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11413

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

*Tubes et raccords en matières plastiques — Préparation d'éprouvettes
par assemblage tube/raccord électrosoudable en polyéthylène (PE)*



Reference number
ISO 11413:1996(E)

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.

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.

International Standard ISO 11413 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 5, *General properties of pipes, fittings and valves of plastic materials and their accessories — Test methods and basic specifications*.

Annexes A to C form an integral part of this International Standard. Annex D is for information only.

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Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting

1 Scope

This International Standard specifies a method for the preparation of test pieces assembled from polyethylene (PE) pipes or spigot-ended fittings and electrofusion fittings (e.g. socket fittings such as couplers, or saddles).

The assembly criteria specified include parameters such as ambient temperature, fusion conditions, fitting and pipe dimensions and pipe shape, taking into account the limiting service conditions specified by the relevant product standards.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4427:—¹⁾, *Polyethylene (PE) pipes for water supply — Specifications.*

ISO 4437:—²⁾, *Plastics pipes and fittings — Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications.*

ISO 8085-2:—¹⁾, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels —*

Metric series — Specifications — Part 2: Spigot fittings for butt fusion jointing, for socket fusion using heated tools and for use with electrofusion fittings.

ISO 8085-3:—¹⁾, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings.*

ISO 12093:—¹⁾, *Plastics pipes and fittings — Content of a manufacturer's technical-data file for polyolefin electrofusion fittings.*

3 Symbols

3.1 General symbols (see figure A.1)

D_{im}	the mean inside diameter of the fusion zone of a fitting in the radial plane located a distance $L_3 + 0,5 L_2$ from the face of the fitting socket;
$D_{im,max}$	the maximum theoretical value of D_{im} as declared by the fitting manufacturer;
$D_{i,max}$	the maximum inside diameter of the fusion zone of the fitting;
$D_{i,min}$	the minimum inside diameter of the fusion zone of the fitting;
d_e	the outside diameter of a pipe or fitting spigot;
d_{em}	the mean outside diameter of a pipe or fitting spigot in conformance with the relevant ISO standard for the product concerned and calculated from the measured circumference;

1) To be published.

2) To be published. (Revision of ISO 4437:1988)

- d_{emp} the mean outside diameter of a pipe or fitting spigot after preparation for assembly with the outer layer removed by scraping or peeling and calculated from the circumference measured in a radial plane coincident with the centre of the fusion zone at a distance $L_3 + 0,5 L_2$ from the face of the fitting socket after assembly;
- L_2 the nominal length of the fusion zone as indicated by the fitting manufacturer;
- L_3 the nominal distance from the face of the fitting socket to the leading edge of the fusion zone;
- e_s the depth of scraping or the thickness of material removed from the pipe surface by peeling.

3.2 Clearances

3.2.1 Socket fittings

- C_1 the clearance between fitting bore and outside diameter of unscraped pipe.

$$C_1 = D_{im} - d_{em}$$

- C_2 the clearance between fitting bore and outside diameter of scraped pipe.

$$C_2 = C_1 + 2e_s$$

NOTE 1 C_2 may be obtained by machining the unscraped pipe to bring its mean outside diameter d_{em} to the value d_{emp} calculated from the equation

$$d_{emp} = D_{im} - C_2$$

- C_3 the maximum theoretical clearance between fitting bore and outside diameter of unscraped pipe.

$$C_3 = D_{im,max} - d_e$$

- C_4 the maximum theoretical clearance between fitting bore and outside diameter of scraped pipe.

$$C_4 = C_3 + 2e_s$$

NOTE 2 C_4 may be obtained by machining the unscraped pipe to bring its mean outside diameter d_{em} to the value d_{emp} calculated from the equation

$$d_{emp} = D_{im} - C_4$$

3.2.2 Saddles

The clearance between saddle fittings and pipes is assumed to be zero.

3.3 Ambient temperature

- T_a the ambient temperature at which a joint is made.

NOTE 3 The ambient temperature may vary from the minimum temperature T_{min} to the maximum temperature T_{max} as specified either in the product standard or by agreement between the manufacturer and the purchaser.

- T_R the reference ambient temperature of $23\text{ °C} \pm 2\text{ °C}$;

- T_{max} the maximum permitted ambient temperature for joint assembly;

- T_{min} the minimum permitted ambient temperature for joint assembly.

3.4 Fusion parameters

- Reference time, t_R : The theoretical fusion time indicated by the fitting manufacturer for the reference ambient temperature.
- Fusion energy: The electrical energy supplied during the fusion jointing cycle as measured at the terminals of the fitting at a given ambient temperature T_a and for electrical parameters whose values lie within the tolerance ranges declared by the manufacturer. The fitting manufacturer is generally required to state in the technical file in accordance with clause 5 of ISO 12093:— any variations in fusion energy input required as a function of the ambient temperature in the range T_{min} to T_{max} .
- Usual energy: The fusion energy supplied to a fitting at the reference ambient temperature T_R , generated using the nominal fusion parameters defined by the fitting manufacturer on the basis of table 9 of ISO 12093:—.
- Reference energy: The usual energy supplied to a fitting having a nominal electrical resistance defined by the manufacturer on the basis of table 6 of ISO 12093:—.
- Maximum energy: The maximum value of the fusion energy supplied for jointing at a given ambient temperature T_a .
- Minimum energy: The minimum value of the fusion energy supplied for jointing at a given ambient temperature T_a .

4 Joint assembly

4.1 General

The joints shall be made using pipes and/or spigot-ended fittings in conformance with ISO 4437, ISO 4427 and ISO 8085-2, and fittings for which the dimensions conform to ISO 8085-3. The preparation of

the assembly for testing shall be carried out in accordance with the electrofusion-fitting manufacturer's written procedures.

Unless a greater scraping depth is recommended by the manufacturer, the minimum scraping depth e_s shall be 0,2 mm.

4.2 Procedure

Carry out the following procedure, where steps d) and f) shall be carried out in a temperature-controlled chamber able to maintain the temperature to within $\pm 2^\circ\text{C}$ and large enough to contain the fitting, the pipes and the holding apparatus. Fittings shall not be used within 170 h of manufacture.

- a) Measure, at the reference temperature T_R , the parts to be joined to determine the dimensional characteristics defined in 3.1 and illustrated in figure A.1.
- b) Prepare the pipes to achieve the necessary clearance conditions, at the reference temperature T_R , as given in 3.2.

- c) Mount the fitting on the pipes in accordance with the manufacturer's instructions.
- d) Condition the assembly and the associated apparatus for at least 4 h at the applicable ambient temperature T_a specified in annex C.
- e) After conditioning, measure the resistance of the heating coil and determine the values of the electrical parameters in accordance with annexes C and D.

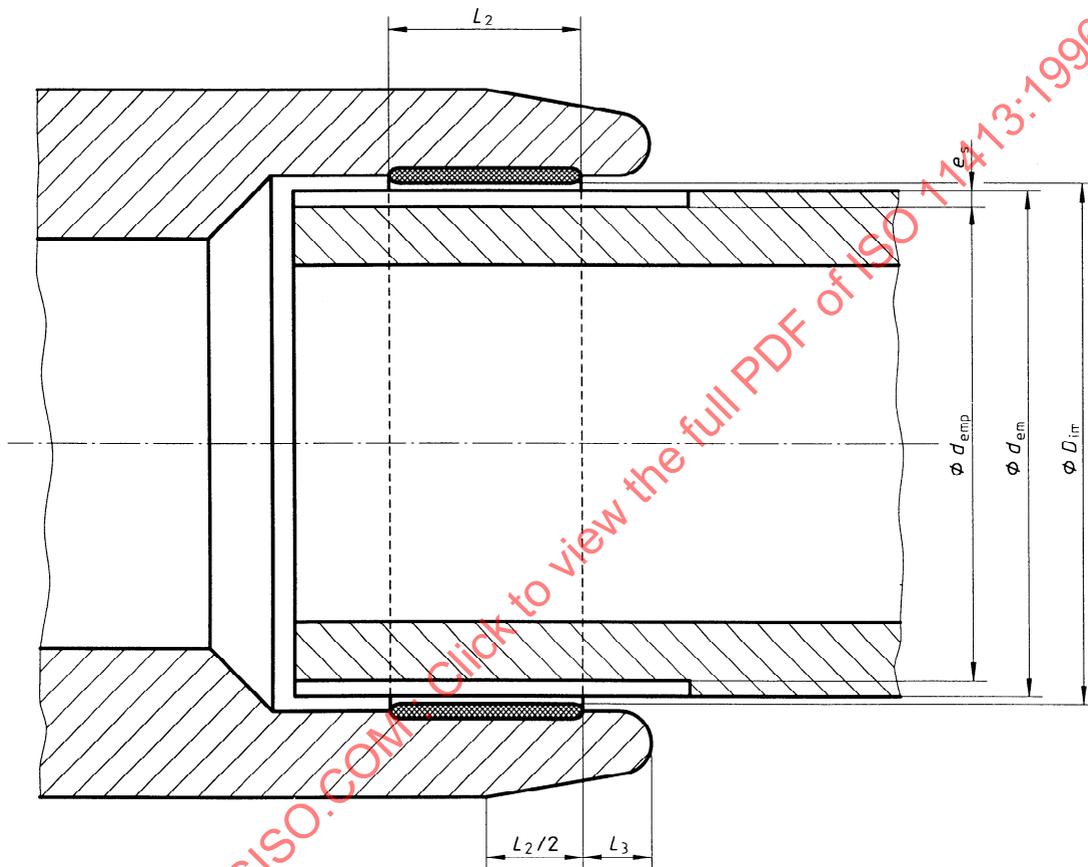
The procedure for measuring the coil resistance implies the use of measuring equipment at the reference ambient temperature T_R with the fitting at the conditioning temperature.

- f) Carry out the fusion jointing in accordance with the fitting manufacturer's instructions at the energy levels indicated in annex C.
- g) Leave the joint to cool until it reaches ambient temperature.

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Annex A (normative)

Symbols for dimensions of an electrofusion socket



L_2 is the nominal length of the fusion zone.

L_3 is the length of the unheated section of the socket.

$$D_{im} = (D_{i,max} + D_{i,min})/2$$

$$d_{em} = \frac{C}{\pi}$$

where C is the circumference of the unscrapped pipe.

$$d_{emp} \text{ (by analogy)} = \frac{C_p}{\pi}$$

where C_p is the circumference of the pipe to be assembled with the fitting.

$$e_s = (d_{em} - d_{emp})/2$$

Figure A.1

Annex B (normative)

Diagrammatic representation of variation in fusion energy with ambient temperature

Figures B.1, B.2 and B.3 illustrate different forms of energy profile (see also annex C).

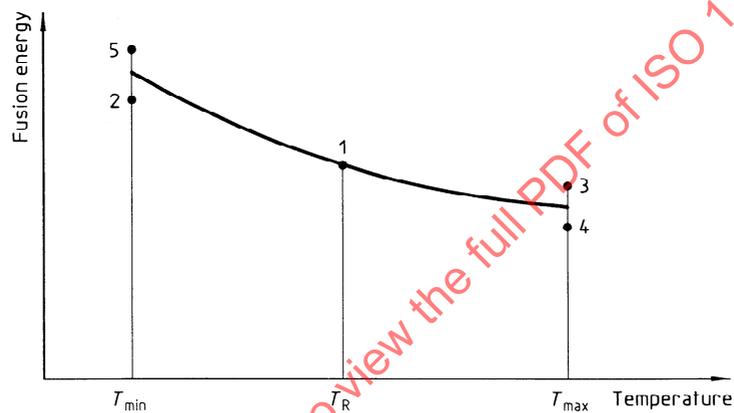


Figure B.1 — Profile with continuous adjustment of energy

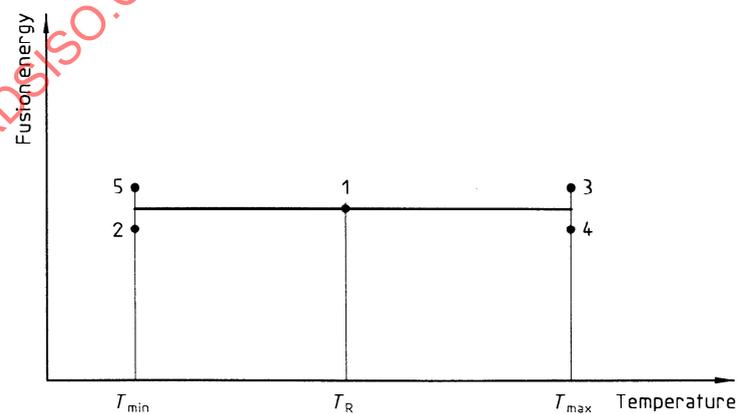


Figure B.2 — Constant-energy profile

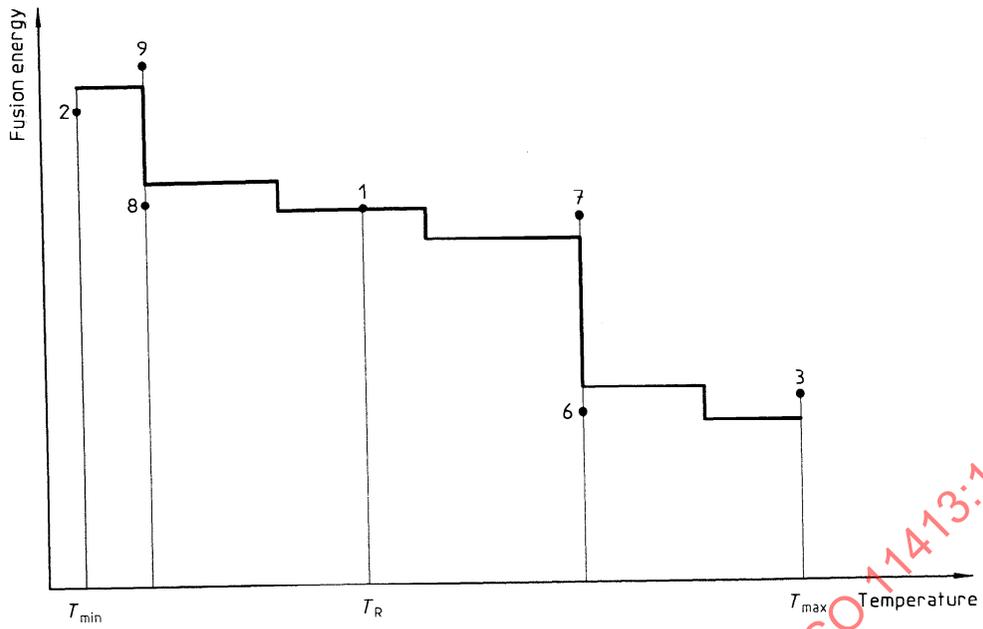


Figure B.3 — Profile with stepped adjustment of energy

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Annex C

(normative)

Conditions for the preparation of pipes and fittings

Table C.1 — Conditions for pipe and fitting preparation

Set of conditions	Ambient temperature, T_a (3.3)	Pipe configuration	Clearance ¹⁾ (3.2)	Energy (3.4)	Assembly load ²⁾
1	T_R	coiled or straight pipe as supplied	C_2	usual	usual
2	T_{min}	straight pipe	C_4	minimum	minimum
3	T_{max}	coiled or straight pipe as supplied	C_2	maximum	maximum
4	T_{max}	straight pipe	C_4	minimum	minimum
5	T_{min}	coiled or straight pipe as supplied	C_2	maximum	maximum
6	$> T_R^{3)}$	straight pipe	C_4	minimum	minimum
7	$> T_R^{3)}$	coiled or straight pipe as supplied	C_2	maximum	maximum
8	$< T_R^{3)}$	straight pipe	C_4	minimum	minimum
9	$< T_R^{3)}$	coiled or straight pipe as supplied	C_2	maximum	maximum

NOTE — Sets of conditions 1 to 5 are applicable to the energy profiles illustrated in figures B.1 and B.2 of annex B. Sets of conditions 1 to 3 and 6 to 9 apply to the stepped energy profile illustrated in figure B.3.

1) In the case of saddles, the clearance shall be considered to be zero.
 2) Applicable to joints with saddles, where the load can be controlled.
 3) Temperature corresponding to the largest energy discontinuity and closest to the extreme temperatures situated on either side of the reference temperature.