INTERNATIONAL STANDARD

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Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion

Tubes et raccords en matières plastiques — Préparation d'éprouvettes par assemblage tube/tube ou tube/raccord en polyéthylène (PE) par soudage bout à bout

Reference number
ISO 11414:1996(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 11414, 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 and B form an integral part of this International Standard.

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Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion

1 Scope

This International Standard specifies a method for preparing butt-fusion-jointed test piece assemblies between polyethylene (PE) pipes and spigot-ended fittings.

It specifies the assembly parameters involved, such as the ambient temperature, joint geometry and fusion parameters, taking into account the service condition limits specified in the relevant product standards, as well as the type of pipe to be used.

This International Standard is intended to enable the effect of site assembly variables on joint performance to be determined. The fusion-jointing procedures and parameters used in the field can differ from those in this document, depending on the manufacturer's written procedures and/or local standards.

NOTE 1 The assembly and fusion-jointing technique described in this International Standard is applicable whatever the polyethylene resin employed, provided it is used in accordance with ISO/TR 11647. Deviations from the fusion cycle specified, in order to demonstrate joint performance, are permitted.

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/TR 11647:1996, *Fusion compatibility of polyethylene (PE) pipes and fittings.*

3 Symbols used

3.1 Symbols used in more than one phase of the fusion-jointing cycle

e_n the nominal pipe wall thickness;

d_n the nominal external diameter of the pipe;

p the pressure applied to the butt-fusion joint interface;

t the length of each phase in the fusion cycle;

1) To be published.

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

T_{max} the maximum permissible ambient temperature;

T_{min} the minimum permissible ambient temperature.

3.2 Joint geometry

D_a the misalignment between the pipes or fittings to be butt-fused, expressed in terms of the difference, in millimetres, between, the external diameters;

D_w the clearance between the fusion faces, expressed in terms of the gap, in millimetres, between the prepared faces.

3.3 Ambient temperature

T_a the ambient temperature at which the joint is made.

NOTE 2 The ambient temperature may vary from the minimum temperature T_{min} to the maximum temperature T_{max} defined either in the system standards or by agreement between the manufacturer and purchaser.

3.4 Butt-fusion cycle parameters

3.4.1 General

T the heater-plate temperature, measured in the zone of the heater-plate surface in contact with the pipe or spigot ends to be butt-fused.

3.4.2 Phase 1: Heating

p_1 the interface pressure during the heating phase, i.e. the pressure applied in the contact zone, expressed in newtons per square millimetre (N/mm^2) (MPa);

B_1 the initial bead width, taken as the bead width at the end of the heating phase, expressed in millimetres;

t_1 the heating time, taken as the time necessary to obtain a bead of width B_1 in the joint region during the heating phase.

3.4.3 Phase 2: Heat soak

p_2 the pressure between the heater plate and the pipe or spigot ends during the heat soak phase, expressed in newtons per square millimetre (N/mm^2);

t_2 the duration of internal heating during the heat soak phase, expressed in seconds.

3.4.4 Phase 3: Withdrawal of heater plate

t_3 the time between the moment when the heater plate is removed from the pipe and/or spigot ends and the moment when the pipe and/or spigot ends are placed in contact with each other, expressed in seconds.

3.4.5 Phase 4: Pressure increase

t_4 the time required to establish the butt-fusion pressure, expressed in seconds.

3.4.6 Phase 5: Butt fusion

p_5 the pressure applied to the contact zone during the butt-fusion phase, expressed in newtons per square millimetre (N/mm^2);

t_5 the time during which the assembly remains under the butt-fusion pressure in the machine, expressed in minutes.

3.4.7 Phase 6: Cooling

t_6 the cooling time, during which the butt-fused assembly is not subjected to any rough handling, expressed in minutes; this cooling can take place outside the machine;

B_2 the bead width obtained at the end of the cooling phase, expressed in millimetres.

4 Pipes used for test assemblies

The pipes used for test assemblies shall be taken from straight lengths.

5 Apparatus

The butt-fusion machine used shall be fitted with an automatic fusion-pressure regulator enabling the pressure to be kept constant during the whole of phases 1, 2 and 5 of the fusion cycle.

6 Jointing procedure

Using straight pipes and fittings conforming to ISO 4427, ISO 4437 and ISO 8085-2, as applicable, join the components as follows, deviations from the procedure being permitted to demonstrate improvements in joint performance (appearance or mechanical properties).

a) Fix the pipes and/or fittings in the butt-fusion machine in such a manner as to obtain a misalignment D_a of, at the most, 0,5 mm when $d_n < 200$ or at the most $0{,}1e_n$ or 1 mm, whichever is the greater, when $d_n \geqslant 200$.

b) Prepare and plane the butt-fusion faces over a maximum of one-third of the circumference by means of a planing machine to limit the clearance D_w to 0,3 mm when $d_n < 200$ or to 0,5 mm when $d_n \geqslant 200$.

c) Perform the butt fusion using the parameters specified in annex A, repeating the procedure on fresh test assemblies while varying the parameters within the limits given in annex B.

Annex A
(normative)

Butt-fusion cycle and parameters

Figure A.1 illustrates the butt-fusion cycle and table A.1 gives reference values for the parameters in each phase.

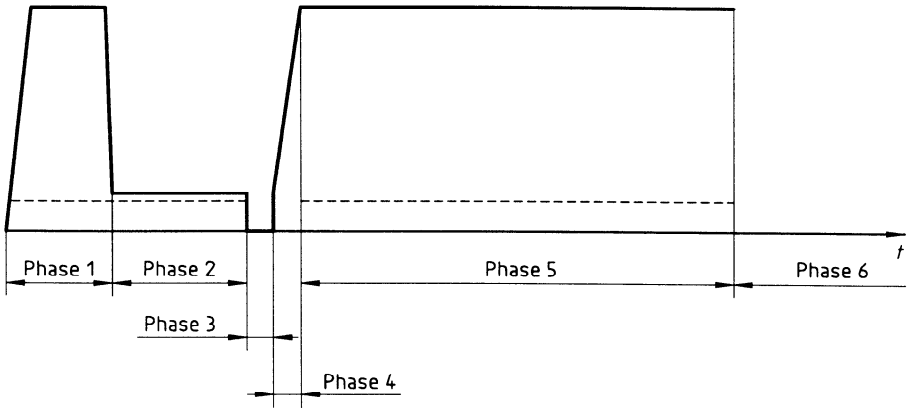

Figure A.1

Table A.1

Parameters		Values	Units
Heater-plate temperature, T $63 \leqslant d_n \leqslant 250$ $250 < d_n$		 210 ± 10 225 ± 10	°C
Phase 1	Pressure, p_1 [1]	$0{,}18 \pm 0{,}02$	N/mm² (MPa)
	Time, t_1	measured as the time until B_1 is reached	s
	Bead width, B_1	$d_n \leqslant 180$: $1 < B_1 \leqslant 2$ $180 < d_n \leqslant 315$: $2 < B_1 \leqslant 3$ $315 < d_n$: $3 < B_1 \leqslant 4$	mm
Phase 2	Pressure, p_2 [1]	$0{,}03 \pm 0{,}02$	N/mm² (MPa)
	Time, t_2	$(30 + 0{,}5d_n) \pm 10$	s
Phase 3	Time, t_3	maximum: $3 + 0{,}01d_n \leqslant 8$	s
Phase 4	Time, t_4	maximum: $3 + 0{,}01d_n \leqslant 6$	s
Phase 5	Pressure, p_5 [1]	$0{,}18 \pm 0{,}02$	N/mm² (MPa)
	Time, t_5	minimum: 10	min
Phase 6	Time, t_6	minimum: $1{,}5e_n$ and maximum 20 min	min

1) Note that this pressure is the interface pressure and is related to d_n, e_n and the butt-fusion equipment used.

Annex B
(normative)

Limits on values of butt-fusion parameters

Table B.1 gives the limits placed on the values of the parameters used in evaluating the jointing procedure.

Table B.1

Conditions	Ambient temperature[1]		Heater-plate temperature, T	Butt-fusion pressure, p
	Symbol	Value, °C	°C	N/mm^2
Minimum	T_{min}	$-5\,^{0}_{-2}$	205 ± 5	0,15 ± 0,02
Maximum	T_{max}	40 ± 2	230 ± 5	0,21 ± 0,02

1) Other values may be used if specified in the appropriate system standard.

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Descriptors: plastics products, pipes (tubes), polyethylene, plastic tubes, pipe fittings, joining, fusion welding, butt welds, tests, specimen preparation.

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