BRITISH STANDARD

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

ICS 23.040.60

National foreword

This British Standard is the UK implementation of ISO 11413:2008. It supersedes BS 2782-11 Method 1150E:1997 which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

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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 11413:2008(E)

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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*.

This second edition cancels and replaces the first edition (ISO 11413:1996), which has been technically revised.

INTERNATIONAL STANDARD **ISO 11413:2008(E)**

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, pipe configuration (coiled or straight pipe), taking into account the limiting service conditions specified by the relevant product standards.

This International Standard can apply to other shapes, e.g. re-rounded pipes, dependent on the manufacturer's instructions.

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 4427-2, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 2: Pipes*

ISO 4427-3, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 3: Fittings*

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

ISO 8085-2, *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 8085-3, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings*

ISO 14531-1, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes*

ISO 15494, *Plastics piping systems for industrial applications — Polybutene (PB), polyethylene (PE) and polypropylene (PP) — Specifications for components and the system — Metric series*

3 Terms and definitions

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

3.1
reference time
t_R
theoretical fusion time indicated by the fitting manufacturer for the reference ambient temperature

3.2
fusion energy
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 stated by the manufacturer

NOTE 1 The fitting manufacturer is generally required to state in the technical file any variations in fusion energy input required as a function of the ambient temperature in the range T_{min} to T_{max}.

NOTE 2 Where applicable, energy measurement should exclude the effect of terminal contact resistance.

3.3
reference energy
energy supplied to a fitting having a nominal electrical resistance and using the nominal fusion parameters defined by the manufacturer at the reference ambient temperature, T_R

3.4
maximum energy
maximum value of the fusion energy supplied for jointing at a given ambient temperature, T_a

3.5
minimum energy
minimum value of the fusion energy supplied for jointing at a given ambient temperature, T_a

3.6
nominal energy
nominal energy supplied for jointing at given ambient temperature, T_a

4 Symbols

4.1 General symbols (see Figure A.1)

D_{im} mean inside diameter of the fusion zone of a fitting in the radial plane located a distance $L_3 + 0{,}5L_2$ from the face of the fitting socket

$D_{im,max}$ maximum theoretical value of D_{im}, as stated by the fitting manufacturer

$D_{i,max}$ maximum inside diameter of the fusion zone of the fitting

$D_{i,min}$ minimum inside diameter of the fusion zone of the fitting

d_e outside diameter of a pipe or fitting spigot

d_{em} mean outside diameter of a pipe or fitting spigot in conformity with the relevant International Standard for the product concerned and calculated from the measured circumference

$d_{em,p}$ 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 $L_3 + 0{,}5L_2$ from the face of the fitting socket after assembly

L_2 nominal length of the fusion zone as indicated by the fitting manufacturer

L_3 nominal distance from the face of the fitting socket to the leading edge of the fusion zone

e_n nominal wall thickness, in millimetres, of the pipe

e_s depth of scraping or the thickness of material removed from the pipe surface by peeling

4.2 Clearances

4.2.1 Socket fittings

C_1 clearance between fitting bore and outside diameter of unscraped pipe

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

C_2 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 $d_{em,p}$ calculated from the equation (see also Note to 5.1):

$$d_{em,p} = D_{im} - C_2$$

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

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

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

$$C_4 = C_3 + 2e_s$$

NOTE 2 C_4 can be obtained by machining the unscraped pipe to bring its mean outside diameter d_{em} to the value $d_{em,p}$ calculated from the equation:

$$d_{em,p} = D_{im} - C_4$$

4.2.2 Saddles

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

4.3 Ambient temperature

T_a ambient temperature at which a joint is made

NOTE 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 reference ambient temperature of (23 ± 2) °C

T_{max} maximum permitted ambient temperature for joint assembly

T_{min} minimum permitted ambient temperature for joint assembly

5 Joint assembly

5.1 General

The joints shall be made using pipes and/or spigot-ended fittings conforming to ISO 4427-2, ISO 4427-3, ISO 4437, ISO 8085-2, ISO 8085-3, ISO 14531-1, ISO 15494 or other standards, as applicable, e.g. standards for pipe renovation, and electrofusion fittings for which the dimensions conform to ISO 8085-3 or ISO 4427-3, or other standards, as applicable. Unless otherwise specified, the pipes selected for the assembly shall be of the same pressure rating as the fitting. 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.

NOTE In cases where the pipes do not need to be scraped, the minimum scraping depth, e_s, may be zero.

5.2 Procedure

Carry out the following procedure, where steps d) and f) shall be carried out in a temperature-controlled environment maintaining the temperature to within $\pm$ 2 °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 4.1 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 4.2.

c) Mount the fitting on the pipes in accordance with the manufacturer's instructions.

d) Condition the assembly and the associated apparatus for a period conforming to Table 1 at the applicable ambient temperature T_a specified in Annex C.

Table 1 — Conditioning periods

Nominal wall thickness, e_n mm	**Minimum conditioning period** h
$e_n < 3$	1
$3 \leqslant e_n < 8$	3
$8 \leqslant e_n < 16$	6
$16 \leqslant e_n < 32$	10
$32 \leqslant e_n$	16

e) After conditioning, if applicable according to Annex C, measure the resistance of the heating coil and determine the values of the electrical parameters in accordance with Annex 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.

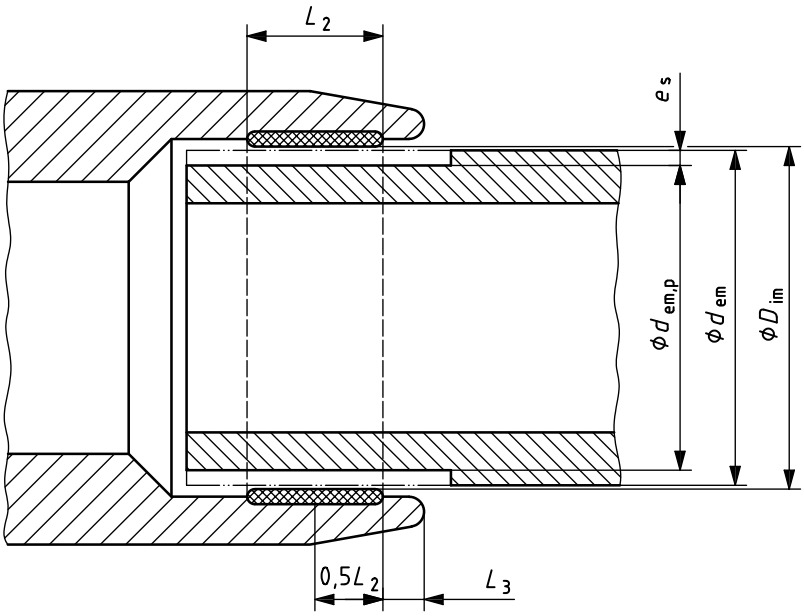
f) With the assembly conditioned at ambient temperature T_a, carry out the fusion jointing in accordance with the fitting manufacturer's instructions at the energy levels indicated in Annex C.

g) Leave the joint to cool until it reaches ambient temperature.

h) Proceed to the tests as given in the relevant product standards.

Annex A
(normative)

Symbols for dimensions of an electrofusion socket



Key

L_2 nominal length of the fusion zone

L_3 length of the unheated section of the socket

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

$d_{em} = C/\pi$ where C is the circumference of the unscraped pipe

$d_{em,p}$ (by analogy) = C_p/π where C_p is the circumference of the pipe to be assembled with the fitting

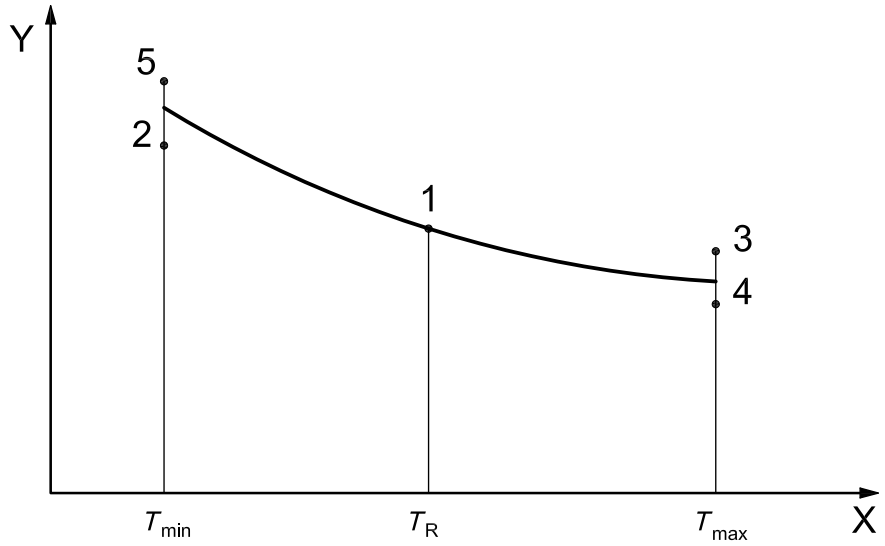
$e_s = (d_{em} - d_{em,p})/2$

Figure A.1 — Dimensions of an electrofusion socket

Annex B
(normative)

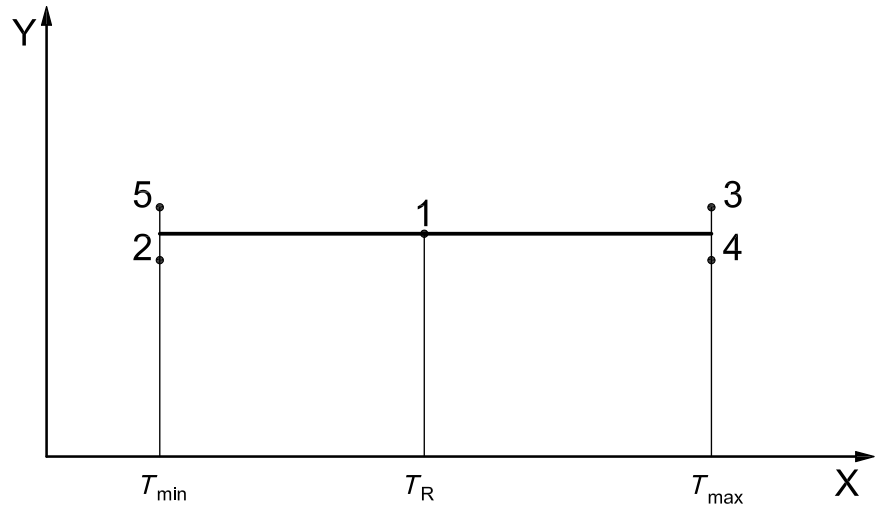
Diagrammatic representation of variation in fusion energy with ambient temperature

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



Key
X temperature
Y fusion energy

Figure B.1 — Profile with continuous adjustment of energy



Key
X temperature
Y fusion energy

Figure B.2 — Constant-energy profile

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	Pipe configuration [a]	Clearance [b]	Energy	Assembly load [c]
1	T_R	Coiled or straight pipe as supplied	C_2	reference	usual [d]
2.1	T_{min}	Straight pipe	C_4	nominal	usual [d]
2.2	T_{min}	Straight pipe	C_4	minimum	minimum
3.1	T_{max}	Straight pipe	C_2	nominal	usual [d]
3.2	T_{max}	Straight pipe	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

NOTE Sets of conditions 1 to 5 are applicable to the energy profiles illustrated in Figures B.1 and B.2.

[a] Other shapes, e.g. re-rounded pipes, shall be treated as straight pipes.

[b] In the case of saddles, the clearance shall be considered to be zero.

[c] Applicable to joints with saddles, where the load can be controlled.

[d] In accordance with the manufacturer's instructions.

Annex D
(informative)

Determination of fusion-jointing electrical parameters using energy, voltage and current tolerances from ISO 12176-2

D.1 Maximum energy input at ambient temperature, T_a

For control boxes using energy control, the energy is the nominal energy plus the tolerance.

For control boxes using voltage control, the applied voltage is given by the formula

$$V_{max}\sqrt{R/R_{min}}$$

For control boxes using current control, the applied current is given by the formula

$$I_{max}\sqrt{R_{max}/R}$$

where

V_{max} is the maximum control-box output voltage, in volts (nominal + tolerance);

I_{max} is the maximum control-box output current, in amperes (nominal + tolerance);

R_{min} is the manufacturer's stated minimum fitting resistance, in ohms, at T_R;

R_{max} is the manufacturer's stated maximum fitting resistance, in ohms, at T_R;

R is the resistance, measured using a four-arm resistance bridge with the performance characteristics specified in Table D.1, of the fitting conditioned at the ambient temperature T_a specified for jointing.

The procedure for measuring the coil resistance implies the use of measuring equipment at the reference ambient temperature of (23 ± 2) °C, conditioning of the fitting at T_{max} or T_{min} and measurement of the resistance of the coil of the fitting within 30 s of removal from the conditioning enclosure.

D.2 Minimum energy input at ambient temperature, T_a

For control boxes using energy control, the energy is the nominal energy minus the tolerance

For control boxes using voltage control, the applied voltage is given by the formula

$$V_{min}\sqrt{R/R_{max}}$$

For control boxes using current control, the applied current is given by the formula

$$I_{min}\sqrt{R_{min}/R}$$

where

V_{min} is the minimum control-box output voltage, in volts (nominal – tolerance);

I_{min} is the minimum control-box output current, in amperes (nominal – tolerance);

R_{min} is the manufacturer's stated minimum fitting resistance, in ohms, at T_R;

R_{max} is the manufacturer's stated maximum fitting resistance, in ohms, at T_R;

R is the resistance, measured using a four-arm resistance bridge with the performance characteristics specified in Table D.1, of the fitting conditioned at the ambient temperature T_a specified for jointing.

The procedure for measuring the coil resistance implies the use of measuring equipment at the reference ambient temperature of (23 ± 2) °C, conditioning of the fitting at T_{max} or T_{min} and measurement of the resistance of the coil of the fitting within 30 s of removal from the conditioning enclosure.

Table D.1 — Resistance-bridge performance characteristics

Range Ω	Resolution mΩ	Accuracy
0 to 1	0,1	0,25 % of reading
0 to 10	1	0,25 % of reading
0 to 100	10	0,25 % of reading

Bibliography

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

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