

# ISO 13953 – Polyethylene (PE) Pipes and Fittings —Determination of the Tensile Strength and Failure Mode of Test Pieces from a Butt-Fused Joint – Testing Equipment

## Description



## 4 Apparatus

4.1 Room, which can be controlled at a temperature of  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

**4.2 Tensile-testing machine**, capable of sustaining between its clamping jaws a constant speed of 5 mm/min  $\pm$  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 ( $e \geq 25$ 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.

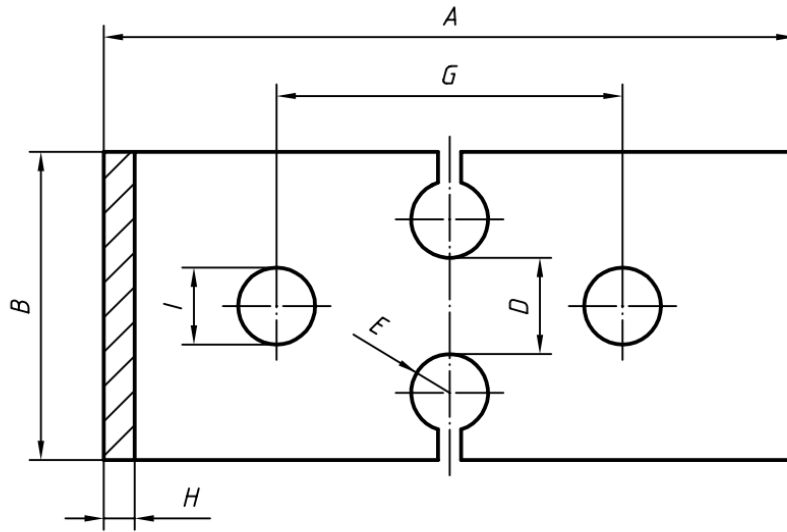


Figure 1 — Machined type A tensile test piece (for  $e < 25$  mm)

Table 1 — Dimensions of type A and B test pieces

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

The “waist” of the test piece shall be formed by drilling or machining holes with their centres 35mm or 45mm 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.

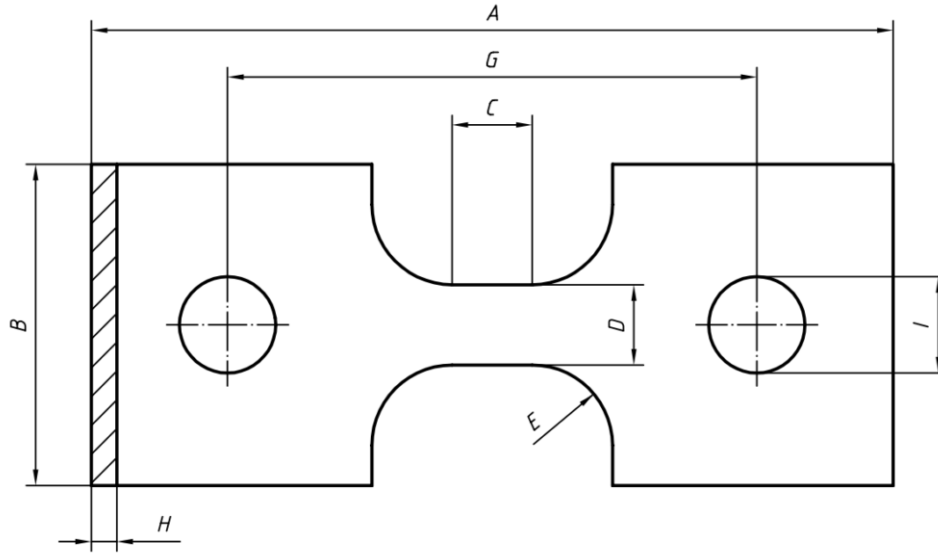


Figure 2 — Machined type B tensile test piece (for  $e \geq 25$  mm)

### 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
$90 \leq d_n < 110$	2
$110 \leq d_n < 180$	4
$180 \leq d_n < 315$	6
$315 \leq d_n$	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 6h at a temperature of  $23 \pm 2^\circ\text{C}$ , starting the period of conditioning at a time such that testing will not be carried out less than 24h 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  $5 \pm 1$  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).

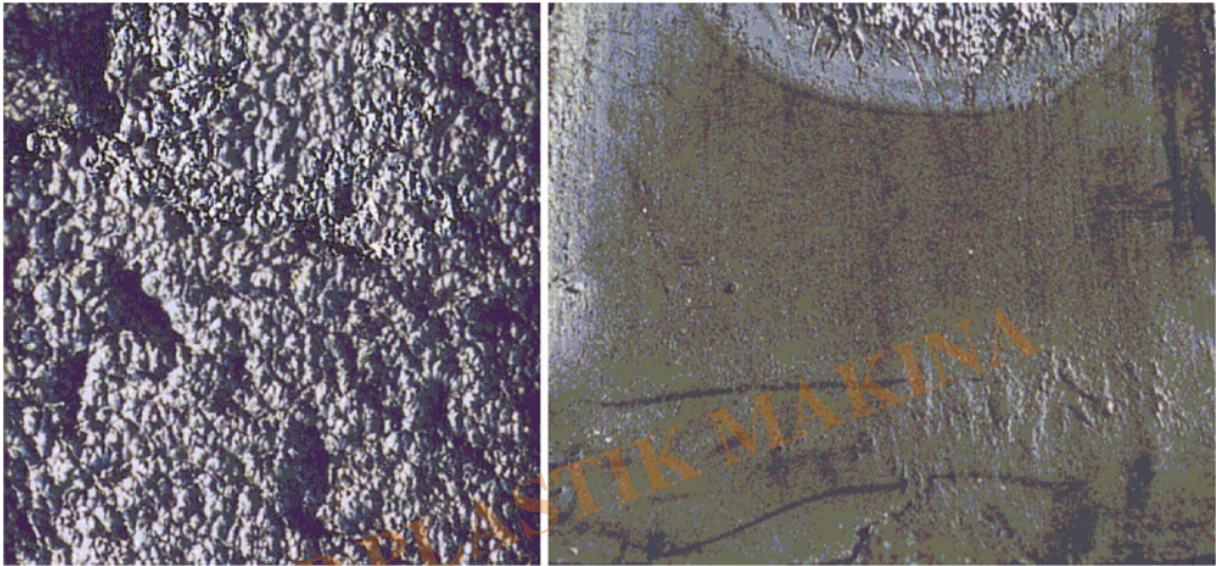


Figure 3 — Typical example of ductile failure mode (left-hand picture) and brittle failure mode (right-hand picture)

[CNC Milling for Tensile Sample Preparation](#)

[Universal Tensile Compression Tester \(UTM\)](#)

## Category

1. Equipment for Standards
2. Standards