

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

ICS 23.040.20; 23.040.45

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



National foreword

This British Standard reproduces verbatim ISO 13953:2001 and implements it as the UK national standard.

The UK participation in its preparation was entrusted to Technical Committee PRI/88, Plastic Piping Systems, to Subcommittee PRI/88/4, Test Methods, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Sector Policy and Strategy Committee for Materials and Chemicals, was published under the authority of the Standards Policy and Strategy Committee on 15 November 2001

Summary of pages

This document comprises a front cover, an inside front cover, ISO title page, page ii to iv, page 1 to 5 and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

© BSI 15 November 2001

ISBN 0 580 38350 4

INTERNATIONAL
STANDARD

ISO
13953

First edition
2001-09-15

**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*



Reference number
ISO 13953:2001(E)

Contents	Page
1 Scope	1
2 Normative reference	1
3 Principle	1
4 Apparatus	1
5 Test pieces	2
6 Conditioning	4
7 Procedure	4
8 Test report	5

www.parsethylene-kish.com

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.

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 $23\text{ °C} \pm 2\text{ °C}$.

4 Apparatus

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

4.2 Tensile-testing machine, capable of sustaining between its clamping jaws a constant speed of $5\text{ mm/min} \pm 1\text{ mm/min}$, 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.

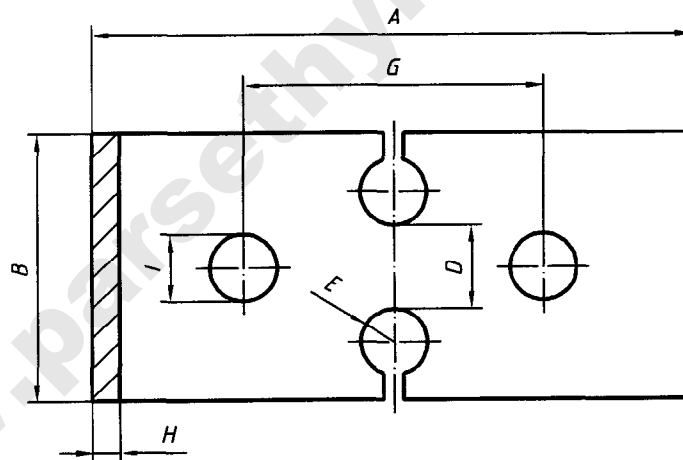


Figure 1 — Machined type A tensile test piece (for $e < 25$ mm)

Table 1 — Dimensions of type A and B test pieces

Dimensions in millimetres

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

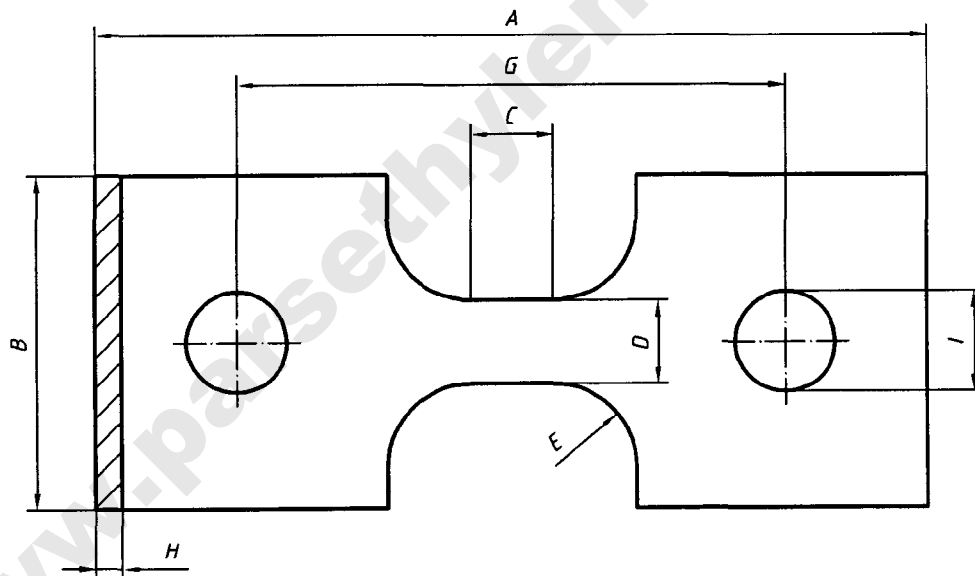


Figure 2 — Machined type B tensile test piece (for $e \geq 25$ mm)

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 6 h at a temperature of $23 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$, 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 $5 \text{ mm/min} \pm 1 \text{ mm/min}$.

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 \times thickness, as measured in accordance with 7.1, in square millimetres).

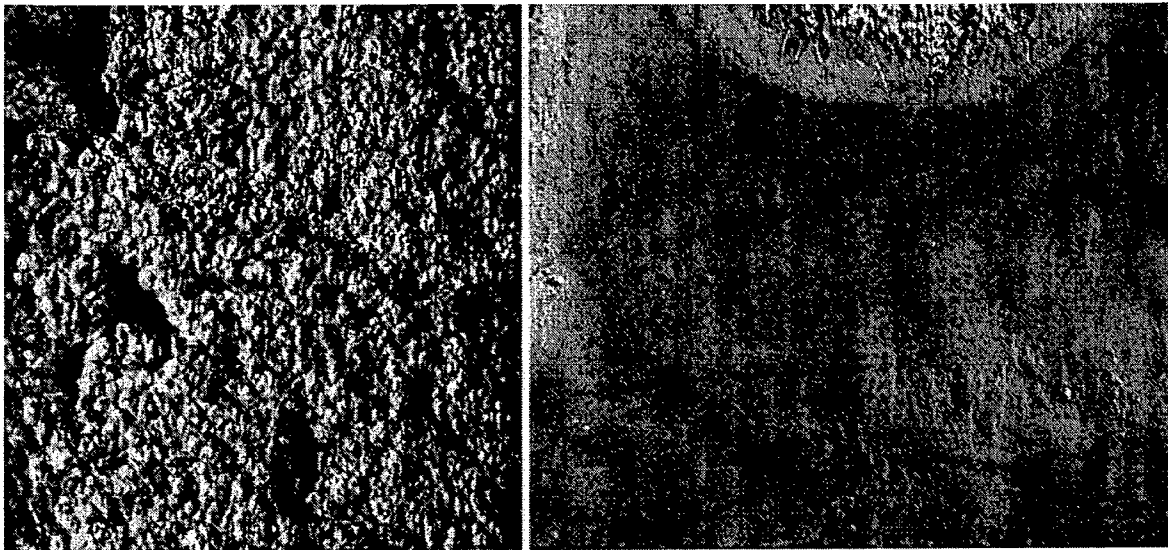


Figure 3 — Typical example of ductile failure mode (left-hand picture) and brittle failure mode (right-hand picture)

8 Test report

The test report shall include the following information:

- a) a reference to this International Standard and the referring standard;
- b) all details necessary for identification of the test pieces, including the nominal size of the pipes used to produce the test pieces, the type of material, the manufacturer's code and the fusion procedure used;
- c) the test piece type (A or B), whether the fusion bead was removed or not and the number of test pieces tested;
- d) the test temperature;
- e) the type of failure for each test piece;
- f) the tensile strength for each test piece;
- g) observations made during the test;
- h) any factors that may have affected the results, such as any incidents or any operating details not specified in this International Standard;
- i) the test laboratory;
- j) the date of the test.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.
Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001. Standards are also available from the BSI website at <http://www.bsi-global.com>.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.
Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.
Tel: 020 8996 7002. Fax: 020 8996 7001. Further information about BSI is available on the BSI website at <http://www.bsi-global.com>.

Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

If permission is granted, the terms may include royalty payments or a licensing agreement. Details and advice can be obtained from the Copyright Manager.
Tel: 020 8996 7070.

BSI
389 Chiswick High Road
London
W4 4AL