 The wall thickness of fittings shall conform to the values given in Table 1 when measured at least 3,2 mm from the edge of the fitting. If a taper is provided to permit easy withdrawal of the part from the die, the thickness shall be not less than that required at the base of threads when measured 0,8 mm from the edge of the fitting.

Compliance is checked by measurement.

Table 1 – Wall thickness of fittings

Material of fitting	Wall thickness Unthreaded parts	Minimum thickness at base of thread
	mm	mm
Sheet steel or machine steel	0,63	0,63 [a] 0,50 [b]
Sheet aluminium	0,78	0,78
Die-cast aluminium, die-cast zinc, or malleable iron	1,57	0,78
Sand-cast aluminium, sand-cast steel, sand-cast bronze or cast iron	3,17	2,36 [c] 1,57 [d]
NOTE The letter "H" in footnotes [c] and [d] denotes designations for EHDERS conduit.		
[a] At the base of cut threads. [b] At the base of rolled threads. [c] At the base of threads in fittings of the 27H conduit designation and larger sizes. [d] At the base of threads in fittings of the 21H conduit designation and smaller sizes.		

4.2.1.2 The minimum thickness is specified in 4.2.1.1 and does not apply to gland rings of compression-type fittings.

4.2.1.3 Zinc die-casting material shall conform to the requirements of ISO 301 for alloy $ZnAl_4Cu_2$.

4.2.2 Corrosion protection

Ferrous metal fittings shall have zinc plating of adequate thickness or have an alternate corrosion protection coating according to IEC 60981:2019.

Compliance of the zinc plating is checked by measurement according to 9.10 and Table 2.

This requirement does not apply to the following:

a) a fitting of stainless steel need not be so protected;

b) cut edges, including punched or threaded holes, need not be so protected.

NOTE 1 Most non-ferrous materials such as copper, zinc, aluminium, and their alloys are generally suitable for indoor and outdoor applications without the need for a protective coating.

NOTE 2 For applications involving severe or unusual corrosive environments, additional corrosion protection or materials having special characteristics can be required as determined by investigation.

Table 2 – Thickness of zinc coating

Type of fitting and material	Thickness of coating	
	Average[a] mm	Minimum mm
A fitting part, locknut or clamp intended for assembly inside a box	0,003 8	0,002 5
Outside of a sheet-steel or a machined-steel coupling, connector, bushing, or conduit locknut	0,012 7	0,010 2
Inside of a sheet-steel or machined-steel fitting	-	[b]
Malleable iron or cast-iron fittings	-	[b]
Screws	-	[b]

[a] The average thickness shall be determined by averaging at least three measurements. Each measurement shall be taken on a different surface, when possible. When it is required to take multiple measurements on a single surface, they shall be spaced equally over that surface.

[b] The minimum thickness of the coating on these fittings and components is not specified. Evidence of corrosion protection provided shall be verified by visual inspection.

4.3 Non-metallic materials

4.3.1 Flammability

Non-metallic material of a fitting shall resist the propagation of flame, where:

a) material plaques shall not flame for more than 30 s after any of the first four applications, or for more than 1 min after the fifth application of the test flame;

b) the finished product material shall not:

   1) openly flame for more than 1 min after the final application of the test flame, or

   2) be consumed;

c) there shall not be an opening in the material such that a 6,4 mm diameter rod passes freely through without force after the material has returned to ambient temperature;

d) there shall not be a visible flame on the surface of the plaque or the sample opposite the surface to which the test flame has been applied;

e) there shall not be glowing or burning particles during the test.

With reference to 4.3.1 b) 2), a polymeric throat or throat liner located in a metal fitting of the 16H or 21H designation that is consumed during the test complies with the requirement.

Compliance is checked by the test in 9.4.

4.3.2 Materials for bushings and insulating liners

Materials for bushings and insulating liners shall be resistant to flame and heat. Bushings shall comply with 4.3.1 b), d), and e).

Compliance is checked by the tests in 9.7.1.

The inside diameter of the throat of a bushing or an insulating bushing shall not be reduced to a dimension less than 90 % of the minimum value specified in Table 3.

Compliance is checked by the test in 9.7.2.

Table 3 – Thickness and diameters of bushings

Metric designator	Maximum diameter of bushing	Throat diameter of bushing	
		Minimum	Maximum
	mm	mm	mm
12H	24,64	11,28	12,52
16H	28,96	14,22	15,80
21H	36,07	18,85	20,93
27H	44,96	23,98	26,64
35H	57,94	31,55	35,05
41H	65,99	36,80	40,89
53H	80,65	47,24	52,50
63H	90,47	56,44	62,71
78H	107,95	70,13	77,92
91H	122,00	81,10	90,12
103H	137,21	92,02	102,26
129H	169,52	115,37	128,19
155H	201,52	138,63	154,05

The bushing shall not show evidence of cracking or softening so as to expose metal or form an incomplete insulating throat.

Compliance is checked by the test in 9.7.3.

A throat or throat liner shall not be dislodged by impact.

Compliance is checked by the test in 9.7.4.

4.3.3 Elastomeric materials

Rubber or other elastomeric materials shall not crack or show a change in hardness of more than ten numbers.

Compliance is checked by the test in 9.8.

4.3.4 Gasket materials

4.3.4.1 Elastomeric materials for gaskets shall comply with 4.3.3.

4.3.4.2 Expanded closed cell material for gaskets, intended for installation between a fitting and its cover, or between a fitting and an enclosure shall maintain its thickness and provide adequate electrical resistance.

Compliance is checked by the tests in 9.14.

4.4 Construction

4.4.1 Threads for fittings and conduit bodies

Cut threads on conduit fittings and conduit bodies shall conform to 6.4 as applicable, except for products that are manufactured and furnished as a complete assembly or that do not require thread interchangeability with conduit or conduit fittings.

4.4.2 Offset and angle fittings

4.4.2.1 Offset fittings

An offset fitting shall have a removable cap or cover to facilitate the installation of wire if the offset is greater than 25 mm or if the axis of the offsetting section is at any angle greater than 35° from the axis of the conduit.

Determination of the applicability of this requirement to a given offset fitting is checked by measurement.

Compliance is checked by inspection.

4.4.2.2 Angle fittings

An angle fitting having a radius of bend less than that specified in Table 4 shall have a removable cap or cover to facilitate the installation of wires.

Determination of the applicability of this requirement to a given angle fitting is checked by measurement.

Compliance is checked by inspection.

Angle fittings without removable covers other than connectors secured to the EHDERS conduit by means other than turning shall adequately facilitate the pulling of conductors. After pulling of the conductors, the conductor insulation:

a) shall not show visible damage; and

b) shall withstand for 5 min without breakdown the application of a 50 Hz to 60 Hz sinusoidal potential of 2 500 V RMS, when applying the potential between the conductor and:

   1) aluminium foil that is wrapped around, and in contact with, the insulation; or

   2) a volume of water containing the conductor, fitting, and conduit section.

Compliance with 4.4.2.2 a) is checked by the test in 9.9.

Table 4 – Radius of bend of angle fittings

Conduit designation	Minimum radius in centre of fitting mm
12H	Not used
16H	100
21H	115
27H	150
35H	180
41H	215
53H	240

Conduit designation	Minimum radius in centre of fitting mm
63H	270
78H	330
91H	380
103H	400
129H	600
155H	760

4.4.2.3 Cross-sectional area

Fittings (for example, angle fittings, offset fittings) that change the direction of a conduit shall have an internal cross-sectional area at all points not less than the values indicated in Table 5.

Compliance is checked by measurement.

Table 5 – Inside throat diameters of fittings and bushings

Conduit designation	Inside throat diameter		Minimum cross-sectional area of angle fittings
	Minimum mm	Maximum mm	mm^2
12H	11,28	12,52	80,1
16H	14,22	15,80	126,7
21H	18,85	20,93	222,1
27H	23,98	26,64	361,9
35H	31,55	35,05	623,5
41H	36,80	40,89	850,9
53H	47,24	52,50	1 399,8
63H	56,44	62,71	1 998,7
78H	70,13	77,92	3 078,8
91H	81,10	90,12	4 122,4
103H	92,02	102,26	5 318,1
129H	115,37	128,19	8 309,5
155H	138,63	154,05	12 315,1

4.5 Screws

Screws designated as No. 8 or No. 10 shall be used as specified in ISO 68-2, ISO 263 and ISO 5864.

4.6 Locknuts

4.6.1 Construction

4.6.1.1 Locknuts shall be provided with notches or other means for their tightening.

Compliance is checked by inspection.

4.6.1.2 Conduit locknuts shall have internal threads, or an equivalent means to assure assembly and functional requirements of the appropriate size conduit.

Compliance is checked by the tests in 9.11.

Conduit locknuts shall also conform to the requirements given in Figure 1.

Conduit locknuts made of steel or aluminium having a reduced thickness and all locknuts made of other metals, or locknuts having an incomplete or non-standard thread shall be capable of assembly without damage.

Compliance is checked by the tests in 9.11.

4.6.1.3 Fitting locknuts shall be provided as part of a fitting and shall have internal threads, or an equivalent means to assure assembly, and functional requirements of the appropriate size fitting as specified in 4.6.2. They shall also conform to the requirements given in Figure 2.

Compliance is checked by inspection.

4.6.2 Functional requirements for fitting locknuts

The locknut shall be turned down hand-tight to a steel plate to prevent the fitting from turning. The locknut shall be further tightened until it has rotated at least 90°. There shall be no breakage, cracking, jumping or stripping of threads, or loosening of the assembly.

Compliance is checked by inspection.

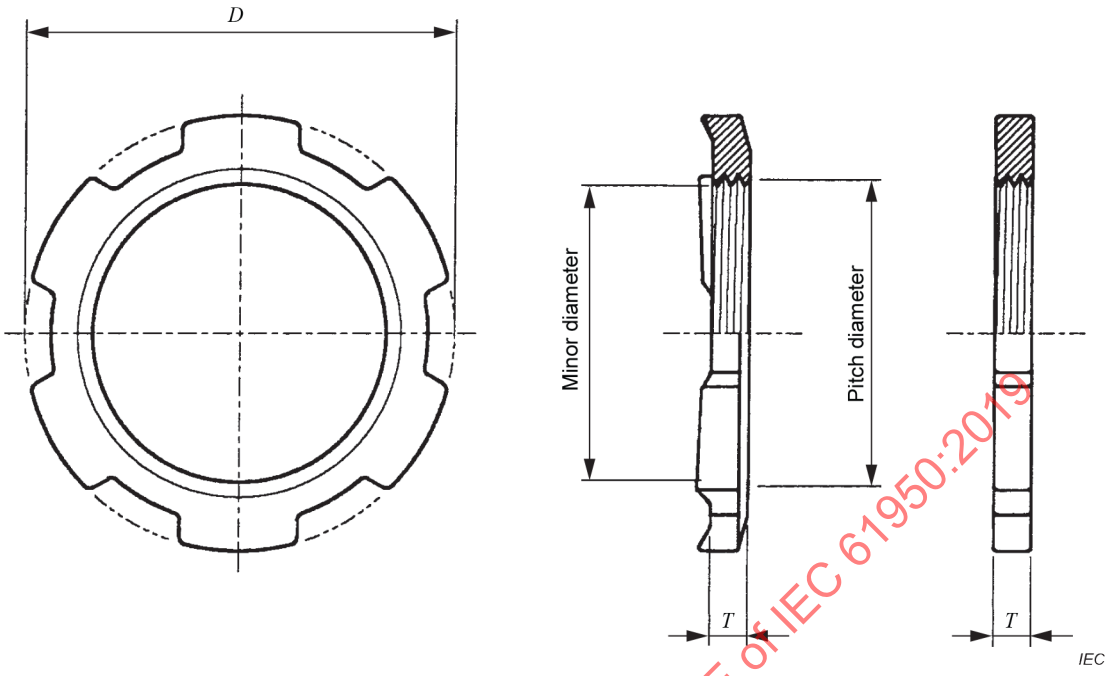
4.7 Classifications

4.7.1 Concrete-tight type

Fittings classified as concrete-tight shall allow no ingress of concrete aggregate; however, a small amount of cement dust is permitted.

Compliance is checked by the test in 9.2.

Type designation: conduit locknut

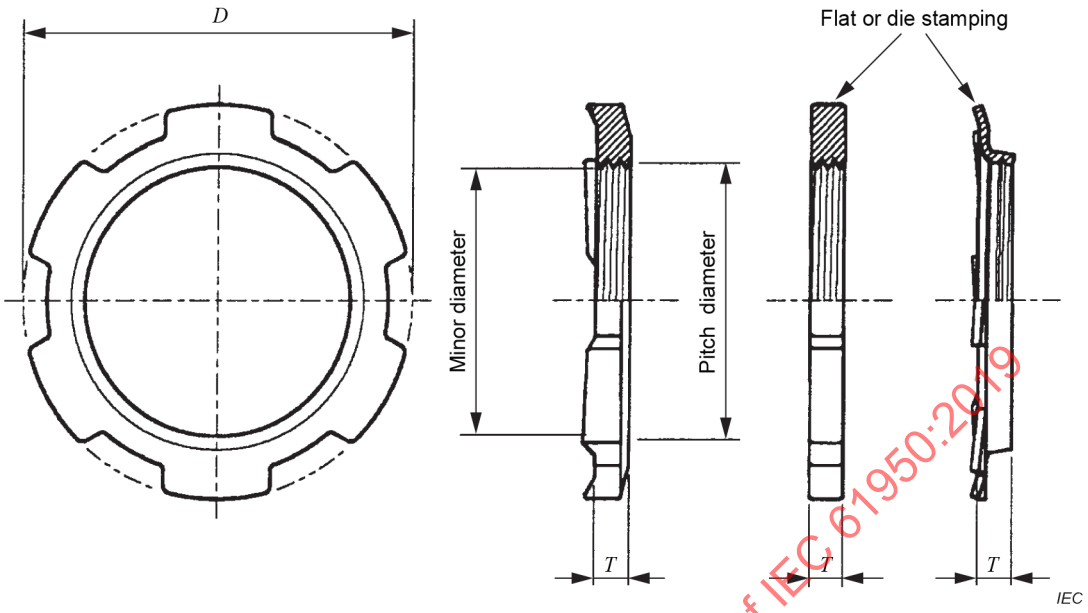


NOTE This drawing is not intended to govern design except as regards the dimensions shown.

Conduit designation	Pitch mm	Minimum pitch diameter mm	Maximum outside diameter *D* mm	Minimum thickness *T* mm
12H	1,411	16,33	24,6	3,2
16H	1,814	20,29	29,0	3,2
21H	1,814	25,63	36,1	3,5
27H	2,209	32,11	45,0	4,3
35H	2,209	40,87	57,9	4,3
41H	2,209	46,96	66,0	4,3
53H	2,209	59,00	80,6	4,7
63H	3,175	71,15	90,5	9,5
78H	3,175	87,05	108,0	9,5
91H	3,175	99,75	122,0	11,1
103H	3,175	112,42	137,2	11,1
129H	3,175	139,40	169,5	12,7
155H	3,175	166,24	201,5	14,3
All dimensions are after plating.				

Figure 1 – Basic dimensions for locknuts for EHDERS conduit

Type designation: fitting locknut



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

Conduit designation	Pitch mm	Pitch diameter minimum mm	Pitch diameter maximum mm	Outside diameter *D* mm	Minor diameter minimum mm	Minor diameter maximum mm
12H	1,411	16,08	16,26	24,64	15,54	15,80
16H	1,814	19,84	20,24	28,96	19,28	19,53
21H	1,814	25,20	25,58	36,07	24,61	24,87
27H	2,209	31,78	32,05	44,96	30,81	31,06
35H	2,209	40,54	40,82	57,94	39,57	39,83
41H	2,209	46,61	46,89	65,99	45,72	45,97
53H	2,209	58,65	58,93	80,65	57,76	58,01
63H	2,209	70,69	71,09	90,47	69,85	70,15
78H	3,175	86,56	87,00	107,95	85,73	86,03
91H	3,175	99,26	99,70	122,00	98,43	98,73
103H	3,175	111,91	112,40	137,21	111,13	111,43
129H	3,175	138,89	139,32	169,52	138,02	138,33
155H	3,175	165,74	166,17	201,52	164,87	165,18
All dimensions are after plating.						

Figure 2 – Basic dimensions for electrical fitting locknuts

4.7.2 Wet-location type

Fittings classified as wet-location type shall allow no more than 0,1 ml of water to enter an enclosure.

Compliance is checked by the test in 9.3.

Wet-location type fittings shall also be considered to be concrete-tight type, but not necessarily liquid-tight type.

4.7.3 Expansion, expansion-deflection, deflection fitting

Fittings classified as expansion, expansion-deflection, or deflection fitting type shall conform to the tests in 9.13, as appropriate.

5 Fittings for EHDERS systems

5.1 Types

In addition to compliance with the general requirements in Clause 4, specific types of fittings shall conform to the requirements for the following, when applicable:

a) fittings for:
   1) threaded extra-heavy-duty electrical rigid steel (EHDERS) conduit (see 5.2);
   2) unthreaded extra-heavy-duty electrical rigid steel (EHDERS) conduit (see 5.3);
b) threaded reducers (see 5.2.4);
c) bushings (see 5.4);
d) service-entrance heads (see 5.5);
e) nipples (see 5.6).

5.2 Fittings for threaded EHDERS conduit

5.2.1 End stop

A fitting, other than a coupling and locknut, which is internally threaded for attachment to an EHDERS conduit shall be provided with a positive end stop for the conduit. The fitting shall also provide an integral bushing or an equivalent smoothly rounded surface to prevent abrasion of insulation on the conductors entering the fitting from the conduit. The throat diameter at the end stop shall be in accordance with Table 5.

Compliance is checked by visual inspection and by measurement.

5.2.2 Torque test

5.2.2.1 When assembled to a threaded EHDERS conduit, an internally threaded metallic fitting other than a locknut and hub shall withstand the tightening torques listed in Table 6 without stripping of threads and without damage to the fitting.

Compliance is checked by visual inspection.

5.2.2.2 A fitting for threaded EHDERS conduit that is not internally threaded shall be exempted from the torque test. This fitting, however, shall conform to the requirements given in 5.3.

Table 6 – Tightening torque, bending load, and pull-out force for threaded and threadless fittings

Conduit designations	Tightening torque Nm	Bending load kg	Pull-out force N
12H	22,6	13,3	890
16H	33,9	26,7	1 334
21H	56,5	35,6	2 002
27H	79,1	53,4	2 668
35H	113,0	71,2	3 114
41H	136,0	71,2	3 559
53H	181,0	71,2	4 450
63H	181,0	71,2	4 450
78H	181,0	71,2	4 450
91H	181,0	71,2	4 450
103H	181,0	71,2	4 450
129H	181,0	71,2	4 450
155H	181,0	71,2	4 450

5.2.3 Earth fault

A fitting for threaded EHDERS conduit shall be capable of carrying a specified earth fault current for the time periods indicated in Table 7. The fitting shall not crack or break, and there shall be continuity between the enclosure, fitting, and EHDERS conduit following the test. A throat insulator is in compliance where the given insulator arcs and burns as a result of the test.

Compliance is checked by the test in 9.6.

Table 7 – Test currents and times

Conduit designation	Test time s	Current ampere A	Minimum size of copper leads used to connect specimen assembly to current source mm^2
12H	4	470	3,3
16H	4	1 180	8,4
21H	6	1 530	13,3
27H	6	1 530	13,3
35H	6	2 450	21,2
41H	6	2 450	21,2
53H	6	3 900	33,6
63H	6	4 900	42,4
78H	9	5 050	53,5
91H	9	5 050	53,5
103H	9	5 050	53,5
129H	9	8 030	85,0
155H	9	8 030	85,0

5.2.4 Threaded reducers

5.2.4.1 Threaded reducers shall be capable of adapting an entry to a smaller size of conduit, and shall be internally threaded for attachment to an EHDERS conduit.

5.2.4.2 The threaded conduit entry containing a threaded reducer shall either conform to 6.4 or shall have a tapered internal thread or other suitable end stop for the conduit. If an end stop is provided, it shall have a smoothly rounded surface at the point where abrasion of the insulation of conductors is likely to occur. The throat diameter of the end stop shall be in accordance with Table 5.

Compliance is checked by visual inspection and by measurement.

5.3 Fittings for unthreaded EHDERS conduit

5.3.1 Electrical continuity and mechanical strength

5.3.1.1 Test sequence

A fitting for unthreaded EHDERS conduit shall be subjected to an electrical continuity test (see 5.3.1.4), a bend test (see 5.3.1.5), an electrical continuity test (repeated) (see 5.3.1.6), and a pull-out test (see 5.3.1.7), in that order.

5.3.1.2 Test specimens

The same specimens shall be used throughout and shall not be conditioned in any way during the test sequence. No fewer than six specimens shall be tested except that, if a line of fittings for a range of designators is being investigated, no fewer than three specimens of each designation shall be tested.

5.3.1.3 Specimen assembly

The specimen of the threadless fitting shall be assembled to short lengths of conduit of the proper size. The conduit shall be pushed against the end or centre stop of the fitting before the latter is tightened. Except where stated otherwise, the tightening torque to be applied to the gland nut shall be that given in Table 6 for threadless fittings. A fitting screw shall be tightened to the torque specified in 9.1.6.3.

A threadless fitting provided with a tightening nut shall have the tightening torque applied by means of an open box or crescent wrench. A nut not provided with flats suitable for use with such wrenches shall be tightened by means of a pipe wrench.

5.3.1.4 Electrical continuity test

The voltage drop shall not exceed 10 mV.

Compliance is checked by the test in 9.5.

5.3.1.5 Bend test

When tested as follows, the fitting shall not become separated from the conduit.

a) Place the assembly, with the fitting at the centre, on supports at a distance, d, as indicated in Figure 3 and in 5.3.1.5 b) and c).

b) For couplings, d shall be 760 mm;

c) For other fittings, d shall be 760 mm plus the distance between the ends of the conduit in the box or fitting.

Suspend the appropriate load given in Table 6 from the centre of the fitting for 60 s and during that time rotate the fitting assembly through a complete revolution about its major axis.

Compliance is checked by visual inspection.

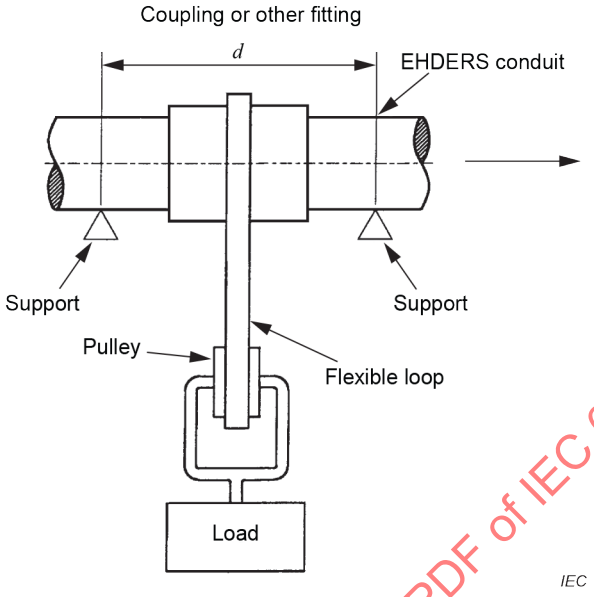


Figure 3 – Bending test for threadless fittings

5.3.1.6 Electrical continuity test (repeated)

The voltage drop across the fitting shall be not more than 15 mV.

Compliance is checked by the test in 9.5.

5.3.1.7 Pull-out test

When subjected to the appropriate pull-out force given in Table 6, the fitting shall withstand the force for 60 s without damage and without pulling loose from the EHDERS conduit.

Compliance is checked by visual inspection.

5.3.2 Earth fault

A fitting for unthreaded EHDERS conduit shall be capable of carrying a specified earth fault current for the time indicated in Table 7. The fitting shall not crack or break, and there shall be continuity between the enclosure, fitting, and EHDERS conduit following the test. A throat insulator is in compliance where the given insulator arcs and burns as a result of the test.

Compliance is checked by the test in 9.6.

5.3.3 Construction

5.3.3.1 End stop

A fitting other than a coupling for use with EHDERS conduit shall have a smooth, well-rounded end stop with a throat diameter within the limits specified in Table 5.

Compliance is checked by measurement.

5.3.3.2 Centre stop

A coupling for use with unthreaded EHDERS conduit shall have a centre stop with an effective diameter no less than the minimum throat diameter specified in Table 5 for the smallest designation of EHDERS conduit intended to be accommodated.

Compliance is checked by measurement.

5.4 Bushings

5.4.1 General

Bushings shall be one of the types defined in 3.4.

Bushings and liners (except outlet bushings) for EHDERS conduit shall have a smooth, well-rounded surface at the throat. The throat diameter shall be within the limits specified in Table 5. A threaded bushing shall be provided with ribs or the equivalent to permit easy tightening.

Compliance is checked by inspection.

5.4.2 Thermoplastic or thermosetting materials

A bushing or throat of a bushing made of a thermoplastic or thermosetting insulating material shall be resistant to flame and heat.

Compliance is checked according to the tests in 9.7.

5.5 Service-entrance heads

5.5.1 End stops for service-entrance heads

A service-entrance head shall have an integral end stop for EHDERS conduit to provide a smooth well-rounded opening. Except for use on oversize EHDERS conduits, the opening shall have an internal diameter equivalent to that provided by the throat of a conduit bushing as specified in Table 5. No minimum internal diameter of the end stop is specified for a service-entrance head for use on oversize EHDERS conduits. Except for the conduit entrance portion, the remainder of the entrance head shall correspond to the smaller size EHDERS conduit.

Compliance is checked by measurement.

5.5.2 Assembly

A service-entrance head shall be installed on the EHDERS conduit to determine that the end stop will be effective as a bushing for the conductors. The edge of the stop shall extend at least to the inside edge of the EHDERS conduit around the entire circumference.

Compliance shall be checked by visual inspection.

5.5.3 Openings

A service-entrance head shall have not more than three open holes of which not more than one shall be uninsulated.

Compliance shall be checked by visual inspection.

5.5.4 Continuity test

The maximum voltage drop of a metallic service-entrance head assembled in accordance with 5.3.1.3 shall not exceed 10 mV.

Compliance is checked according to the test in 9.5.

5.5.5 Wet-location test

A service-entrance head for use on EHDERS conduit shall allow no more than 0,1 ml of water to enter the conduit.

Compliance is checked by the test in 9.3.

5.6 Nipples

A nipple shall have a tightening means that has a maximum diameter not exceeding that of a locknut as specified in Figure 2.

Compliance is checked by measurement.

6 Cast metal conduit bodies and covers

6.1 General

6.1.1 Applicability

The requirements specified in this Clause 6 shall apply to all cast metal conduit bodies, and covers. They shall be supplemented or modified by requirements for specific types given in Clause 7.

6.1.2 Openings

Conduit bodies with covers, when assembled, shall have no openings.

Compliance is checked by visual inspection.

6.2 Materials

6.2.1 Wall thickness

Cast metal conduit bodies and covers shall have a wall thickness not less than 3,2 mm. The wall thickness of a malleable-iron or a die-cast or permanent-mould-cast aluminium, brass, or bronze conduit body and cover shall not be less than 2,4 mm.

Compliance is checked by measurement.

6.2.2 Coatings on metallic surfaces

Coatings on metallic surfaces shall conform to 4.2.2.

6.3 Integral bushings

The integral bushing shall have a smooth, well-rounded surface with an inside throat diameter conforming to Table 5.

Compliance is checked by measurement and visual inspection.

6.4 Threads

Threads shall comply with Figure 4 or Figure 5. An internal recess that is equivalent to two full threads shall be allowed between the integral bushing and the threaded portion of the entry.

Compliance is checked by measurement and visual inspection.

6.5 Threadless connections

An entry into a conduit body intended for connection to threadless EDHERS shall comply with 5.3.

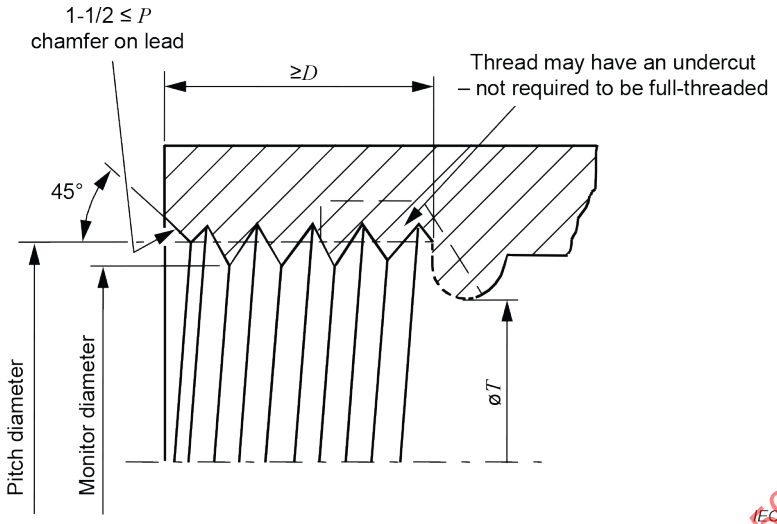
6.6 External thread construction

Other thread constructions shall conform to Figure 4, Figure 5, Figure 6, or to IEC 60981, as applicable.

6.7 Wet-location type

Conduit bodies classified as wet-location type shall allow no more than 0,1 ml of water to enter the enclosure.

Compliance is checked by the test in 9.3.



Conduit designation	Pitch of thread *P* mm	Minor diameter mm		Pitch diameter mm		Throat diameter *T* mm		Minimum depth *D* [a] short [b] mm	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Bushing NSC	Fitting NSC
12H	1,411	15,37	15,60	15,98	16,13	11,28	12,52	4,94	10,36
16H	1,814	19,05	19,35	19,84	20,02	14,22	15,80	6,35	13,56
21H	1,814	24,41	24,71	25,20	25,37	18,85	20,93	6,35	13,86
27H	2,209	30,63	30,89	31,60	31,80	23,98	26,64	8,83	17,34
35H	2,209	39,40	39,62	40,34	40,54	31,55	35,05	8,83	17,95
41H	2,209	45,47	45,69	46,41	46,61	36,80	40,89	8,83	18,38
53H	2,209	57,51	57,73	58,45	58,65	47,24	52,50	8,83	19,22
63H	3,175	68,96	69,44	70,33	70,64	56,44	62,71	12,70	28,89
78H	3,175	84,86	85,34	86,26	86,56	70,13	77,93	12,70	30,48
91H	3,175	97,59	97,92	98,96	99,26	81,10	90,12	12,70	31,75
103H	3,175	110,24	110,57	111,61	111,91	92,02	102,26	12,70	33,02
129H	3,175	137,21	137,54	138,58	138,89	115,37	128,19	12,70	35,72
155H	3,175	164,06	164,36	165,43	165,74	138,63	154,05	12,70	38,42

All dimensions are after plating.

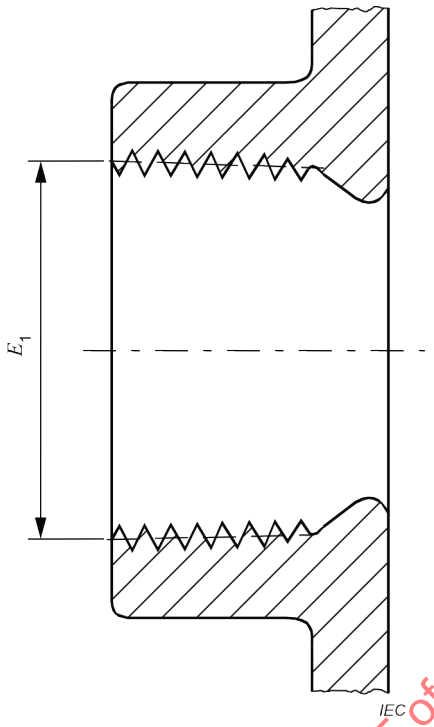
These threads are applicable to those fittings for use with conduit, other conduit fittings, or apparatus. Those products that are manufactured and furnished as a complete fitting and/or do not require thread interchangeability with conduit or other conduit fittings or locknuts need not conform.

NOTE In lieu of chamfer, a countersink or recess can be used. The chamfer illustrated is at a 45° angle. This detail is not a requirement and is given for information only.

[a] Minimum depth that a plug gauge with minimum pitch diameter shall enter.

[b] Minimum length for short threaded bushings or hubs.

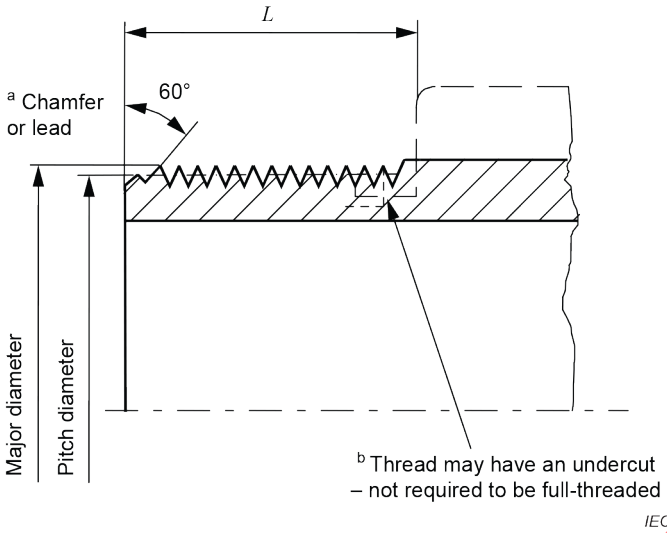
Figure 4 – Basic dimensions of internal straight pipe threads for conduit fittings having short threads on bushings or hubs for use with EHDERS conduit or electrical equipment having tapered or straight threads



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

Conduit designation	Pitch mm	E_1[a] mm	E_1[a] min. mm	E_1[a] max. mm
16H	1,814	19,772	19,630	20,169
21H	1,814	25,117	24,976	25,514
27H	2,209	31,461	31,289	31,944
35H	2,209	40,218	40,045	40,701
41H	2,209	46,287	46,115	46,771
53H	2,209	58,325	58,153	58,808
63H	3,175	70,159	69,911	70,853
78H	3,175	86,068	85,820	86,762
91H	3,175	98,776	98,528	99,470
103H	3,175	111,433	111,185	112,127
129H	3,175	138,412	138,164	139,106
155H	3,175	165,252	165,004	165,946
[a] E_1 equals the pitch diameter of the first full thread.				

Figure 5 – Pitch diameter dimensions of tapered thread conduit entries



[a] The diameter illustrated is at a 60° angle. This detail is not a requirement and is given for information only.

[b] An undercut should allow a locknut to be properly tightened with minimum cabinet thickness.

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

Conduit designation	Pitch of thread *P* mm	Major diameter mm		Pitch diameter mm		Minimum length *L* mm
		Minimum	Maximum	Minimum	Maximum	
12H	1,4111	16,56	16,61	15,75	15,88	5,82
16H	1,814	20,62	20,90	19,56	19,71	8,20
21H	1,814	25,62	26,26	24,92	25,07	8,59
27H	2,209	32,46	32,84	31,19	31,39	9,93
35H	2,209	41,25	41,61	39,95	40,16	9,93
41H	2,209	47,32	47,68	46,02	46,23	9,93
53H	2,209	59,36	59,72	58,06	58,27	10,36
63H	3,175	71,68	72,16	69,80	70,10	16,61
78H	3,175	87,60	88,06	85,73	86,00	16,61
91H	3,175	100,33	100,79	98,43	98,70	18,21
103H	3,175	112,95	113,44	111,07	111,35	18,21
129H	3,175	139,93	140,41	138,05	138,33	17,79
155H	3,175	166,80	167,26	164,90	165,18	21,36
All dimensions are after plating. These threads are applicable to those fittings for use with conduit, other conduit fittings, or apparatus. Those products that are manufactured and furnished as a complete fitting and/or do not require thread interchangeability with conduit or other conduit fittings or locknuts need not conform.						

Figure 6 – Basic dimensions of external straight pipe threads for conduit fittings for use with EHDERS coupling or electrical equipment having tapered or straight internal threads

7 Conduit bodies and covers

7.1 Cross-sectional area

A conduit body shall have a cross-sectional area not less than that specified in Table 8, based on the largest size EHDERS conduit that is intended to be connected to it. A conduit body shall have a minimum internal distance to cover as specified in Table 9, based on maximum wire size.

Compliance is checked by measurement.

Table 8 – Minimum cross-sectional area of conduit bodies

Metric designator	Cross-section cm^2	Metric designator	Cross-section cm^2
16H	3,9	78H	95,4
21H	6,9	91H	128
27H	11,1	103H	164
35H	19,3	129H	258
53H	43,3	155H	373
63H	61,8	-	-

Table 9 – Space inside a conduit body

Maximum wire size mm^2	Minimum distance to cover mm
2 to 7	Not specified
8 to 17	38,1
18 to 30	50,8
31 to 40	63,5
41 to 50	76,2
51 to 80	88,9
81 to 120	102
121 to 140	114
141 to 190	127
191 to 280	152
281 to 370	203
371 to 480	203
481 to 680	254
681 to 1 020	305

7.2 Connection to conduit

A conduit body having provision for the connection of conduit 27H and larger designator shall:

a) have a removable blank cover;

b) comply with 7.3 and 7.4.

This requirement does not apply to a conduit body marked for use with 14 mm^2 and smaller conductors only.

This requirement does not apply to a conduit body intended for a maximum three-conductor installation having dimensions smaller than specified in Figure 7, dimensions *A* or *B*, but equal to, or larger than, the dimensions given in Table 10.

Compliance is checked by inspection and by measurement.

Table 10 – Minimum distance between conduit body hubs for three-conductor installation with no investigation

Minimum distance mm										
Wire size mm²		**Hub size**								**Minimum distance**
		27H	**35H**	**41H**	**53H**	**63H**	**78H**	**91H**	**103H**	
16	a	114,30	114,30	114,30	114,30	114,30	114,30	114,30	114,30	114
	b	57,15	57,15	57,15	57,15	57,15	57,15	57,15	57,15	57
	c	101,60	101,60	101,60	101,60	101,60	101,60	101,60	101,60	102
25	a	-	126,49	126,49	126,49	126,49	126,49	126,49	126,49	126
	b	-	67,77	64,77	64,77	64,77	64,77	64,77	64,77	65
	c	-	107,95	107,95	107,95	107,95	107,95	107,95	107,95	108
25	a	-	138,18	138,18	138,18	138,18	138,18	138,18	138,18	138
	b	-	69,09	69,09	69,09	69,09	69,09	69,09	69,09	69
	c	-	114,30	114,30	114,30	114,30	114,30	114,30	114,30	114
35	a	-	-	147,83	147,83	147,83	147,83	147,83	147,83	148
	b	-	-	101,60	101,60	101,60	101,60	101,60	101,60	102
	c	-	-	121,92	121,92	121,92	121,92	121,92	121,92	122
50	a	-	-	153,92	153,92	153,92	153,92	153,92	153,92	154
	b	-	-	113,79	113,79	113,79	113,79	113,79	113,79	114
	c	-	-	127,00	127,00	127,00	127,00	127,00	127,00	127
50	a	-	-	-	191,26	191,26	191,26	191,26	191,26	191
	b	-	-	-	127,00	127,00	127,00	127,00	127,00	127
	c	-	-	-	149,35	149,35	149,35	149,35	149,35	149
70	a	-	-	-	234,95	234,95	234,95	234,95	234,95	235
	b	-	-	-	136,65	136,65	136,65	136,65	136,65	137
	c	-	-	-	174,50	174,50	174,50	174,50	174,50	175
95	a	-	-	-	245,87	245,87	245,87	245,87	245,87	246
	b	-	-	-	146,05	146,05	146,05	146,05	146,05	146
	c	-	-	-	203,20	203,20	203,20	203,20	203,20	203
120	a	-	-	-	-	259,08	259,08	259,08	259,08	259
	b	-	-	-	-	170,43	170,43	170,43	170,43	170
	c	-	-	-	-	213,36	213,36	213,36	213,36	213
150	a	-	-	-	-	321,06	321,06	321,06	321,06	321
	b	-	-	-	-	188,47	188,47	188,47	188,47	188
	c	-	-	-	-	221,49	221,49	221,49	221,49	221
150	a	-	-	-	-	-	377,10	377,10	377,10	378
	b	-	-	-	-	-	201,68	201,68	201,68	202
	c	-	-	-	-	-	277,08	277,08	277,08	227

Minimum distance mm										
Wire size		**Hub size**								**Minimum distance**
mm^2		**27H**	**35H**	**41H**	**53H**	**63H**	**78H**	**91H**	**103H**	
185	a	-	-	-	-	-	-	-	-	-
	b	-	-	-	-	-	-	-	-	-
	c	-	-	-	-	-	10,30	10,30	10,30	262
240	a	-	-	-	-	-	-	-	-	-
	b	-	-	-	-	-	-	-	-	-
	c	-	-	-	-	-	12,43	12,43	12,43	316
Where values are not specified, an investigation should be performed to determine the acceptability of the intended installation.										
a Applies to straight pull conduit body (see Figure 7 a)). b Applies to conduit body with hub on the side. c Applies to conduit body with hub on the back (see Figure 7 b)).										

7.3 Straight conduit bodies

A conduit body that does not change the direction of wiring passing through it shall have a dimension not less than the specified distance of the connected largest conduit in Figure 7 a). The length shall be measured inside the conduit body from the end stop of the conduit hub to an equivalent point on the conduit hub on the opposite wall. In a conduit body having a single conduit entry, the length is measured to the opposite wall.

Compliance is checked by measurement.

7.4 Angle conduit bodies

A conduit body constructed to enable a change in the direction of the axis of a conduit system (see Figure 7 b)) shall:

a) have a distance inside the body between the conduit entry and the entry hub on the opposite wall of the body not less than the distance B in Figure 7 b); and

b) have a radius of curve to the centreline of a conduit body not less than the radius to the centre of the tube as indicated for an elbow in Table 3 of IEC 60981:2019.

Compliance is checked by measurement.

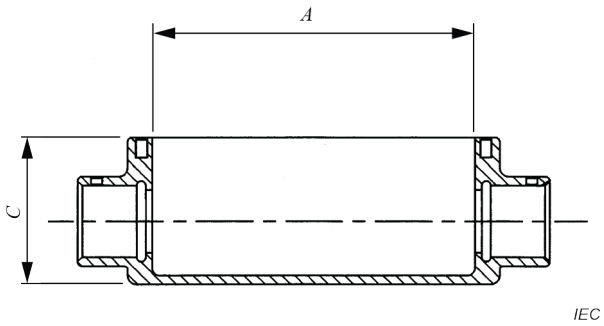


Figure 7 a) – Straight pull (side view)

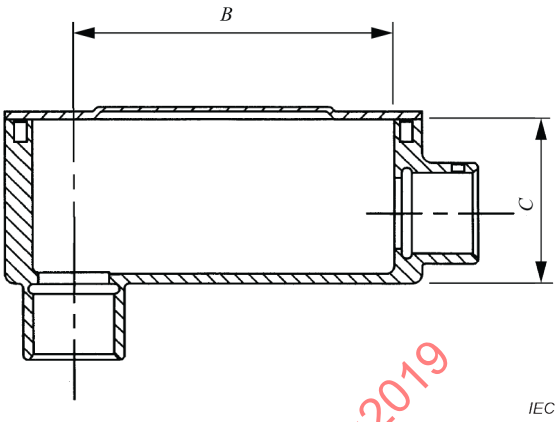


Figure 7 b) – Angled pull (side view)

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

Conduit designation	Trade size mm	*A* Minimum distance – opposite walls mm	*B* Minimum distance – conduit entry to opposite wall mm	*C* Minimum distance – wall to cover mm
21H	21,00	152,40	114,30	50,80
27H	27,00	203,20	152,40	63,50
35H	35,00	254,40	190,80	88,90
41H	41,00	304,80	228,60	101,60
53H	53,00	406,40	304,80	127,00
63H	63,00	508,00	381,00	152,40
78H	78,00	609,60	457,20	203,20
91H	91,00	711,20	533,40	203,20
103H	103,00	812,80	609,60	254,00
129H	129,00	1016,00	762,00	304,80
155H	155,00	1219,20	914,40	304,80

Figure 7 – Conduit body openings

7.5 Short conduit bodies

A short conduit body marked according to 8.3 and investigated for installation of a combination of conductors that are fewer than the specified maximum fill for the largest conduit size that the conduit body will accommodate, is in compliance with 7.3 and 7.4. See Figure 8.

Compliance is checked by measurement.

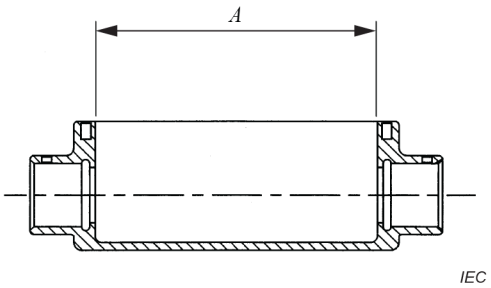


Figure 8 a) – Straight pull (side view)

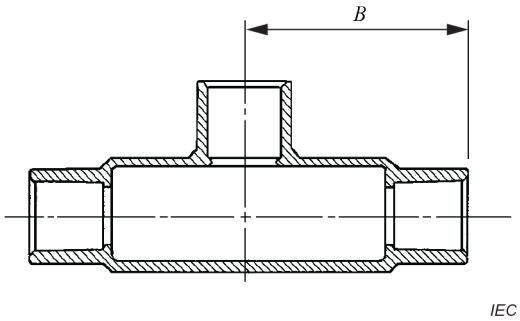


Figure 8 b) – T-Fitting (side view)

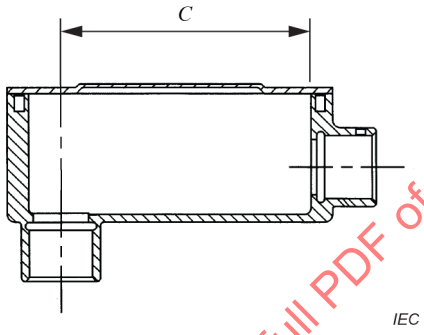


Figure 8 c) – Angle pull (side view)

Wire size maximum mm^2	Hub size minimum mm	Minimum distance mm		
		A	*B*	*C*
25	27H	114	57	102
30	35H	126	65	108
35	35H	138	69	114
45	41H	148	102	122
55	41H	154	114	127
70	53H	191	127	149
85	53H	235	137	175
110	53H	246	146	203
130	63H	259	170	213
155	63H	321	188	221
180	78H	378	202	227
205	78H	-	-	262
255	78H	-	-	316

Figure 8 – Short conduit bodies

8 Marking

8.1 All fittings

8.1.1 Permanence and legibility

All markings shall be legible. All product markings shall be permanent.

Compliance is checked by the test in 9.15.

The following types of markings or their equivalents are considered permanent and are not required to be tested:

a) etched;

b) moulded;

c) die stamped;

d) paint stencilled.

8.1.2 Manufacturer identification

A fitting shall be marked with the manufacturer's name, trademark or other descriptive marking identifying the organization responsible for the product. The fitting shall also be marked with a catalogue number or an equivalent designation. The marking shall be located where it is readily visible after the fitting has been installed. When the catalogue number or its equivalent designation is not able to be placed on the fitting, it shall be marked on the smallest unit shipping carton.

Compliance is checked by visual inspection.

NOTE The following information is generally also provided on the fitting, the smallest shipping container, or an instruction sheet:

a) permissive or restrictive usage to designate the intended use of the fitting;

b) instructions for fittings requiring special installation techniques.

8.1.3 Location of marking

Unless specifically required to be marked on the product according to this document, required markings shall be incorporated either on the product or on the smallest unit shipping carton.

Compliance is checked by visual inspection.

8.1.4 Specific conditions of installation

A fitting that has been found usable for specific conditions of installation shall be marked to indicate the condition of installation on the smallest unit carton.

Compliance is checked by visual inspection.

8.1.5 Specific instructions

Where specific fitting assembly techniques are required, instructions for proper assembly shall be provided with the fitting.

Compliance is checked by visual inspection.

8.2 Insulating bushings or parts

8.2.1 Colour coding

An insulating or insulated bushing, a fitting for use as a connector and having an insulating throat, and an insulating part for use as the throat of such a bushing or fitting shall be marked with its temperature rating so that the marking is visible after installation, except that:

a) a component rated 150 °C is permitted to be identified by a black or brown colour;

b) a component rated other than 150 °C shall not be black or brown in colour;

c) a component rated 90 °C shall not be black or brown in colour and shall not be required to be marked with its temperature rating.

Compliance is checked by visual inspection.

8.2.2 Temperature rating

8.2.2.1 Other than as specified in 8.2.2.2, the temperature rating of an insulating bushing or a bushing having an insulating throat shall be marked in accordance with Table 11, in a location that is visible after installation.

Table 11 – Temperature for conditioning polymeric materials

Temperature rating of device °C	Conditioning temperature[a] °C
90	112
105	128
150	173
200	225

[a] The conditioning temperature is the rated temperature of the polymeric material plus 15 °C plus 2 % of the rated temperature on the absolute scale.

Compliance is checked by visual inspection.

8.2.2.2 An insulating bushing and a bushing having an insulating throat rated at 90 °C is not required to be marked with a temperature rating.

Compliance is checked by visual inspection.

8.2.3 Unthreaded bushings

An unthreaded bushing intended for threaded conduit shall be marked "unthreaded for threaded conduit". When the bushing is also intended for unthreaded conduit it shall be marked "unthreaded for threaded or unthreaded conduit".

Compliance is checked by visual inspection.

8.3 Conduit bodies

8.3.1 Manufacturer identification

A conduit body, and a separately shipped cover shall be plainly marked with the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified and, if practical, with a catalogue number or an equivalent designation. The catalogue number or an equivalent designation, if not marked on

the product, shall appear on the smallest unit carton or other container in which the product is packaged.

Compliance is checked by visual inspection.

8.3.2 Specific conditions of installation

A conduit body that has been found acceptable for specific conditions of installation shall be marked indicating these conditions on the smallest unit carton in which the product is packed.

Compliance is checked by visual inspection.

8.3.3 Short conduit bodies

A short conduit body that has been investigated for a specific combination of conductors shall be marked with the maximum number and maximum size of the conductors for which it is intended. See 7.5.

Compliance is checked by visual inspection.

8.3.4 Angle conduit bodies

A conduit body that complies with the requirements in 7.4 shall be marked with the following symbol, or equivalent. The symbol shall be visible after installation and before the wires are pulled:

Compliance is checked by visual inspection.

8.3.5 Conduit bodies requiring pulling compound

A conduit body that requires the use of a pulling lubricant in order to comply with the conductor pull test in 9.9 shall be marked "for use with conductor-pulling lubricant" or equivalent wording.

Compliance is checked by visual inspection.

8.4 Fittings for threaded hubs

A fitting provided without a locknut and intended for securement to a threaded hub shall have a marking on the smallest unit shipping carton "for securement to a threaded hub only" or the equivalent wording.

Compliance is checked by visual inspection.

8.5 Expansion, expansion-deflection and deflection fittings

The smallest unit shipping carton of expansion fittings intended for use with external bonding jumpers shall be marked "intended for use with external bonding jumpers".

Where specified, the deflection range of an expansion-deflection or deflection fitting shall be provided with the fitting in the installation instructions or marked on the smallest unit carton.

Compliance is checked by visual inspection.

9 Type tests

9.1 General

9.1.1 Samples under test

Samples shall not be additionally tightened, serviced, or conditioned between the tests of a sequence, unless otherwise stated.

9.1.2 Mechanical connection

A fitting intended to be installed in a knockout on a sheet-metal surface with or without the use of a locknut shall provide a mechanical connection to a minimum thickness of metal to which it might be installed. All product sizes shall be assembled in accordance with 9.1.6 to sheet metal having a thickness of 0,66 mm to 0,71 mm and subjected to the electrical continuity test of 9.5.

9.1.3 Number of samples

Two samples of each fitting shall be subjected to the required tests, unless otherwise specified. To ensure realistic results, the fitting shall be assembled as in service and all samples shall meet test requirements.

9.1.4 Locknuts

Locknuts provided as part of a fitting shall be tested as part of the fitting and shall comply with the applicable requirements in this document.

9.1.5 Temperature

Unless otherwise specified, the tests shall be carried out at an ambient temperature of 20 °C ± 5 °C.

9.1.6 Assembly

9.1.6.1 Unless otherwise specified, the samples of fittings for all tests shall be assembled in the intended manner. For a fitting that has an end or centring stop, the conduit shall be pushed against the stop before the fitting is tightened.

9.1.6.2 The tightening torque to be applied to a compression-type fitting shall be as specified in Table 6.

9.1.6.3 Screws or slotted bolt head screws shall be tightened to a torque of 4,0 Nm or in accordance with the fitting manufacturer's instructions. Un-slotted bolt head screws, direct-bearing or securing a clamp, shall be wrench-tightened to a torque of 18,1 Nm or in accordance with the fitting manufacturer's instructions.

9.2 Concrete-tightness test

9.2.1 Two samples of each designation of a concrete-tight fitting shall be tested as described in 9.2.2 to 9.2.6.

9.2.2 A concrete-tight connector shall be assembled in the intended manner to a concrete-tight box and to a length of EHDERS conduit in accordance with 9.1.6. A concrete-tight coupling shall be assembled in the intended manner to two short lengths of EHDERS conduit. All conduit ends shall be sealed.

9.2.3 The connector assembly shall be secured to the bottom of the formwork used to contain the concrete. The coupling assembly shall be supported between 25 mm and 50 mm above the bottom of the formwork. The formwork shall be filled with concrete prepared in accordance with 9.2.4.

9.2.4 The concrete shall be vibrated immediately after it is poured, using a vibrator in accordance with 9.2.5.

The assembly shall be tested in accordance with 9.2.6. Twenty-four hours after the concrete has been poured, it shall be broken loose from the assembly; the interior of the fitting, box, and conduit shall then be examined to determine compliance with 4.7.1.

Fittings of the 16H to 53H designations are not required to be vibrated during the concrete-tightness test when the fitting is intended to be installed in the field at a depth of concrete that is 600 mm or less.

9.2.5 Portland-type grey cement shall be used in the preparation of the concrete for the test. Mason sand of the type known to the construction industry shall be used. The cement-to-sand ratio shall be 1:2 by volume, and there shall be a 1,5 mm deep film of water on the surface of the mixture after it has stood for 1 min in the mixing vat.

9.2.6 The concrete shall be vibrated with an internal type vibrator that operates between 13 500 vibrations per min and 15 000 vibrations per min in free air. The vibrator head shall have a:

a) circumference not less than 95 mm and not greater than 140 mm;

b) length not less than 350 mm and not greater than 400 mm.

9.2.7 The assembly shall be covered with a minimum of 600 mm of concrete. The vibrator head shall be placed into the concrete so that:

a) its major axis is vertical;

b) its free end is within 25 mm of the bottom of the formwork and within 25 mm of the assembly.

The head shall then be withdrawn at a rate not less than 25 mm/s and not more than 50 mm/s. This procedure shall be repeated until all of the concrete has been vibrated as indicated by an overlap of vibration patterns over the entire surface. The vibrator shall not come into contact with the assembly or formwork. The total vibration time shall be 10 s per 0,28 m^3 of concrete used.

9.3 Wet locations test

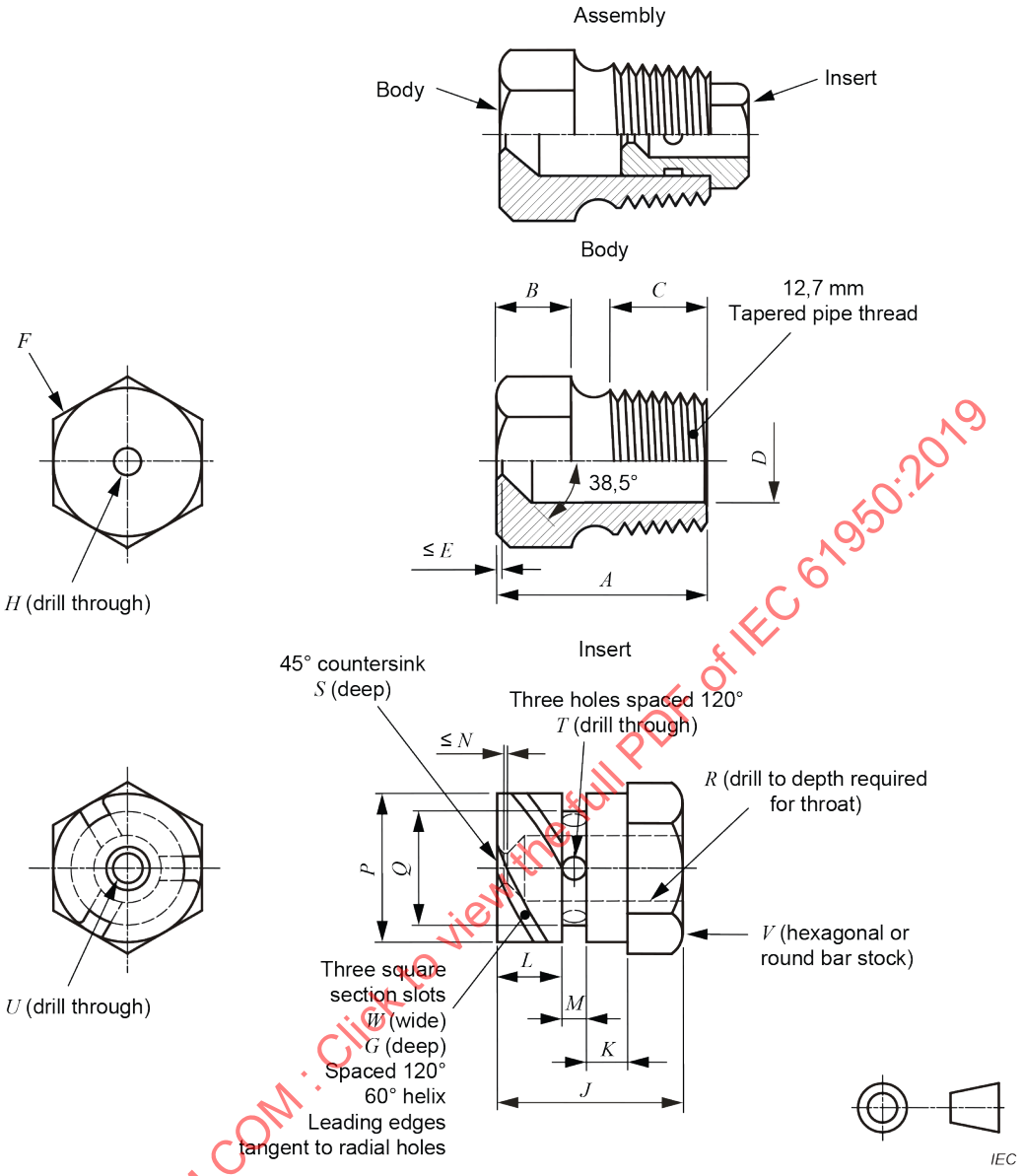
9.3.1 Two samples of a fitting for each designation intended for use in a wet location shall be tested as described in 9.3.2 to 9.3.5.

9.3.2 Prior to assembly, dry absorbent paper shall be placed in a sealable container. The paper and sealed container shall be weighed. The paper shall then be removed from the container and placed in the interior of the enclosure at the point where the fitting interfaces with the electrical enclosure and also where it interfaces with the conduit. A threaded end cap shall be used in place of the enclosure for a fitting intended for securement to a threaded hub only.

9.3.3 The fitting shall be assembled and vented to atmosphere to equalize the pressure during the test. The assembly shall be mounted under the apparatus described in 9.3.4. The water spray shall be applied for 1 h.

9.3.4 The water spray apparatus shall consist of three spray heads constructed in accordance with the details illustrated in Figure 9 and mounted in a water supply pipe rack as illustrated in Figure 10. The water pressure shall be maintained at each spray head at 35 kPa. The fitting shall be placed in the focal area of the three spray heads at a distance of 1,5 m. It shall be positioned in a manner that water is most likely to enter.

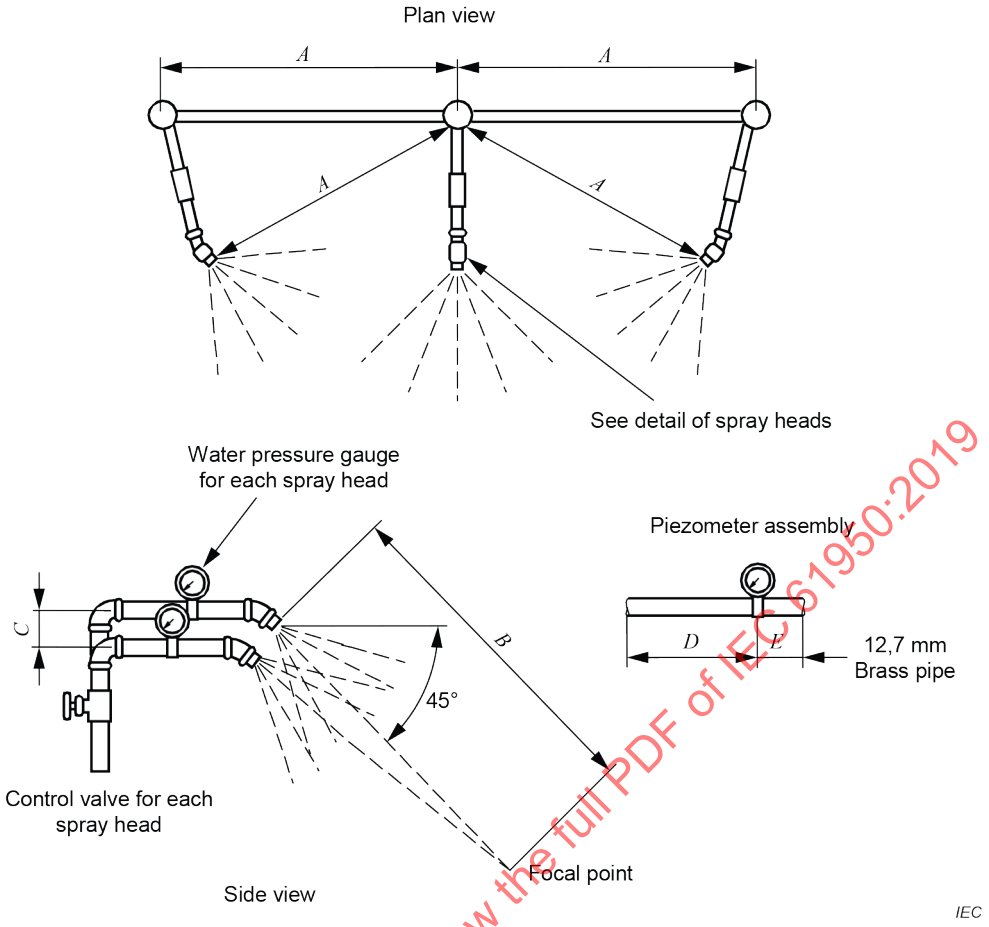
9.3.5 Immediately following the water spray, the outside of the test assembly shall be wiped dry. The test assembly shall then be disassembled. The absorbent paper shall be removed and placed in the container. The container shall then be resealed and weighed. The difference between the weight of the paper before and after the test shall be used to determine the quantity of water.



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

Dimensions	mm	Dimensions	mm
A	30,9	*M*	0,7
B	11,1	*N*	14,6
C	14,2		14,6
D	14,6	*Q*	11,5
	14,7		11,5
E	0,4	*R*	6,3
F	2,0	*S*	0,7
G	1,5	*T*	2,7
H	5,0	*U*	2,4
J	18,2	*V*	15,8
K	3,9	*W*	1,5
L	6,3		

Figure 9 – Wet locations test spray head



Dimensions	mm
A	710
B	1 400
C	55
D	230
E	75

Figure 10 – Wet locations test spray head piping

9.4 Flammability test

9.4.1 Six plaque samples or finished product samples shall be tested. Three shall be tested as received, and three shall be tested after being conditioned for 168 h at a temperature of 90 °C ± 1 °C in a full-draft air-circulating oven that has been preheated at full draft.

9.4.2 The apparatus for this test shall consist of a test chamber of sheet metal 300 mm wide × 350 mm deep × 600 mm high, open at the top and front. When the fitting is too large to be tested in this chamber, a chamber with proportionately larger dimensions shall be used.

9.4.3 When plaque samples are tested, the plaques shall be of moulded composition, in sheet form 100 mm × 100 mm, having a thickness equal to the minimum thickness of the part. Each plaque or finished sample shall be secured with its vertical axis in the centre of the apparatus shown in Figure 11 and with both axes parallel to the back of the apparatus.

9.4.4 A Tirrill gas burner to which a gas pilot light is attached shall supply the test flame. The barrel of the burner shall extend 100 mm above the air inlets and its inside diameter shall be 9,5 mm. While the barrel is vertical, the overall height of the flame shall be adjusted to 125 mm. The blue inner cone shall be 40 mm high. Without disturbing the adjustments for the height of the flame, the valves supplying gas to the burner and pilot flames shall be closed. The above ignition source is equivalent to that of IEC 60695-11-3, Test Method A.

9.4.5 The gas shall be 37 MJ/m^3 at normal pressure (76 mm to 127 mm of water). The valve supplying gas to the pilot shall be opened and the pilot flame lit. The valve supplying gas to the burner shall be opened to apply the flame to the sample automatically. This valve shall be held open for 15 s and then closed for 15 s. This procedure shall be repeated four times for a total of five applications of flame to the plaque or finished sample.

9.4.6 The test shall take place in a room from which all draughts of air are excluded.

9.4.7 The fitting or plate shall be supported so that the long axis of the surface to be tested is vertical and so that the plane of the test surface is normal to the vertical plane through the axis of the burner tube when the burner is tilted at 20°. The test surface shall be positioned vertically so that it is intersected by the axis of the burner tube at a point 40 mm from the top of the burner, and at a point between one-third and one-half of the way up the test surface, as shown in Figure 11. The burner-positioning guide stop shall be adjusted so that the axis of the burner tube intersects the plane of the test surface at a point 40 mm from the top of the burner when the burner is tilted at 20° by the angle block.

NOTE To facilitate this adjustment, a conical plug gauge can be inserted into the top of the burner, as shown in Figure 11.

9.4.8 The burner shall be placed on the 20° angle block ready for the first application of the test flame as shown in Figure 11.

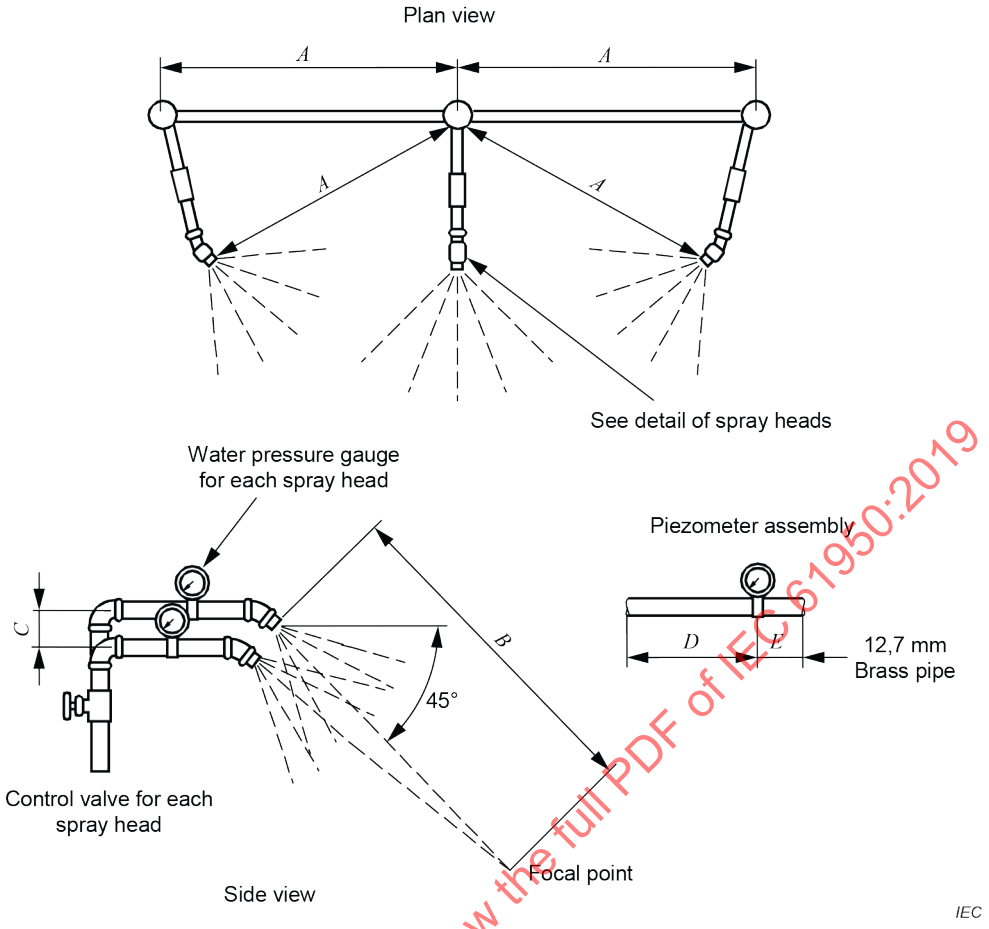


Figure 11 – Flammability test apparatus

9.5 Electrical continuity test

9.5.1 The resistance between the points specified in 9.5.2 shall not be greater than that specified in the individual requirements for the fitting. The resistance shall be determined by passing a direct current of 30 A through the fittings and the connections between the fitting and the conduit, box, or enclosure to which the fitting is assembled. For a connector, a threaded coupling or a plate used to simulate a box shall be allowed.

9.5.2 For a coupling, the voltage drop shall be measured between two points, one on each section of the conduit. For a connector, the voltage drop shall be measured between a point on the conduit and a point on the box, enclosure, or threaded coupling used to simulate a box. The point on the box, enclosure, or threaded coupling shall be 1,6 mm from the fitting. The point on the conduit shall be 1,6 mm from the fitting or the contact point between the fitting and the conduit, as shown in Figure 12.

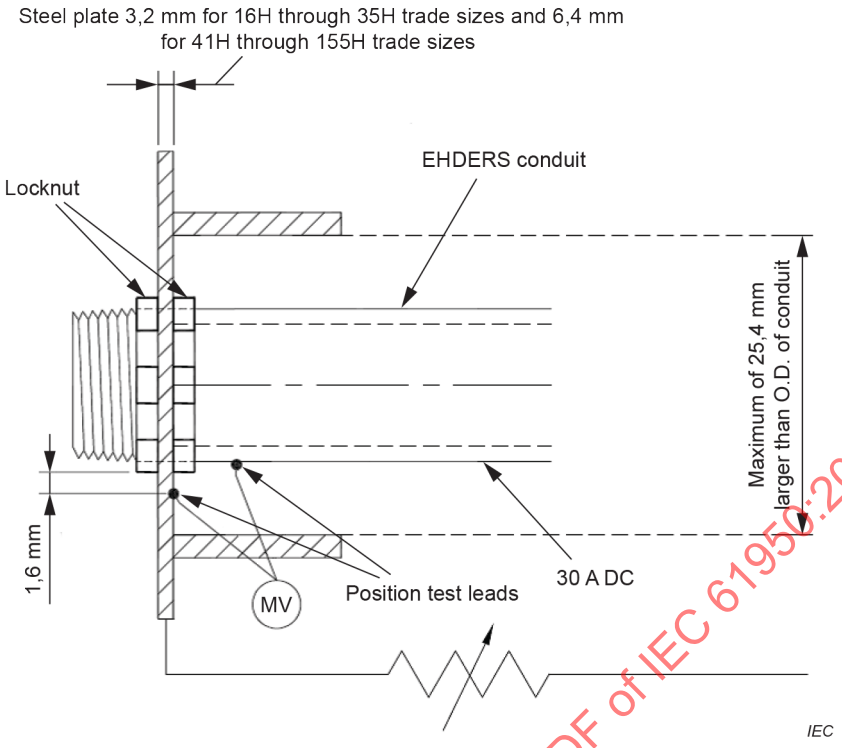
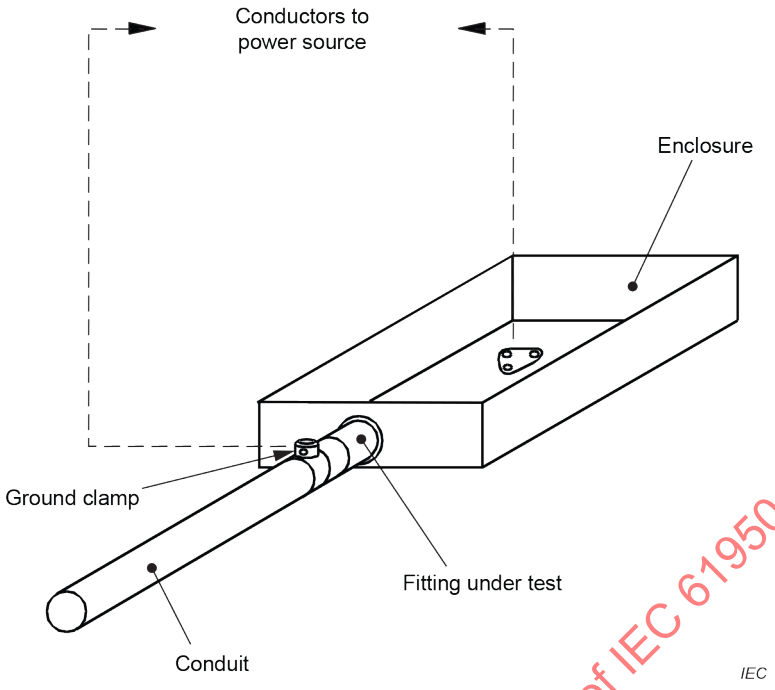


Figure 12 – Measurement of voltage drop for fittings

9.6 Earth fault current test

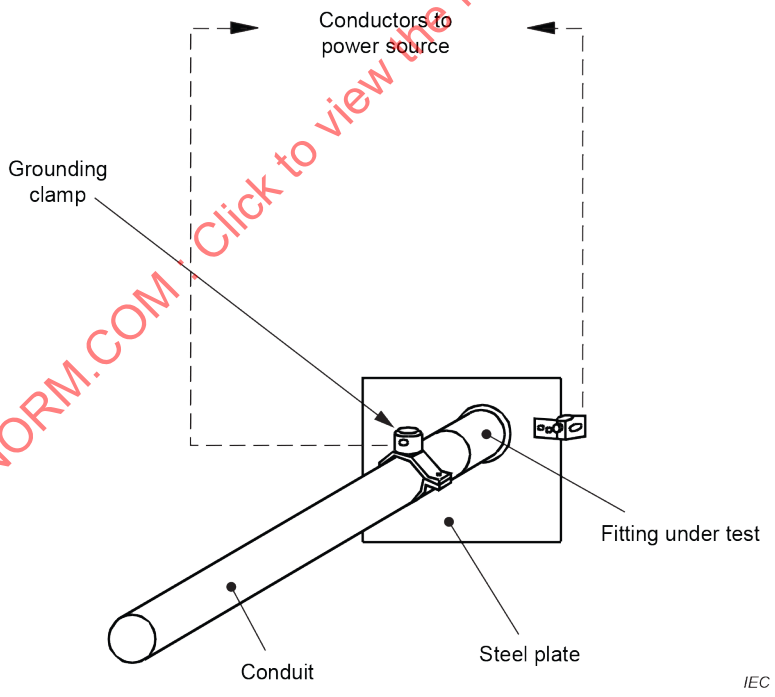
9.6.1 Three samples of each fitting shall be tested as described in 9.6.2 to 9.6.5.

9.6.2 Each fitting shall be assembled to a minimum 150 mm length of EHDERS conduit of the intended size and an unpainted, plated or unplated, steel enclosure as shown in Figure 13, or steel plate simulating an enclosure as shown in Figure 14. The thickness of the enclosure or plate shall be as specified in 9.6.4.



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

Figure 13 – Fault current test using an enclosure



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

Figure 14 – Fault current test using a steel plate

9.6.3 A locknut shall be hand-tightened and then further tightened one-quarter turn with a hammer and a standard screwdriver or by an equivalent method. A copper wire lead (see Table 7) not less than 600 mm long, shall be connected:

a) to the enclosure by a pressure wire connector; and

b) to the conduit 1 mm from the fitting, by an earthing clamp that is sized accordingly.

Pressure wire connectors shall be tightened using the torque specified in Table 12. The test current shall be passed through the wire and assembly.

Table 12 – Tightening torque value

Screw or bolt size mm	Tightening torque Nm
Larger than 3,5 up to 4,5	2
Larger than 4,5 up to 5,5	3
Larger than 5,5 up to 7,0	8
Larger than 7,0 up to 8,0	15
Larger than 8,0 up to 10,0	26
Larger than 10,0 up to 12,0	41
Larger than 12,0 up to 13,0	54
Larger than 13,0	75

9.6.4 For designations 16H to 35H, a fitting shall be tested with:

a) a steel enclosure or plate of thickness 1,35 mm to 1,40 mm at the currents and times specified in Table 7; and

b) a steel enclosure or plate of thickness 0,66 mm to 0,71 mm at 470 A for 4 s.

Alternatively, a fitting of designations 16H to 35H may be tested only with a steel enclosure or plate of 0,66 mm to 0,71 mm thickness, provided it is tested at the currents and times specified in Table 7.

For designations 41H to 155H, a fitting shall be tested with a steel enclosure or plate of 1,35 mm to 1,40 mm thickness.

9.6.5 After having carried the test current, continuity according to 9.5 shall exist between the parts of the test assembly when measured between a point on the EHDERS conduit and a point on the enclosure 6,4 mm from the fitting. An indicating device such as an ohmmeter or battery-and-buzzer combination shall be used to determine whether continuity exists.

9.7 Tests for temperature ratings of insulating material used for bushings or insulating liners

9.7.1 Flammability test

9.7.1.1 Six samples of each size of bushing or an insulating bushing made entirely of polymeric material shall be subjected to the test described in 9.7.1.2.

9.7.1.2 A sample of a bushing or an insulating bushing as specified in 9.7.1.1 shall be mounted on a 300 mm length of conduit and suspended at an angle of 45° to the axis of the test flame. Perform the test as described in 9.4.4 to 9.4.8. The tip of the inner blue cone of the flame shall be applied to the upper edge of the inner diameter of the bushing or insulating bushing.

9.7.2 Accelerated aging test

9.7.2.1 Six samples of each size of bushing or insulating bushing shall be subjected to the test described in 9.7.2.2.