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Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications —

Part 3: Electrofusion fittings

*Raccords en polyéthylène pour utilisation avec des tubes en polyéthylène
pour la distribution de combustibles gazeux — Série métrique —
Spécifications —*

Partie 3: Raccords électrosoudables



Reference number
ISO 8085-3:2001(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 8085 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 8085-3 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

ISO 8085 consists of the following parts, under the general title *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications*:

- *Part 1: Fittings for socket fusion using heated tools*
- *Part 2: Spigot fittings for butt fusion, for socket fusion using heated tools and for use with electrofusion fittings*
- *Part 3: Electrofusion fittings*

Annexes B, C and D form a normative part of this part of ISO 8085. Annex A is for information only.

In this corrected version of ISO 8085-3:2001, the reference to Table 5 in 7.2.2.2 b) has been corrected to read “conform to Table 4...”.

In addition, Clause 2 (normative references) has been updated by inserting the years of publication of ISO 9080, ISO 18553 and EN 682.

Users should further note that normative reference ASTM D 4019-94 (cited in Table 1) has been withdrawn without replacement.

Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications —

Part 3: Electrofusion fittings

1 Scope

This part of ISO 8085 specifies the requirements for polyethylene (PE) electrofusion fittings intended to be used with PE pipes and fittings for the supply of gaseous fuels.

In addition, it specifies some general properties of the material from which these fittings are made.

This part of ISO 8085 also lays down requirements for dimensions and performance of such fittings.

It is applicable to electrofusion fittings designed to be fusion-jointed to PE pipes conforming to ISO 4437, and to spigot fittings conforming to ISO 8085-2.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 8085. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 8085 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*

ISO 497:1973, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

ISO 1133:1997, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

ISO 1167:1996, *Thermoplastics pipes for the conveyance of fluids — Resistance to internal pressure — Test method*

ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics*

ISO 1872-1:1993, *Plastics — Polyethylene (PE) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 3126:—¹⁾, *Plastics piping systems — Plastics piping components — Measurement and determination of dimensions*

1) To be published. (Revision of ISO 3126:1974)

ISO 8085-3:2001(E)

ISO 4437:1997, *Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications*

ISO 6964:1986, *Polyolefin pipes and fittings — Determination of carbon black content by calcination and pyrolysis — Test method and basic specification*

ISO 8085-2:2001, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 2: Spigot fittings for butt fusion, for socket fusion using heated tools and for use with electrofusion fittings*

ISO 9356:1989, *Polyolefin pipe assemblies with or without jointed fittings — Resistance to internal pressure — Test method*

ISO 9080:2003, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO/TR 10837:1991, *Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings*

ISO/TS 10839:2000, *Polyethylene pipes and fittings for the supply of gaseous fuels — Code of practice for design, handling and installation*

ISO 11413:1996, *Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting*

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 12176-2:2000, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion*

ISO 13477:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test)*

ISO 13478:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST)*

ISO 13479:1997, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes (notch test)*

ISO 13951:2001, *Plastics piping systems — Test method for the resistance of polyolefin pipe/pipe or pipe/fitting assemblies to tensile loading*

ISO 13954:1997, *Plastics pipes and fittings — Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm*

ISO 13955:1997, *Plastics pipes and fittings — Crushing decohesion test for polyethylene (PE) electrofusion assemblies*

ISO 13957:1997, *Plastics pipes and fittings — Polyethylene (PE) tapping tees — Test method for impact resistance*

ISO 18553:2002, *Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds*

ASTM D 4019-94, *Standard Test Method for Moisture in Plastics by Coulometric Regeneration of Phosphorus Pentoxide*

EN 682:2002, *Elastomeric seals — Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids*

EN 12117:1997, *Plastics piping systems — Fittings, valves and ancillaries — Determination of gaseous flow rate/pressure drop relationships*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this part of ISO 8085, the following terms and definitions apply.

3.1 Geometrical definitions

3.1.1

nominal diameter of a fitting

d_n

the nominal diameter of a fitting is taken as the nominal diameter of the corresponding pipe series

3.1.2

nominal wall thickness of a fitting

e_n

the nominal wall thickness of a fitting is taken as the nominal wall thickness of the corresponding pipe series

3.1.3

mean inside diameter

arithmetic mean of at least two inside diameters measured at right angles to each other in transverse planes

3.1.4

out-of-roundness of a socket

maximum inside diameter minus the minimum inside diameter of the socket, measured in the same plane, parallel to the plane of the mouth

3.1.5

maximum out-of-roundness of a socket

greatest value of the out-of-roundness between the plane of the mouth and a plane separated from it by a distance L_1 (the design penetration depth)

3.1.6

standard dimension ratio of a fitting

SDR

quotient of the nominal outside diameter and the nominal wall thickness

$$\text{SDR} = \frac{d_n}{e_n}$$

3.1.7

wall thickness of a fitting

E

wall thickness at any point of the body of the fitting which could be subjected to the full stress induced by the pressure of the gas in the piping system

3.2 Material definitions

3.2.1

virgin material

thermoplastics material in a form such as granules or powder which has not been previously processed other than for compounding and to which no reprocessible or recyclable materials have been added

3.2.2

reprocessible material

thermoplastics material prepared from clean unused rejected pipes, fittings or valves, produced in a manufacturer's plant by a process such as injection-moulding or extrusion, which will be reprocessed in the same plant

NOTE Such material may include trimmings from the production of such pipes, fittings and valves.

3.2.3

compound

homogenous mixture of base polymer (PE) and additives, e.g. anti-oxidants, pigments and UV-stabilizers, at concentrations necessary for the particular application

3.3 Definitions related to material characteristics

3.3.1

lower confidence limit

σ_{cl}

quantity with the dimensions of stress, in megapascals, which can be considered as a property of the material and represents the 97,5 % lower confidence limit of the mean long-term hydrostatic strength at 20 °C for 50 years determined by pressurizing internally with water

3.3.2

overall service (design) coefficient

C

overall coefficient, with a value larger than 1,0, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit

NOTE For gas applications, C can have any value equal to or greater than 2,0.

3.3.3

minimum required strength

MRS

the value of σ_{cl} rounded down to the next lower value in the R 10 series when σ_{cl} is less than 10 MPa, or to the next lower value in the R 20 series when σ_{cl} is greater than or equal to 10 MPa

NOTE The R 10 and R 20 series are the Renard number series as defined in ISO 3 and ISO 497.

3.3.4

melt mass-flow rate

MFR

value relating to the viscosity of molten thermoplastic material at a specified temperature and rate of shear

3.4 Definitions related to service conditions

3.4.1

gaseous fuel

any fuel which is in the gaseous state at a temperature of + 15 °C and a pressure of 1 bar²⁾

2) 1 bar = 10⁵ N/m² = 0,1 MPa

3.4.2 maximum operating pressure MOP

maximum effective pressure of the gas in a piping system, expressed in bars, which is allowed in continuous use

NOTE It takes into account the physical and the mechanical characteristics of the components of a piping system and is given by the equation:

$$\text{MOP} = \frac{20 \times \text{MRS}}{C \times (\text{SDR} - 1)}$$

3.5 Definitions specific to the design of electrofusion fittings

3.5.1 electrofusion socket fitting

polyethylene (PE) fitting which contains one or more integral heating elements that are capable of transforming electrical energy into heat to produce a fusion joint with a spigot-end or a pipe

3.5.2 electrofusion saddle fitting

polyethylene (PE) fitting (top-loading or wrap-round) which contains one or more integral heating elements that are capable of transforming electrical energy into heat to produce a fusion joint with a pipe

3.5.3 tapping tee

electrofusion saddle fitting which contains an integral cutter designed to cut through the pipe wall

NOTE The cutter remains in the body of the saddle after installation.

3.5.4 branch saddle

electrofusion saddle fitting which requires an ancillary cutting tool to drill a hole in the adjoining main pipe

3.5.5 U-regulation

control of the energy supplied, during fusion-jointing of an electrofusion fitting, by regulating the voltage

3.5.6 I-regulation

control of the energy supplied, during fusion-jointing of an electrofusion fitting, by regulating the current

4 Symbols

4.1 Symbols for electrofusion socket fittings

The dimensions and the main symbols used in this part of ISO 8085 are shown in Figure 1, where

D_1 is the mean inside diameter in the fusion zone, i.e. the mean inside diameter measured in a plane parallel to the plane of the mouth at a distance of $L_3 + 0,5L_2$ from the plane of the mouth.

D_2 is the minimum bore, i.e. the minimum diameter of the flow channel through the body of the fitting.

L_1 is the design penetration depth of the pipe or of the male end of a spigot fitting.

L_2 is the nominal length of the fusion zone, corresponding to the heated length.

L_3 is the nominal unheated entrance length of the fitting, i.e. the distance between the mouth of the fitting and the near end of the fusion zone.

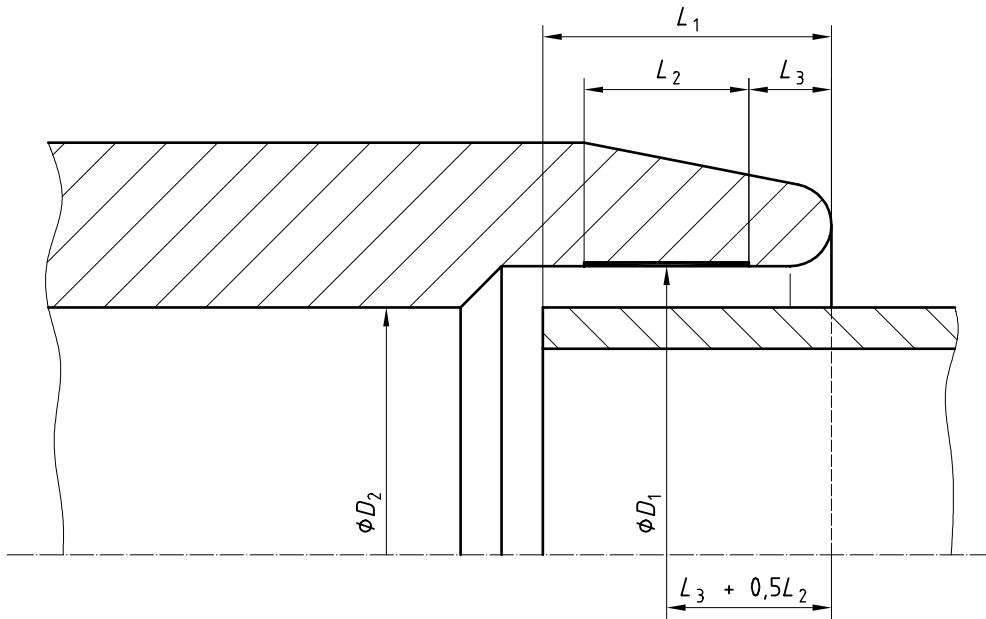


Figure 1 — Socket dimensions

4.2 Symbols for electrofusion tapping tees

The main symbols used for tapping tees are shown in Figure 2, where

- h is the height of the service pipe, i.e. the distance between the axis of the main pipe and the axis of the service pipe.
- L is the width of the tapping tee, i.e. the distance between the axis of the main pipe and the plane of the mouth of the service pipe.
- H is the height of the tapping tee, i.e. the distance from the top of the main pipe to the top of the tapping tee.

5 Material

5.1 Technical data

The technical data referred to in Table 1 concerning the materials used shall be made available by the fitting manufacturer.

Any change in the choice of materials affecting the quality shall require fresh type-testing of the fitting in accordance with clause 8.

5.2 Compound

The compound from which the fitting is produced shall be polyethylene which shall be made by adding only those additives necessary for the manufacture and end use of fittings conforming to this specification and for their fusion jointing.

All additives shall be uniformly dispersed. The additives shall not have a negative influence on the performance with respect to fusability.

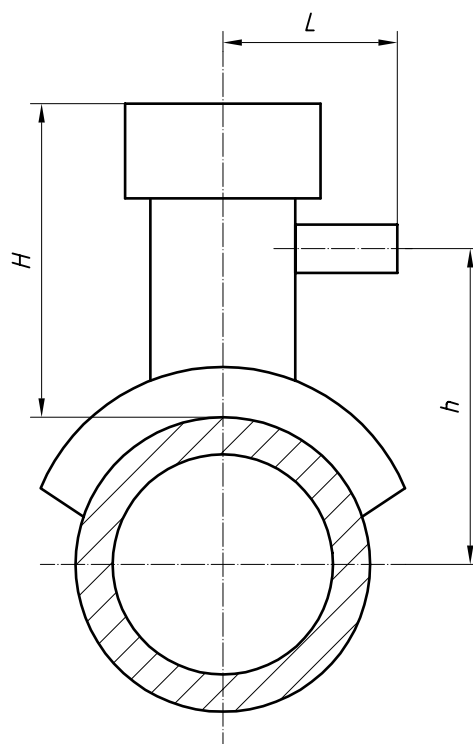


Figure 2 — Tapping tee dimensions

5.3 Reprocessable material

Only clean reprocessable material generated from a manufacturer's own production of fittings to this specification may be used, and it shall be derived from the same resin as used for the relevant production.

5.4 Characteristics of the compound

The fittings shall be made of

- a) virgin material,
- b) reprocessable material or
- c) a combination of virgin and reprocessable material.

The PE compound from which the fitting is manufactured shall conform to the requirements given in Table 1.

Table 1 — Characteristics of the PE compound ^{a)}

Property	Units	Requirement	Test parameters	Test method
Density	kg/m ³	≥ 930 (base polymer)	23 °C	ISO 1183, ISO 1872-1
Melt mass-flow rate	g/10 min	± 20 % of value declared by compound producer	190 °C/5 kg (set of conditions T)	ISO 1133:1997
Thermal stability	minutes	> 20	200 °C ^b	ISO/TR 10837
Volatile-matter content	mg/kg	≤ 350		ISO 4437:1997, annex A
Water content ^c	mg/kg	≤ 300		ASTM D 4019
Carbon black content ^d	% (m/m)	2,0 % to 2,5 %		ISO 6964
Carbon black dispersion ^d	grade	≤ 3		ISO 18553
Pigment dispersion ^e	grade	≤ 3		ISO 18553
Resistance to gas constituents	h	≥ 20	80 °C, 2 MPa	ISO 4437:1997, annex B
Resistance to rapid crack propagation (RCP): ^f Full-scale (FS) test: $d_n > 250$ mm or S4 test ^g	MPa MPa	The critical pressure in the FS test shall be greater than or equal to the value of the MOP of the system multiplied by 1,5 The critical pressure in the S4 test shall be greater than or equal to the value of the MOP of the system divided by 2,4, minus 0,72 (expressed in bars) ^h	0 °C 0 °C	ISO 13478 ISO 13477
Resistance to slow crack growth, $e_n > 5$ mm ^f	h	165	80 °C, 8,0 bar ⁱ 80 °C, 9,2 bar ^j	ISO 13479

^a Non-black compounds shall conform to the weathering requirements of ISO 4437.

^b Test may be carried out at 210 °C provided that there is a clear correlation with the results at 200 °C. In cases of dispute the reference temperature shall be 200 °C.

^c Only applicable if the compound does not conform to the requirement for volatile-matter content. In cases of dispute, the requirement for water content shall apply.

^d For black compounds only.

^e Pigment dispersion method for non-black compounds only.

^f Only applicable to material in pipe form.

^g Shall be performed on pipe with a wall thickness ≥ 15 mm.

^h If this requirement is not met, then retesting using the full-scale (FS) test shall be performed (the calculation formula is still under study).

ⁱ Test parameters for PE 80, SDR 11.

^j Test parameters for PE 100, SDR 11.

5.5 Classification

PE compounds shall be classified by MRS as specified in Table 2.

Table 2 — Classification of PE compounds

Designation	σ_{cl} (20 °C, 50 years, 97,5 %) MPa	MRS MPa
PE 80	$8,00 \leq \sigma_{cl} \leq 9,99$	8,0
PE 100	$10,00 \leq \sigma_{cl} \leq 11,19$	10,0

The classification shall be established by the producer of the compound using the ISO 9080 extrapolation method and stated in accordance with ISO 12162.

5.6 Compatibility

Conformity to clause 8 shall be established by the fitting manufacturer to ensure compatibility of the fittings with PE pipes conforming to ISO 4437. The PE pipe compound(s) used for this demonstration, the fusion condition(s) and the tooling shall be as detailed in the fitting manufacturer's technical file (see clause 10).

5.7 Materials for non-polyethylene parts

5.7.1 General

All materials shall conform to the relevant International Standards, except where suitable International Standards do not exist in which case alternative standards may be utilized. In all cases, however, fitness for purpose of the components shall be established.

All materials used in making the fitting (including rubber, greases and any metal parts which may be used) shall be as resistant to the external and internal environment as the other elements of the piping system and shall have a life expectancy, under the following conditions, at least equal to that of the PE piping, conforming to ISO 4437, with which they are intended to be used:

- a) during storage;
- b) under exposure to the gas conveyed therein;
- c) under exposure to the service environment under the operating conditions.

The requirements for the level of material performance of non-polyethylene parts shall be at least as stringent as those for the PE compound used for the piping system.

Fitting materials in contact with the PE pipe shall not adversely affect pipe performance or initiate stress cracking.

5.7.2 Metal parts

All parts susceptible to corrosion shall be adequately protected.

When dissimilar metallic materials which may be in contact with moisture are used, steps shall be taken to avoid galvanic corrosion.

All metal parts shall conform to the relevant International Standards, if such exist, for quality and grade.

5.7.3 Elastomers

Elastomeric seals shall conform to EN 682.

Other sealing materials intended for gas supply service may be used.

5.7.4 Other materials

Greases and lubricants shall not exude onto fusion areas, and shall not affect the long-term performance of fitting materials.

Any other material conforming to 5.7.1 may be used, provided that it is established that the fittings containing these materials conform to this part of ISO 8085.

6 General requirements

6.1 Multiple connections

If a fitting includes one or more spigot ends, these shall conform to the relevant product standard.

6.2 Appearance of the fitting

When viewed without magnification, the internal and external surfaces shall be smooth, clean and free from scoring, cavities and other surface defects which might prevent conformity to this part of ISO 8085.

6.3 Design

The design of the fitting shall be such that, when the fitting is assembled with a pipe or with another fitting, electrical coils and/or seals are not displaced.

6.4 Appearance of the joint (factory-made)

When viewed without magnification, the internal and external surfaces of the pipe and fitting after fusion-jointing shall be free from melt exudation outside the confines of the fitting, apart from that which may be declared acceptable by the fitting manufacturer.

Any such exudation shall not cause wire movement which could result in short-circuiting when the fitting is jointed in accordance with the manufacturer's instructions. There shall be no excessive deformation of the internal surfaces of the adjoining pipes.

6.5 Electrical characteristics (electrofusion fittings)

The electrical protection provided will depend on the voltage and current used and on the characteristics of the electrical-power source.

For voltages greater than 25 V, direct human contact with live parts shall not be possible during the fusion-jointing cycle when jointing is carried out in accordance with the instructions of the fitting manufacturer and assembly equipment manufacturer.

NOTE During the fusion-jointing process, the fitting is part of an electrical system as defined in IEC 60335-1, IEC 60364-1 and IEC 60449.

The resistance of the wire at 23 °C shall be as stated by the manufacturer to within the following tolerance limits:

maximum limit: stated value + 10 % + 0,1 Ω

minimum limit: stated value – 10 %

The 0,1 Ω added to the maximum limit is to allow for any contact resistance which may exist during measurement.

The protection against direct contact with live parts shall conform to IEC 60529. This protection will depend on worksite conditions (see ISO/TS 10839).

NOTE See annex A for examples of typical connector sockets.

The surface finish on the connector pins shall ensure minimum contact resistance.

7 Geometrical characteristics

7.1 General

The dimensions of the fittings shall be measured, not less than 24 h after manufacture, in accordance with ISO 3126, after being conditioned for at least 4 h without any support for re-rounding of the fusion ends.

This part of ISO 8085 concerns only fittings and assemblies and is not concerned with the fusion-jointing equipment.

The fittings are designated by the nominal diameter of the socket or saddle, which corresponds to the nominal outside diameter d_n of the pipe with which they are to be used.

7.2 Electrofusion socket fittings

7.2.1 Diameters and lengths of sockets

The depth of penetration L_1 and the minimum length of the fusion zone are given in Table 3. The values of L_1 are given for both I- and U-regulation.

In addition to the values given in Table 1, the following requirements apply:

$$L_3 \geq 5 \text{ mm}$$

$$D_2 \geq d_n - 2e_{\min}$$

where e_{\min} is the minimum wall thickness specified for corresponding pipe conforming to ISO 4437.

Formulae for calculating the equivalent dimensions of non-metric fitting series are given in annex B.

The mean inside diameter of the fitting in the middle of the fusion zone, D_1 , shall not be less than d_n .

The manufacturer shall declare the actual minimum and maximum values of D_1 , to allow the end user to determine the suitability of the fittings for clamping and joint assembly.

In the case of a fitting having sockets of differing sizes, each one shall conform to the requirements for the corresponding nominal diameter.

Table 3 — Socket dimensions

Dimensions in millimetres

Nominal diameter of fitting d_n	Depth of penetration L_1			Minimum nominal length of fusion zone $L_2 \text{ min}$
	min.		max.	
	Current regulation	Voltage regulation		
16	20	25	41	10
20	20	25	41	10
25	20	25	41	10
32	20	25	44	10
40	20	25	49	10
50	20	28	55	10
63	23	31	63	11
75	25	35	70	12
90	28	40	79	13
110	32	53	82	15
125	35	58	87	16
140	38	62	92	18
160	42	68	98	20
180	46	74	105	21
200	50	80	112	23
225	55	88	120	26
250	73	95	129	33
280	81	104	139	35
315	89	115	150	39
355	99	127	164	42
400	110	140	179	47
450	122	155	195	51
500	135	170	212	56
560	147	188	235	61
630	161	209	255	67

7.2.2 Wall thickness E of the fitting

7.2.2.1 General

Appropriate combinations of the wall thickness E of the fitting and of the minimum required strength MRS selected in accordance with 5.5 shall be used in the production of fittings conforming to this part of ISO 8085.

Fittings and associated fusion joints shall meet the requirements for mechanical characteristics given in 8.1 (Table 5).

Any changes in wall thickness inside the body of the fitting shall be gradual in order to prevent stress concentrations.

7.2.2.2 Relationship between fitting and pipe wall thickness

Fittings and associated fusion joints shall meet the performance requirements given in 8.2 (Table 7) or, alternatively, the wall thickness of the fitting E shall

- a) be greater than or equal to the minimum wall thickness of the corresponding pipe e_{\min} at every part of the fitting located at a distance beyond $2L_1/3$ from any entrance face of the fitting, when the fitting and the corresponding pipe are made from polyethylene with the same MRS classification;
- b) conform to Table 4 when the fitting and the corresponding pipe are not made from polyethylene with the same MRS classification.

Table 4 — Relationship between fitting and pipe wall thickness

Pipe and fitting material		Relationship between fitting (E) and pipe (e_n) wall thickness
Pipe	Fitting	
PE 80	PE 100	$E \geq 0,8e_n$
PE 100	PE 80	$E \geq e_n/0,8$

7.2.3 Out-of-roundness of the socket

When a fitting leaves the manufacturer's production site, the maximum out-of-roundness of the fitting socket(s) shall not exceed $0,015d_n$.

7.3 Electrofusion saddle fittings

Outlets from tapping tees and branch saddles shall have spigots conforming to ISO 8085-2 or sockets conforming to this part of ISO 8085.

The manufacturer shall specify the characteristic overall dimensions of the fittings in a technical file. These dimensions shall include the maximum height of the saddle, H , and for tapping tees the height of the service pipe, h .

7.4 Other dimensions

Other dimensions and dimensional characteristics appropriate to each manufacturer, such as the overall dimensions or mounting dimensions, shall be as specified in the manufacturer's technical file.

In the case of a coupling without an internal stop or a coupling with a removable centre register, the geometry of the fitting shall allow penetration of the pipe through the fitting.

8 Mechanical characteristics

8.1 General

Fittings shall be tested using pipes which conform to ISO 4437. Test assemblies shall be assembled in accordance with ISO 11414 and in accordance with the manufacturer's instructions, using fusion-jointing equipment conforming to ISO 12176-1.

When tested in accordance with the methods specified in Table 5, using the parameters indicated, the fitting/pipe assemblies shall have mechanical characteristics conforming to the requirements given in Table 5.

Table 5 — Mechanical properties

Property	Units	Requirement ^a	Test parameters		Test method
Hydrostatic strength at 20 °C	h	Failure time \geq 100	End caps Orientation Conditioning time Type of test Pressure calculated to produce the following circumferential (hoop) stress: PE 80 pipe PE 100 pipe Test temperature	Type a) Unimportant 1 h Water-in-water 10 MPa 12,4 MPa 20 °C	ISO 9356
Hydrostatic strength at 80 °C	h	Failure time \geq 165	End caps Orientation Conditioning time Type of test Pressure calculated to produce the following circumferential (hoop) stress: PE 80 pipe PE 100 pipe Test temperature	Type a) Unimportant 12 h Water-in-water 4,6 MPa 5,5 MPa 80 °C	ISO 9356
Hydrostatic strength at 80 °C	h	Failure time \geq 1 000	End caps Orientation Conditioning time Type of test Pressure calculated to produce the following circumferential (hoop) stress: PE 80 pipe PE 100 pipe Test temperature	Type a) Unimportant 12 h Water-in-water 4 MPa 5 MPa 80 °C	ISO 9356
Decohesive strength	%	Percentage brittle-failure decohesion \leq 33,3 %	Test temperature	23 °C	ISO 13954 ^b ISO 13955 ^b
Impact resistance ^c		No failure No leakage	Test temperature Drop height Mass of striker	0 °C 2 m 2,5 kg	ISO 13957
Pressure drop ^c	mbar	$d_n \leq 63$: 0,5 mbar $d_n > 63$: 0,1 mbar	Air flow rate Test medium Test pressure	As indicated by the manufacturer Air 25 mbar	EN 12117

^a For the hydrostatic strength test at 80 °C, only brittle failures shall be taken into account. If ductile failure occurs before the required time, a lower stress shall be selected and the minimum test time shall be obtained from the line through the stress/time points given in Table 6.

^b For socket fittings only (use either method). No suitable International Standard exists at present for tapping tees, although a standard is in preparation (future ISO 13956). In the interim, use a method agreed between the interested parties.

^c For tapping tees only.

Table 6 — Hydrostatic strength (80 °C) — Stress/minimum failure time correlation

PE 80		PE 100	
Stress MPa	Minimum failure time h	Stress MPa	Minimum failure time h
4,6	165	5,5	165
4,5	219	5,4	233
4,4	293	5,3	332
4,3	394	5,2	476
4,2	533	5,1	688
4,1	727	5,0	1 000
4,0	1 000	—	—

In the event of modification of the fusion-jointing parameters, the manufacturer shall ensure that the joint conforms to clause 8.

When preparing test assemblies, it shall be borne in mind that dimensional variations may occur due to manufacturing tolerances and assembly tolerances, and consideration shall be given to the fact that the fittings may be used at different ambient temperatures.

NOTE It is recommended that the manufacturer take into consideration the code of practice for design, handling and installation of PE fittings given in ISO/TS 10839.

8.2 Relationship between fitting and pipe wall thickness

The performance requirements specified in 7.2.2.2 shall be verified by the tests given in Table 7.

Table 7 — Performance requirements

Property	Units	Requirement	Test parameters		Test method
Short-term internal-pressure resistance	bar	Failure pressure shall be greater than pressure equivalent of $2,00 \times MRS$ calculated for thickest-walled pipe for which fitting has been designed	End caps Orientation Conditioning time Type of test Minimum pressure: PE 80 pipe, SDR 11 PE 100 pipe, SDR 11 Pressure increase rate Test temperature	Type a) Unimportant 12 h Water-in-water 32 bar 40 bar 5 bar/min 20 °C	Annex C
Resistance to tensile load ^a	—	Minimum elongation shall be 25 % before pipe yields	Test temperature	23 °C	Annex D

^a Limited to fitting/pipe assemblies for which the wall thickness of the fitting is greater than that of the pipe. In other cases, equivalent tensile tests shall be carried out as agreed between manufacturer and purchaser.

9 Physical characteristics

When determined in accordance with the methods specified in Table 8, using the test parameters indicated, the physical characteristics of the fittings shall conform to the requirements given in Table 8.

Table 8 — Physical characteristics of fittings

Characteristic	Units	Requirement	Test parameters	Test method
Thermal stability	minutes	> 20	200 °C ^a	ISO/TR 10837
Melt mass-flow rate (MFR)	g/10 min	The MFR of the material of the manufactured fitting shall not differ by more than ± 20 % from the MFR of the batch compound from which the fitting was manufactured	190 °C/5 kg (set of conditions T)	ISO 1133
^a The test may be carried out at 210 °C provided that there is a clear correlation with the results at 200 °C. In cases of dispute, the reference temperature shall be 200 °C.				

10 Technical file

The manufacturer of the fittings shall ensure the availability of a technical file (generally confidential) containing all relevant data necessary to prove the conformity of the fittings to this part of ISO 8085. The file shall include all results of type-testing and shall conform to the relevant publicly available technical brochure. It shall also include all data necessary to implement a traceability system where required.

The manufacturer's technical file shall include at least the following information:

- a) conditions of use (pipe and fitting temperature limits, SDRs and out-of-roundness);
- b) dimensions;
- c) assembly instructions;
- d) required fusion-jointing equipment;
- e) fusion-jointing instructions (fusion-jointing parameters with limits);
- f) for saddles and tapping tees:
 - 1) the means of attachment (whether an underclamp is used and details of any other auxiliary equipment necessary),
 - 2) whether it is necessary to hold the underclamp in position in order to ensure satisfactory performance of the assembly.

If applicable, the fact that the production site is certified to e.g. ISO 9001 or ISO 9002 shall also be stated in the technical file.

11 Marking

11.1 General

Unless otherwise specified in Table 9, the marking elements shall be printed or formed directly on the fitting in such a way that, after storage, handling and installation in accordance with ISO/TS 10839, legibility is maintained.

NOTE The manufacturer is not responsible for marking being illegible due to actions caused during installation and use such as painting, scratching, covering of the components or using detergents on the components unless agreed to or specified by the manufacturer.

Marking shall not initiate cracks or other types of defect which adversely influence the performance of the fitting.

If printing is used, the colour of the printed information shall differ from the basic colour of the fitting.

The size of the markings shall be such that they are legible without magnification.

11.2 Minimum required marking

The minimum required markings are specified in Table 9.

Table 9 — Minimum required markings

Item	Marking
Reference to this part of ISO 8085 ^a	ISO 8085-2
Manufacturer's name and/or trademark ^b	Name or symbol
Nominal diameter(s) d_n of pipe(s) to which fitting is intended to be jointed	e.g. 110
Material and designation	e.g. PE 80
Applicable pipe series	SDR (e.g. SDR 11 and/or SDR 17,6) or SDR range
Manufacturing information ^b	— the production period (year and month in figures or in code); — name or code for production site if manufacturer produces at different sites, nationally and/or internationally.
Fluid to be conveyed ^a	Gas
^a This information may be printed on a label associated with the fitting or on the bag containing an individual fitting. ^b To provide traceability.	

11.3 Additional marking

Additional information relative to the fusion-jointing conditions, e.g. fusion and cooling time, may be given on a label which may be attached to a fitting or may be separate from the fitting.

12 Packaging

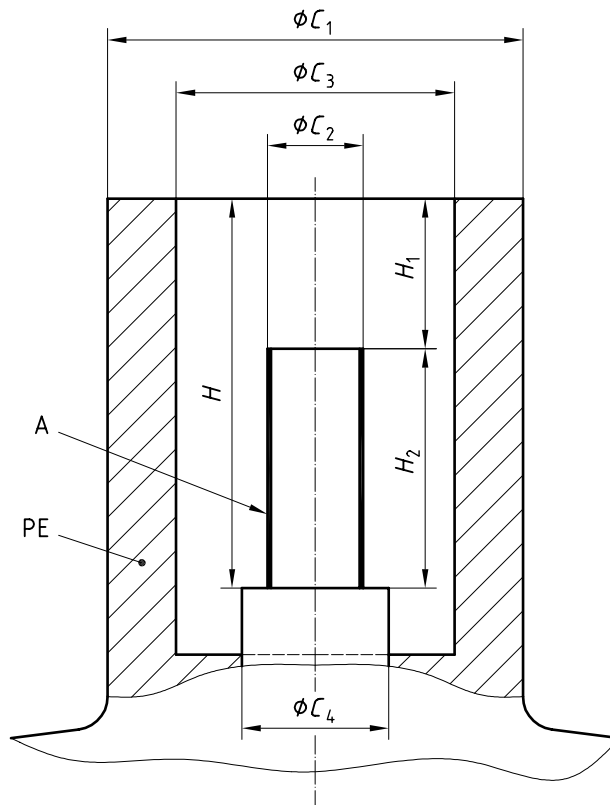
The fittings shall be packaged in bulk or individually protected where necessary in order to prevent deterioration. Whenever possible, they shall be placed in individual bags in cardboard boxes or cartons.

The boxes or cartons and/or the individual bags shall bear at least one label with the manufacturer's name, the type of part, the dimensions of the part, the number of units in the box or carton, and any special storage conditions and storage time limits.

Annex A (informative)

Examples of typical connector sockets for electrofusion fittings

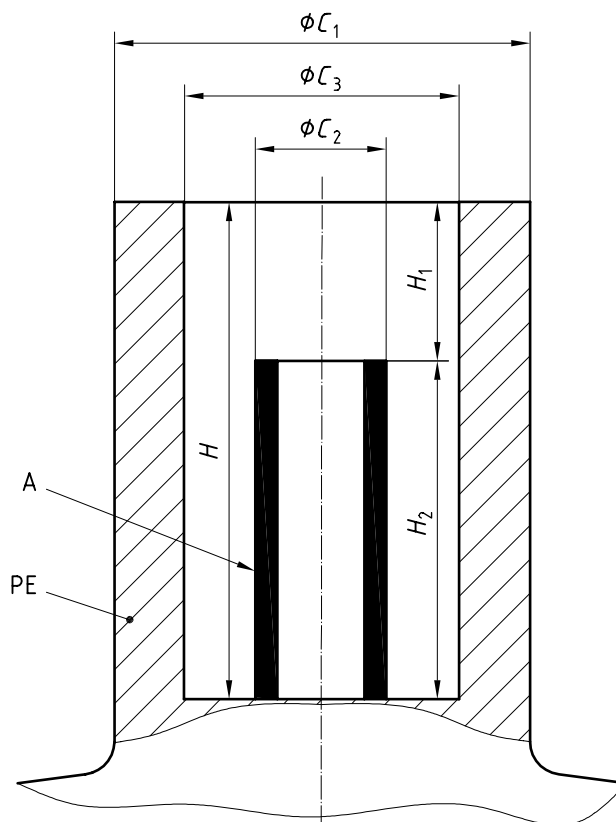
Figures A.1 and A.2 illustrate examples of connector sockets suitable for use with voltages less than or equal to 48 V (type A and type B sockets).



Key (dimensions in millimetres)

A	Live zone	
C_1	Outside diameter of socket	$C_1 \geq 11,8$
C_2	Diameter of live part of socket	$C_2 = 4,0 \pm 0,03$
C_3	Inside diameter of socket	$C_3 \leq 9,5 \begin{smallmatrix} 0 \\ -1,0 \end{smallmatrix}$
C_4	Maximum overall diameter of base of live part	$C_4 \leq 6,0$
H	Inside depth of socket	$H \geq 12,0$
H_1	Distance between far end of socket and live part	$H_1 = 3,2 \pm 0,5$
H_2	Depth of live part of socket	

Figure A.1 — Typical type A socket

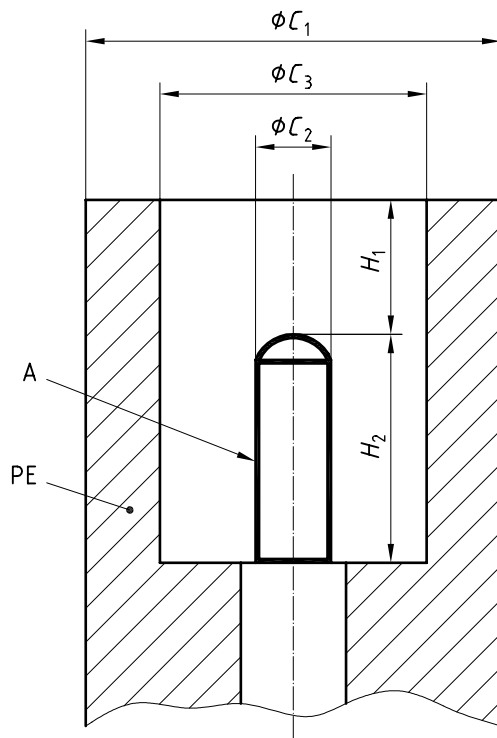


Key (dimensions in millimetres)

A	Live zone	
C_1	Outside diameter of socket	$C_1 = 13,0 \pm 0,5$
C_2	Diameter of live part of socket	$C_2 = 4,7 \pm 0,03$
C_3	Inside diameter of socket	$C_3 = 10,0 \pm 0,1$
H	Inside depth of socket	$H \geq 15,5$
H_1	Distance between far end of socket and live part	$H_1 = 4,5 \pm 0,5$
H_2	Depth of live part of socket	

Figure A.2 — Typical type B socket

Figure A.3 illustrates an example of a typical electrofusion connector socket suitable for use with voltages up to 250 V (type C).



Key (dimensions in millimetres)

A Live zone

C_1 Outside diameter of socket

$$C_1 \geq C_3 + 2,0$$

C_2 Diameter of live part of socket

$$C_2 \geq 2,0$$

C_3 Inside diameter of socket

$$C_3 \geq C_2 + 4,0$$

H_1 Distance between far end of socket and live part

Sufficient to ensure a degree of protection of IP 2 X as defined in IEC 60529:2001

H_2 Depth of live part of socket

$$H_2 \geq 7,0$$

Figure A.3 — Typical type C socket

Annex B (normative)

Formulae for calculating the equivalent dimensions of non-metric fitting series

B.1 For I-regulation, the minimum value of the penetration depth L_1 is given by

$$L_1 = 20 \text{ mm} \quad \text{for } d_n < 50 \text{ mm};$$

$$L_1 = 0,2 \times d_n + 10 \text{ mm} \quad \text{for } 50 \text{ mm} \leq d_n < 250 \text{ mm};$$

$$L_1 = 0,245 \times d_n + 12 \text{ mm} \quad \text{for } 250 \text{ mm} \leq d_n < 500 \text{ mm};$$

$$L_1 = 0,2 \times d_n + 35 \text{ mm} \quad \text{for } 500 \text{ mm} \leq d_n \leq 630 \text{ mm}.$$

B.2 For U-regulation, the minimum value of the penetration depth L_1 is given by

$$L_1 = 25 \text{ mm} \quad \text{for } d_n < 50 \text{ mm};$$

$$L_1 = 0,3 \times d_n + 12,5 \text{ mm} \quad \text{for } 50 \text{ mm} \leq d_n < 110 \text{ mm};$$

$$L_1 = 0,3 \times d_n + 20 \text{ mm} \quad \text{for } 110 \text{ mm} \leq d_n \leq 630 \text{ mm}$$

B.3 The maximum value of the penetration depth L_1 is given by

$$L_1 = 41 \text{ mm} \quad \text{for } d_n < 32 \text{ mm};$$

$$L_1 = 0,6 \times d_n + 25 \text{ mm} \quad \text{for } 32 \text{ mm} \leq d_n < 110 \text{ mm};$$

$$L_1 = 0,335 \times d_n + 44,85 \text{ mm} \quad \text{for } 110 \text{ mm} \leq d_n < 250 \text{ mm};$$

$$L_1 = 0,333 \times d_n + 45,5 \text{ mm} \quad \text{for } 250 \text{ mm} \leq d_n < 560 \text{ mm};$$

$$L_1 = 0,286 \times d_n + 75 \text{ mm} \quad \text{for } 560 \text{ mm} \leq d_n \leq 630 \text{ mm}.$$

B.4 The minimum length of the fusion zone L_2 is given by

$$L_2 = 10 \text{ mm} \quad \text{for } d_n < 50 \text{ mm};$$

$$L_2 = 0,091 \times d_n + 5,1 \text{ mm} \quad \text{for } 50 \text{ mm} \leq d_n < 250 \text{ mm};$$

$$L_2 = 0,09 \times d_n + 10,2 \text{ mm} \quad \text{for } 250 \text{ mm} \leq d_n < 400 \text{ mm};$$

$$L_2 = 0,087 \times d_n + 12 \text{ mm} \quad \text{for } 400 \text{ mm} \leq d_n \leq 630 \text{ mm}.$$

B.5 The minimum unheated entrance length L_3 shall be 5 mm.

B.6 The minimum bore D_2 is given by

$$D_2 \geq d_n - 2 \times e_{\min}$$

where e_{\min} is the minimum wall thickness specified for the corresponding pipe conforming to ISO 4437.

B.7 All results shall be rounded to the nearest millimetre.

Annex C (normative)

Short-term pressure test method

C.1 Principle

A test piece, consisting of an electrofusion fitting assembled with one or more PE pipes with reduced free length sufficient to suppress pipe failure and create preferential failure in the fitting or in the connecting-pipe-to-fitting joint, is placed in a controlled-temperature environment and subjected to an essentially continually increasing internal hydraulic pressure until failure of the test piece occurs. The method is designed to establish the short-term failure pressure of the fitting/pipe assembly.

C.2 Apparatus

C.2.1 Constant-temperature water bath, conforming to the requirements of ISO 1167:1996, capable of being maintained at $(20 \pm 2)^\circ\text{C}$.

C.2.2 Pressure test equipment, conforming to the requirements of ISO 1167:1996, capable of applying a continuously increasing internal hydraulic pressure at a rate of (5 ± 1) bar/min until the test piece fails.

C.2.3 Pressure gauge, with an accuracy of not less than 1 % of full-scale deflection and with a hand which indicates the maximum pressure reached. A gauge shall be used that will indicate the failure pressure at approximately mid-scale. The gauge should preferably be equipped with a surge protection device.

The gauge shall be located in a position within the pressure system where it will indicate the internal pressure of the test piece without being affected by pressure transients within the pressure supply lines, etc.

C.3 Test piece

The test piece shall be an assembly of one or more electrofusion fittings connected to PE pipes, with a minimum free pipe length between fittings of any type not exceeding d_n .

The pipes used shall be the thickest-walled pipe for which the fitting has been designed.

The test piece shall be closed with type a) end caps as illustrated in ISO 1167:1996.

C.4 Procedure

Attach the end caps to the test piece and fill it with water at ambient temperature.

Connect the test piece to the pressure source, ensuring that no air is trapped in the test assembly.

Immerse the test piece in the constant-temperature bath and condition it at $(20 \pm 2)^\circ\text{C}$ for at least as long as the period defined in ISO 1167 for the appropriate pipe wall thickness.

Increase the pressure uniformly at a rate of (5 ± 1) bar/min until failure of the test piece occurs.

Record the pressure at failure.

After testing, inspect the test piece and record the location and mode of failure.

C.5 Test report

The test report shall include the following information:

- a) a reference to this part of ISO 8085;
- b) all details necessary for complete identification of the pipes and socket fusion fittings used, including manufacturer, type of material, and size of fitting and pipe;
- c) details of the fusion-jointing procedure used to assemble the test piece;
- d) the pressure at failure;
- e) the time to failure;
- f) the failure location;
- g) the mode of failure, e.g ductile in fitting, brittle along fusion interface;
- h) any factors which may have affected the results, such as any incidents or operating details not specified in this part of ISO 8085;
- i) the date of the test.

Annex D (normative)

Tensile test for fitting/pipe assemblies

D.1 Principle

A test piece consisting of an electrofusion fitting and two connecting PE pipes is subjected to an increasing tensile load at a constant pulling rate until ductile pipe failure occurs. The test is conducted at a constant temperature and is intended to simulate the creation of longitudinal tensile loading along a pipeline as a consequence of external mechanical interference. Rupture of the fitting or the connecting fusion joints is not an acceptable failure mode.

D.2 Apparatus

Generally in accordance with ISO 13951, with the additional requirement that the tensile-testing machine shall be capable of accommodating a test piece elongation of 25 % and sustaining a constant test speed of 5 mm/min \pm 25 %.

D.3 Test piece

As specified in ISO 13951.

In cases, when $d_n \geq 180$ mm, where the conduct of tensile tests on fitting/pipe assemblies is beyond the limits of the available test equipment, the testing of joint segments may be appropriate. Testing of segment test pieces shall not be undertaken, however, unless a correlation with testing of complete pipe/joint assemblies has been established.

D.4 Procedure

In accordance with ISO 13951, but without the requirement for the load to be constant. The pulling rate shall be 5 mm/min \pm 25 %, sustained until a test piece elongation of 25 % is reached.

D.5 Test report

The test report shall include the following information:

- a) a reference to this part of ISO 8085;
- b) all details necessary for complete identification of the pipes and electrofusion fittings used, including manufacturer, type of material, and size of fitting and pipe;
- c) details of the fusion-jointing procedure used to assemble the test piece;
- d) the test temperature;
- e) the leaktightness and integrity of the fitting and fusion joint after 25 % elongation of the test piece;
- f) any factors that may have affected the results, such as any incidents or operating details not specified in this part of ISO 8085;
- g) the date of the test.

Bibliography

- [1] IEC 60335-1:2001, *Household and similar electrical appliances — Safety — Part 1: General requirements*
- [2] IEC 60364-1:2001, *Electrical installations of buildings — Part 1: Fundamental principles, assessment of general characteristics, definitions*
- [3] IEC 60449:1973, *Voltage bands for electrical installations of buildings*

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