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INTERNATIONAL STANDARD

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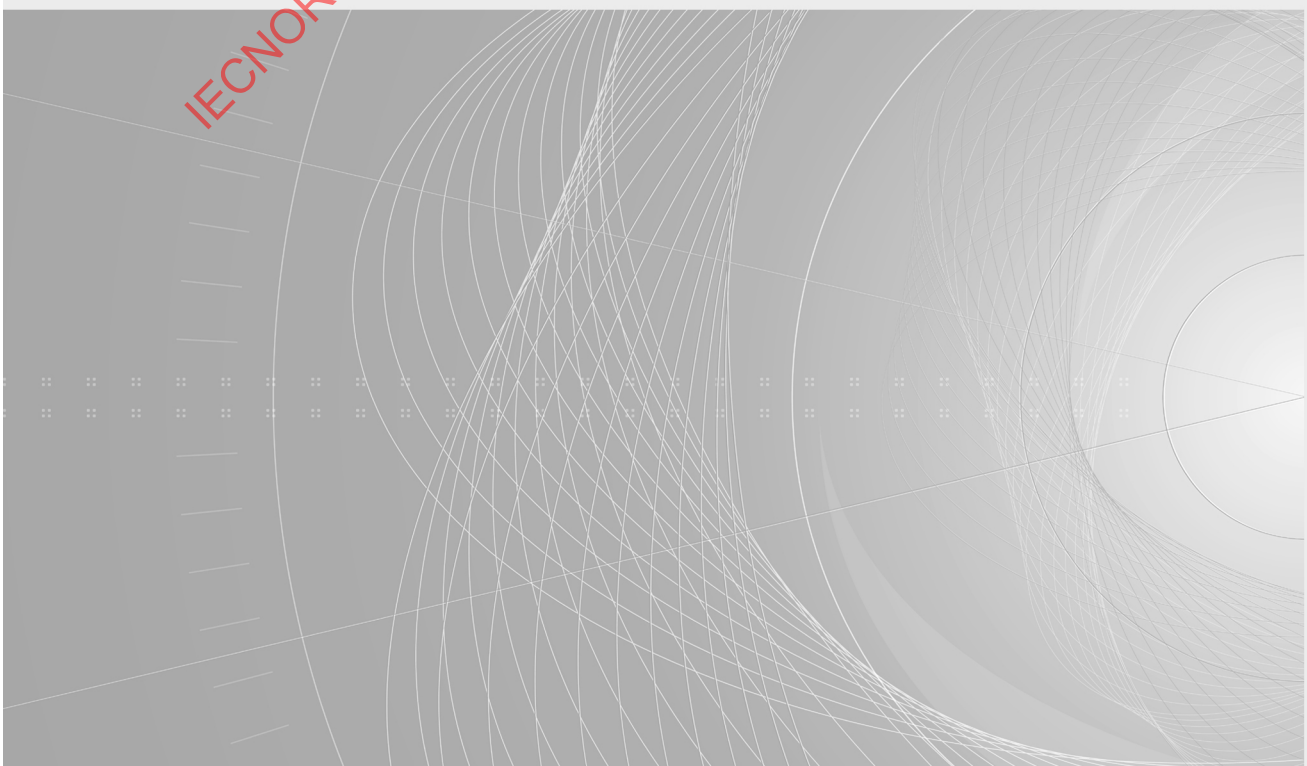
Extra heavy-duty electrical rigid steel conduits



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXTRA HEAVY-DUTY ELECTRICAL RIGID STEEL CONDUITS

FOREWORD

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International Standard IEC 60981 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 2004. This edition constitutes a technical revision.

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

a) addition of provisions for alternative coatings to zinc;
b) addition of elasticity test for organic coatings;
c) new Annex B on tests for evaluating alternative exterior coatings applied on extra heavy-duty electrical rigid steel (EHDERS) conduits.

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

FDIS	Report on voting
23A/886/FDIS	23A/888/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 document, 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

EXTRA HEAVY-DUTY ELECTRICAL RIGID STEEL CONDUITS

1 Scope

This document specifies requirements for extra heavy-duty electrical rigid steel (EHDERS) conduits, couplings, nipples and elbows for electrical installations, including communications and fibre optics. This document also specifies threads for these components.

It is not applicable to the conduits specified in IEC 60423.

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 60695-11-3, *Fire hazard testing – Part 11-3: Test flames – 500 W flames – Apparatus and confirmational test methods*

IEC 61950, *Cable management systems – Specifications for conduit fittings and accessories for cable installations for extra heavy duty electrical steel conduit*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 9227, *Corrosion tests in artificial atmospheres – Salt spray tests*

ISO 13263, *Thermoplastics piping systems for non-pressure underground drainage and sewerage – Thermoplastics fittings – Test method for impact strength*

ISO 19095-3, *Plastics – Evaluation of the adhesion interface performance in plastic-metal assemblies – Part 3: Test methods*

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

3.2
straight conduit
straight length of EHDERS, greater than 0,6 m long and threaded at each end, without a coupling

3.3
finished conduit
straight length of EHDERS with one coupling attached

3.4
threaded coupling
internally threaded steel cylinder for connecting two sections of an EHDERS conduit

3.5
elbow
factory-curved section of an EHDERS conduit threaded at each end

3.6
glowing combustion
combustion of a material in the solid phase without flame but with emission of light from the combustion zone

3.7
nipple
straight section of an EHDERS conduit not more than 0,6 m long and threaded at each end

3.8
type test
test made on a specimen for the conformity of the design of a given product to the requirements of the relevant document

3.9
alternative corrosion-resistant coating
exterior primary coating(s) other than one consisting solely of zinc

Note 1 to entry: The coating(s) may include zinc. See Annex B.

3.10
organic coating
coating(s) other than one consisting solely of zinc

Note 1 to entry: The coating(s) may include zinc.

3.11
zinc coating
interior or exterior primary coating consisting solely of zinc

4 General requirements

4.1 Tests

Tests according to this document shall be type tests.

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

Unless otherwise specified, each test shall be carried out on two new samples. If a sample tested in accordance with this document fails, two additional samples shall be tested, both of which shall comply with all the requirements of this document.

4.2 Circular cross-section

An EHDERS conduit shall have a circular cross-section sufficiently accurate to allow the cutting of threads in accordance with Figure 1.

4.3 Wall thickness

The wall thickness shall comply with the dimensions given in Table 1.

4.4 Surface condition

4.4.1 General

Surfaces of a conduit shall be free from slivers, burrs, scale and other defects likely to cause damage to conductors or cables.

Compliance shall be checked by visual inspection of the external and internal surfaces.

4.4.2 Localized surface imperfections

Localized surface imperfections shall not exceed a depth of 12,5 % of the nominal wall thickness given in Table 1.

Compliance of localized surface imperfections shall be checked by measurement.

4.5 Welding

The welding of all seams shall be continuous and carried out in a professional manner.

Compliance is checked by visual inspection.

4.6 Cleaning

The conduit shall be adequately cleaned before the application of the protective coating. The cleaning process shall leave the exterior and interior surfaces of the conduit in such a condition that the protective coating will be firmly adherent and smooth, as defined in 4.4.

4.7 Protective coating(s)

4.7.1 Primary coating(s)

The exterior surface shall be thoroughly and evenly coated with either a metallic zinc or an alternative corrosion protection coating applied directly to the surface of the steel so that metal-to-metal contact and galvanic protection against corrosion are provided. Zinc coatings or alternative corrosion protection coatings having a zinc component shall be in metal-to-metal contact with the steel.

The interior surface shall be protected by a zinc or organic or other suitable corrosion-resistant coating.

4.7.2 Secondary coating(s)

When (an) additional coating(s) is(are) applied to enhance the primary coating, the evaluation for each additional coating's degree of corrosion protection shall be optional.

5 Dimensions

5.1 Dimensions

The dimensions and mass of the EHDERS conduit shall be in accordance with those given in Table 1.

5.2 Threads

5.2.1 General

The pitch and the length of the threaded portion at each end of each length of conduit, nipple, and elbow shall be as indicated in Figure 1 and shall be compatible with IEC 61950. The complete thread shall be tapered for its entire length, and the taper shall have a ratio of 1 to 16.

5.2.2 Pitch form

The form of the thread profile, the dimensional relationships for the form of the thread and the general notation are shown in Figure 2.

5.2.3 Angle of thread

The angle between the sides of the thread, measured in the axial plane, shall be 60°. The line bisecting this angle is perpendicular to the axis.

6 Protective coatings

6.1 Interior coatings

6.1.1 Zinc

The presence of a zinc coating on the interior surface shall be verified.

Compliance shall be checked by the method described in Annex A for one test cycle only.

6.1.2 Organic coatings

6.1.2.1 Elasticity test

An organic coating used to protect the interior of the conduit shall not crack, flake off or be otherwise damaged.

Compliance shall be checked by the following test:

The coating shall be applied to a sheet-steel test piece and baked in an oven for 5 h, and shall withstand without damage ten successive bends of the test piece back and forth through an angle of 180° against an edge having a radius of 1,6 mm.

The apparatus shall consist of flat test pieces of sheet steel of a width of 75 mm by a length of 125 mm and a thickness of approximately 0,25 mm, an oven for baking the test pieces, and a vice with jaws of a width of at least 75 mm for holding the test pieces during the bending test. The 75-mm edge of each jaw shall be rounded to a radius of 1,6 mm.

Two test pieces shall be cleaned with a suitable organic solvent to remove any grease and foreign material and shall then be dipped in the organic coating. After air drying for 30 min, the test pieces shall be suspended by means of short wires in the oven. Samples shall be baked for 5 h at the normal baking temperature for the organic coating in question but, if the normal baking temperature is lower than 135 °C or the enamel is regularly air dried, the oven temperature shall be maintained between 135 °C and 150 °C.

At the end of 5 h, the test pieces shall be removed from the oven and cooled in still air to room temperature. Each flat test piece shall be secured in the vice, gripped at its free end, and then bent for 90° against one of the 75-mm edges of the vice jaws. Each test piece shall then be bent back past its original position through 180° so that it ends bent 90° against the other 75-mm edge of the vice jaws. It shall then be bent for 90° in the opposite direction, ending with the test piece in its original position. This cycle shall be repeated five times.

6.1.2.2 Warm humid air test

No corrosion of the metal shall be present after 1 440 h of exposure to humidity.

Compliance shall be checked by the following test:

The test apparatus shall be an insulated chamber with inside dimensions of approximately 119 cm × 71 cm × 71 cm. It shall contain a temperature-controlled water reservoir, pump, spray chamber for humidifying the air, an air-circulating fan, provisions for heating the air, specimen supports, and the necessary means of control.

The dry bulb temperature of the test chamber shall be maintained at (60 ± 1) °C for 1 440 h and at (98 ± 2) % relative humidity throughout the test. The specimens shall be supported in racks at an angle of 15° from the vertical.

6.2 Exterior coatings

6.2.1 Zinc

A zinc coating on the outside surface shall have a minimum thickness of 0,02 mm.

Compliance shall be checked by measurement. In case of a dispute, the minimum acceptable thickness shall be determined using the method described in Annex A.

6.2.2 Alternative corrosion-resistant coating

6.2.2.1 General

An alternative corrosion-resistant coating on the outside surface shall provide an equal or greater protection from corrosion as a zinc coating.

Compliance shall be checked by the requirements in Clauses B.2 to B.6, 6.2.2.2 to 6.2.2.5 (as applicable) and the electrical continuity and mechanical strength test sequence for fittings for unthreaded EHDERS conduits in accordance with IEC 61950. Separate sets of assembled specimens of the conduit, elbow, or nipple to both set-screw and compression-type couplings shall be subjected to the fault current test, electrical continuity test, a bend test, an electrical continuity test (repeated), and a pull-out test as specified in IEC 61950.

6.2.2.2 Tensile strength

The tensile strength of a polyvinyl chloride (PVC) alternative corrosion-resistant coating for EHDERS conduits shall have a minimum tensile strength of 13,79 MPa (2 000 psi).

Compliance shall be checked by the tests in ISO 527 (all parts). Other materials shall be subject to special investigation.

6.2.2.3 Adhesion

The adhesion of an alternative corrosion-resistant coating shall be greater than the strength of the alternative corrosion-resistant coating itself. The coating may tear rather than separate from the substrate.

Compliance for coatings of a thickness of 0,51 mm to 1,27 mm shall be checked by the following test:

Two parallel circumferential cuts 38 mm long shall be made 13 mm apart through the alternative corrosion-resistant coating to the substrate. A third cut shall be made perpendicular to, and crossing, the circumferential cuts. The edge of the alternative corrosion-resistant coating shall be carefully lifted with a knife to form a tab. To determine compliance, this tab shall be pulled perpendicularly to the conduit with a pair of pliers.

Compliance for coatings with a thickness of 0,127 mm or less shall be checked by the test in ISO 19095-3.

6.2.2.4 Cold impact

The coating shall not separate from the metal nor be damaged to the extent that bare metal is exposed on each individual specimen.

Compliance shall be checked by inspection without magnification after the following test:

Ten 152 mm to 203 mm specimens of finished conduit provided with a non-metallic alternative corrosion-resistant coating shall be conditioned at a temperature of 0 °C for a period of 60 min. Conduits intended for use in temperatures below 0 °C shall be conditioned at the rated temperature, for which the rated temperature shall be any temperature below 0 °C in 5 °C increments. The specimens shall then be subjected to an impact force of 12,2 J. A combination of any height and weight resulting in this impact force shall be considered equivalent if the impact face remains unchanged.

The impact shall be performed according to the apparatus, falling mass and method specified in ISO 13263. The test shall be conducted inside the cold chamber or within 15 s of removal from the cold chamber.

6.2.2.5 Flammability

The finished conduit provided with a non-metallic alternative corrosion-resistant coating shall be flame resistant.

The finished conduit shall not flame for longer than 5 s following any of three 60-s applications of flame, the period between applications being 30 s. A specimen shall not:

- emit flaming or glowing particles or flaming drops at any time that ignite the cotton on the burner, wedge, or floor of the enclosure (flameless charring of the cotton shall be ignored);
- continue to flame longer than 5 s after any application of the gas flame; or
- have the coating completely consumed during or after any application of the gas flame.

NOTE When an alternative corrosion protection system employs a thin exterior organic topcoat measuring less than or equal to 0,125 mm in thickness, over a confirmed three-dips worth of zinc, a specimen can display a total consumption of the top coat at the point of flame contact to the conduit without any measureable flame propagation as long as it meets the requirements of 6.2.2.5, first and second bullet points. Confirmation of the presence of three-dips worth of zinc coating is accomplished using the zinc coating test of Annex A as part of a separate test.

Compliance is checked by the following test:

Materials and reactants shall consist of the following:

a) *Methane, at 98 % minimum purity, having a heat content of (37 ± 1) MJ/m^3 at 25 °C and 101 kPa; or natural gas, with a heat content of (37 ± 1) MJ/m^3 at 25 °C and 101 kPa;*

   Alternative gases, such as propane, at a 95 % minimum purity, having a heat content of (94 ± 2) MJ/m^3 at 25 °C and 101 kPa or butane, at 99 % minimum purity, having a heat content of (120 ± 3) MJ/m^3 at 25 °C and 101 kPa, may be used if a stable flame is obtained and the heat evolution profile complies with IEC 60695-11-3.

   WARNING Propane and butane gases are denser than air and can settle and become an explosion hazard. Consult the gas supplier for special precautions to be taken.

b) *Surgical cotton, dry and untreated.*

The apparatus and a means for supporting the test specimen in a vertical position shall consist of the following:

1) *A three-sided metal enclosure in an exhaust hood or cabinet. The metal enclosure shall be 305 mm wide, 355 mm deep, and 610 mm high, and the top and front shall be open. A 457-mm specimen of finished conduit shall be secured with its longitudinal axis vertical in the centre of the enclosure. A flat, horizontal layer of untreated surgical cotton of a thickness between 6 mm and 25 mm shall cover the floor of the enclosure. The upper surface of the cotton shall be between 229 mm and 241 mm below point B, which is the point at which the tip of the blue inner cone of the test flame touches the specimen. See Figure 6.*

2) *An angle block, wedge, (see Figure 5) to which the base of the burner can be secured, shall be provided for tilting the barrel 20° from the vertical while the longitudinal axis of the barrel remains in a vertical plane. The burner shall be secured to the wedge and the assembly shall be placed in an adjustable support jig. A layer of untreated surgical cotton of a thickness between 6 mm and 25 mm shall be placed on the wedge and around the base of the burner. The jig shall be adjusted toward one side or the other of the enclosure to place the longitudinal axis of the barrel in the vertical plane that contains the longitudinal axis of the specimen. The plane shall be parallel to the sides of the enclosure. The jig shall also be adjusted toward the rear or front of the enclosure to position the point A, which is the intersection of the longitudinal axis of the barrel with the plane of the tip of the barrel, 38 mm from the point B at which the extended longitudinal axis of the barrel meets the outer surface of the specimen. Point B is the point at which the tip of the blue inner cone touches the centre of the front of the specimen. The specimen shall be adjusted vertically to keep point B from being any closer than 76 mm to the lower clamp or other support for the specimen.*

3) *A laboratory burner in conformance with IEC 60695-11-3, suitable for the calorific value of the gas and having an inside diameter of (9,5 ± 0,3) mm and a length of (100 ± 10) mm above the primary-air inlets. The burner shall be calibrated in accordance with IEC 60695-11-3 each time a cylinder of gas, when used, is changed or refilled, or any of the apparatus is changed.*

   The burner flame shall be calibrated at least every 30 days and each time that a cylinder of gas is changed or if any of the apparatus is changed. If using gas different from the grade of methane specified for referee purposes, the burner flame shall be calibrated immediately before testing.

4) *A length-measuring device accurate to within 5 % of char length requirements.*

5) *A flame height gauge capable of measuring the specified flame heights.*

6) *A timing device capable of measuring the specified times in seconds, having a resolution of 1 s and an accuracy of ±0,5 s.*

Three specimens having a minimum length of 457 mm taken from a sample of finished conduit shall be conditioned at room temperature for a minimum of 6 h.

When conducting the test, the specimens, apparatus, and surrounding air shall be at room temperature.

The specimens shall be mounted vertically in the supports in the chamber (see Figure 6).

A continuous horizontal layer of cotton between 6 mm and 25 mm shall be placed on the floor of the test chamber, centred on the vertical axis of the test specimen, extending from 75 mm to 100 mm outward in all directions except in the direction of the burner, where it shall extend to just contact the angle block. The upper surface of the cotton shall be between 229 mm and 241 mm, (235 ± 6) mm below the point at which the tip of the blue inner cone of the flame shall impinge on the specimen. There shall be no cotton on the burner, or on or under the angle block.

With the burner in vertical position, the height of the test flame shall be adjusted to (125 ± 10) mm, with an inner blue cone of a length of (40 ± 2) mm. The burner shall then be positioned on the angle block, with its barrel at an angle of 20° to the vertical.

The alignment of the angle block shall be such that the axis of the burner barrel and the longitudinal axis of the specimen are in the same plane.

The motion of the angle block, which allows smooth removal of the flame from the specimen and smooth reapplication of the flame, shall not disturb the layer of cotton on the floor of the enclosure.

The angle block shall be moved into position such that the tip of the inner blue cone of the flame impinges on the outer surface of the specimen for 60 s, and is then moved away for 30 s. This cycle shall be repeated until three applications of the flame have been completed. In all cases, the movement of the angle block shall be smooth and quick, with minimum disturbance of the chamber air. On a flat specimen, the flame shall impinge on the centre of the broad face of the specimen. If the specimen changes location due to heating or burning, the position of the burner shall be adjusted so that the point of impingement remains on the same location of the specimen.

When any specimen emits flaming or glowing particles or flaming drops that fall outside the area of the testing surface covered by the cotton, or fall onto the wedge or burner, or both, the test results shall be discarded and the test repeated. For the repeat test, the area covered by the cotton may be increased, placed over the wedge, or both.

When flaming of the specimen persists for longer than 5 s after removal of the burner flame, the burner flame shall not be re-applied until immediately after the flaming ceases. If flaming ceases and only glowing combustion continues after 30 s, the burner flame shall be re-applied.

After the test is completed, the exhaust system shall be activated to remove all smoke and fumes from the chamber.

During and after the test, occurrence of the following shall be recorded:

- *flaming or glowing particles or flaming drops at any time that ignite the cotton on the burner, wedge, or floor of the enclosure (flameless charring of the cotton shall be ignored);*
- *non-metallic alternative corrosion-resistant coating flaming longer than 5 s following any of three 60-s applications of gas flame; or*
- *complete consumption of the coating during or after any application of the gas flame.*

7 Threading and chamfering

Each length of conduit, as well as each nipple and elbow shall be threaded at both ends. Each end shall be chamfered or otherwise treated to remove burrs and sharp edges.

If threads are cut after the zinc coating has been applied, the threads, before installation, shall be treated with a protective coating to prevent corrosion. This treatment shall not impair electrical continuity through the joint after installation.

8 Couplings

8.1 General

8.1.1 Corrosion protection

The exterior surface of couplings shall be protected by means of a zinc coating or alternative corrosion protection coating, which shall comply with the requirements of Clause 6, and the interior surface shall be treated to keep corrosion from taking place prior to installation onto the conduit.

8.1.2 Chamfering

Both ends of couplings shall be chamfered between 11° and 15°, to prevent damage to the start of the thread (see Figure 4).

8.1.3 Dimensions

The outside diameter and length of couplings shall be as indicated in Table 2. Each length of conduit shall be supplied with one coupling attached.

8.2 Coupling threads

8.2.1 Thread form

Coupling threads in accordance with this document shall be straight (parallel) threads of the same thread form as the taper thread specified in 5.2.1.

8.2.2 Dimensions

The dimensions and pitch diameter limits shall be as indicated in Table 2, and the truncation shall be as indicated in Figure 3.

The major and minor diameters vary with the pitch diameter. The thread form shall be as indicated in Figure 2.

9 Elbows and nipples

Conduit elbows and conduit nipples shall have the same dimensions and quality employed in the straight lengths of the EHDERS conduit, and shall be treated, coated, threaded and marked for identification according to the requirements of this document. The dimensions of 90° elbows shall be as indicated in Table 3.

10 Ductility

10.1 Bending properties

The specimen is deemed to have passed the test if after bending there is no cracking on the surface, or opening of the weld, visible under normal or corrected-to-normal vision.

10.2 Ductility of zinc coating

The ductility of protective coatings used on the exterior or interior surfaces of an EHDERS conduit shall be checked by the following test, which shall be carried out within one year of manufacture.

A specimen of conduit shall be bent at ambient temperature around a mandrel to a radius specified in Table 3.

Conduits designated as 12H and 16H are bent at 180°. Conduits of other designators are bent at 90°.

The specimen is deemed to have passed the test if after bending there is no visible cracking or flaking of the coating, visible under normal or corrected-to-normal vision.

11 Marking

11.1 General

Marking shall be durable and easily legible.

11.2 Required information

Each length of conduit, nipple and elbow shall be marked with the name of the manufacturer or responsible vendor or trademark or other identifying symbols, as well as being marked with at least one of the following:

a) "extra heavy-duty electrical rigid steel conduit";

b) "EHDERS conduit";

c) "EHDERS";

d) "electrical rigid metal conduit"; or

e) "ERMC-S".

Nipples, where the unthreaded portion is less than 25 mm long, need not be marked.

Each finished length of conduit, elbow, or nipple shall be legibly and durably marked with "Consult manufacturer for proper installation" or equivalent marking. Elbows and nipples of trade sizes 53 or smaller may be marked on the smallest shipping container instead of the product.

The conduits provided with a non-metallic alternative corrosion-resistant coating shall be allowed to be marked with a maximum use temperature of "90°C". A conduit tested for use at a maximum ambient temperature higher than 90 °C shall be marked "____°C" with the rated temperature as evaluated in Clause B.3. The conduit shall be marked at a minimum of once every 3 m and no less than once every piece.

The conduits, elbows, or nipples provided with primary and secondary coatings shall be marked with "Properties of the _____ coating have been investigated as primary corrosion protection. The secondary coating of _____ has/has not been evaluated for corrosion protection" or equivalent wording. The blank shall be filled in with the type of primary and/or secondary coatings. Elbows and nipples of trade sizes 53 or smaller may be marked on the smallest shipping container instead of the product.

Table 1 – Dimensions and mass of EHDERS conduits

Conduit designation	Nominal inside diameter mm	Outside diameter mm	Wall thickness mm	Length without coupling m	Minimum mass of ten unit lengths with couplings attached kg
12H	12,5	17,1	2,31	3,00	23,1
16H	16,1	21,3	2,64	3,00	35,5
21H	21,2	26,7	2,72	3,00	47,2
27H	27,0	33,4	3,20	3,00	68,9
35H	35,4	42,2	3,38	3,00	90,6
41H	41,2	48,3	3,51	3,00	112,0
53H	52,9	60,3	3,71	3,00	150,0
63H	63,2	73,0	4,90	3,00	238,0
78H	78,5	88,9	5,21	3,00	309,0
91H	90,7	101,6	5,46	3,00	377,0
103H	102,9	114,3	5,72	3,00	441,0
129H	128,9	141,3	6,22	3,00	596,0
155H	154,8	168,3	6,76	3,00	792,0

NOTE 1 The applicable tolerances are:

a) Length: ±6,35 mm (without coupling)

b) Outside diameter:

Conduit designation	*Tolerance*
from 12H up to and including 53H	±0,38 mm
from 63H up to and including 103H	±0,64 mm
129H and 155H	±1 %

NOTE 2 The letter "H" in the first column denotes an EHDERS conduit.

Table 2 – Dimensions of couplings

Trade size designator	Outside diameter [a]	Minimum length	Pitch diameter [b]		Chamfer diameter [c]	
			Minimum	Maximum	Minimum	Maximum
	mm	mm	mm	mm	mm	mm
16	25,7	41,3	20,35	20,68	20,27	21,29
21	31,8	41,7	25,68	26,01	25,60	26,62
27	38,7	50,0	32,18	32,59	32,00	33,02
35	47,5	51,6	40,94	41,35	40,77	41,78
41	54,7	52,4	47,04	47,45	46,86	47,88
53	67,3	54,0	59,11	59,51	58,93	59,94
63	82,6	81,0	71,27	71,83	71,12	72,64
78	98,3	84,1	87,15	87,71	87,00	88,52
91	114,3	86,5	99,85	100,40	99,70	101,20
103	123,8	89,3	112,60	113,10	112,40	113,90
129	152,4	100	139,60	140,10	140,20	141,70
155	182,9	108	166,50	167,10	167,40	168,90

[a] Outside diameter tolerances:

plus tolerances: no requirements

minus tolerances: for trade sizes smaller than 35: −0,4 mm

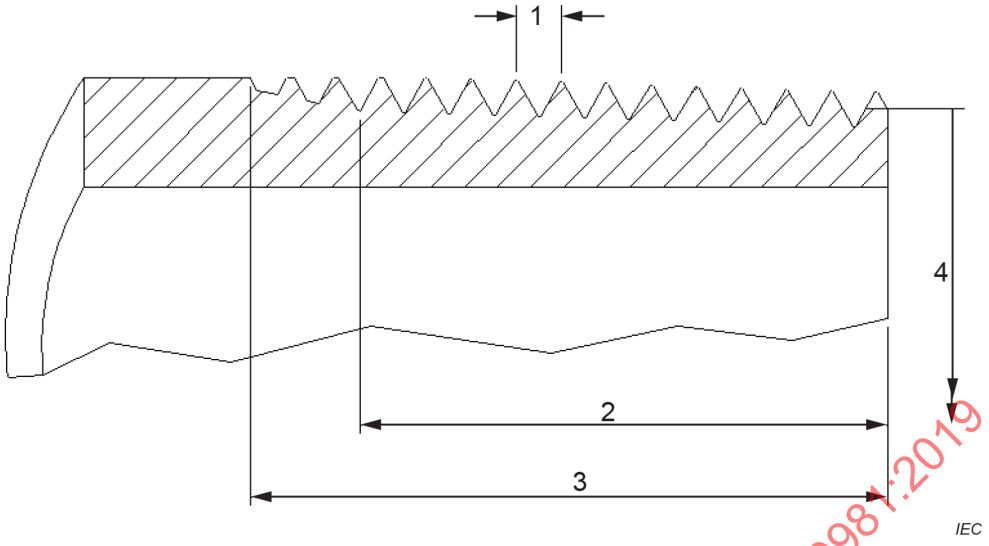
for trade sizes 35 and larger: −1 %

[b] All couplings have straight tapped threads.

[c] Chamfer angle shall be between 11° and 15°.

Table 3 – Dimensions of 90° elbows

Trade size designator	Minimum radius to centre of conduit	Minimum straight length at each end
	mm	mm
12	Not used	Not used
16	102	38
21	114	38
27	146	48
35	184	51
41	210	51
53	241	51
63	267	76
78	330	79
91	381	83
103	406	86
129	610	92
155	762	95



(1) Pitch (p)

(2) Effective length of thread

(3) Total length of thread

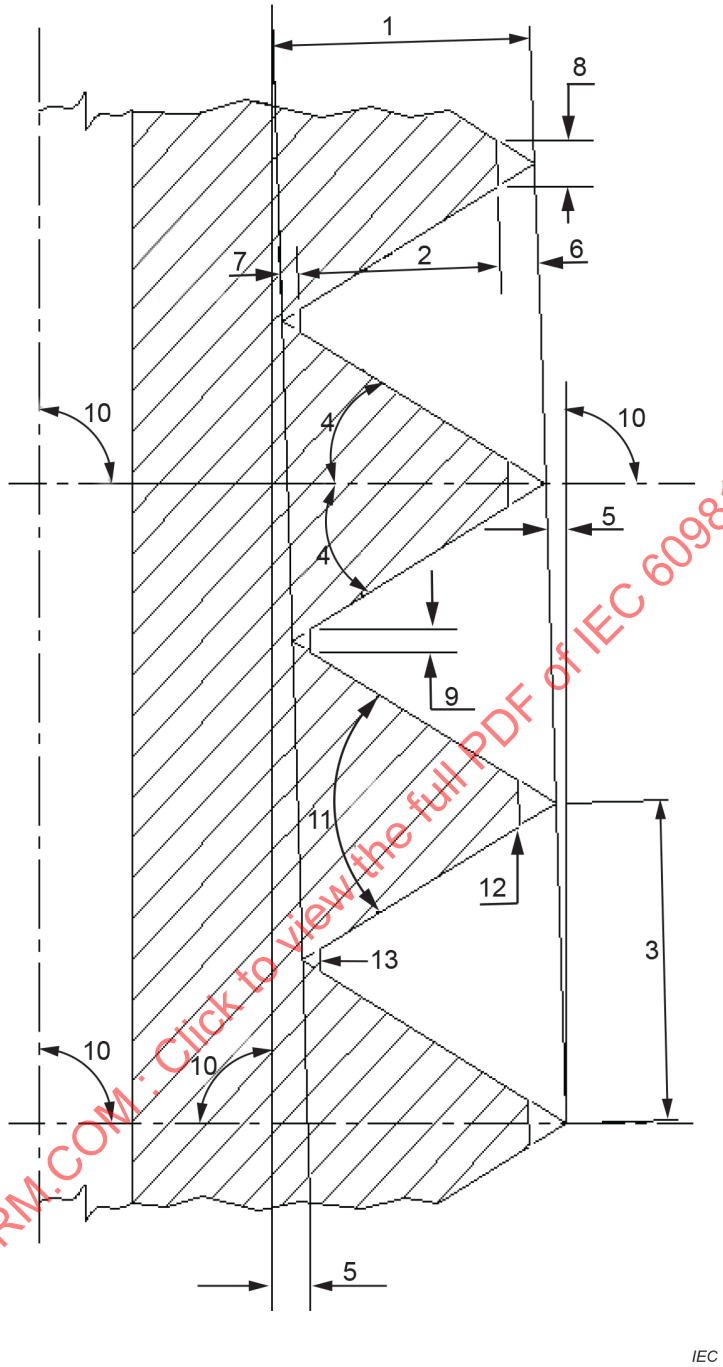
(4) Pitch diameter at end of thread E_0

Conduit designation [a]	Pitch [b] mm	Pitch diameter at end of thread E_0 mm Taper 1 to 16	Length of thread	
			Effective mm	Total mm
12H	1,411	15,545	10,41	15,24
16H	1,814	19,263	13,46	19,81
21H	1,814	24,580	13,97	20,07
27H	2,209	30,825	17,27	24,89
35H	2,209	39,550	18,03	25,65
41H	2,209	45,621	18,29	26,16
53H	2,209	57,633	19,30	26,92
63H	3,175	69,075	28,96	39,88
78H	3,175	84,851	30,48	41,40
91H	3,175	97,473	31,75	42,67
103H	3,175	110,100	33,02	43,94
129H	3,175	136,924	35,81	46,74
155H	3,175	163,731	38,35	49,53

[a] The letter "H" in the first column denotes an EHDERS product.

[b] The tolerance on the pitch diameter at E_0 shall be ±1 turn of the ring gauge from flush.

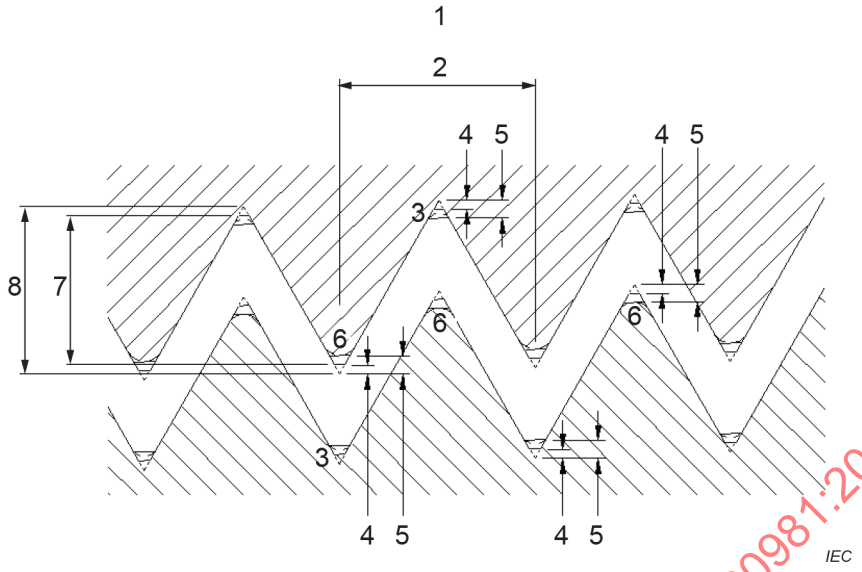
Figure 1 – Dimensions of threads for EHDERS conduits



External thread

(1) 0,866 025 p = height of 60° sharp V thread
(2) 0,800 000 p = height of thread
(3) Pitch
(4) 30° = flank angle
(5) 1° 47" = thread taper angle of 1 to 16 taper
(6) Depth of truncation at crest
(7) Depth of truncation at root
(8) Width at crest
(9) Width at root
(10) 90°
(11) 60°
(12) Crest
(13) Root

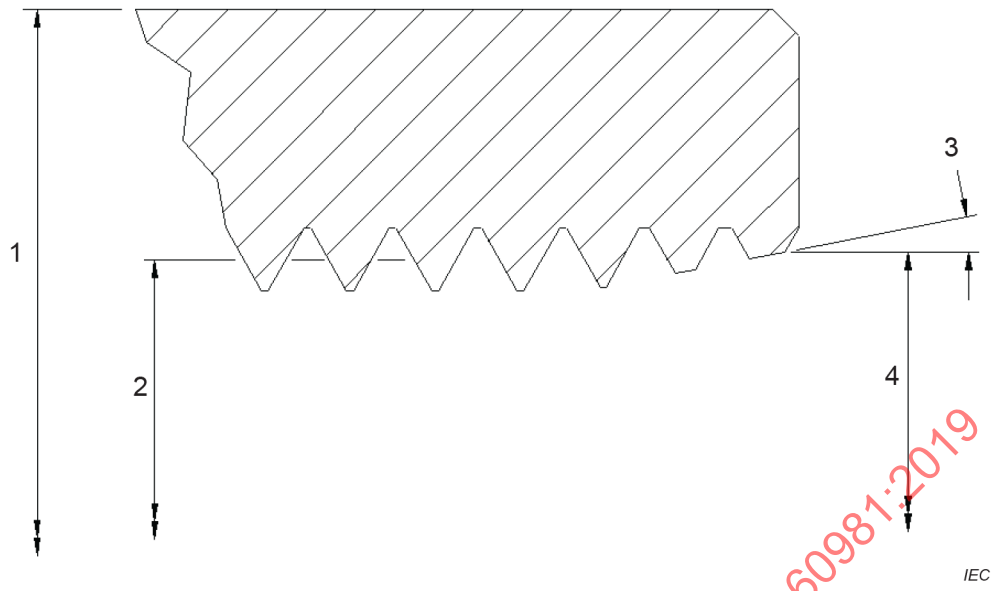
Figure 2 – Basic form of taper thread



(1) Internal thread
(2) Pitch
(3) Root
(4) Minimum truncation
(5) Maximum truncation
(6) Crest
(7) Maximum height of thread
(8) Height of sharp V thread

Pitch	Height of sharp V thread	Height of thread mm		Truncation mm			Equivalent width at crest and root mm		
mm	mm	Min.	Max.	Min.	Max.	Tolerance	Min.	Max.	Tolerance
1,411	1,222	0,974	1,129	0,046	0,124	0,078	0,053	0,145	0,092
1,814	1,571	1,288	1,451	0,061	0,142	0,081	0,069	0,163	0,094
2,209	1,913	1,590	1,767	0,074	0,160	0,086	0,084	0,185	0,101
3,175	2,750	2,356	2,540	0,104	0,198	0,094	0,122	0,229	0,107

Figure 3 – Limits on crest and root truncation of external and internal threads



(1) Outside diameter

(2) Pitch diameter

(3) Chamfer angle

(4) Chamfer diameter

See Table 2 for dimensions.

Figure 4 – Dimensions of a ferrous metal coupling

Dimensions in millimetres (inches)

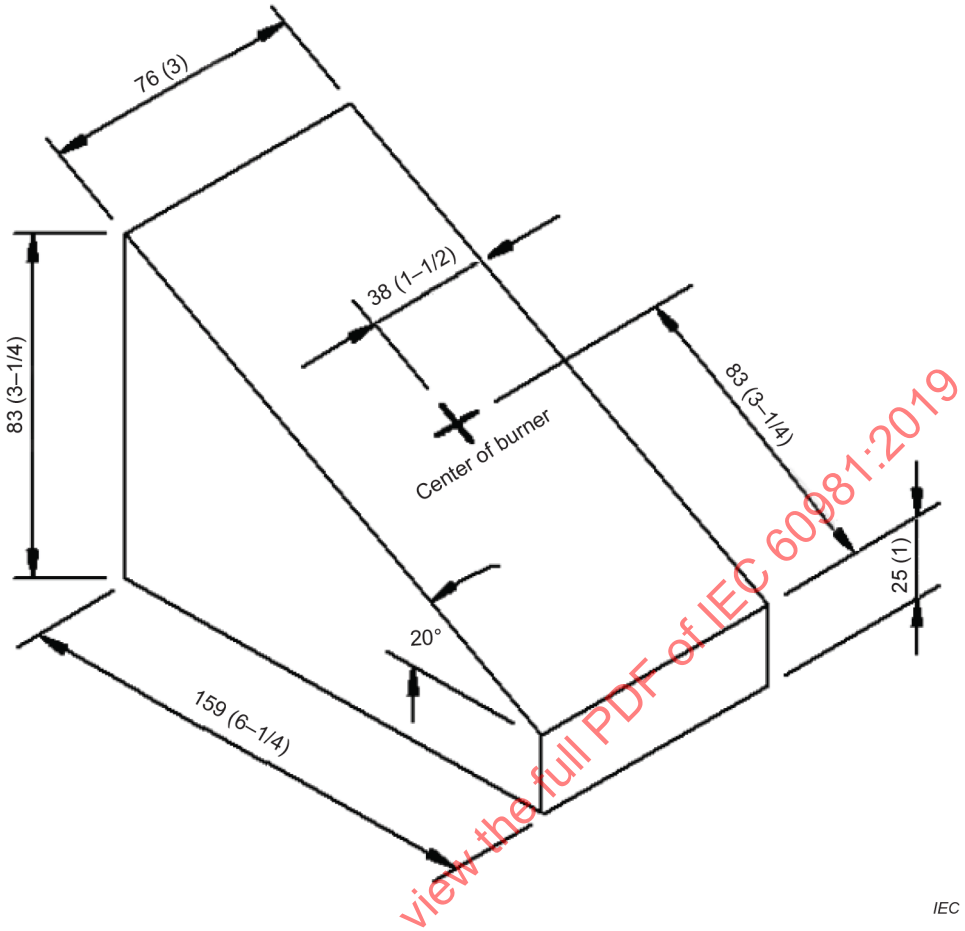


Figure 5 – Dimensions of wedge

Dimensions in millimetres (inches)

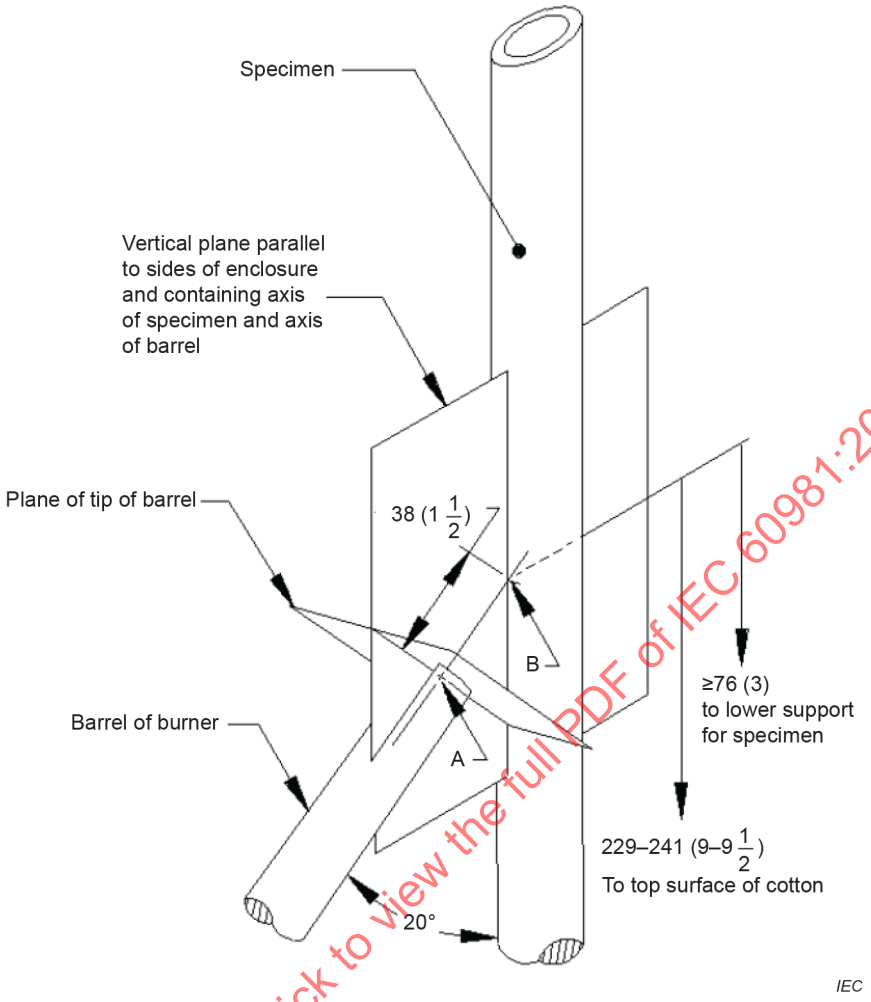


Figure 6 – Essential dimensions for flame test

Annex A
(normative)

Test for thickness of zinc coating on extra heavy-duty electrical rigid steel (EHDERS) conduits

A.1 Requirement

A protective coating of zinc shall be such that a specimen of finished EHDERS conduit does not show a bright, adherent deposit of copper after four 60-s immersions in a copper sulphate solution.

A.2 Solutions required

The solution of copper sulphate shall be made from distilled water and reagent grade of cupric sulphate ($CuSO_4$). In a copper container or in a glass, polyethylene, or other chemically non-reactive container in which a bright piece of copper is present, 500 g of the cupric sulphate is to be dissolved per litre of hot distilled water to obtain a solution that has a specific gravity slightly higher than 1,186 after the solution is cooled to room temperature of 18,3 °C ± 1 °C. Any free acid that might be present is to be neutralized by the addition of approximately
1 g ± 0,25 g of cupric oxide (CuO) or 1 g ± 0,25 g of cupric hydroxide ($Cu(OH)_2$) per litre of solution. The solution shall be diluted with distilled water to obtain a specific gravity of exactly 1,186 at a temperature of 18,3 °C ± 1 °C. The solution shall then be filtered.

A.3 Preparation of samples

Several 150-mm specimens shall be cut from a specimen length of the finished conduit. With prudent attention to the risks to health and to the risk of fire, the specimens shall be cleaned with an organic solvent. Each specimen shall then be examined for evidence of damage to the zinc coating, and one that is not damaged shall be selected for use in the test.

A.4 Specimen surface condition

The selected specimens shall be rinsed in water and all of their surfaces shall be dried with clean cheesecloth. As much of the water as possible shall be removed in the drying operation, as water slows the reaction between the zinc and the solution, thereby adversely affecting the test results. The surface of the zinc shall be dry and clean before a specimen is immersed in the solution of copper sulphate. The specimens shall not be touched by hands or anything else that can contaminate or damage the surfaces.

A.5 Test method

A glass, polyethylene, or other chemically non-reactive beaker having a diameter equal to twice the diameter measured over the specimen shall be filled with the solution of copper sulphate to a depth of not less than 76 mm. The temperature of the solution shall be maintained at (18,3 ± 1,1) °C. The specimen shall be immersed in the solution and supported on one end in the centre of the beaker so that not less than 64 mm of its length is immersed. The specimen shall remain in the solution for 60 s, during which time it shall not be moved nor shall the solution be stirred.

At the end of the 60 s period, the specimen shall be removed from the beaker, rinsed immediately in running tap water, rubbed with clean cheesecloth until any loosely adhering deposits of copper are removed, and shall then be dried with clean cheesecloth. Again, hands and other damaging and contaminating objects and substances shall not touch the surfaces that were immersed. The part of the specimen that was immersed shall be examined, disregarding any threaded area and the portions of the specimen within 13 mm of the cut ends and within 3 mm of any longitudinal edges cut in the process of preparing the specimen.

Deposits of bright, firmly adhering copper shall be noted.

EXCEPTION Copper adhering to threaded areas, the 13 mm cut end portions, and any 3 mm longitudinal cut-edge portions shall be disregarded.

When bright adhering copper is not found, the process of immersion, washing, rubbing, drying, examining and recording shall be repeated up to a total of four immersions, or until the presence of copper is noted, using the same specimen and beaker of solution. After the dips are completed on any single specimen, the used solution of copper sulphate shall be discarded. A fresh portion of the solution shall be used for each succeeding specimen.

A.6 Results

There shall not be any evidence of bright, adherent deposits of copper (disregarding the threaded area and cut portions noted in Clause A.5) on any of the three specimens following the immersions into the copper sulphate solution.