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Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint

Tubes et raccords en polyéthylène (PE) — Détermination de la résistance en traction et du mode de rupture d'éprouvettes prélevées dans des assemblages par soudage bout à bout

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13953 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*.

Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint

1 Scope

This International Standard describes a test method for determination of the tensile strength and tensile failure mode of butt-fused polyethylene (PE) pipe assemblies.

The method is applicable to butt-fused joints between PE pipes with a nominal outside diameter of not less than 90 mm.

The method may be used, together with other test methods, to evaluate the quality of the butt-fused joints.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 11414:1996, *Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion*.

3 Principle

A test piece machined from a butt-fused PE pipe joint to give a waisted section is subjected to a tensile stress at constant speed. When loading the test piece in a tensile-testing machine, the stress is concentrated through the jointed region and ultimate failure is in the vicinity of the joint.

The failure mode and tensile strength are used as criteria for the evaluation of the butt-fused joint.

The test is carried out at a temperature of 23 °C ± 2 °C.

4 Apparatus

4.1 Room, which can be controlled at a temperature of 23 °C ± 2 °C.

4.2 Tensile-testing machine, capable of sustaining between its clamping jaws a constant speed of 5 mm/min ± 1 mm/min, and equipped with means for recording the consequent applied force, and a device to detect test piece failure.

4.3 Clamping device, equipped with bars fitting into traction holes machined in the test piece.

4.4 Measuring devices, capable of determining the width and thickness of the test piece to within 0,05 mm (see 7.1).

4.5 Template with the geometry of the test piece (see Figures 1 and 2), to mark the shape of the test piece to be machined.

5 Test pieces

5.1 Sampling

The pipes used to produce the test piece shall be obtained by sampling as specified in the product standard.

5.2 Preparation

5.2.1 General

The butt-fused PE pipe joints shall be prepared in accordance with the manufacturer's instructions or the instructions specified in the relevant standards (e.g. ISO 11414).

For each test piece required, a strip shall be machined out along the longitudinal direction of the pipe, across the joint. The strip shall be further machined to prepare a test piece with dimensions conforming to:

a) Table 1 and Figure 1 for pipes with wall thickness $e < 25$ mm (type A);

b) Table 1 and Figure 2 for pipes with wall thickness $e \geqslant 25$ mm (type B);

using a template to ensure that the joint interface will be aligned with the cross-section of the centre of the waist of the test piece of type A or type B, as applicable.

The fusion beads may be removed.

5.2.2 Type A test piece

The dimensions and shape of the type A test piece shall conform to Figure 1 and Table 1.

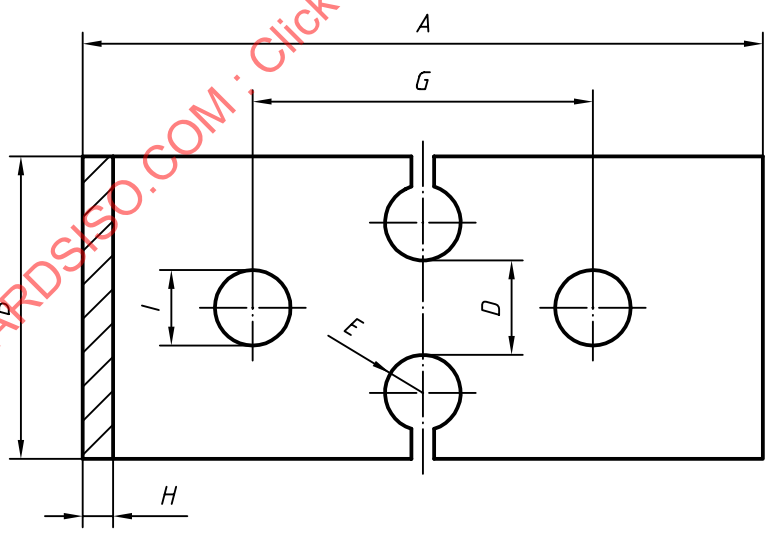

Figure 1 — Machined type A tensile test piece (for $e < 25$ mm)

Table 1 — Dimensions of type A and B test pieces

Dimensions in millimetres

Symbol	Description	Dimensions of type A test piece		Dimensions of type B test piece
		$d_n \leqslant 160$	$d_n > 160$	
A	Overall length (min.)	180	180	250
B	Width at ends	60 ± 3	80 ± 3	100 ± 3
C	Length of narrow parallel-sided portion	Not applicable	Not applicable	25 ± 1
D	Width of narrow portion	25 ± 1	25 ± 1	25 ± 1
E	Radius	$5 \pm 0{,}5$	$10 \pm 0{,}5$	25 ± 1
G	Initial distance between grips	90 ± 5	90 ± 5	165 ± 5
H	Thickness	Full wall thickness	Full wall thickness	Full wall thickness
I	Diameter of the traction holes	20 ± 5	20 ± 5	30 ± 5

The “waist” of the test piece shall be formed by drilling or machining holes with their centres 35 mm or 45 mm apart, as applicable, so that the centrelines of the holes lie in the same plane as the joint interface, and then cutting towards the holes from the corresponding edge of the strip. The faces of the test piece waist shall be smooth. The finish of the remaining edges is not critical.

5.2.3 Type B test piece

The dimensions and shape of the type B test piece shall conform to Table 1 and Figure 2.

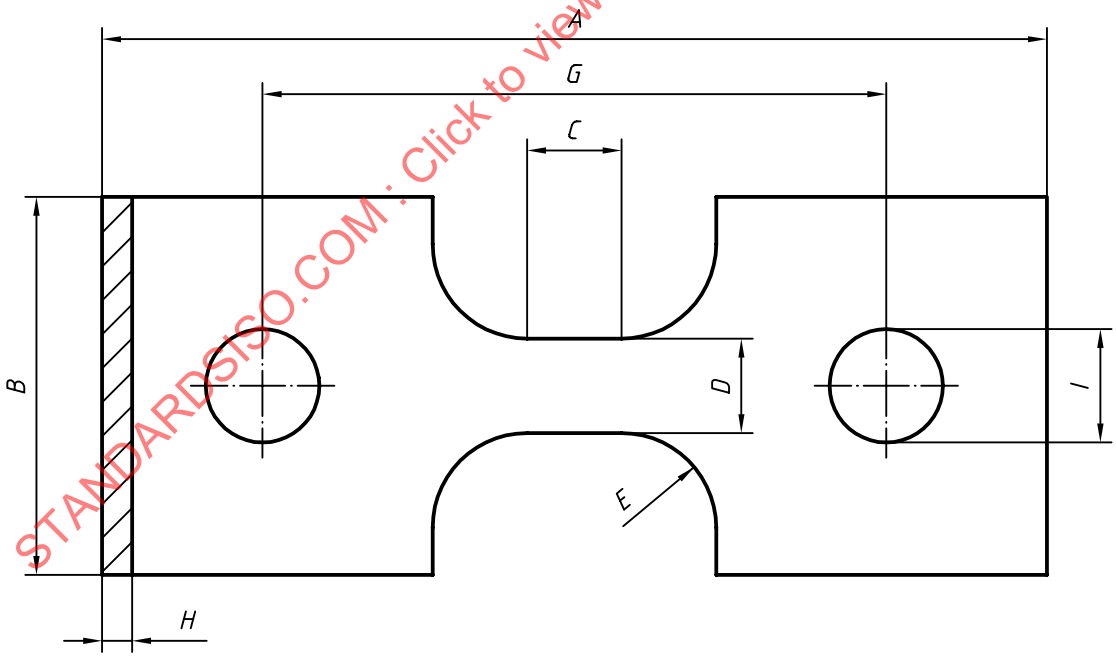

Figure 2 — Machined type B tensile test piece (for $e \geqslant 25$ mm)

5.3 Number of test pieces

The number of test pieces shall depend upon the nominal outside diameter d_n of the pipe, as given in Table 2.

Table 2 — Number of test pieces

Nominal outside diameter d_n mm	Number of test pieces
$90 \leqslant d_n < 110$	2
$110 \leqslant d_n < 180$	4
$180 \leqslant d_n < 315$	6
$315 \leqslant d_n$	7

One test piece shall be taken at the position of maximum misalignment. The other test pieces shall be taken uniformly around the circumference of the joint.

6 Conditioning

Immediately prior to testing in accordance with clause 7, condition each test piece in air for a minimum of 6 h at a temperature of 23 °C ± 2 °C, starting the period of conditioning at a time such that testing will not be carried out less than 24 h after the butt fusion of the joint.

7 Procedure

7.1 Measure the thickness of the test piece as the thickness of the pipe wall and the width of the test piece as the distance between the two holes drilled at the joint (D) for test pieces of type A (see Table 1 and Figure 1) or as the width of the narrow portion (D) for test pieces of type B (see Table 1 and Figure 2).

7.2 Place the test piece in the clamping device of the tensile-testing machine, so that the direction of the force applied to the test piece is perpendicular to the butt-fusion joint.

7.3 Apply tension to the test piece with a cross-head speed of 5 mm/min ± 1 mm/min.

7.4 Record the force applied during extension until complete failure of the test piece.

7.5 Record the maximum force applied (in newtons) and the type of failure as ductile or brittle, as characterized by the ductile and brittle failure modes shown in Figure 3. Only failures at the butt-fusion joint shall be taken into account.

7.6 Calculate the tensile strength as the maximum recorded tensile force (in newtons) divided by the cross-sectional area of the centre of the test piece (i.e. width × thickness, as measured in accordance with 7.1, in square millimetres).