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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

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Foreword

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The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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*.

This second edition cancels and replaces the first edition (ISO 11414:1996), which has been technically revised.

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.

This International Standard 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 International Standard, depending on the manufacturer's written procedures and/or local standards.

NOTE The assembly and fusion-jointing technique specified in this International Standard is applicable whatever the polyethylene resin employed, provided it is used in accordance with ISO/TR 11647[1]. Deviations from the fusion cycle specified, in order to demonstrate joint performance, can be considered in accordance with the notes in Annexes A and B.

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 12176-1, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 1: Butt fusion*

3 Symbols

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

e_n nominal pipe wall thickness

d_n nominal external diameter of the pipe

p pressure applied to the butt-fusion joint interface

t duration of each phase in the fusion cycle

T_{nom} nominal temperature, (23 ± 2) °C

T_{max} maximum permissible ambient temperature

T_{min} minimum permissible ambient temperature

3.2 Joint geometry

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

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

3.3 Ambient temperature

T_a ambient temperature at which the joint is made

NOTE 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 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 interface pressure, in megapascals[1)], during the heating phase, i.e. the pressure applied in the contact zone

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

t_1 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 pressure, in megapascals, between the heater plate and the pipe or spigot ends during the heat soak phase

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

3.4.4 Phase 3: Withdrawal of heater plate

t_3 time, in seconds, 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

1) 1 MPa = 1 N/mm^2

3.4.5 Phase 4: Pressure increase

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

3.4.6 Phase 5: Butt fusion

p_5 pressure, in megapascals, applied to the contact zone during the butt-fusion phase

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

3.4.7 Phase 6: Cooling

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

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

4 Pipes used for test assemblies

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

5 Conditioning

Condition the pipes used for test assemblies at temperature T_a (refer to Table B.1) for a period of time according to Table 1.

Table 1 — Conditioning periods

Thickness, e_n mm	**Minimum conditioning period** h
$e_n < 8$	3
$8 \leqslant e_n < 16$	6
$16 \leqslant e_n < 32$	10
$32 \leqslant e_n$	16

6 Apparatus

The butt-fusion machine shall conform to ISO 12176-1, which means that a fusion-pressure controller is present enabling the pressure to be kept constant during the whole of phases 1, 2 and 5 of the fusion cycle.

7 Jointing procedure

Using straight pipes and fittings conforming to ISO 4427-2, ISO 4427-3, ISO 4437 or 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, Δa, of at the most, 0,5 mm when $d_n < 200$ mm or at the most $0{,}1e_n$ or 1 mm, whichever is the greater, when $d_n \geqslant 200$ mm.

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

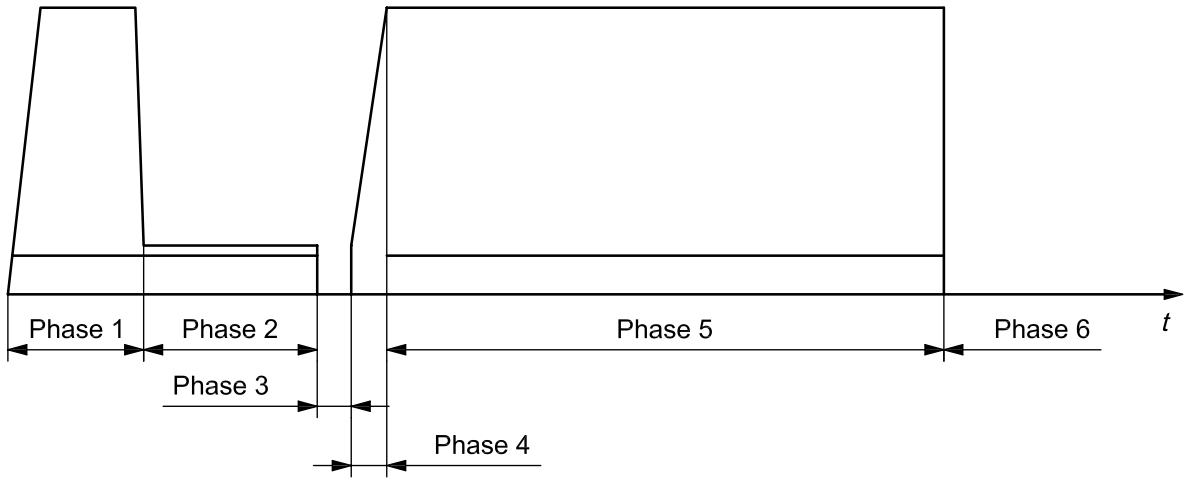
c) Perform the butt-fusion using the parameters specified in Annex A, repeating the procedure on fresh test assemblies while varying the parameters within the limits given in Annex B.

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

Annex A
(normative)

Butt-fusion cycle and parameters

Figure A.1 illustrates the butt-fusion cycle and Tables A.1 and A.2 give reference values for the parameters in each phase.



Key

t time

Figure A.1 — Butt-fusion cycle

Table A.1 — Butt-fusion cycle and parameters

Parameters		Values	Units
Heater-plate temperature, T		200 to 230	°C
Phase 1	Pressure, p_1 [a]	0,15 ± 0,02	MPa
	Time, t_1	Measured as the time until B_1 is reached	s
	Bead width, B_1 [b]	See Table A.2	mm
Phase 2	Pressure, p_2 [a]	⩽ 0,03	MPa
	Time, t_2	$10e_n$, see Table A.2	s
Phase 3	Time, t_3	Maximum value, see Table A.2	s
Phase 4	Time, t_4	Maximum value, see Table A.2	s
Phase 5	Pressure, p_5 [a]	0,15 ± 0,02	MPa
	Time, t_5	Minimum value, see Table A.2	min
Phase 6	Time, t_6	= t_5	min

[a] This pressure is the interface pressure and is related to d_n, e_n and the butt-fusion equipment used.

[b] Minimum value obtained around the complete circumference of the pipe.

Table A.2 — Wall thickness dependent butt-fusion parameters [a]

Wall thickness, e_n mm	B_1 mm	t_2 s	t_3 s	t_4 s	t_5 min
$\leqslant$ 4,5	0,5	45	5	5	6
4,5 < $e_n \leqslant$ 7	1,0	45 to 70	5 to 6	5 to 6	6 to 10
7 < $e_n \leqslant$ 12	1,5	70 to 120	6 to 8	6 to 8	10 to 16
12 < $e_n \leqslant$ 19	2,0	120 to 190	8 to 10	8 to 11	16 to 24
19 < $e_n \leqslant$ 26	2,5	190 to 260	10 to 12	11 to 14	24 to 32
26 < $e_n \leqslant$ 37	3,0	260 to 370	12 to 16	14 to 19	32 to 45
37 < $e_n \leqslant$ 50	3,5	370 to 500	16 to 20	19 to 25	45 to 60
50 < $e_n \leqslant$ 70	4,0	500 to 700	20 to 25	25 to 35	60 to 80

[a] If other parameters are considered, they have to be agreed between the pipe/fitting manufacturer and the end-user.

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 — Limits on values of butt-fusion parameters [a]

Set of conditions	Condition	Ambient temperature [b]		Heater-plate temperature, T	Butt-fusion pressure, p
		Symbol	Value °C	°C	MPa
1	Normal	T_{nom}	23 ± 2	215 ± 5	$0{,}15 \pm 0{,}02$
2	Minimum	T_{min}	-5 ± 2	205 ± 5	$0{,}13 \pm 0{,}02$
3	Maximum	T_{max}	40 ± 2	230 ± 5	$0{,}17 \pm 0{,}02$

[a] If other parameters are considered, they have to be agreed between the pipe/fitting manufacturer and the end-user.

[b] Other values may be used if specified in the appropriate system standard.

Bibliography

[1] ISO/TR 11647, *Fusion compatibility of polyethylene (PE) pipes and fittings* [2)]

2) Withdrawn.

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