# British Standard

BRITISH STANDARD

BS 2782-11: Method 1150E: 1997
ISO 11413: 1996

## Methods of testing

# Plastics —

## Part 11: Thermoplastics pipes, fittings and valves —

## Method 1150E Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting

ICS 23.040.20; 23.040.45

This British Standard, having been prepared under the direction of the Sector Board for Materials and Chemicals, was published under the authority of the Standards Board and comes into effect on 15 March 1997



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# National foreword

This British Standard reproduces verbatim ISO 11413:1996 and implements it as the UK national standard.

The UK participation in its preparation was entrusted by Technical Committee PRI/61, Plastics piping systems and components, to Subcommittee PRI/61/4, Methods of test for thermoplastics piping systems and components, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

**Cross-references**

This international standard is incorporated into BS 2782 Methods of testing plastics: Part 11: Thermoplastics pipes, fittings and valves, as Method 1150E:1996, for association with related test methods for plastics materials and plastics piping components.

British Standards which implement international or European publications referred to in dual numbered standards may usually be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or using the "Find" facility of the BSI Standards Electronic Catalogue.

Reference is made to ISO 4427, for which there is no identical British Standard because the corresponding British Standards are expected to be replaced by implementation of the collected Parts of EN 12201 when they are finalized.

Reference is made to ISO 4437, ISO 8085-2 and ISO 8085-3, for which there are no identical British Standards because the corresponding British Standards are expected to be replaced by implementation of the collected Parts of EN 1555 when they are finalized.

WARNING NOTE. This British Standard, which is identical with ISO 11413:1996, does not necessarily detail all the precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the method should be operated only by trained personnel.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, the ISO title page, page ii, pages 1 to 6 and a back cover

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

INTERNATIONAL STANDARD

**ISO 11413**

First edition
1996-09-15

# 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.*

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



**Descriptors:** Pipes (tubes), polyethylene, plastic tubes, pipe fittings, welded joints, tests, specimen preparation.

## 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;

$d_{emp}$ 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.

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

[1] To be published.

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

$C_4$ 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 °C ± 2 °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 spigotended 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 ± 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 **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.

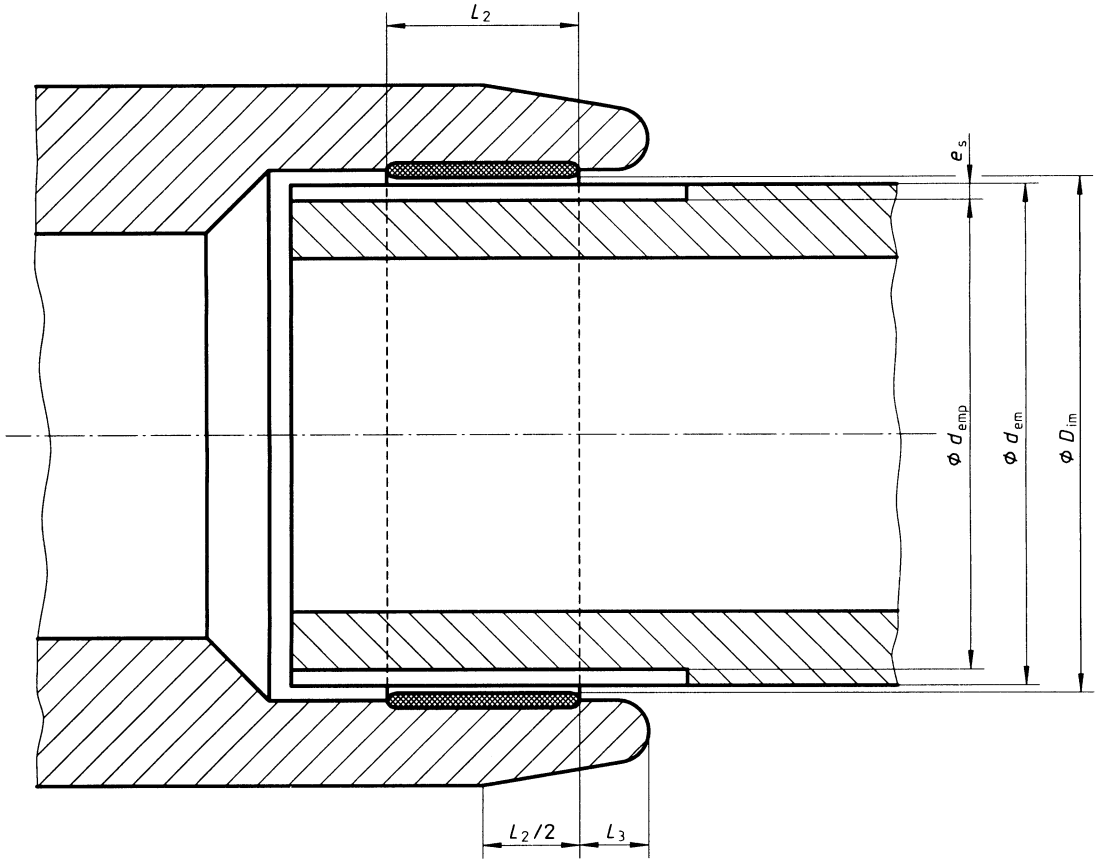
e) After conditioning, measure the resistance of the heating coil and determine the values of the electrical parameters in accordance with Annex C and Annex D.

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) 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.

## 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 unscraped pipe.

$d_{emp}$ (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

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

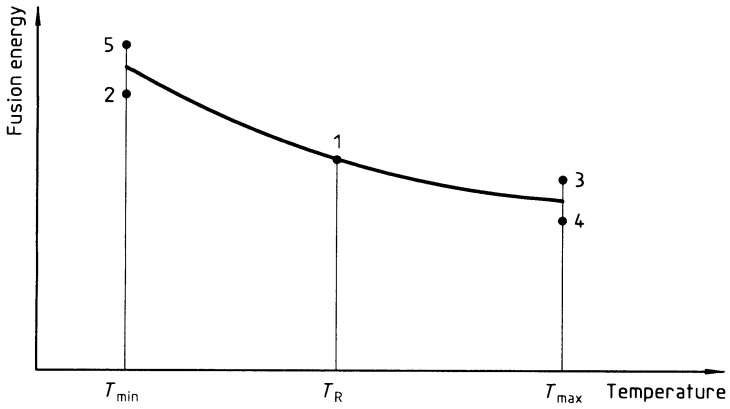



**Figure B.1 — Profile with continuous adjustment of energy**

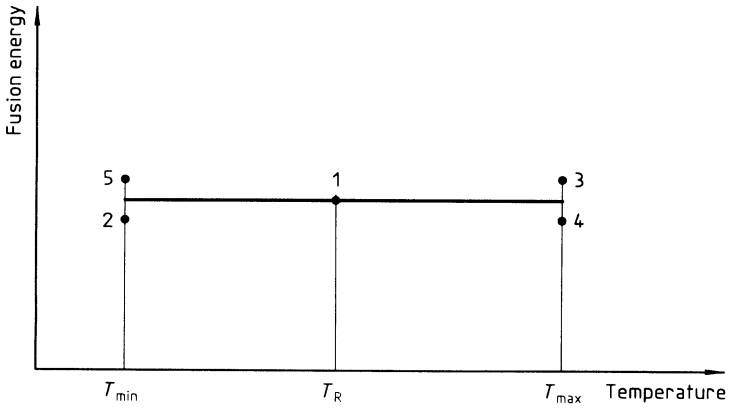



**Figure B.2 — Constant-energy profile**

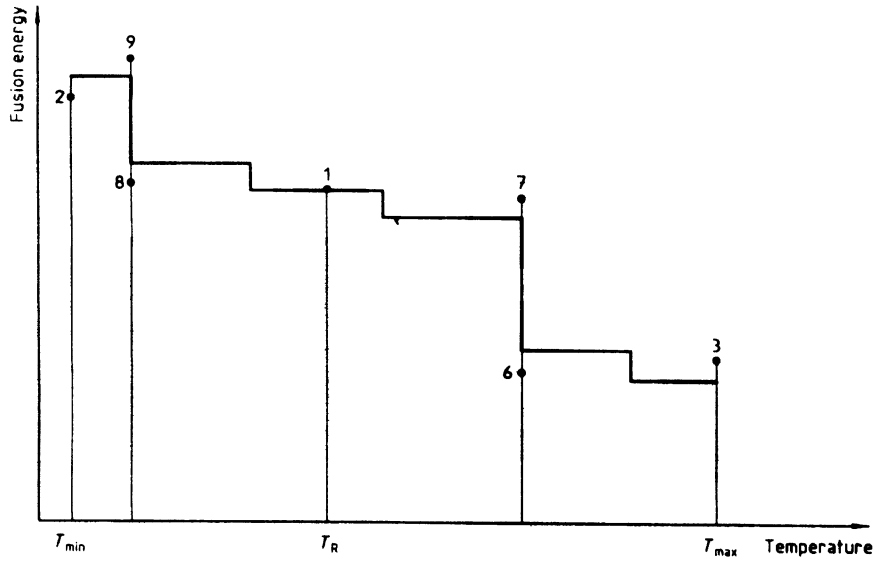



**Figure B.3 — Profile with stepped adjustment of energy**

## 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[a] (3.2) | Energy (3.4) | Assembly load[b] |
|---|---|---|---|---|---|
| 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 | $> T_R$[c] | straight pipe | $C_4$ | minimum | minimum |
| 7 | $> T_R$[c] | coiled or straight pipe as supplied | $C_2$ | maximum | maximum |
| 8 | $< T_R$[c] | straight pipe | $C_4$ | minimum | minimum |
| 9 | $< T_R$[c] | 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 Figure B.1 and Figure 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.

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

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

[c] Temperature corresponding to the largest energy discontinuity and closest to the extreme temperatures situated on either side of the reference temperature.

## Annex D (informative) Determination of fusion-jointing electrical parameters

(using the energy, voltage and current tolerances specified in ISO 12176-2[3])

### D.1 Maximum energy input at ambient temperature $T_a$

For control boxes using energy control:

energy = nominal energy + tolerance

For control boxes using voltage control:

applied voltage = $V_{max}\sqrt{R/R_{min}}$

For control boxes using current control:

applied current = $I_{max}\sqrt{R_{max}/R}$

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 minimum fitting resistance at $T_R$, in ohms, declared in accordance with ISO 12093;

$R_{max}$ is the manufacturer's maximum fitting resistance at $T_R$, in ohms, declared in accordance with ISO 12093;

$R$ 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.

### D.2 Minimum energy input at ambient temperature $T_a$

For control boxes using energy control:

energy = nominal energy – tolerance

For control boxes using voltage control:

applied voltage = $V_{min}\sqrt{R/R_{max}}$

For control boxes using current control:

applied current = $I_{min}\sqrt{R_{min}/R}$

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 minimum fitting resistance at $T_R$, in ohms, declared in accordance with ISO 12093;

$R_{max}$ is the manufacturer's maximum fitting resistance at $T_R$, in ohms, declared in accordance with ISO 12093;

$R$ 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 °C ± 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 |

[3] ISO 12176-2:—, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion equipment* (to be published).

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