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Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems —

Part 1: Butt fusion

Tubes et raccords en matières plastiques — Appareillage pour l'assemblage par soudage des systèmes en polyéthylène — Partie 1: Soudage bout à bout

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of the standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

This fourth edition cancels and replaces the third edition (ISO 12176-1:2012), which has been technically revised so that it applies to larger pipe diameters.

The modifications are the following:

— increase of the wall thickness and diameter;

— various clarifications such as the guide elements and work-holding fixtures;

— editorial changes have been introduced.

A list of all parts in the ISO 12176- series can be found on the ISO website.

Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems —

Part 1: Butt fusion

1 Scope

This document specifies the general characteristics of, and performance requirements for, equipment for butt fusion jointing of polyethylene (PE) piping systems using electrically powered heater plates.

It is applicable to mechanical and pressure-activated equipment for butt fusion jointing of PE pipes and fittings either intended to be used for the supply of gaseous fuels, conforming to ISO 4437-2[1] and ISO 4437-3[2], or intended for the conveyance of water for human consumption (including raw water prior to treatment) and for the conveyance of water for general purposes, conforming to ISO 4427-2[3] and ISO 4427-3[4].

Butt fusion machines with an automatic controller are subject to additional requirements as given in Annex A.

NOTE This document is also applicable to butt fusion machines for larger nominal pipe diameters and nominal wall thicknesses than given in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 11414, *Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
base framework
self-supporting entity composed of two or more guides and pipe clamps

Note 1 to entry: It provides the mechanism for heating and fusing the pipes and/or fittings.

3.2
frictional resistance of the butt fusion machine
force necessary to overcome friction in the whole mechanism without pipe

Note 1 to entry: See 6.1.

3.3
nominal outside diameter
d_n
numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size

Note 1 to entry: It is a convenient round number for reference purposes.

3.4
nominal wall thickness
e_n
numerical designation of the wall thickness of a component

Note 1 to entry: It is a convenient round number approximately equal to the manufacturing dimension in millimetres.

3.5
drag compensation
ability of the butt fusion machine to overcome mechanical and frictional forces, as well as forces caused by operating on site, in order to achieve and maintain the fusion parameters specified for the pipe

3.6
standard dimension ratio
SDR
ratio of the nominal outside diameter, d_n, of a pipe to its nominal wall thickness, e_n

[SOURCE: ISO 4427-1:2007, 3.1.1.15]

4 Design configurations

4.1 General

The normal ambient temperature range in which the butt fusion machine is intended to operate is –10 °C to +40 °C. Use outside this temperature range shall be agreed upon between the user and the supplier of the machine.

4.2 Configurations

To conform to the requirements of this document, butt fusion machines may have different design configurations, as follows:

— a mechanical linkage system for force generation;

— a hydraulic hand-pump system for force generation;

— a semi-automatic externally powered system for force generation (manual pre-set of pressure);

— a semi-automatic system incorporating a device for monitoring and recording the fusion parameters;

— an automatic system that controls and records the fusion parameters.

Machines are generally designed for well-defined ranges of diameters, SDR ratios and fusion cycles.

Each component of the machine shall conform to relevant national safety regulations.

NOTE For example, the safety aspects for Europe are regulated in Reference [5].

Machines which record fusion data shall be capable of transferring the data for further use.

5 Chassis and clamps

5.1 General

The butt fusion machine shall be as maintenance-free as possible.

The base framework of the butt fusion machine shall provide rigidity and stability without unnecessary weight.

The butt fusion machine shall be sufficiently robust to withstand normal field use.

The chassis shall provide facilities for the alignment of and relative movement between pipes and/or fittings.

The butt fusion machine shall incorporate a facility for supporting the heating plate and planing tool when in use. This support shall not affect transmission of interface forces across the heating plate and shall not prevent proper alignment of the heating plate during the heating operation.

The butt fusion machine shall be capable of making satisfactory joints at ambient temperature and under normal worksite conditions with pipes and fittings at extremes of dimensional tolerances.

With butt fusion machines designed for use in narrow trenches, the design and construction of the clamps shall enable the butt fusion machine to be removed from the trench after fusion without damaging the PE pipe.

The base framework shall be fitted with a minimum of two clamps, one fixed and one moveable, to position the PE pipes during the fusion cycle. These clamps shall be designed to enable the pipes to be positioned or removed quickly.

The clamps shall grip the circumference of the pipes and fittings and shall be designed and dimensioned to avoid damage to the pipe or fitting surfaces.

To avoid human damage, the clamp jaws should preferably be designed so that they cannot close to less than a certain minimum distance apart.

No adjustment of the centreline of either pipe shall be required after changing the relevant parts to accommodate different pipe sizes. The clamps, inserts and liners shall not damage the pipe or fitting.

Clamps and/or liners for each pipe size should preferably be interchangeable between similar machines made by the same manufacturer.

The maximum number of removable clamping liners shall be three for machines for pipe diameters up to and including d_n = 400 mm, and four for machines for pipe diameters above d_n = 400 mm.

Operating instructions shall be available.

5.2 Guide elements

5.2.1 General

The sliding surfaces of the guide elements shall be protected from corrosion, e.g. by hard chromium plate.

The design of the butt fusion machine shall allow the heating plate to be removed and the pipe ends to be closed after heating, without damaging the heated surfaces, within a maximum time as given in Table 1.

Table 1 — Maximum time for removing the heating plate

Nominal wall thickness e_n mm	Maximum time t_{max} s
$e_n \leq 4{,}5$	≤ 5
$4{,}5 < e_n \leq 7$	≤ 6
$7 < e_n \leq 12$	≤ 8
$12 < e_n \leq 19$	≤ 10
$19 < e_n \leq 26$	≤ 12
$26 < e_n \leq 37$	≤ 16
$37 < e_n \leq 50$	≤ 20
$50 < e_n \leq 70$	≤ 25
$70 < e_n \leq 90$	≤ 30
$90 < e_n \leq 130$	≤ 35

The clamp alignment system shall provide the frictional resistance necessary to resist the jointing forces at extreme temperatures.

5.2.2 Rigidity under pressure

The butt fusion machine shall provide rigidity and stability, which shall be evaluated after trimming the gap between the pipe ends, when they are in contact. When measured in accordance with 10.3.4, the gap between Sp1 and Sp2 (see Figure 5) shall conform to Table 2.

Table 2 — Maximum gap

Nominal outside diameter d_n mm	Maximum gap between pipe ends mm
$d_n \leq 315$	0,25
$315 < d_n \leq 630$	0,50
$630 < d_n \leq 800$	0,65
$800 < d_n \leq 1\ 000$	0,80
$1\ 000 < d_n \leq 1\ 200$	0,95
$1\ 200 < d_n \leq 1\ 600$	1,30
$1\ 600 < d_n$	0,2 % of d_n

5.2.3 Rigidity under bending

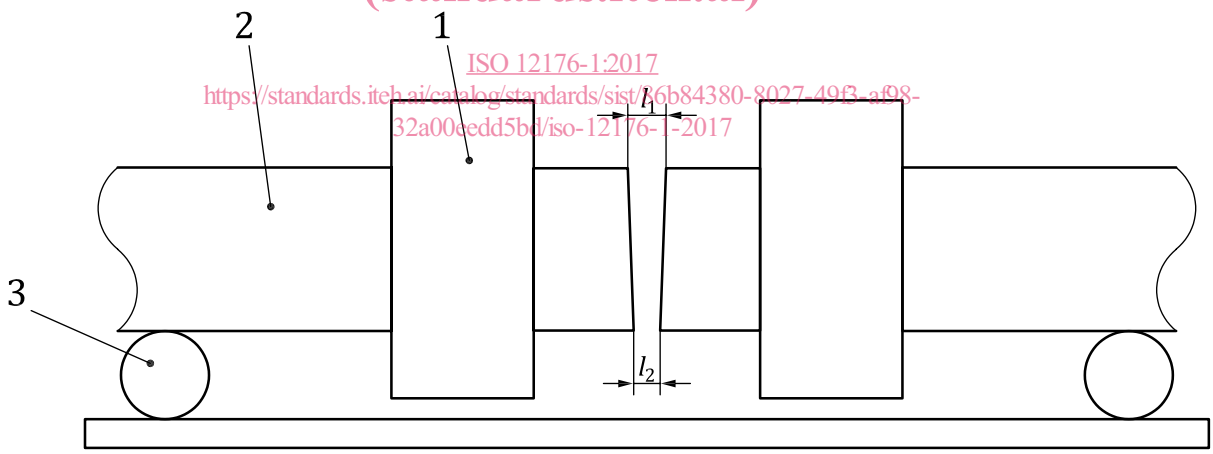
The clamp support and bearing system shall be sufficiently rigid to maintain axial alignment to within 0,2 mm over its entire length of travel when tested in accordance with 10.1.2.1.

Angular misalignment of supported pipes shall not exceed 0,5 mm when determined in accordance with 10.1.2.2.

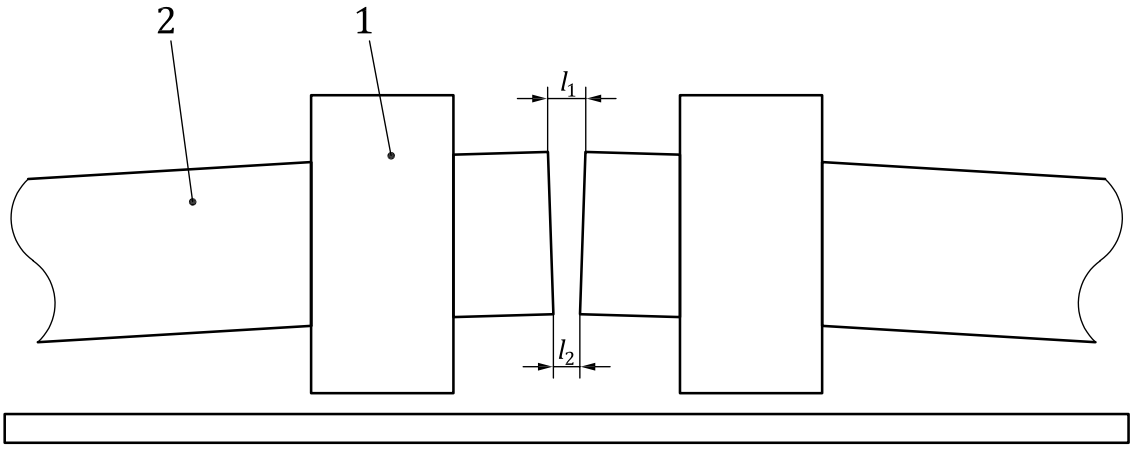
For equipment suitable for PE pipes ≤ 315 mm, when the pipe supports are removed (see Figure 1), the additional misalignment by bending of the butt fusion machine chassis and clamps shall not result in a deflection greater than the values given in Table 3.

Table 3 — Maximum additional angular misalignment (to be tested with SDR 17,6 or SDR 17 pipes)

Nominal outside diameter d_n mm	Maximum additional angular misalignment f_{max} mm
≤ 225	0,5
250	1
315	2



a) Support rollers present, $|l_1 - l_2| \leq 0{,}5$ mm



b) Support rollers removed, $|l_1 - l_2| \leq f_{max} + 0{,}5\,mm$

Key

1	clamp
2	pipe
3	support roller
l_1	gap at upper measurement position
l_2	gap at lower measurement position
f_{max}	maximum additional angular misalignment given in Table 3

Figure 1 — Gap (angular misalignment) between pipes

5.2.4 Re-rounding action

The clamp alignment system shall have a re-rounding action on the pipe such that any out-of-roundness at the pipe end does not exceed 5 % of the pipe wall thickness and any mismatch of the pipe ends does not exceed 10 % of the wall thickness, when the test for out-of-roundness is carried out in accordance with 10.1.1.

6 Interface force transmission

6.1 General

All types of operating system are acceptable (e.g. manual, hydraulic, pneumatic, electric), provided they meet the requirements of this document.

Pipe-to-pipe interface forces generated during the jointing cycle shall either be measured directly or, alternatively, means shall be provided to determine the interface force indirectly from the measurement of appropriate machine-operating parameters which take into account the force transfer efficiency and frictional resistance of the machine.

In the case of machines with fluid power rams, the force may be indicated in terms of the applied cylinder pressure.

For such machines, a specific calibration table shall be provided that gives the relationship between the real interface force and the pressure indicated by the pressure gauge. The pressure gauge shall be calibrated. The accuracy of the pressure gauge shall be 1 % of full scale.