

# INTERNATIONAL STANDARD



Extra heavy-duty electrical rigid steel conduits **PREVIEW**  
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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- withdrawn,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
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## 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*

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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

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**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  $(20 \pm 5)$  °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  $(60 \pm 1)$  °C for 1 440 h and at  $(98 \pm 2)$  % 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.