BS EN 13067:2012

BSI Standards Publication

Plastics welding personnel — Qualification testing of welders — Thermoplastics welded assemblies

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National foreword

This British Standard is the UK implementation of EN 13067:2012. It supersedes BS EN 13067:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/80, Welding thermoplastics.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Kunststoffschweißpersonal - Anerkennungsprüfung von Schweißern - Thermoplastische Schweißverbindungen

This European Standard was approved by CEN on 22 September 2012.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 13067:2012) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13067:2003.

In this revision, the scope of this standards includes solvent welding: socket and covers the welding of the polypropylene (PP) lining membranes (group 9: PP).

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This standard covers the principles to be observed in the qualification testing of welder performance for the welding of thermoplastic materials.

The ability of the welder to follow verbal or written instructions and testing of his skill are important factors in ensuring the quality of the welded product.

This standard is intended to provide the basis for the mutual recognition by examining bodies for qualification relating to welders competence in the various fields of application.

1 Scope

This European Standard specifies the method of testing the knowledge and skill of a welder who is required to carry out welds on thermoplastics in new constructions and repair work.

The skill examination of a welder is an essential condition for the assurance of the quality of the welding work.

The application of this standard guarantees that the examination is carried out according to a uniform test procedure.

This European Standard applies when the contractor or the authorities responsible for the application require it.

Gas and water utility network industries with alternative qualification programmes are excluded from this standard.

This European Standard applies to the following welding processes:

— hot gas welding: round nozzle, high speed nozzle, wedge;

— extrusion welding;

— heated tool welding: butt, saddle, socket, wedge;

— electrofusion welding: socket, saddle;

— solvent welding: socket.

This European Standard applies to the welding of the following products:

— sheet;

— pipe;

— fittings;

— lining membrane.

This European Standard covers the welding of the following groups of materials:

a) for sheets, pipes and fittings:

   1) group 1: PVC (including all kinds of PVC-U, PVC-C), ABS**;**

   2) group 2: PP (including all kinds of PP);

   3) group 3: PE (including all kinds of PE);

   4) group 4: PVDF;

   5) group 5: ECTFE or PFA or FEP;

b) for lining membranes:

   1) group 6: PVC-P;

2) group 7: PE (including all kinds of PE);

3) group 8: ECB;

4) group 9: PP.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12814-1, *Testing of welded joints of thermoplastics semi-finished products — Part 1: Bend test*

EN 12814-2:2000, *Testing of welded joints of thermoplastics semi-finished products — Part 2: Tensile test*

EN 12814-4, *Testing of welded joints of thermoplastics semi-finished products — Part 4: Peel test*

EN 12814-8, *Testing of welded joints of thermoplastics semi-finished products — Part 8: Requirements*

EN 13100-1, *Non destructive testing of welded joints of thermoplastics semi-finished products — Part 1: Visual examination*

EN 14728, *Imperfections in thermoplastic welds — Classification*

EN ISO/IEC 17024:2003, *Conformity assessment — General requirements for bodies operating certification of persons (ISO/IEC 17024:2003)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

3 Terms and definitions

For the purposes of this document, the terms and definitions from EN ISO/IEC 17024:2003 and the following apply.

3.1
AD-WLD break
failure mode in an extrusion welded membrane peel test specimen where the failure is through the weld material

3.2
certificate issuing authority
establishment responsible for approving the PWE and or the Invigilator

3.3
invigilator
qualified person approved by Certificate Issuing Authority (CIA) who can supervise the practical and theoretical tests

Note 1 to entry: 3.3 and 3.5 can be the same person.

3.4
manufacturer
company, contractor or organisation who is responsible for the welding

3.5
Plastics Welding Examiner
PWE
qualified person approved by Certificate Issuing Authority (CIA) who verifies the compliance with this standard

3.6
qualification test
theoretical and practical tests in order to verify the knowledge and the skill of the welder

3.7
range of qualification
welding processes, types of joint, materials, thicknesses and diameters for which a welder is qualified

3.8
test piece
assembly which is welded during the practical test

3.9
test specimen
part or portion cut from the test piece for the test specified

3.10
test house
establishment having all relevant test equipment to carry out the required tests and working in compliance with EN ISO/IEC 17025

3.11
training centre
educational establishment for training plastics welding personnel and/or Plastics Welding Examiner, approved by CIA

3.12
welding process
technique characterized by the method of softening to obtain permanent assembly

3.12.1
electrofusion welding
softening of fitting and pipe surfaces to be welded is obtained by means of a heating element embedded in the fitting which remain between welded joints

3.12.2
extrusion welding
welding process in which an extruder unit with a melting chamber gives the extruded material required by the thickness and shape of the joint. Hot air or inert gas heats simultaneously the parent material

3.12.3
heated tool welding
welding process in which the joint surfaces are adequately heated by exposure, through direct contact with heated elements and are welded under pressure, which includes butt fusion welding (also called hot plate welding, platen welding or mirror welding) and socket fusion welding

3.12.4
heated wedge
welding process in which the lining membrane welded is gripped by rollers which guide and propel the welding machine which uses either hot gas to heat the lining membrane and the wedge to effect the weld or electrically heated wedge to heat the lining membrane in the area being welded

3.12.5
high-speed nozzle
welding process in which the welding rod is suitably guided and pre-heated and the nozzle tip is provided with a profiled area to apply the welding pressure

3.12.6
hot gas welding
welding process in which the materials to be unified are softened by hot air or inert gas and are pressed together

3.12.7
round nozzle
welding process in which the pressure is applied via the welding rod or a suitable attachment such as a pressure roller

3.12.8
solvent welding
softening of fitting and pipe surfaces, by means of a solvent contained in the cement

Note 1 to entry: After suitable cure time, the solvent dries leaving the parent material in the interface between welded joints.

3.13
welding Procedure Specification
WPS
document providing in detail the required variables for a specific application to assure repeatability

3.14
welding record sheet
document recording in detail the variables used during the practical test

3.15
welder
person making a welded assembly by any process, whose manual skill and knowledge are two of the determining factors influencing the quality of the welded joint, or person performing a welding operation by means of mechanical or automatic equipment

4 Admission to the qualification tests

Only welders whose training and/or for whose previous activities show that they are likely to pass the planned test may be admitted. As a rule this is the case if one of the following conditions is met:

— completed apprenticeship as plastics fabricator;

— at least two years experience as a plastics welder confirmed by manufacturer’s declaration;

— completion of both a technical and practical training course in preparation for the plastic welders qualification test.

An example of a suitable training course is defined in Entry [1] in the Bibliography or may be identified in national standards.

5 Testing of skill and knowledge

5.1 General

During the qualification test, the welder shall demonstrate his practical skill according to 5.2 and his theoretical knowledge according to 5.3.

5.2 Practical test

This test is carried out under the supervision of the PWE or Invigilator.

The welder shall complete the test piece specified by the required sub-group in Table 1 or Table 2 in accordance with the relevant WPS.

All welding equipment, materials and documents necessary to complete the test piece shall be available to the welder.

All welding shall be performed in a horizontal position.

The time taken by the welder to complete the test piece shall correspond to that taken under production conditions.

5.3 Theoretical test

This test is carried out under the supervision of the PWE or Invigilator.

The welder's knowledge of the practical working rules for skilful and safe working shall be evaluated in the theoretical test.

The welder shall answer a minimum of 20 multiple-choice questions relevant to the qualification testing.

Completion of the theoretical test shall not exceed one hour, be continuous without access to teaching aids.

The questions shall cover the following subjects, as appropriate:

— rules for welding of thermoplastics to which the test is designed to apply, meaning of the welding signs and symbols of the range of work;

— operation and control of the welding equipment;

— welding processes;

— knowledge concerning on-site welding;

— correct preparation of the work pieces for welding;

— knowledge concerning the characteristics of thermoplastics within the sub-groups;

— knowledge concerning the characteristics of solvents / cements within the relevant sub-group;

— preventing and correcting faults when making welds;

— knowledge concerning the types of imperfections for the applied welding process(es);

— knowledge concerning the WPS and welding record sheet;

— awareness of the consequences of misapplying welding parameters and/or procedures;

— knowledge concerning non-destructive examinations and destructive tests necessary for the applied welding process(es);

— awareness of health and safety requirements for the above work.

Table 1 — Sheets, pipes and fitting details of tests *(1 of 3)*

Dimensions in millimetres

Group of material	Sub groups	Type of product S = sheet P = pipe e_n = nominal wall thickness d_n = nominal pipe outside diameter SDR=d_n/e_n		Welding process	Weld form[b]	Examination and testing Type of test [a]	Test piece according to Figure	Range of qualification	
								Dimensions	Type of joint [b]
1 PVC	1.1	S	e_n=5	Hot gas round nozzle	V	V/ B f+r	1	All e_n	V,X,⊥
	1.2	S	e_n=5	Hot gas high speed nozzle	V	V/ B f+r	1	All e_n	V,X,⊥
	1.3	S	e_n=5	Heated tool	][	V/ B	1	$e_n \geq 3$	][
	1.4	P	d_n=40 and d_n=110 SDR≤21	Solvent Welding	I	V/ Vls	4	d_n< 160	I
	1.5	P	d_n≥160 SDR≤21	Solvent Welding	I	V/ Vls	4	d_n≥160	I
2 PP	2.1	S	e_n=9 or 10	Hot gas high speed nozzle	X	V/ B f+r	1	All e_n	V,X,⊥
	2.2	S	e_n=9 or 10	Extrusion continuous	V	V/ B f+r	1	$e_n \geq 3$	V,X,⊥
	2.3	S	e_n=9 or 10	Heated tool	][	V/ B	1	$e_n \geq 3$	][
	2.4	P	d_n=110 SDR≤17,6	Heated tool	][	V/ B	2	$e_n \geq 3$ $d_n \leq 315$	][
	2.5	P	d_n≥400 SDR≤17,6	Heated tool	][	V/ B s	2	d_n> 315	][
	2.6	P	d_n=63 SDR≤17,6	Heated tool [c]	I	V/ Pc	4	All d_n	I
	2.7	P	d_n=63 SDR≤17,6	Electrofusion	I	V/ Pc	4	All d_n	I

Table 1 *(2 of 3)*

Dimensions in millimetres

Group of material	Sub groups	Type of product S = sheet P = pipe e_n = nominal wall thickness d_n = nominal pipe outside diameter SDR=d_n/e_n		Welding process	Weld form[b]	Examination and testing Type of test [a]	Test piece according to Figure	Range of qualification	
								Dimensions	Type of joint [b]
3 PE	3.1	S	e_n=10	Hot gas high speed nozzle	X	V/ B f+r	1	All e_n	V,X,⊥
	3.2	S	e_n=10	Extrusion continuous	V	V/ B f+r	1	$e_n \geq 3$	V,X,⊥
	3.3	S	e_n=10	Heated tool	][	V/ B	1	$e_n \geq 3$	][
	3.4	P	110≤d_n≤180 SDR≤17,6	Heated tool	][	V/ T	2	d_n≤ 315	][
	3.5	P	d_n≥400 SDR≤17,6	Heated tool	][	V/ T	2	d_n >315	][
	3.6	P	90≤d_n≤125 SDR≤17,6	Electrofusion	I	V/ Pc	4	$d_n \leq 315$	I
	3.7	P	d_n≥355 SDR≤17,6	Electrofusion	I	V/ Pd	4	d_n>315	I
	3.8	P	d_n≤63 on 90≤d_n≤125 SDR≤17,6	Electrofusion	.†.	V/ Pc	5	All d_n	.†.
	3.9	P	d_n=63 SDR=11	Heated tool [c]	I	V/ Pc	4	All d_n	I
	3.10	P	d_n=32 on d_n=90 SDR=11	Heated tool	.†.	V/ Pc	5	All d_n	.†.

Table 1 *(3 of 3)*

Dimensions in millimetres

Group of material	Sub groups	Type of product S = sheet P = pipe e_n = nominal wall thickness d_n = nominal pipe outside diameter SDR=d_n/e_n		Welding process	Weld Form [b]	Examination and testing Type of test [a]	Test piece according to Figure	Range of qualification	
								Dimensions	Type of joint [b]
4 PVDF	4.1	S	e_n=4	Hot gas high speed nozzle	V	V/ B f+r	1	$e_n \geq 2$	V,X,⊥
	4.2	S	e_n=4	Heated tool	V	V/ B	1	$e_n \geq 2$	][
	4.3	P	d_n=110 e_n=5,3	Heated tool	][	V/ B	2	All d_n $e_n \geq 1,9$	][
	4.4	P	d_n=63 e_n=3	Heated tool [c]	I	V/ Pc	4	All d_n	I
5 ECTFE or FEP or PFA	5.1	S	e_n=2,3	Hot gas high speed nozzle	V	V/ T	3	$e_n \geq 1,6$	V,X,⊥
	5.2	P	d_n=110 e_n=3	Heated tool	][	V/ T	2	All d_n All e_n	][

[a] " / " = and; B = Bend test (f: face ; r: root ; s: side (for thick materials)) Pc = Peel test (crush test) ; V = Visual examination; Pd = Peel test (decohesion test); T = Tensile test; Vls = Visual examination of longitudinal sections

[b] V = V preparation
X = double V preparation
⊥ = fillet weld
][= butt weld
.†. = saddle
I = socket

[c] Welding by machine only

Table 2 — Lining membranes details of tests *(1 of 2)*

Dimensions in millimetres

Group of material	Sub groups	Type of product M=membrane e_n = nominal wall thickness		Welding process	Weld form	Examination and testing Type of test [a]	Test piece according to Figure	Range of qualification	
								Dimensions	Type of joint
6 PVC-P	6.1	M	e_n=2	Hot gas manual		V/ Pt	6	$1 \le e_n \le 4$	All Lap
	6.2	M	e_n=2	Hot gas high by machine		V/ Pt	7	$1 \le e_n \le 4$	All Lap
	6.3	M	e_n=2	Heated wedge by hot gas		V/ Pt	7	$1 \le e_n \le 4$	All Lap
	6.4	M	e_n=2	Heated wedge electric		V / Pt	7	$1 \le e_n \le 4$	All Lap
7 PE	7.1	M	$2 \le e_n \le 2,5$	Hot gas manual		V/ Pt	6	$1 \le e_n \le 5$	All Lap
	7.2	M	$2 \le e_n \le 2,5$	Hot gas by machine		V/ Pt	7	$1 \le e_n \le 5$	All Lap
	7.3	M	$2 \le e_n \le 2,5$	Heated wedge by hot gas		V/ Pt	7	$1 \le e_n \le 5$	All Lap
	7.4	M	$2 \le e_n \le 2,5$	Heated wedge electric		V/ Pt	7	$1 \le e_n \le 5$	All Lap
	7.5	M	$2 \le e_n \le 2,5$	Extrusion manual		V/ Pt	8	$1 \le e_n \le 5$	All Lap

Table 2 *(2 of 2)*

Dimensions in millimetres

Group of material	Sub groups	Type of product M=membrane e_n = nominal wall thickness		Welding process	Weld form	Examination and testing Type of test [a]	Test piece according to Figure	Range of qualification	
								Dimensions	Type of joint
8 ECB	8.1	M	e_n=2	Hot gas manual		V/ Pt	6	$1 \le e_n \le 4$	All Lap
	8.2	M	e_n=2	Hot gas high by machine		V/ Pt	7	$1 \le e_n \le 4$	All Lap
	8.3	M	e_n=2	Heated wedge by hot gas		V/ Pt	7	$1 \le e_n \le 4$	All Lap
	8.4	M	e_n=2	Heated wedge electric		V / Pt	7	$1 \le e_n \le 4$	All Lap
9 PP	9.1	M	$1 \le e_n \le 2$	Hot gas manual		V/ Pt	6	$0,7 \le e_n \le 3$	All Lap
	9.2	M	$1 \le e_n \le 2$	Hot gas by machine		V/ Pt	7	$0,7 \le e_n \le 3$	All Lap
	9.3	M	$1 \le e_n \le 2$	Heated wedge by hot gas		V/ Pt	7	$0,7 \le e_n \le 3$	All Lap
	9.4	M	$1 \le e_n \le 2$	Heated wedge electric		V/ Pt	7	$0,7 \le e_n \le 3$	All Lap
	9.5	M	$1 \le e_n \le 2$	Extrusion manual		V/ Pt	8	$0,7 \le e_n \le 3$	All Lap

[a] " / " = and; Pt= Peel test (T-peel test) ; V = Visual examination

6 Duty of Plastics Welding Examiner and invigilator

The test shall be supervised by a PWE or invigilator and shall be marked and signed by a PWE.

The PWE shall be responsible for sending the test pieces to the qualified test house.

The PWE shall not examine any candidate trained by himself. The PWE shall reach his professional decisions independently.

The PWE shall check the test house qualification and, where applicable, the training centre.

7 Range of qualification

The designation of a plastics welder's test shall be formed according to the group and sub-group and the range of qualification (see Table 1 or Table 2). The range of validity of qualification shall be shown on the certificate.

8 Welding of test piece

8.1 Difficulties and corrections whilst welding the test piece

If difficulties arise during the practical test that are not caused by the welder, a test piece on which welding has been started may be replaced after qualification by the PWE or invigilator.

Errors made or occurring during the hot gas or extrusion welding may be repaired only after permission has been given by the PWE or invigilator.

8.2 Inspection requirements

Before welding, the PWE or invigilator shall check the identity of candidate, the suitability of the materials, WPS, machines and equipment. The test piece shall be identified with the number or mark of the PWE or invigilator and the welder.

The PWE or invigilator shall supervise the welding of the test piece.

The welder shall complete the welding record sheet (see proposal given in Annex A) controlled and witnessed by the PWE or invigilator.

The PWE or invigilator shall stop the test if the welding conditions are not in compliance with the WPS or the welder does not have the skill required to obtain a satisfactory result.

The PWE shall visually check the test piece after completion by the welder.

8.3 Test piece

The test piece shall be as required in Table 1 or Table 2.

9 Test piece and test specimens, shapes and dimensions

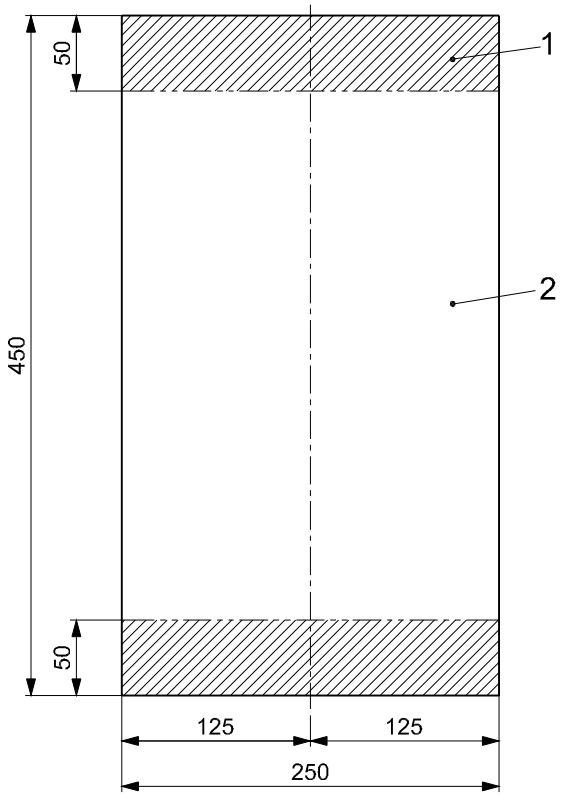
The dimensions of the test piece and the number of test specimens to be cut from the test piece shall be those specified for the particular test sub-groups (see Figures 1 to 9).

The shapes, dimensions and conditioning of the test specimens are specified in the relevant test standards.

Cutting the test specimens shall be carried out without significant damage to the welds and their heat affected zones.

Tests, other than the initial visual examination, shall be carried out by a qualified test house agreed upon by the parties involved. The test house shall be responsible for cutting the test specimen and carrying out the tests. The standards against which the test house is qualified shall be referenced.

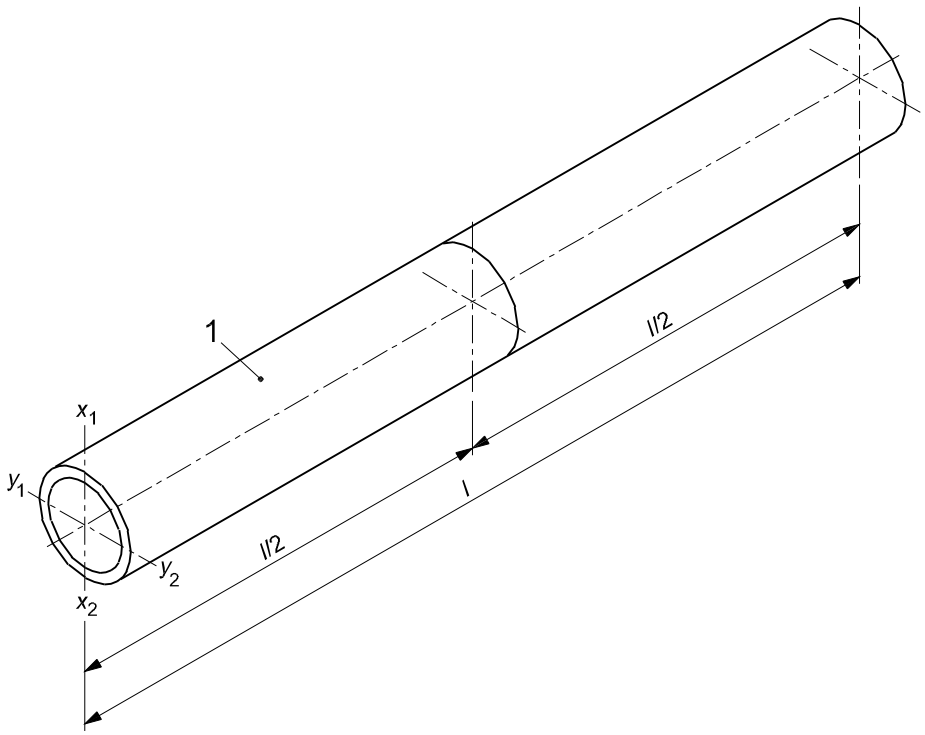
Minimum dimensions in millimetres



Key

1 discard
2 6 bend test specimens cut as directed by the PWE

Figure 1 — Test piece for a butt weld on sheet (for bend test specimens)



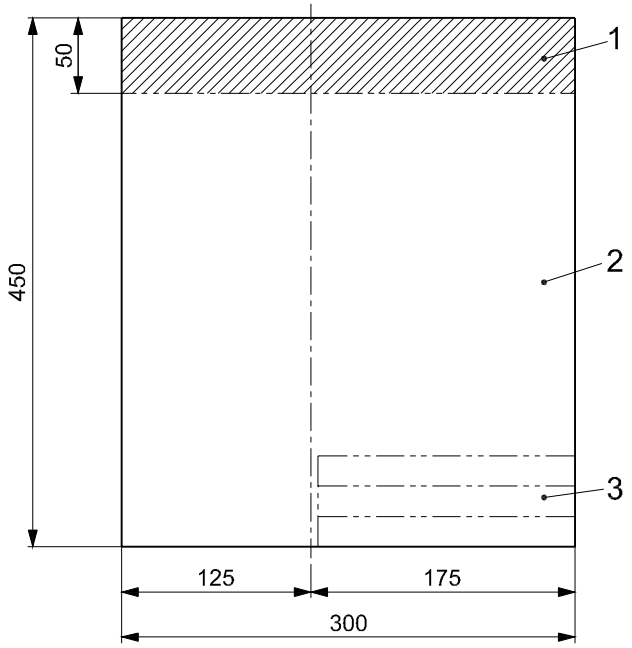
Key

1 4 test specimens, 1 in each location (x_1, x_2, y_1, y_2) cut as directed by the PWE

l ≥ 350 or 2 d_n, whichever is longer

Figure 2 — Test piece for a butt weld on pipe (for bend or tensile test specimens)

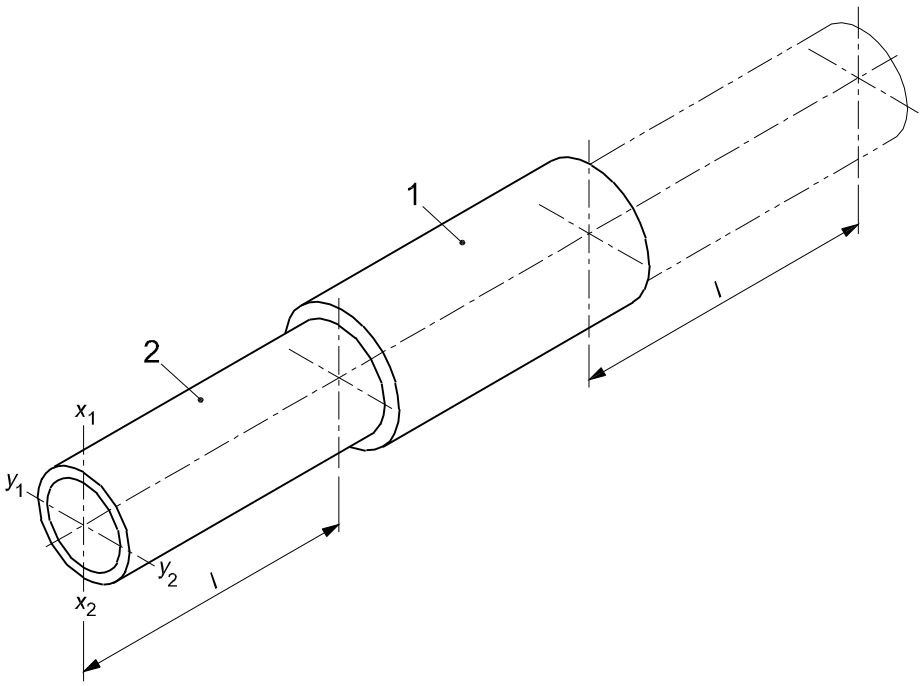
Minimum dimensions in millimetres



Key

1 discard
2 5 tensile test specimens cut as directed by the PWE
3 3 tensile test specimens (for reference) cut as directed by the PWE

Figure 3 —Test piece for a butt weld on sheet (for tensile test specimens)



Key

1 socket
2 pipe
For subgroups 1.5, 3.7, $l \geq d_n$
For subgroups 1.4, 2.6, 2.7, 3.6, 3.9, 4.4, $l \geq 5\ d_n$

Figure 4 — Test piece for a socket weld

Minimum dimensions in millimetres

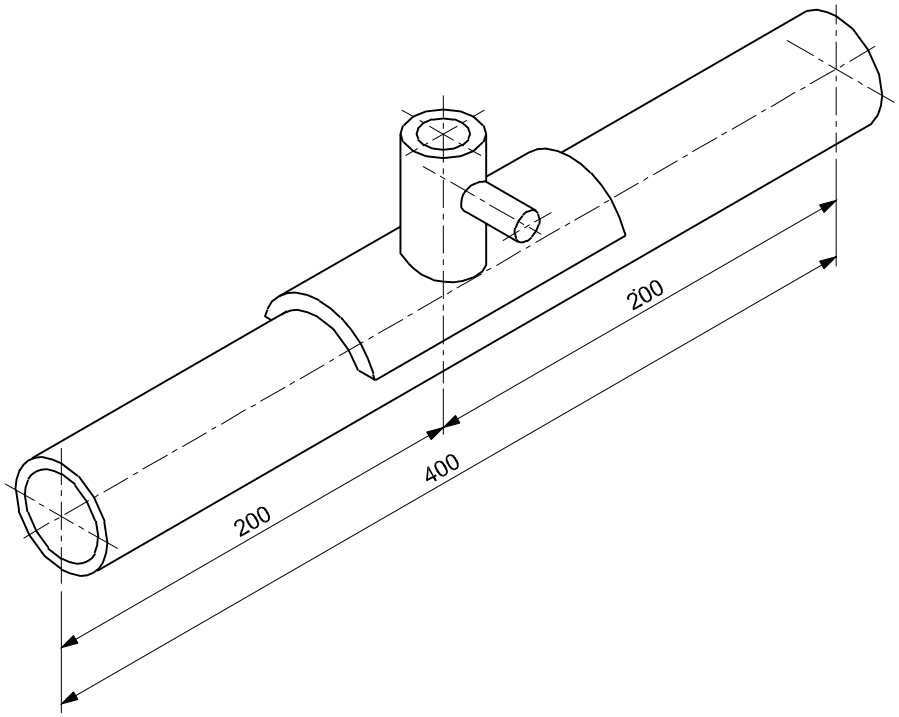
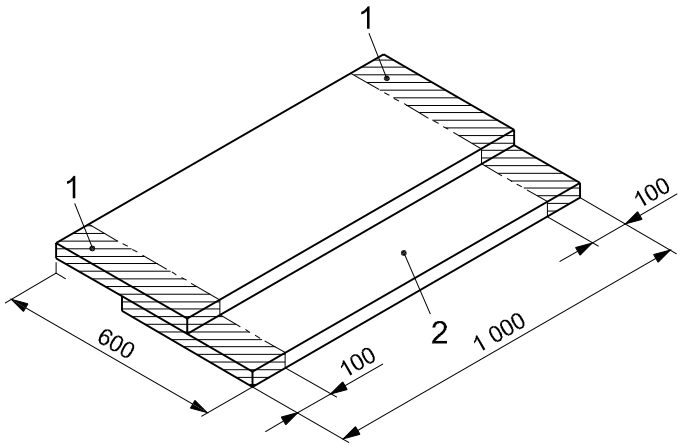


Figure 5 — Test piece for a saddle weld

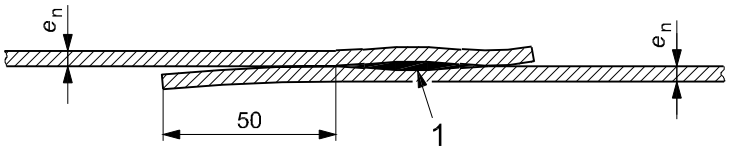
Minimum dimensions in millimetres



Key

1 discard
2 5 peel test specimens cut as directed by the PWE

a)



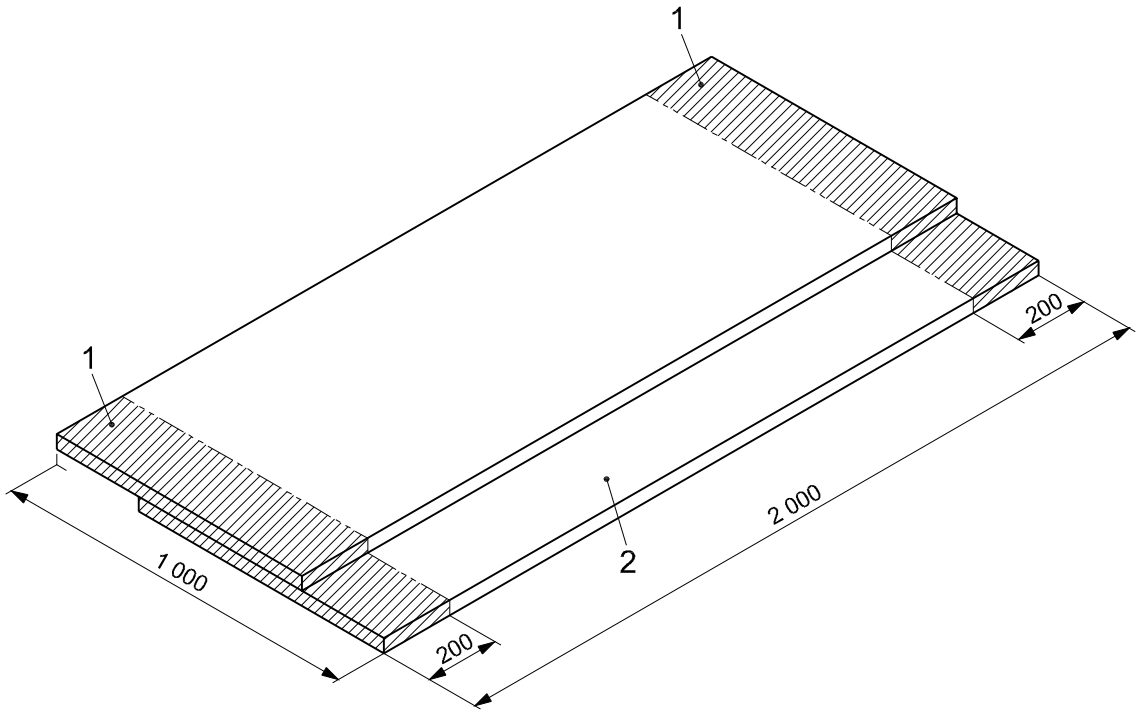
Key

1 welding zone

b)

Figure 6 — Test piece for lining membranes - Lap seam without testing channel

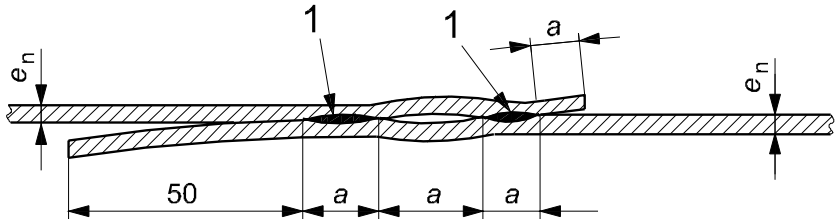
Minimum dimensions in millimetres



Key

1 discard
2 5 peel test specimens cut as directed by the PWE

a)



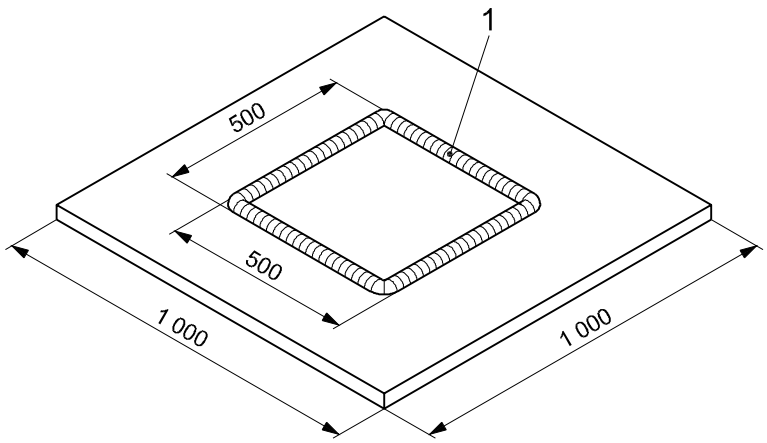
Key

1 welding zone
a the dimensions are dictated by the machine, WPS employed.

b)

Figure 7 — Test piece for lining membranes - Lap seam with testing channel

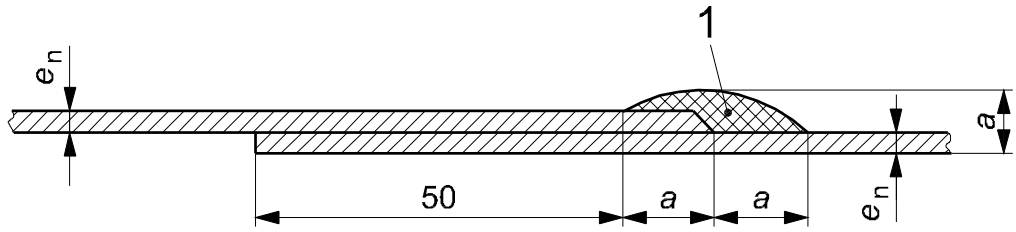
Minimum dimensions in millimetres



Key

1 5 test specimens cut as directed by the PWE

a)



Key

1 welding zone
a the dimensions are dictated by the WPS employed

b)

Figure 8 — Test piece for lining membranes - Lap seam extrusion welded

10 Evaluation and acceptance criteria of test piece(s) and test specimens

10.1 General

The PWE evaluates the test piece, the test specimens and the results produced by the test house. The evaluation of the test piece and the test specimens is divided into two sections, visual and destructive.

Visual examination is described in 10.2.

Destructive tests are described in 10.3.

The following designation for the test evaluation applies:

— c: conform;

— nc: not conform.

The results and the evaluation shall be noted on the relevant evaluation record form (see proposal given in the informative Annex C).

10.2 Visual examination

Visual evaluation applies to all stages of practical and destructive tests.

The visual examination shall be carried out in accordance with EN 13100-1 and any relevant imperfections observed, as defined in EN 14728 (where applicable), shall be recorded.

The test piece shall comply with the WPS.

10.3 Destructive tests

10.3.1 General

The PWE or invigilator, after confirming that the test pieces conform to the visual examination carried out in accordance with 10.2, shall submit the test pieces to the test house for tests described in Clause 9 and Table 1 or Table 2.

The test house shall be operating in compliance with EN ISO/IEC 17025.

Results produced (test record) and tested specimens shall be sent by the test house to the PWE for verification.

Storage or disposal of the test piece or test specimens shall be as instructed by the PWE.

10.3.2 Bend test

The bend test shall be carried out in accordance with EN 12814-1, except for the number of specimens tested and that the test specimen width shall be 20 mm in all cases.

Where Table 1 requires "B f+ r" half of the test specimens shall be tested as B f and half as B r.

The minimum requirements for each test specimen shall equal or exceed the values given in EN 12814-8. If the criterion for failure used is that a maximum load is reached, then bend angles or ram displacements below the minimum values shall be considered acceptable providing that they are not less than the values achieved by test specimens cut from the parent sheet.

Should one test specimen fail to meet the required minimum bending angle, two additional test specimens shall be taken, from the same test piece and re-tested under identical conditions. If the bending angle thus obtained fails to give the required value, the test does not conform.

10.3.3 Peel test

The peel test shall be carried out in accordance with EN 12814-4.

The peel test method for each material and sub-group given in Tables 1 and 2 are shown in Table 3.

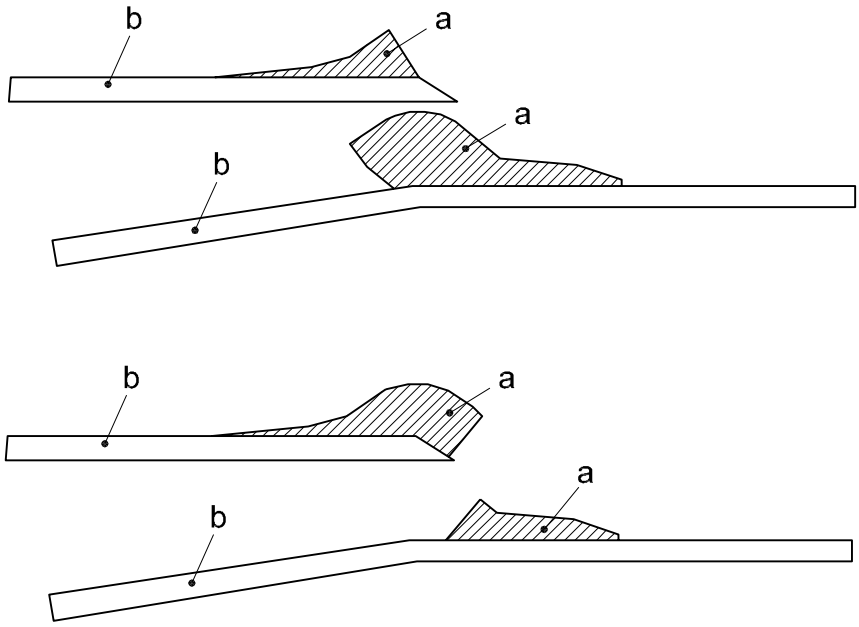
Table 3 — Peel test method

Group of material	Sub-group	Peel test method
PP	2.6	crush
	2.7	crush
PE	3.6	crush
	3.7	decohesion
	3.8	crush
	3.9	crush
	3.10	crush
PVDF	4.4	crush
PVC-P	6.1 to 6.4	T-peel
PE	7.1 to 7.5	T-peel
ECB	8.1 to 8.4	T-peel
PP	9.1 to 9.5	T-peel

For the decohesion test, rupture in the brittle mode shall not exceed 25 % of the axial length of the weld.

For the crush test, the fracture in the weld shall not extend beyond the second turn of wire of an electrofusion fitting. For heated tool welds any resulting fracture shall not occur between the pipe and fitting.

For the T-peel test, all failures, except for an AD-WLD break (Figure 9), shall be in the parent material.



Key

a extrusion weld
b membrane

Figure 9 — AD-WLD break

10.3.4 Tensile test

The tensile test shall be carried out in accordance with EN 12814-2 except for the number of test specimens.

For PE pipes covering sub-groups 3.4 and 3.5 in Table 1, test specimens conforming to Annex B of EN 12814-2:2000 shall be used. For group 5 materials, type 2 test specimens shall be used.

Depending on the test specimen used, the purpose of the tensile test is slightly different. For test specimens conforming to Annex B of EN 12814-2:2000, rupture in the brittle mode (as shown in ISO 13953) of any of the test specimens does not conform.

For test specimens conforming to a type 2 geometry the purpose of the test is to determine the short term tensile welding factor, *f*s. The short term tensile welding factor shall be determined based on:

- five welded and three unwelded reference test specimens for Subgroup 5.1;
- four welded and four unwelded reference test specimens for Subgroup 5.2 in the same location.

The values for the short term tensile welding factor *f*s are given in Table 4.

For multiple destructive evaluation, where the source, grade and direction of extrusion of the parent material is exactly the same as the welded test specimen, then at the discretion of the PWE there shall be no need for the reference tests to be repeated.

Should one test specimen fail to meet the required short term tensile welding factor *f*s, two additional test specimens shall be taken, from the same test piece and re-tested under identical conditions. If the short term tensile welding factor *f*s thus obtained fails to give the required value, the test does not conform.

Table 4 — Short term tensile welding factor *f*s to be obtained

Group of material	Group of material	Welding factor *fs*
ECTFE or FEP or PFA	5.1 5.2	≥0,8 ≥0,8
The crosshead speed for tensile testing materials should preferably be 50 mm/min.		

10.3.5 Visual examination of longitudinal cross-sections

In case of Subgroups 1.4 and 1.5 the test pieces shall be cut longitudinally into quarters and each of the four test specimens shall be visually examined and any imperfections observed shall be recorded, in particular any non uniformity of the gap between the pipe and socket and excessive weld material. After not less than 24 hours after sectioning the test specimens shall be heated in an oven using the conditions given in Table 5. After heating the pipe and socket shall be separated manually minimising the shearing between the two parts and the inside of the socket shall be visually examined.

At least 70 % of the socket surface shall have a whitened rough texture, which indicates that the area was welded. In addition, any unbonded area shall have a longitudinal length not greater than 50 % of the socket length.

Table 5 — Heating conditions for longitudinal sections (Subgroup 1.4 and 1.5 test pieces)

Thickness e_n	T (°C)		Heating time (min)	
	PVC-U, ABS	PVC-C	PVC-U, ABS	PVC-C
$e_n \leq 5$	115 ±5	140	10 to 15	15 to 20
$5 < e_n \leq 12$			20 to 25	25 to 30
$e_n > 12$			> 40	> 40

11 Test result and qualification test certificate

11.1 Overall assessment

For the overall assessment the results of the practical and theoretical parts of the test are collected together. Both parts shall conform and the qualification test is passed.

11.2 Practical test

The candidate is considered to conform to the practical test if the requirements of each of the evaluation sections (see Clause 8 and Clause 10 as appropriate) are fulfilled.

11.3 Qualification test certificate

The welder's qualification test certificate shall be issued by the CIA in compliance with EN ISO/IEC 17024 in the language (or languages) agreed upon by the parties involved and contain at least the following information:

— welder's full name;

— date, place and country of birth;

— clear photograph of good likeness;

— reference to this standard and the group of materials and sub-group number(s) of qualification test passed according to Table 1 or Table 2;

— date of overall assessment pass;

— date of issue;

— period of validity;

— signature of PWE;

— Certificate Issuing Authority (full name and address);

— individual certificate identification number.

Copyright to the qualification test certificate remains with the CIA.

Annex B gives a recommended format to be used as the welder's qualification test certificate.

11.4 Theoretical test

A minimum percentage of 80 % of correct answers given are required to award an acceptable result in the theoretical test defined in 5.3.

12 Failed test

The welder shall undergo further education and training at a training centre prior to taking a new qualification test.

13 Period of validity

13.1 Initial qualification

The validity of the welder's qualification begins from the date of the last qualification test (practical or theoretical) that was passed. This date may be different to the date of issue marked on the certificate.

A welder's qualification shall remain valid for a period of two years providing the following conditions are fulfilled:

a) the welder shall be engaged with reasonable continuity on welding work within the range of qualification corresponding to the qualification test certificate. An interruption period longer than six months is not permitted;

b) there shall be no specific reason to question the welder's skill and knowledge;

c) annually the manufacturer shall establish that the welder's quality is in accordance with the technical conditions under which the qualification test certificate is awarded.

Any factor not in accordance with the conditions stated in a), b) and c), the qualification test certificate shall be cancelled.

13.2 Prolongation

Prolongation is only allowed when the CIA is advised before expiry of the period of initial qualification.

Prolongation is only allowed when proof of welding quality is available to the CIA who accept this is the case. The validity within the range of qualification is extended under the original qualification for a further two years provided the conditions according to 13.1 are fulfilled. When this prolongation expires a new qualification test is required.

14 Qualification test certificate renewal

A qualification test taken within three months before the expiry date of the test certificate shall commence from that date of expiry.

Annex A
(informative)

Welding recording sheet

Manufacturer's WPS : .....……..... Reference No : .....
Material : Grade.....…….. Reference trade designation : .....……

Origin ..... Lot No..... Works.....							
Sketch of edge preparation		Sketch, welding completed					
Edge preparation..... / Machining Manual machining, Solvent cleaning …… Interrun cleaning : Scraping Surface dressing Other .....……..... Finishing :..... Weld flush machined ..... Outside Inside							
Marking of runs Welding process							
Welding rod or granules	Sizes in mm Material ref. : Origin Cleaning Scraping, Solvent Lot No.						
Equipment used	Nozzle (round or high speed) Torch Extruder : - Reference : - Trade name : - No. :						
Welding Parameters	Gas type : Air = A, Nitrogen = N Gas flowrate, l/min Gas pressure, bar Temperature, °C Speed, cm/min Force on filler material, daN						

Type of heated tool : Flat Bushes Welding wedges
Equipment used Mechanical guiding
Pressure regulated spring rating (lever)
Regulated hydraulic pressure
Automation by pre-adjustments

Machine used	Reference :	Trade name : ..... No : .....
	Equalization pressure (force) :	..... MPa (daN)
Welding	Temperature regulated adjusted at :	..... °C
	Heating time	..... . min
	Heating pressure (force)	..... MPa (daN)
	Change-over time	..... sec
Parameters	Welding time	..... sec
	Total joining time	..... min
	Welding pressure (force)	..... MPa (daN)

Manufacturer	Date	Drafted by Signed

Annex B
(informative)

Welders qualification tests certificate format

Welder's full name:

Date place and country of birth:

Testing standard: EN 13067

(Photograph)

Group of material and sub-group(s)

(according to Table 1 or Table 2):

Date of overall assessment pass: Date of issue:

Validity of qualification until:

Signature of PWE: CIA**:**

- full name:
- full address:
- individual certificate identification number:

Annex C
(informative)

PWE evaluation sheet for practical test

C.1 Welding process: Hot gas round nozzle - Hot gas high speed nozzle

Type of product: Sheet Pipe
Dimensions: e_n = ... mm d_n = ... mm e_n = ... mm
SDR .....
Welder's name: ..... **Control No./Code** .....

		Sub-group								
		1.1	**1.2**	**2.1**	**3.1**	**4.1**	**5.1**			
1	Welding of test pieces									
	- base material (type, conditions									
	- weld edge preparation									
	- component alignment									
	- welding rod (type, conditions, pretreatment									
	- choice of weld parameters									
	- equipment (conditions, setting)									
	. gas flow									
	. gas temperature									
	- equipment handling									
	- welding record									
	Evaluation									
2	Visual examination:									
	- double sean									
	- notches									
	- colour of materials									
	- heat effects									
	- start faults, irregular weld surface									
	- stretching/punching of filler rod									
	- linearity of weld seam									
	- weld penetration									
	- misalignement									
	- reiforcement									
	Evaluation									
3	mechanical-technological examination:									
	- tensile test (reference spec.) N/mm^2									
	- tensile test (weld spec.) N/mm^2									
	- short term tensile welding factor f_s (required)									
	- short term tensile welding factor f_s (actual)									
	Evaluation of welding factor [a]									
	- minimum bending angle (required									
	- bending angle (actual value)									
	Evaluation of bend test [a]									
Result										
[a] if required										

Enter: c = conform, nc = not conform
Date: Signature of PWE:

C.2 Welding process: Extrusion welding

Type of product: **Sheet**
Dimensions : e_n = ... mm

Welder's name : ..... **Control No./Code .....**

		Sub-group								
		2.2	**3.2**							
1	Welding of test pieces									
	- weld edge preparation									
	- component alignment									
	- welding rod (type, conditions, pretreatment									
	- equipment (conditions, setting)									
	- equipment control measurement									
	. extrudat temperature									
	. gas flow rate									
	. gas temperature									
	. extrudat output									
	. welding speed									
	- equipment handling (wed start, weld end)									
	- welding record									
	Evaluation									
2	Visual examination:									
	- root defects (notches, cavities...)									
	- homogeneity : shape, evenness of weld									
	- lateral breakout/welding shoe guidance									
	- joint coverage/edge welding									
	- heat effect/heating width/overheating									
	Evaluation									
3	mechanical-technological examination:									
	- minimum bending angle (required									
	- bending angle (actual value)									
	Evaluation of bend test [a]									
Result										
[a] if required										

Enter: c = conform, nc = not conform
Date: Signature of PWE:

C.3 Welding process: Heated tool butt welding

Type of product: **Sheet** **Pipe**
Dimensions: e_n = ... mm d_n = ... mm
e_n = ... mm

SDR .....

Welder's name : ..... **Control No./Code .....**

		Sub-group									
		1.3	**2.3**	**2.4**	**2.5**	**3.3**	**3.4**	**3.5**	**4.2**	**4.3**	**5.2**
1	Welding of test pieces										
	- base material (type, conditions)										
	- weld edge preparation										
	- component alignment										
	- ovality										
	- choice of weld parameters										
	- equipment (conditions, setting, control measurement)										
	- equipment handling										
	- welding record										
	Evaluation										
2	Visual examination:										
	Weld beads										
	- shape										
	- height/width										
	- surface										
	- notch between weld bead										
	- misalignment										
	- evenness of weld										
	- defect in cross-section										
	Evaluation										
3	mechanical-technological examination:										
	- tensile test										
	- short term tensile welding factor f_s (required)										
	- short term tensile welding factor f_s (actual)										
	Evaluation of welding factor [a]										
	- minimum bending angle (required										
	- bending angle (actual value)										
	Evaluation of bend test [a]										
Result											
[a] if required											

Enter: c = conform, nc = not conform
Date: Signature of PWE:

C.4 Welding process: Heated tool socket welding - Heated tool saddle welding

Type of product : Pipe Socket Saddle

Dimensions : d_n = ... mm d_n = ... mm d_n = ... mm

d_n = ... mm

SDR ..... **SDR** ..... **SDR** .....

Welder's name : ..... Control No./Code .....

		Sub-group								
		2.6	**3.9**	**3.10**	**4.4**					
1	Welding of test pieces									
	- base material (type, conditions)									
	- preparation of weld area on pipe									
	- ovality									
	- alignment									
	- equipment (conditions)									
	- choice and control of weld parameters									
	- welding record									
	Evaluation									
2	Visual examination:									
	-									
	-									
	-									
	Evaluation									
3	Peel test									
	-									
	-									
	-									
	Evaluation									
Result										

Enter: c = conform, nc = not conform

Date: Signature of PWE:

C.5 Welding process: Electrofusion socket welding - Electrofusion saddle welding

Type of product : Pipe Socket Saddle

Dimensions : d_n = ... mm d_n = ... mm d_n = ... mm

d_n = ... mm

SDR ..... **SDR** ..... **SDR** .....

Welder's name: ..... Control No./Code .....

		Sub-group								
		2.7	**3.6**	**3.7**	**3.8**					
1	Welding of test pieces									
	- base material (type, conditions)									
	- preparation of weld area on pipe									
	- ovality									
	- alignment									
	- equipment (conditions)									
	- choice and control of weld parameters									
	- welding record									
	Evaluation									
2	Visual examination:									
	-									
	-									
	-									
	Evaluation									
3	Peel test									
	-									
	-									
	-									
	Evaluation									
Result										

Enter: c = conform, nc = not conform

Date: Signature of PWE:

C.6 Welding of lining membranes

Welding process:	**Type of seam :**
Hot gas manual	Single seam
Hot gas by machine	Double seams
Heated wedge by hot gas	Double seams
Heated wedge electric	Double seams
Extrusion welding	Single seam Surfacing weld

Welder's name : ..... **Control No./Code** .....

		Sub-group								
		6.1	**to**	**6.4**	**7.1**	**to**	**7.5**	**8.1**	**to**	**8.4**
1	Welding of test pieces									
	- Seam preparation: cleaning, drying, mechanical treatment bevelling of top edges									
	- Welding material: weldability, pretreatment									
	- Equipment: setting, control measurement, handling									
	- Test weld: seam assessment, peeling test									
	- welding record									
	Evaluation									
2	Visual examination of the test pieces, seam dimensions									
	- Seam profile: shape and uniformity, defects, centricity, surface									
	- Beading: at front seam edge, lateral flow									
	-- Notching and scoring									
	- Seam dimensions requirements as per Rating sheet									
	Evaluation									
3	Seam strength									
	- Peel test: requirements as per Rating sheet									
	Evaluation									
Overall result										

Enter: c = conform, nc = not conform
Date: Signature of PWE

— Rating sheets for lap seams with testing channel

Welder's name : ..... **Control No./Code .....**

1) Seam dimensions

	Sub-Group	Width of the seam sections (b_{N1}, b_{N2}) mm	Width of the testing channel (b_p) mm
Specifications			

Measurements results	Sub.-group:			Sub.-group		
Measurements points	Specimen N_o			Specimen N_o		
	1	2	3	1	2	3
d_o (mm) d_u (mm)						
Sum : d_o + d_u (mm)						
d_{N1} (mm)						
d_{N2} (mm)						
Difference : d_o+d_u -d_{N1} (mm) d_o + d_u -d_{N2}						
Assessment :						
b_{N1} (mm) b_{N2} (mm)						
Difference 0 mm Target : b_{N1} + 3 mm 0 mm b_{N2} + 3 mm						
Assessment :						
b_P (mm)						
Difference + 0 mm Target : b_P - 6 mm						
Assessment :						

2) Seam strength - Peel test

Sub Group	Sample N_o	Specimen width mm	Peeling resistance		Deformation and failure behaviour	Assessment
			Total force N	Force/ Specimen width N/mm		
	1					
	2					
	3					
	4					
	5					

Date: Signature of PWE:+

— Rating sheets for surfacing weld (Sub-group 7.5)

Welder's name : ..... Control No./Code .....

1) Seam dimensions

Specifications Seam thickness (d) $(d_o + d_u)$ x 1,25 to 1,75

Seam width (b) ≥ 30 mm welded in the middle ± 5 mm

Measurements results:

Sample N°	d_o **mm**	d_u **mm**	**S. thickness** ***d*** **mm**	**Sum** d_o+d_u **mm**	**Assessment**	**Seam width** ***b*** **mm**	**Assessment**	

2) Seam-strength - Peel test

Sample N_o	**Specimen width mm**	**Peeling resistance**		**Deformation and failure behaviour**	**Assessment**
		Total force N	**Force / Specimen width N/mm**		
1					
2					
3					
4					
5					

Date: Signature of PWE:

C.7 Test report for solvent welding practical test.

Company	Welder		
Mechanical pipe-fitting puller	Pipes identification	Fittings Identification	Procedure reference (where applicable)
Cement identification		Cement production batch	Expiring date / Reference standard
Cleaner / Primer		**Cement application tool**	

Joint n.	Time	Size			Room Temperature	Beveling		Insertion depth	Insertion		Remarks
		dn	thickness	PN		angle	depth		Manual	Mechanical	

Date	Place	Welder Signature	PWE / Invigilator signature

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[3] ISO 13953, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

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