

Specification and approval of welding procedures for metallic materials

Part 3. Welding procedure tests for the arc welding of steels

The European Standard EN 288 : Part 3 : 1992 has the status of a
British Standard

Descriptif et qualification d'un mode
opératoire de soudage sur les matériaux
métalliques
Partie 3. Epreuves de qualification d'un mode
opératoire de soudage à l'arc sur acier

Anforderung und Anerkennung von
Schweißverfahren für metallische Werkstoffe
Teil 3. Schweißverfahrensprüfungen für das
Lichtbogenschweißen von Stählen

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National foreword

This British Standard has been prepared under the direction of the Welding Standards Policy Committee and is the English language version of EN 288 'Specification and approval of welding procedures for metallic materials — Part 3 : Welding procedure tests for the arc welding of steels', published by the European Committee for Standardization (CEN). It will supersede BS 4870 : Part 1 : 1981 which will be withdrawn on 28 August 1992.

EN 288-3 was produced as a result of international discussion in which the UK took an active part.

National appendix NA gives the constitution of the committee responsible for UK participation in the preparation of this standard.

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Part 3: Welding procedure tests for the arc welding of
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Foreword

This standard has been prepared by Working Group 1 Specification and approval of welding procedures for metallic materials of CEN/TC 121 Welding.

For this standard, ISO/TC 44/SC10 N 177 was considered and used as a basis. However, alterations were necessary due to the consideration of experience and updated knowledge.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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0 Introduction

All new welding procedure approvals are to be in accordance with this standard from the date of its issue.

However, this standard does not invalidate previous welding procedure approvals made to former national standards or specifications providing, the intent of the technical requirements is satisfied and the previous procedure approvals are relevant to the application and production work on which they are to be employed.

Also, where additional tests have to be carried out to make the approval technically equivalent, it is only necessary to do the additional tests on a test piece which should be made in accordance with this standard.

Consideration of previous procedure approvals to former national standards or specifications should be at the time of the enquiry or contract stage and agreed between the contracting parties.

1 Scope

This standard specifies how a welding procedure specification is approved by welding procedure tests.

It defines the conditions for the execution of welding procedure approval tests and the limits of validity of an approved welding procedure for all practical welding operations within the range of variables listed in clause 8.

Tests shall be carried out in accordance with this standard unless more severe tests are specified by the relevant application standard or contract when these shall apply.

This standard applies to the arc welding of steels. The principles of this standard may be applied to other fusion welding processes subject to agreement between the contracting parties.

NOTE: Specific service, material or manufacturing conditions may require more comprehensive testing than is specified by this standard in order to gain more information and to avoid repeating the welding procedure test at a later date just to obtain additional test data.

Such tests may include:

- longitudinal weld tensile test;
- all weld metal bend test;
- Charpy V-notch impact test;
- yield strength or 0,2 % proof stress;
- elongation;
- chemical analysis;
- micro examination;
- delta ferrite determination in austenitic stainless steels.

Arc welding is covered by the following processes in accordance with ISO 4063 :

- 111 - metal-arc welding with covered electrode;
- 114 - flux-cored wire metal-arc welding without gas shield;
- 12 - submerged arc welding;
- 131 - metal-arc inert gas welding (MIG welding);
- 135 - metal-arc active gas welding (MAG welding);
- 136 - flux-cored wire metal-arc welding with active gas shield;
- 141 - tungsten inert gas arc welding (TIG welding);
- 15 - plasma arc welding;

other fusion welding processes by agreement e.g. metal cored wire arc welding.

2 Normative references

This standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287-1, Approval testing of welders - Fusion welding - Part 1: Steels

- EN..., Welded joints in metallic materials – Hardness testing (Document CEN/TC121/WG 5 A N72rev)¹⁾
- EN..., Welded butt joints in metallic materials – Transverse tensile tests (Document CEN/TC121/WG 5 A N67)¹⁾
- EN..., Welded butt joints in metallic materials – Bend tests (Document CEN/TC121/WG 5 A N68)¹⁾
- EN..., Welded joints in metallic materials – Specimen, location and notch orientation for impact tests (Document CEN/TC121/WG 5 A N59)¹⁾
- ISO 1106-1:1984, Recommended practice for radiographic examination of fusion welded joints – Part 1: Fusion welded butt joints in steel plates up to 50 mm thick
- ISO 1106-2:1985, Recommended practice for radiographic examination of fusion welded joints – Part 2: Fusion welded butt joints in steel plates thicker than 50 mm and up to and including 200 mm in thickness
- ISO 1106-3:1984, Recommended practice for radiographic examination of fusion welded joints – Part 3: Fusion welded circumferential joints in steel pipes of up to 50 mm wall thickness
- ISO 3452:1984, Non destructive testing – Penetrant inspection – General principles
- ISO 4063:1990, Welding brazing, soldering and braze welding of metals – Nomenclature of processes and reference numbers for symbolic representation on drawings
- ISO 5817:1992, Arc-welded joints in steel – Fusion welding – Guidance on quality levels for imperfections
- ISO 6947:1990, Welds – Working positions – Definitions of angles of slope and rotation.

3 Definitions

For the purpose of this standard, the definitions listed in part 1 of this standard apply.

4 Preliminary welding procedure specification (pWPS)

- The preliminary welding procedure specification shall be prepared in accordance with part 2 of this standard. It shall specify the range for all the relevant parameters.

5 Welding procedure test

The making and testing of test pieces representing the type of welding used in production shall be in accordance with clauses 6 and 7 of this standard.

The welder who undertakes the welding procedure test satisfactorily in accordance with this standard is approved for the appropriate range of approval given in the relevant part of EN 287.

6 Test piece

6.1 General

The welded assembly to which the welding procedure will relate in production shall be represented by making a standardized test piece or pieces, as specified in 6.2.

6.2 Shape and dimensions of test pieces

The test pieces shall be of a sufficient size to ensure a reasonable heat distribution.

In figures 1 to 5 "t" is the thickness of the thicker component part.

Additional test pieces, or longer test pieces than the minimum size, may be prepared in order to allow for extra and/or for re-testing specimens (see 7.5).

If required by the application standard, the direction of plate rolling shall be marked on the test piece when impact tests are required to be taken in the Heat Affected Zone (HAZ).

The thickness and/or pipe outside diameter of the test pieces shall be selected in accordance with 8.3.2.1. to 8.3.2.4.

¹⁾ Under preparation.

Unless otherwise specified, the shape and minimum dimensions of the test piece shall be as follows :

6.2.1 Butt weld in plate

The test piece shall be in accordance with figure 1. The length of the test piece shall be such as to provide for the appropriate test specimens as given in table 1.

6.2.2 Butt weld in pipe

The test piece shall be in accordance with figure 2. When small pipe diameters are used, several test pieces may be necessary.

NOTE: The word "pipe", alone or in combination, is used to mean "pipe", "tube" or "hollow section".

6.2.3 T-butt joint

The test piece shall be in accordance with figure 3. The length of the test piece shall be such as to provide for the appropriate test specimens as given in table 1.

6.2.4 Branch connection

The test piece shall be in accordance with figure 4. The angle α is the minimum to be used in production.

A branch connection is considered as a fully penetrated joint (set-on or set-in or set-through joint).

6.2.5 Fillet weld

The test piece shall be in accordance with figure 4 or 5.

These may also be used with an edge preparation to give partial penetration.

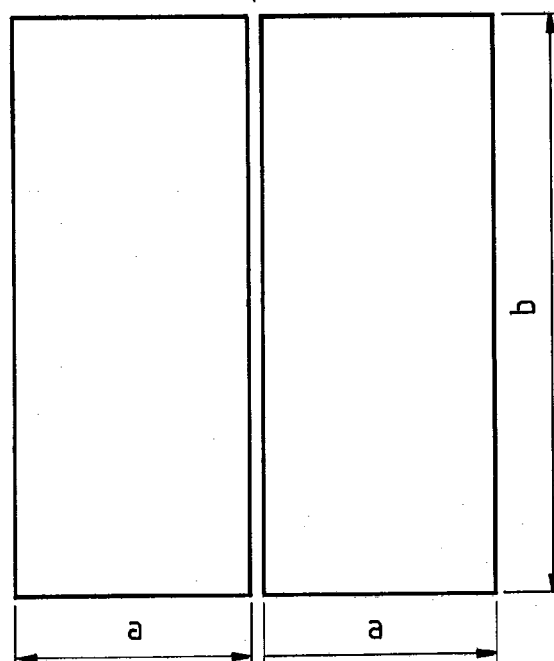
6.3 Welding of test pieces

Preparation and welding of test pieces shall be carried out in accordance with the pWPS, and under the general conditions of production welding which they shall represent. Welding positions and limitations for the angle of slope and rotation of the test piece shall be in accordance with ISO 6947.

If tack welds are to be fused into the final joint they shall be included in the test piece.

Welding and testing of the test pieces shall be witnessed by an examiner or test body.

Edge preparation and fit-up as detailed
in the preliminary Welding Procedure Specification (pWPS)

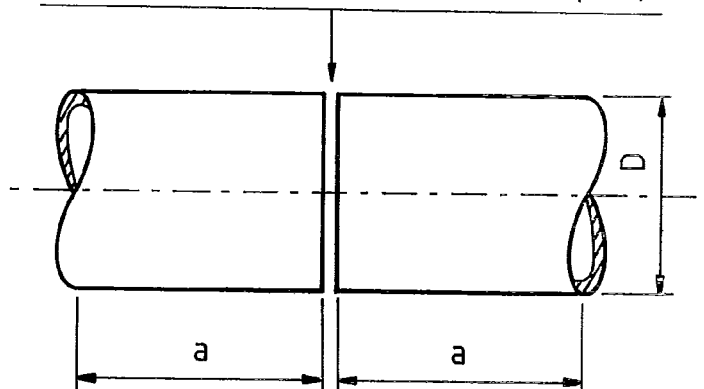


$a = 3t$; minimum value 150 mm

$b = 6t$; minimum value 350 mm

Figure 1: Test piece for a butt weld in plate

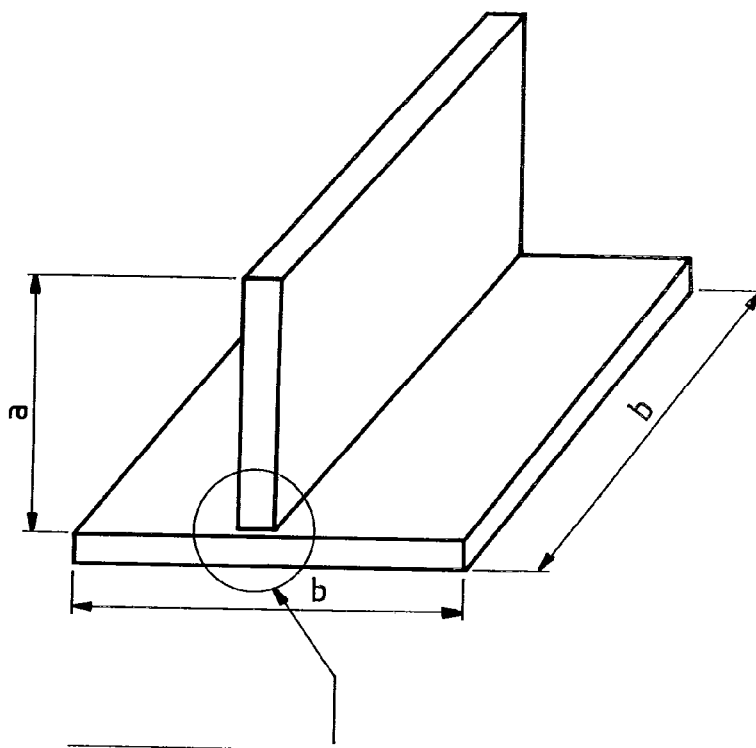
Edge preparation and fit-up as detailed
in the preliminary Welding Procedure Specification (pWPS)



a = minimum value 150 mm

D = outside diameter

Figure 2: Test piece for a butt weld in pipe



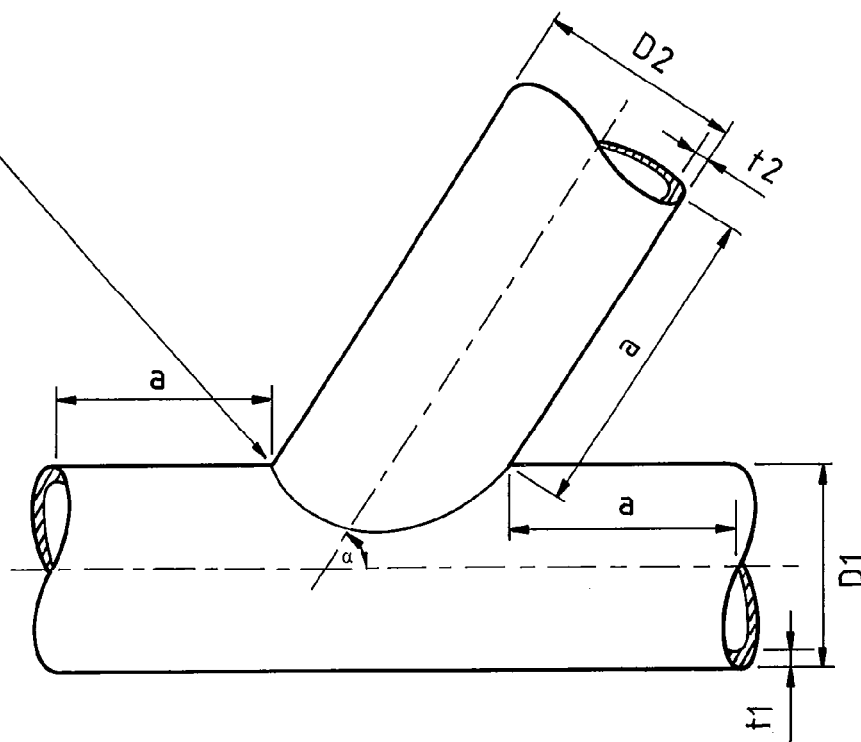
Edge preparation and fit-up as detailed
in the preliminary Welding Procedure Specification (pWPS)

$a = 3t$; minimum value 150 mm

$b = 6t$; minimum value 350 mm

Figure 3: Test piece for a T-butt joint

Edge preparation and fit-up
as detailed in the preliminary Welding
Procedure Specification (pWPS)



a = minimum value 150 mm

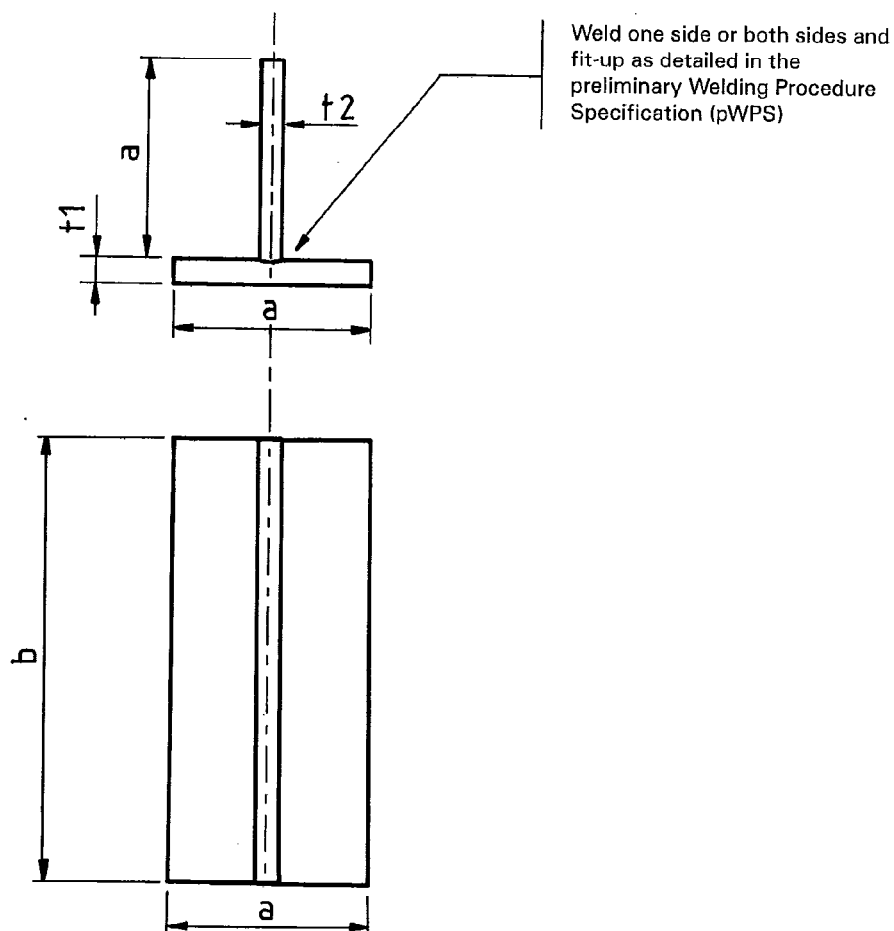
$D1$ = outside diameter of the main pipe

$t1$ = wall thickness of the main pipe

$D2$ = outside diameter of the branch pipe

$t2$ = wall thickness of the branch pipe

Figure 4: Test piece for a branch connection or a fillet weld on pipe



$a = 3t$; minimum value 150 mm

$b = 6t$; minimum value 350 mm

$t1$ and $t2$ = thicknesses of the plates

Figure 5: Test piece for a fillet weld on plate

7 Examination and testing

7.1 Extent of testing

The testing includes both non-destructive examination (NDE) and destructive testing which shall be in accordance with the requirements of table 1.

Table 1: Examination and testing of the test pieces

Test piece	Type of test	Extent of testing	Footnote
Butt-weld figures 1 and 2	Visual	100 %	—
	Radiographic or ultrasonic	100 %	—
	Surface crack detection	100 %	1
	Transverse tensile test	2 specimens	—
	Transverse bend test	2 root and 2 face specimens	2
	Impact test	2 sets	6
	Hardness test	required	3
	Macro-examination	1 specimen	—
T-butt joint (5) figure 3 Branch connection (5) figure 4	Visual	100 %	—
	Surface crack detection	100 %	1
	Ultrasonic	100 %	4 and 7
	Hardness test	required	3
	Macro-examination	2 specimens	—
Fillet weld on plate (5) figure 5 Fillet weld on pipe (5) figure 4	Visual	100 %	—
	Surface crack detection	100 %	1
	Macro-examination	2 specimens	—
	Hardness test	required	3

NOTE 1: Dye penetrant according to ISO 3452 or magnetic particle testing.
For non-magnetic materials, dye penetrant only.

NOTE 2: 2 root and 2 face bend test specimens may be preferably substituted by 4 side bend test specimens for $t \geq 12$ mm.

NOTE 3: Not required for parent metals:

- ferritic steels with $R_m \leq 420$ N/mm² ($R_e \leq 275$ N/mm²);
- group 9 steels.

NOTE 4: Only applicable for ferritic steels and for $t \geq 12$ mm.

NOTE 5: When the pWPS or WPS has not been approved by other means, additional tests for the mechanical properties of the joint should be considered.

NOTE 6: 1 set in the weld metal and 1 set in the HAZ. Required only for $t \geq 12$ mm and only for parent metals having specified impact properties or when required by the application standard. If a testing temperature has not been specified, testing shall be performed at room temperature. See also 7.4.4.

NOTE 7: For outside diameter ≤ 50 mm no ultrasonic test is required.

For outside diameter > 50 mm if it is not technically possible to execute the ultrasonic examination, a radiographic examination shall be carried out for branch connection test pieces when possible (figure 4).

7.2 Location and cutting of test specimens

The location of test specimens shall be in accordance with figures 6, 7, 8 and 9.

Test specimens shall be taken after NDE has shown satisfactory results. It is permitted to take the test specimens from locations avoiding areas showing acceptable imperfections.

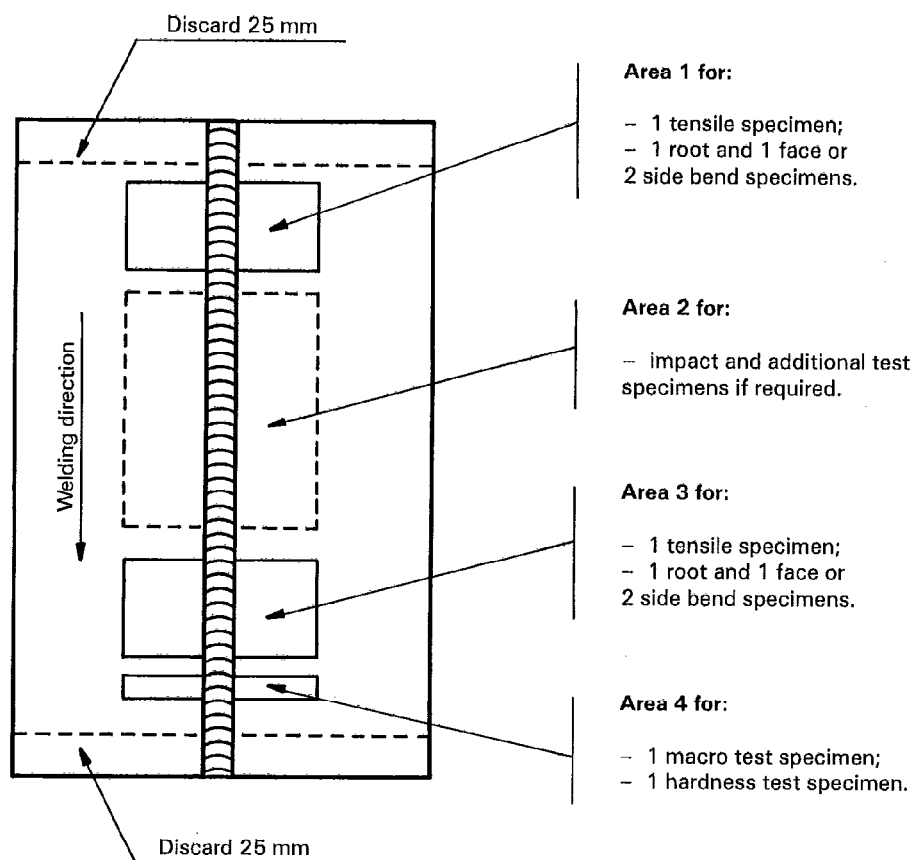


Figure 6: Location of test specimens for a butt weld in plate

Top for fixed pipe

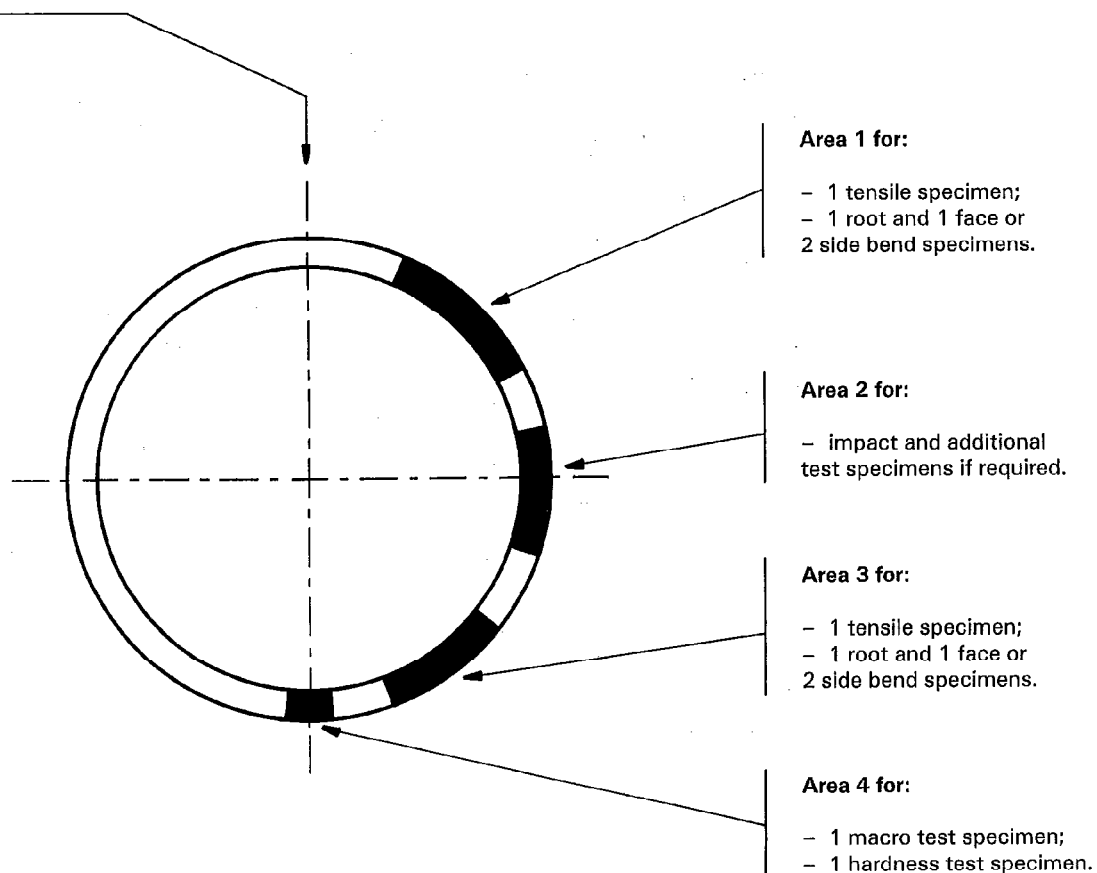


Figure 7: Location of test specimens for a butt weld in pipe

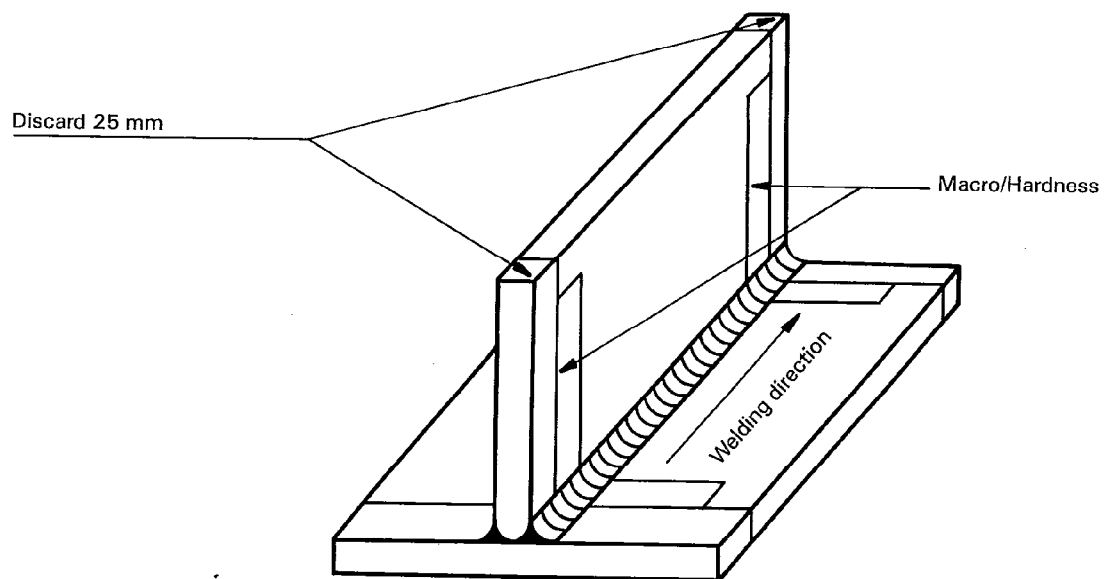


Figure 8: Location of test specimens in a T-butt joint or a fillet weld on plate

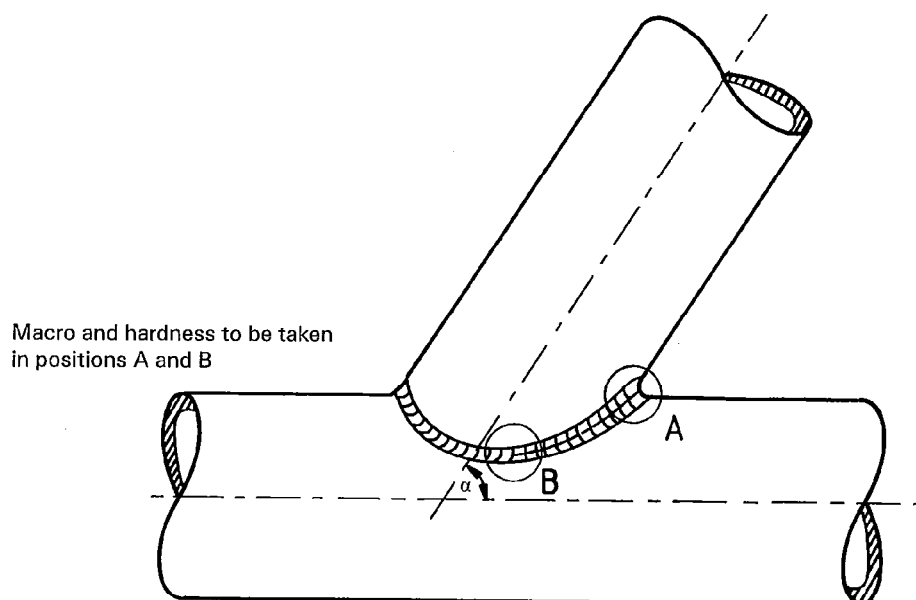


Figure 9: Location of test specimens for a branch connection or a fillet weld on pipe

7.3 Non-destructive examination

7.3.1 Method

After any required post-weld heat treatment and prior to the cutting of test specimens, all test pieces shall be examined visually and non-destructively in accordance with 7.1.

For non-post-weld heat treated test pieces, account should be taken of the materials that are susceptible to hydrogen induced cracking and consequently the NDE should be delayed.

Depending upon joint geometry, materials and the requirements for production work, the NDE shall be carried out according to appropriate standards (e.g. ISO 1106-1, -2 and -3).

7.3.2 Acceptance levels

A welding procedure is approved if the imperfections in the test piece are within the specified limits of level B in ISO 5817 except for imperfection types as follows: excess weld metal, excess convexity, excess throat thickness and excessive penetration, for which level C shall apply.

7.4 Destructive tests

7.4.1 Transverse tensile testing

Specimens and testing for transverse tensile testing for butt joints shall be in accordance with EN.... (Document CEN/TC121/WG 5 A N67).

For pipes > 50 mm outside diameter, the weld reinforcement shall be removed on both faces to give the test specimen a thickness equal to the wall thickness of the pipe.

For pipes $\leq$ 50 mm outside diameter, and when full section small diameter pipes are used, the weld reinforcement may be left undressed on the inside surface of the pipe.

The tensile strength of the test specimen shall normally not be less than the corresponding specified minimum value for the parent metal.

7.4.2 Bend testing

Specimens and testing for bend testing for butt joints shall be in accordance with EN.... (Document CEN/TC121/WG 5 A N68).

For dissimilar metal joints or heterogeneous butt joint in plates, one longitudinal bend test specimen may be used instead of transverse bend tests.

The diameter of the former or the inner roller shall be 4t and the bending angle 120° unless the low ductility of the parent metal or filler metal impose other limitations.

During testing, the test specimens shall not reveal any one single flaw > 3 mm in any direction. Flaws appearing at the corners of a test specimen during testing shall be ignored in the evaluation.

7.4.3 Macro-examination

The test specimen shall be prepared and etched on one side to clearly reveal the fusion line, the HAZ and the build up of the runs.

The macro-examination shall include unaffected parent metal.

The acceptance levels stated in 7.3.2 shall apply.

7.4.4 Impact testing

Test specimens and testing for impact tests for butt joints shall be in accordance with this standard for position of specimens, and temperature of testing, and with EN for dimensions and testing (Document CEN/TC121/WG 5 A N59).

For weld metal, test specimen type VWT (V: Charpy V-notch – W: notch in weld metal – T: notch through the thickness) and for HAZ specimen type VHT (V: Charpy V-notch – H: notch in heat affected zone – T: notch through the thickness) shall be used. From each specified position, each set shall be comprised of three test specimens.

Specimens with Charpy V-notch shall be used and sampled from 1 mm to 2 mm below the surface of the parent metal and transverse to the weld.

The V-notch shall be cut perpendicular to the surface of the weld.

In the HAZ the notch shall be at 1 mm to 2 mm from the fusion line and in the weld metal the notch shall be at the weld centreline.

For thicknesses > 50 mm, two additional sets of specimens shall be taken, one from the weld metal and one from the HAZ, just below the mid thickness or in the root area of the weld.

Test temperature and absorbed energy shall be in accordance with the specified design requirements for the complete product in question, provided the requirements laid down by the application standard are met.

For dissimilar metal joints impact tests shall be carried out on specimens from each HAZ in each parent metal.

7.4.5 Hardness testing

The hardness testing shall be in accordance with EN.... (Document CEN/TC121/WG 5 A N72rev). The Vickers method HV10 shall be used. The indentation shall be made in the weld, the HAZs and the parent metal with the object of measuring and recording the range of values in the weld joint. This will include rows of indentation one of which shall be 2 mm maximum below the surface. Typical examples are shown in figure 10.

For each row of indentation there shall be a minimum of 3 individual indentations in each part of the weld, the HAZ (both sides) and the parent metal (both sides).

For the HAZ the first indentation shall be placed as close to the fusion line as possible.

The results from the hardness test shall meet the requirements given in table 2.

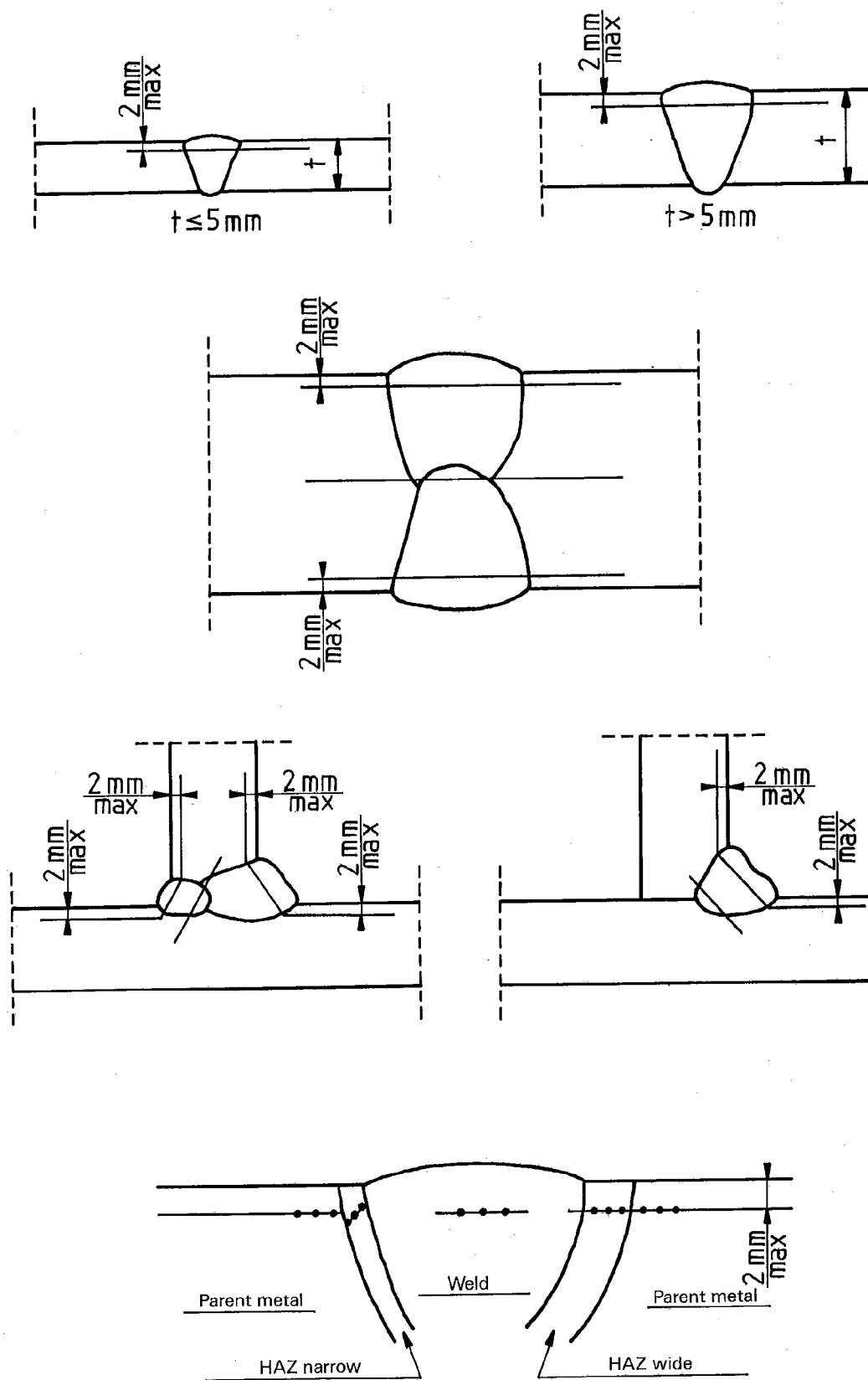


Figure 10: Typical examples of hardness testing

Table 2: Permitted maximum hardness values HV10

Steel groups	Single run butt and fillet welds		Multi-run butt and fillet welds	
	Non-heat treated	Heat treated	Non-heat treated	Heat treated
1 ⁽¹⁾ , 2	380	320	350	320
3 ⁽²⁾	450	(3)	420	(3)
4,5	(3)	320	(3)	320
6	(3)	350	(3)	350
Ni ≤ 4% Ni > 4%	(3) (3)	300 (3)	320 400	300 (3)
NOTE 1: If hardness tests are required. NOTE 2: For steels with min Re > 885 N/mm ² special agreements are required. NOTE 3: Special agreements are required.				

7.5 Re-testing

If the test piece fails to comply with any of the requirements for visual examination or NDE specified in 7.3.2, one further test piece shall be welded and subjected to the same examination. If this additional test piece does not comply with the relevant requirements, the pWPS shall be regarded as not capable of complying with the requirements of this standard without modification.

If any test specimen fails to comply with the relevant requirements of 7.4 only due to geometric weld imperfections, two further test specimens shall be obtained for each one that failed. These can be taken from the same test piece if there is sufficient material available or from a new test piece, and shall be subjected to the same test.

If either of these additional test specimens does not comply with the relevant requirements, the pWPS shall be regarded as not capable of complying with the requirements of this standard without modification.

8 Range of approval

8.1 General

All the conditions of validity stated below shall be met independently of each other.

Changes outside of the ranges specified shall require a new welding procedure test.

8.2 Related to the manufacturer

An approval of a WPS obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of that manufacturer.

8.3 Related to the material

8.3.1 Parent metal

8.3.1.1 Grouping system

In order to minimise the unnecessary multiplication of welding procedure tests, steels shall be grouped as shown in table 3.

A procedure test carried out with one of the steels of a group covers the lower alloyed steels of the same group for the intentional added elements, but not for fortuitous impurities, or the steels with lower specified yield stress of this group, as long as the welding consumables used for the test can also be used for the other steels of this group. Group 2 covers group 1. Permanent backing material shall be considered as a parent metal.

A separate welding procedure approval shall be obtained for each steel or steel combinations not covered by the grouping system.

If one steel could belong to two groups then it would be classified always in the lower group.

Table 3: Grouping system for steel

Group	Type of steel
1	Steels with a minimum specified yield stress $Re \leq 355 \text{ N/mm}^2$ or $Rm \leq 520 \text{ N/mm}^2$ and with analysis not exceeding in %: C = 0,24 Si = 0,55 Mn = 1,60 Mo = 0,65 S = 0,045 P = 0,045 Any other single element = 0,3 All other elements total = 0,8
2	Normalized or thermo-mechanically treated fine grain steels with a specified minimum yield stress $Re > 355 \text{ N/mm}^2$
3	Quenched and tempered fine grain steels with a specified yield stress $Re > 500 \text{ N/mm}^2$
4	Steels with Cr max. 0,6 %, Mo max. 0,5 %, V max. 0,25 % See note 1
5	Steels with Cr max. 9 %, Mo max. 1,2 % See note 1
6	Steels with Cr max. 12 %, Mo max. 1 %, V max 0,5 % See note 1
7	Steels with Ni max. 9 % See note 1
8	Ferritic or martensitic stainless steels from 12% to 20 % Cr. See note 1
9	Austenitic stainless steels
NOTE 1: For groups 4 to 8: the alloy content relates to nominal ladle analysis.	

8.3.1.2 Dissimilar metal joints

For dissimilar metal joints the range of approval is given in table 4.

Any dissimilar metal joint not covered by table 4, shall require a specific test with no range of approval.

Table 4: Range of approval for dissimilar metal joints

Existing approved welding procedure test for group of steel or dissimilar metal joints	Range of approval
2	2 welded to 1
3	3 welded to 1 3 welded to 2
8 welded to 2	8 welded to 1 8 welded to 2
8 welded to 3	8 welded to 1 8 welded to 2 8 welded to 3
9 welded to 2 or 9 welded to 3	9 welded to 1 9 welded to 2 9 welded to 3

8.3.2 Parent metal thickness and pipe diameter**8.3.2.1 General**

Nominal thickness t shall have the following meanings:

a) For a butt joint:

the parent metal thickness, which for joints between dissimilar thicknesses is that of the thinner material.

b) For a fillet weld:

the parent metal thickness approved for joints between different thicknesses is that of the thicker material. For each thickness range approved as in table 5 there is also an associated range of approved fillet weld throat thicknesses as given in 8.3.2.3.

c) For a set-on branch connection:

the thickness of the branch pipe.

d) For a set-in or set-through branch connection:

the thickness of the main pipe.

e) For a T-butt joint in plate:

the thickness of the prepared plate.

8.3.2.2 Range of approval for butt welds

The approval of a welding procedure test on thickness t shall include approval for thicknesses in the following ranges given in table 5.

Table 5: Range of approval for thickness
(Dimensions in mm)

Thickness of the test piece t	Range of approval ^{1) 2)}	
	for single run or single run from both sides	for multi-run welding
$t \leq 3$	0,8 t to 1,1 t	t to 2 t
$3 < t \leq 12$	0,8 t to 1,1 t	3 to 2 t
$12 < t \leq 100$	0,8 t to 1,1 t	0,5 t to 2 t (max. 150)
$t > 100$	0,8 t to 1,1 t	0,5 t to 1,5 t
¹⁾ For tests below the impact limit (12 mm) approval is < 12 mm, without impact testing. ²⁾ The range of approval may have to be reduced in order to avoid hydrogen cracking.		

8.3.2.3 Range of approval for fillet welds

In addition to the requirements of table 5, the range of approval of the throat thickness " a " shall be " $0,75 a$ " to " $1,5 a$ ". However a test with a throat thickness ≥ 10 mm, shall give approval for all throat thicknesses ≥ 10 mm.

8.3.2.4 Range of approval for the diameter of pipes and branch connections

The approval of a welding procedure test on diameter D shall include approval for diameters in the following ranges given in table 6.

Table 6: Range of approval for pipe and branch connection

Diameter of the test piece D ^{1) 2)} mm	Range of approval
$D \leq 168,3$	0,5 D to 2 D
$D > 168,3$	$\geq 0,5 D$ and plates ³⁾
¹⁾ D is the outside diameter of the pipe or outside diameter of the branch pipe. ²⁾ Approval given for plates also covers pipes when the outside diameter is > 500 mm. ³⁾ See also 8.4.2.	

8.3.3 Angle of branch connection

A procedure test carried out on a branch connection with angle α shall approve all branch angles α_1 in the range of $\alpha \leq \alpha_1 \leq 90^\circ$.

8.4 Common to all welding procedures**8.4.1 Welding process**

The approval is valid only for the welding process used in the welding procedure test. In a multi-process procedure test the approval is only valid for the order used during the approval test.

Note: For multi-process procedures each welding process may be approved separately or in combination with other processes. Similarly one or more processes may be deleted from an approved WPS provided the joint thickness is within the approved thickness range of the relevant welding process(es) to be applied.

8.4.2 Welding positions

When neither impact nor hardness requirements are specified, welding in any one position (pipe or plate) approves for welding in all positions (pipe or plate).

When either impact and/or hardness requirements are specified impact tests shall be taken from the highest heat input position and hardness tests shall be taken from the lowest heat input position in order to approve for all positions.

8.4.3 Type of joint

The range of approval for the types of welded joints used in the procedure test is given in table 7. In this table the range of approval is indicated in the same horizontal line.

Table 7: Range of approval for type of joint

Type of joint in approval test piece			Range of approval									
			Butt welds on plate				T butt welds on plate		Fillet weld on plate	Butt welds on pipe		Fillet welds on pipe
										Welded from one side		
			with backing	no backing	with gouging	no gouging					with backing	
Butt weld on plate	Welded from one side	with backing	★	—	x	x	—	x	x	—	—	x
		no backing	x	★	x	x	x	x	x	—	—	x
	Welded from both sides	with gouging	—	—	★	x	x	x	x	—	—	x
		no gouging	—	—	—	★	—	x	x	—	—	x
Butt weld on pipe	Welded from one side	with backing	x	—	x	x	—	x	x	★	—	x
		no backing	x	x	x	x	x	x	x	x	★	x
T butt weld on plate	Welded from one side		—	—	—	—	★	x	x	—	—	x
	Welded from both sides		—	—	—	—	—	★	x	—	—	x
Fillet weld	Plate		—	—	—	—	—	—	★	—	—	x
	Pipe		—	—	—	—	—	—	x	—	—	★
Key: ★ indicates the weld for which the WPS is approved in the approval test x indicates those welds for which the WPS is also approved — indicates those welds for which the WPS is not approved												

8.4.4 Filler metal, classification

The approval range of filler metals covers other filler metals as long as they are:

- either in the same group of tensile properties unless impact testing is required. Change in the type of coating will entail new approval of the welding procedure;
- or within the same nominal chemical composition.

8.4.5 Filler metal, make

When impact testing is required, the approval given is only applicable to the specific make used in the welding procedure test. It is permissible to change the specific make of filler metal to another with the same compulsory part of the classification when an additional test piece is welded.

This test piece shall be welded using the identical welding parameters as the original weld procedure test and only weld metal impact test specimens shall be tested.

NOTE: This provision does not apply to wire with the same classification and nominal chemical composition.

8.4.6 Type of current

The approval given is the type of current (AC, DC, pulsed current) and polarity used in the welding procedure test.

8.4.7 Heat Input

The requirements of this clause only apply when the control of heat input is specified.

When impact requirements apply, the upper limit of heat input approved is 15 % greater than that used in welding the test piece.

When hardness requirements apply, the lower limit of heat input approved is 15 % lower than that used in welding the test piece.

8.4.8 Preheat temperature

The lower limit of approval is the nominal preheat temperature applied at the start of the welding procedure test.

8.4.9 Interpass temperature

The upper limit of approval is the nominal interpass temperature reached in the welding procedure test.

8.4.10 Post-weld heat-treatment

Addition or deletion of post-weld heat-treatment is not permitted.

The temperature range used for the welding procedure test is the range approved. Where required, heating rates, cooling rates and holding time shall be related to the production component.

8.5 Specific to processes

8.5.1 Processes 111 and 114

The approval given is for the diameter of electrode used in the welding procedure test plus or minus one electrode diameter size for each run, with the exception of the root run on single sided butt welds without backing for which no size change is permissible.

8.5.2 Process 12

8.5.2.1 The approval given is restricted to the wire system used in the welding procedure test (e.g. single-wire or multiple-wire system).

8.5.2.2 The approval given for the flux is restricted to the make and classification used for the procedure welding test.

8.5.3 Processes 131, 135 and 136

8.5.3.1 The approval given to the face and/or back shielding gas is restricted to the type of gas (nominal composition) used in the welding procedure test.

8.5.3.2 The approval given is restricted to the wire system used in the welding procedure test (e.g. single-wire or multiple-wire system).

8.5.4 Process 141

The approval given to the face and/or back shielding gas is restricted to the type of gas (nominal composition) used in the welding procedure test.

8.5.5 Process 15

8.5.5.1 The approval given is restricted to the type of plasma gas used in the welding procedure test.

8.5.5.2 The approval given to the face and/or back shielding gas is restricted to the type of gas (nominal composition) used in the welding procedure test.

9 Welding procedure approval record (WPAR)

The welding procedure approval record (WPAR) is a statement of the results of assessing each test piece including re-tests. The relevant items listed for the WPS in part 2 of this standard shall be included, together with details of any features that would be rejectable by the requirements of clause 7. If no rejectable features or unacceptable test results are found, a WPAR detailing the welding procedure test piece results is approved and shall be signed and dated by the examiner or test body.

A WPAR format shall be used to record details for the welding procedure and the test results, in order to facilitate uniform presentation and assessment of the data.

An example of the WPAR-format is shown in annex A.

Annex A

(informative)

Welding Procedure Approval Record form (WPAR)

Welding procedure approval - Test certificate

Manufacturer's Welding Procedure
Reference No.:

Examiner or test body
Reference No.:

Manufacturer:

Address:

Code/Testing Standard:

Date of Welding:

Extent of Approval

Welding Process:

Joint Type:

Parent metal (s)

Conditions of tempered:

Metal Thickness (mm):

Outside Diameter (mm):

Filler Metal Type:

Shielding Gas/Flux:

Type of Welding Current:

Welding Positions:

Preheat:

Post-Weld Heat Treatment and/or ageing:

Other Information:

Certified that test welds prepared, welded and tested satisfactorily in accordance with the requirements of the code/testing standard indicated above.

Location

Date of issue

Examiner or test body

Name, date and signature

continued

Annex A (continued)**Details of weld test**

Location:
 Manufacturer's Welding Procedure
 Reference No.:
 WPAR No.:

Examiner or test body:

Manufacturer:
 Welder's Name:
 Welding Process:
 Joint Type:
 Weld Preparation Details (Sketch)*:

Method of Preparation and Cleaning:
 Parent Material Specification:

Material Thickness (mm):
 Outside Diameter (mm):
 Welding Position:

Joint Design	Welding Sequences

Welding Details

Run	Process	Size of Filler Metal	Current A	Voltage V	Type of current/ Polarity	Wire Feed Speed	Travel Speed*	Heat input*

Filler Metal Classification and trade name:

Any Special Baking or Drying:

Gas/Flux: shielding:

backing:

Gas Flow Rate – Shielding:

Backing:

Tungsten Electrode Type/Size:

Details of Back Gouging/Backing:

Preheat Temperature:

Interpass Temperature:

Other information*:

e.g. weaving (maximum width of run):

Oscillation: amplitude, frequency, dwell time

Pulse welding details:

Stand off distance:

Plasma welding details:

Torch angle:

Post-Weld Heat Treatment and/or Ageing:

Time, Temperature, Method:

Heating and Cooling Rates*:

Manufacturer

Name, date and signature

Examiner or test body

Name, date and signature

* If required

continued

Annex A (continued)

Test results

Manufacturer's Welding Procedure
Reference No.:Examiner or test body
Reference No.:Visual Examination:
Penetrant/Magnetic Particle Test*Radiography*:
Ultrasonic Examination*:

Tensile Tests

Temperature:

Type/No.	Re N/mm ²	Rm N/mm ²	A % on	Z %	Fracture Location	Remarks
Requirement						

Bend Tests

Former Diameter:

Type/No.	Bend Angle	Elongation*	Result

Macro Examination:
Micro Examination*:

Impact Test*

Type:

Size:

Requirement:

Notch Location/Direction	Temp.°C.	Values			Average	Remarks
		1	2	3		

Hardness Tests*

Type/load

Location of Measurements (Sketch*)

Parent Metal:
H.A.Z.:
Weld Metal:

Other Tests:

Remarks:

Tests Carried out in accordance with the requirements of:
Laboratory Report Reference No.:
Test results were acceptable/not acceptable (Delete as appropriate)
Test carried out in the presence of:

Examiner or test body

Name date and signature

* If required

concluded

Annex B

(informative)

Types of steel according to the grouping system of table 3**Table B1: German grouping system of steel types according to DIN standards**

Group					
1	USt 34-1 RSt 34-1 USt 34-2 RSt 34-2 USt 37-1 RSt 37-1 USt 37-2 RSt 37-2 St 37-3 St 52-3	St 35 St 45 St 52 St 35-4 St 45-4 St 52-4 St 35-8 St 45-8 15 Mo-3	St 35-8 St 45-8 17 Mn 4 19 Mn 5 19 Mn 6 16 Mo 5	C 16-8 C 22-3 C 22-8 C 21 H1 H11 H111 17 Mn 4 19 Mn 5 15 Mo 3	St E 26 WSt E 26 St E 29 WSt E 29 St E 32 WSt E 32 St E 36 WSt E 36
2	St E 39 WSt E 39 St E 43 WSt E 43	St E 47 WSt E 47 St E 51 WSt E 51			
3	N-A-XTRA 56 N-A-XTRA 63 N-A-XTRA 70	XABO 90			
4	14 4 MoV 63				
5	13 CrMo 44	10 CrMo 9-10 12 CrMo 19-5 X9 CrMo 9-1	13 CrMo 4-4 10 CrMo 9-10		
6	X20 CrMo V 12-1				
7	X8 Ni 9	14 Ni 6	10 Ni 14	12 Ni 9	
8	X7 Cr 13	X 7 Cr 14	X 7 CrAl 13X	X8 Cr 17	X 22 CrNi 17
9	X5 CrNi 18-9 X5 CrNi 19-11 X2 CrNi 18-9 X10 CrNiTi 18-9 X10 CrNiN6 18-9 X5 CrNiMo 18-10 X2 CrNiMo 18-10 X10 CrNiMoTi 18-10 X10 CrNiMoNb 18-10 X5 CrNiMo 18-12 X2 CrNiMo 18-12	X2 CrNiMo 18-16 X2 CrNiN 18-10 X2 CrNiMoN 18-12 X2 CrNiMoN 18-13 X10 CrNiMoN 6 18-12 X10 CrNiMoTi 18-12 X5 CrNiMo 17-13 X3 CrNiMoN 17-13-5 X5 CrNiMoTi 25-25 X5 NiCrMoCuNb 20-18	X5 NiCrMoCuTi 20-18 X5 CrNi 18-10 X12 CrNi 18-9 X10 CrNiTi 18-10 X10 CrNiNb 18-10 X8 CrNiNb 16-13 X8 CrNiMoMn 16-16 X8 CrNiMoMb 16-13		

Table B2: French grouping system of steel types according to AFNOR standards

Group	NF	Steel	NF	Steel
1	A 36-205 A 36-601 A 49-296	A 37 CP, AP, FP A 42 CP, AP, FP A 48 CP, AP, FP A 52 CP, AP, FP	A 35-052 A 35-554 A 37-503	TSA TSB XC 10 XC 18 S XC 15 XC 18
	A 36-207	A 510 A 530	A 36-211	BS 1 BS 2 BS 3
	A 49-281	AE 220 AE 250 AE 275	A 36-212	PF 24 PF 28 PF 36
	A 35-501	E 24, E 28 E 36, A 50	A 49-240	TS 42 BT
	A 36-201	E 355	A 49-241	TSE 220 - TSE 250
	A 36-203	E 275 D E 335 D	A 49-400	TSE 275 - TSE 355 TSE 360
	A 35-520	E 240 SP E 270 SP E 320 SP E 360 SP	A 49-242	TS 37 C
	A 49-210	TU 37 B - TU 42 B	A 49-243	TS 42 C
	A 49-230	TU 42 BT	A 49-245	TS 48 C
	A 49-211	TUE 220 - TUE 250	A 49-252	TS 52 C
	A 49-230	TUE 275 - TUE 290 TUE 320 - TUE 360	A 49-253	TS 37 CP - TS 42 CP TS 48 CP - TS 52 CP
	A 49-212	TU 37 C - TU 42 C	A 49-341	TS 30-0 TS 30-a TS 34-a TS 37-a TS 42-a TS 47-a
	A 49-213	TU 42 CR - TU 52 C	A 49-343	TS 37 b TS 18 M 5
	A 49-310	TU 37-b	A 49-401	TSE 220 b TSE 250 b TSE 290 b TSE 320 b TSE 360 b
	A 49-321	TU 52-b	A 49-643	TS 30 TS 34 TS 37
	A 43-322	TU 52 BT	A 49-645	TS 42 TS 47 TS 335 D
	A 49-323	TU 17 MU 5	A 49-501	TU/TS E 235 E 275
	A 49-326		A 49-541	TU/TS E 295 E 355
	A 49-327			
	A 49-411	TUE 290 TUE 320 TUE 360		
	A 36-612	F 37 - F 42 F 48 - F 52		
	A 32-051	230 - 400 M 280 - 480 M		
	A 32-053	FA-M FB-M FC-M FB1-M FC1-M FC2-M FC2-1-M FC3-M		

continued

Table B2 (continued): French grouping system of steel types according to AFNOR standards

Group	NF	Steel	NF	Steel
2	A 35-504	E 375	A 36-203	E 390 D E 430 D E 445 D E 490 D
	A 36-201	E 420		
	A 36-207	A 550 A 590	A 35-016 A 35-018	Fe 400 Fe 500
	A 36-201	E 460		
	A 35-256	TH 520	A 35-520	E 390-SP E 430 SP
	A 49-411	TUE 415 TUE 450 TUE 485		
	A 49-501 A 49-541	TU/TS E 450	A 35-612	F 60
3	A 49-643 A 49-645	TS 390 D TS 445 D		
	A 35-210	16 MND 5	A 36-204	E 420 T E 460 T E 500 T E 550 T E 620 T E 690 T
	A 36-210	14 MNDV 5 20 MND 5 12 CD 9-10		
	A 36-612	F 70	A 33-101	AF 34 C 10 AF 37 C 12 AF 42 C 20 AF 50
4	A 36-206	15 D 3	A 37-503	15 C 2
	A 36-602			
	A 36-606		A 49-321	TU 18 MDV 5
	A 49-213			
	A 49-215			
	A 49-243			
	A 49-253			
5	A 36-206	18 MD 4-05	A 36-210	16 MND 5 20 MND 5 14 MNDV 5 12 CD 9-10
	A 36-602	15 MDV 4-05		
	A 36-606	15 CD 2-05 15 CD 4-05 10 CD 9-10 210 CD 5-05		
	A 32-058	18 CDB 2-M 16 MCDV 6-M		
	A 49-213	TU Z 10 CDNbV 9-2	A 35-502	E 24 W E 36 W
	A 49-242	TSE 24 W 3	A 35-554	25 CD 4 S 15 CDV 6
	A 49-245	TSE 36 WB 3	A 37-503	16 MC 5 20 MC 5 18 CD 4 16 NC 6
6	-	-	-	-

continued

Table B2 (concluded): French grouping system of steel types according to AFNOR standards

Group	NF	Steel	NF	Steel
7	A 36-208	0.5 Ni 10 N 2 1.5 Ni 15 N 6 3.5 Ni 12 N 14 5 Ni Z 10 N 05 9 Ni Z 8 N 09	A 49-230 A 49-330 A 49-240 A 49-245	TU 17 N 2 TU 10 N 9 TU 10 N 14 TU Z 6 N 9 TS 17 N 2 TS 10 N 9
8	A 35-573 A 35-574 A 36-613 A 49-217	Z 6 C 13 Z 6 ND 16-04-01 Z 6 CA 13 Z 6 CT 12 Z 8 C 17 Z 2 CT 18 Z 8 CD 17-01 Z 12 C 13 Z 8 CT 17 Z 10 C 17 Z 8 CNb 17 Z 20 C 13	A 32-056	Z 6 CNDU 20-08-M
9	A 35-573 A 35-574 A 35-582 A 36-209 A 49-207 A 49-214 A 49-217 A 49-247 A 49-249 A 49-296 A 49-317 A 49-647 A 32-056	Z 2 CN 18-10 Z 5 CN 18-09 Z 6 CN 18-09 Z 6 CNT 18-10 Z 6 CNNb 18-10 Z 10 CN 18-09 Z 12 CN 17-07 Z 6 CNT 18-10 Z 6 CNNB 18-10 Z 2 CND 17-12 Z 6 CND 17-11 Z 6 CNDT 17-12 Z 6 CNDNb 17-12 Z 2 CND 17-13 Z 2 CND 19-15 Z 2 CN 18-10-M Z 6 CN 18-10-M Z 6 CNNb 18-10-M Z 2 CND 18-12-M Z 6 CND 18-12-M Z 6 CNDNb 18-12-M Z 8 CN 25-20-M Z 6 CNDU 25-20-04-M	A 35-584 A 36-219 A 36-209 A 35-580 A 35-584	Z 5 CNDU 21-08 Z 2 CN 23-4 AZ Z 2 CND 22-5 AZ Z 2 CND 25-7 AZ Z 2 CNDU 22-7 Z 2 CNDU 21-08 Z 6 CND 18-13 Z 6 CND Nb 18-13 Z 2 CN 18-10 AZ Z 5 CN 18-09 AZ Z 2 CND 17-12 AZ Z 3 CMN 18-08-07 AZ Z 2 CN 23-04 AZ Z 6 MCND 17-12 B Z 6 CNDNb 17-13 B Z 6 CNNb 18-12 B Z 1 NCDU 25-20 Z 2 CNNb 25-20 Z 2 CNDU 17-16 Z 5 CNDU 21-08 Z 1 CNS 18-15 Z 01 CD 26-01 Z 1 CDb 26-01

concluded

Table B3: Finnish grouping system of steel types according to SFS-standards

Group	
1	—
2	SFS 255 Steel grades Fe 355 C Fe 355 D SFS 256 Steel grades Fe 390 C Fe 390 D
3	—
4	—
5	—
6	—
7	—
8	SFS 815 Steel X2 CrMoTi 18 2
9	SFS 720 Steel X2 CrNi 18 10 SFS 721 Steel X2 CrNiN 18 10 SFS 725 Steel X4 CrNi 18 9 SFS 750 Steel X2 CrNiMo 17 12 2 SFS 752 Steel X2 CrNiMo 17 13 3 SFS 753 Steel X2 CrNiMoN 17 11 3 SFS 757 Steel X4 CrNiMo 17 12 3 SFS 770 Steel X2 CrNiMo 19 13 4 SFS 772 Steel X2 CrNiMoN SFS 772 Steel X2 CrNiMoN 18 14 5 SFS 773 Steel X2 CrNiMo 17 14 5

Table B4: British grouping system of steel types according to BSI standards

Group			
1	BS 970	Grades	040A04, 040A10, 040A12, 080A15, 080A20, 055M15, 080M15, 070M20, 120M19
	BS 1449	Grades	1, 2, 3, 4 (up to H 3 condition), 10 (HR or A), 12, 15, 17, 20CS/A, 34/20, 37/23, 43/25, 50/35, 40/30, 43/35
	BS 1501 BS 1502 BS 1503	Grades	141, 154, 151, 161, 164, 223, 224, 225, 221, 245
	BS 3059 BS 3601 BS 3602 BS 3603	Grades	243, 320, 360, 410, 460 490Nb
	BS 4360	Grades	40 A, B, C, D, DD, E, EE, 43 A, B, C, D, DD, E, 50 A, B, C, D, DD, E
2	BS 1449	Grades	46/40, 50/45, 60/55
	BS 4360	Grades	55C, EE, F
3		Types	RQT 501, RQT 601, RQT 701 QT 445
4	BS 1501	Grades	261, 271, 281, 282
	BS 1502		660
5	BS 1501	Grades	620, 621, 622,
	BS 1502		623, 625, 626, 629
	BS 1503		
	BS 3059		
	BS 3604		
6	BS 3059	Grade	762
7	BS 1501	Grades	503, 509, 510
	BS 1502		
	BS 1503		
	BS 3603		
8	BS 970	Grades	403S, 405S, 409S, 410S, 420S,
	BS 1449		416S, 430S, 434S,
	BS 1501		431S29, 460S52
	BS 1503		
9	BS 970	Grades	301S, 302S, 303S, 304S, 305S,
	BS 1449		309S, 310S, 315S, 316S, 317S,
	BS 1501		320S, 321S, 347S
	BS 1502		
	BS 1503		
	BS 3059		
	BS 3604		

Table B5: Swedish grouping system of steel types according to SIS standards

Group	SS-steel		SS-steel	
1	1311 1312 1412 1414 2172 2174 2632 2634 2642 2644		1330 1331 1430 1431 1432 2101 2102 2103	
2	2132 2134 2135 2142 2144 2145 2652 2654 2662 2664		2106 2107 2116 2117	
3	2614 2615 2624 2625			
4	2912			
5	2216 2218			
6	-			
7	-			
8	2301 2302 2320 2325 2326			
9	2331 2332 2333 2337 2338 2340	2343 2347 2348 2350 2352	2353 2361 2366 2367 2368 2371	2275 2378 2562 2564 2584

Table B6: Italian grouping system of steel types according to UNI standards

Group	UNI	Steel	UNI	Steel
1	5869	(1KW (2KW Fe 360 (1KG (2KG (1KW (2KW Fe 410 (1KG (2KG	pipes: 6363 6363 7287 7288	Fe 360 Fe 410 Fe 320 Fe 320
			UNI-ISO 3183	E 17 E 21 E 24 - 1
		(1KW (2KW Fe 460 (1KG (2KG Fe 510 1 KW,2KW 1 KG,2KG	5462 663	C 14 C 18 Fe 35 - 1 Fe 35 - 2 Fe 45 - 1 Fe 45 - 2 Fe 52 - 2
	UNI-EU28	Fe E 225-1 Fe E 235 Fe E 265 Fe E 295 Fe F 355-2 Fe E 355-3 Fe E 285 KG,KW,KT Fe E 315 KG,KW,KT	5949	C 15, C 20
	7070	Fe 360 B,C,D Fe 430 B,C,D Fe 510 B,C,D	7660 7660 (forgings)	Fe 410 KW,KG,KT Fe 460 1KW,KG,KT Fe 510 1KW,KG,KT
	7382	Fe E 285 KG,KW,KT Fe E 315 KG,KW,KT Fe E 355 KG,KW,KT	7316 (cast)	Fe C 42
2	7382	Fe E 390 KG,KW,KT Fe E 420 KG,KW,KT Fe E 460 KG,KW,KT		
3	UNI EU137	Fe E 550 V KG,KW,KT Fe E 620 V KG,KW,KT Fe E 690 V KG,KW,KT		
4	5869	16 Mo 3 16 Mo 5 14 Mn Mo 55	7317 (cast) 7660 (forgings) 5462 (pipes)	C 22 Mo 5 16 Mo 3 KW, KG 16 Mo 5 KW, KG 16 Mo 5
	UNI EU28	16 Mo		

continued

Table B6 (continued): – Italian grouping system of steel types according to UNI standards

Group	UNI	Steel	UNI	Steel
5	5869 UNI EU28 5462 (pipes) 7660 (forgings)	14 Cr Mo 45 12 Cr Mo 9 10 10 Cr Mo 9 10 11 Cr Mo 9 10 14 Cr Mo 3 12 Cr Mo 9 10 A 12 Cr Mo 910 KW, KG A 16 Cr Mo 205 KW, KG A 18 Cr Mo 45 KW, KG		
6	–	–	–	–
7	UNI EU 129 7660 (forgings)	Fe E 245 Ni 2 Fe E 285 Ni 2 Fe E 355 Ni 2 Fe E 285 Ni 6 Fe E 355 Ni 6 Fe E 285 Ni 14 Fe E 355 Ni 14 Fe E 390 Ni 20 Fe E 490 Ni 36 Fe E 585 Ni 36 10 Mi 2 KT 14 Mi 8 KT 18 Mi 14 KT X 10 Mi 9 KT	5949 (pipes) 7317 (cast)	18 Ni 9 18 Ni 14 X 12 Ni 09 C 22 Ni 10 C 12 Ni 14
8	–	–	–	–
9	7500	X 5 Cr Ni 1811 X 5 Cr Ni 1810 X 6 Cr Ni Ti 1811 X 6 Cr Ni Nb 1811 X 2 Cr Ni Mo 1712 X 5 Cr Ni Mo 1712 X 6 Cr Ni Mo Ti 1712 X 2 Cr Ni Mo 1713 X 5 Cr Ni Mo 1713 X 2 Cr Ni Mo 1815 X 5 Cr Ni Mo 1815 X 2 Cr Ni N 1811 X 5 Cr Ni N 1810 X 2 Cr Ni Mo N 1712 X 2 Cr Ni Mo N 1713 X 6 Cr Ni 2314 X 6 Cr Ni 2520	7660 (forgings)	X 2 Cr Ni 1811 KW,KG X 5 Cr Ni 1810 KW,KG,KT X 6 Cr Ni Nb 1811 KW,KG,KT X 6 Cr Ni Ti 1811 KW,KG,KT X 5 Cr Ni Mo 1712 KW,KG X 6 Cr Ni Mo Ti 1712 KW,KG X 2 Cr Ni Mo 1713 KW,KG X 6 Cr Ni 2521 KW, KG

concluded

Table B7: Austrian grouping system of steel types according to ON standards

Group	ON-steel	ON-steel
1	St 360 C St 360 CE St 360 D St 430 C St 430 D St 510 C St 510 D	St 35 KW St 35 KK St 35 KKW St 41 KW St 41 KKW 17 Mn4 KW 17 Mn4 KK 17 Mn4 KKW 19 Mn6 KW 19 Mn6 KK 19 Mn6 KKW 15 Mo3 KW
2	(W, T) StE 380 (W, T) StE 420 (W, T) StE 460	
3	StE 690 TM, StE 550 V StE 890 TM, StE 620 V	
4	15 Mn Ni Mo V 5 3	
5	13 Cr Mo 44 KW 10 Cr Mo 910 KW	
6	-	
7	14 Ni Mn 6 KK 10 Ni 14 KK 12 Ni 19 KK X8 Ni 9 KK	
8	X3 CrNi 13 4	
9	X5 CrNi 18 10 KKW X5 CrNi 18 12 KKW X2 CrNi 19 11 KKW X6 CrNiTi 18 10 KKW X6 CrNiNb 18 10 KKW X5 CrNiMo 17 12 2 KKW X2 CrNiMo 17 13 2 KKW X6 CrNiMoTi 17 12 2 KKW	X6 CrNiMoNb 17 12 2 KKW X5 CrNiMo 17 13 3 KW X2 CrNiMo 18 14 3 KW X2 CrNiMo 18 16 4 KW X2 CrNiN 18 10 KKW X2 CrNiMoN 17 12 1 KKW X2 CrNiMoN 17 13 3 KKW X2 CrNiMoN 17 13 5 KW

National appendix NA (informative)

The United Kingdom participation in the preparation of this European Standard was entrusted by the Welding Standards Policy Committee (WEE/-) to Technical Committee WEE/36, upon which the following bodies were represented:

Aluminium Federation
Associated Offices Technical Committee
Association of Consulting Scientists
British Constructional Steelwork Association Ltd.
British Gas plc
British Nuclear Fuels plc
British Railways Board
British Steel Industry
Electricity Industry in United Kingdom
Engineering Equipment and Materials Users' Association
General, Municipal, Boilermakers' and Allied Trades Union
Health and Safety Executive
Lloyd's Register of Shipping
Ministry of Defence
Power Generation Contractors' Association (BEAMA Ltd.)
Process Plant Association
Railway Industry Association of Great Britain
Stainless Steel Fabricators' Association of Great Britain
United Kingdom Atomic Energy Authority
The Welding Institute
Welding Manufacturers' Association (BEAMA Ltd.)

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