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ISO 9956-3

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AMENDMENT 1
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Specification and approval of welding procedures for metallic materials —

Part 3:
Welding procedure tests for arc welding of steels

AMENDMENT 1

Descriptif et qualification d'un mode opératoire de soudage pour les matériaux métalliques —

Partie 3: Épreuve de qualification d'un mode opératoire de soudage à l'arc sur acier

AMENDEMENT 1

Reference number
ISO 9956-3:1995/Amd.1:1998(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Amendment 1 to International Standard ISO 9956-3:1995 was prepared by ISO Technical Committee ISO/TC 44 *Welding and allied processes*, Subcommittee SC 10 *Unification of requirements in the field of welding*. It is based on – and equivalent to – EN 288-3:1992/A 1:1997.

This amendment was prepared with the aim of not changing the content technically, but of clarifying the existing standard by modifications brought about by experience gathered during application.

It is intended and under discussion to revise ISO 9956-3 technically, applying the parallel procedure according to the Vienna agreement under leadership of CEN/TC 121/SC 1. After the technical revision, the number of this International Standard will be changed to ISO 15614-1, and EN ISO 15614-1.

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

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Specification and approval of welding procedures for metallic materials —

Part 3:
Welding procedure tests for arc welding of steels

AMENDMENT 1

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Page 1, clause 1

Amend the list of processes as follows:

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

111 — metal-arc welding with covered electrode;

114 — flux-cored metal-arc welding without gas shield;

121 — submerged arc welding with wire electrode;

122 — submerged arc welding with strip electrode;

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;

137 — flux-cored wire metal-arc welding with inert gas shield;

141 — tungsten inert gas welding, TIG welding;

15 — plasma arc welding.

Page 2, clause 2

Delete the text of clause 2 and replace by the following:

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 9956. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 9956 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3452:1984, *Non-destructive testing — Penetrant inspection — General principles.*

ISO 4136:—[1], *Destructive tests on welds in metallic materials – Transverse tensile test.*

ISO 5173:—[2], *Destructive tests on welds in metallic materials – Bend test.*

ISO 5817:1992, *Arc-welded joints in steel — Guidance on quality levels for imperfections.*

ISO 6947:1990, *Welds – Working positions – Definitions of angles of slope and rotation.*

ISO 9015:—[3], *Destructive tests on welds in metallic materials — Hardness testing — Hardness test on arc welded joints.*

ISO 9016:—[3], *Destructive tests on welds in metallic materials – Impact tests – Test specimen location, notch orientation and examination.*

ISO 9606-1:1994, *Approval testing of welders – Fusion welding – Part 1: Steels.*

ISO 9956-2:1995, *Specification and approval of welding procedures for metallic materials – Part 2: Welding procedure specification for arc welding.*

EN 970:1997, *Non-destructive examination of fusion welds — Visual examination.*

EN 1290:1997, *Non-destructive examination of welds — Magnetic particle examination of welds.*

EN 1321:1996, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds.*

EN 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints.*

EN 1714:1997, *Non destructive examination of welds — Ultrasonic examination of welded joints.*

Page 3, clause 4

Delete the text of clause 4 and replace by the following:

The preliminary welding procedure specification shall be prepared in accordance with ISO 9956-2. It shall specify the tolerance for all the relevant parameters.

Page 3, subclause 6.2

Delete the text of 6.2 and replace by the following:

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

In figures 1 to 5 "t" is the thickness of the thicker component part from t_1 and t_2

If t > 100 mm, test piece dimensions a and b may be reduced by agreement.

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.

Unless otherwise agreed, the shape and minimum dimensions of the test piece shall be as follows.

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[1] To be published. (Revision of ISO 4136:1989)

[2] To be published. (Revision of ISO 5173:1981)

[3] To be published.

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Page 3, subclause 6.2.3

Delete the text of 6.2.3 and replace by the following:

A T-butt joint is considered as a fully penetrated joint.

Page 3, subclause 6.2.5

Amend the title to "Fillet weld in plate or pipe".

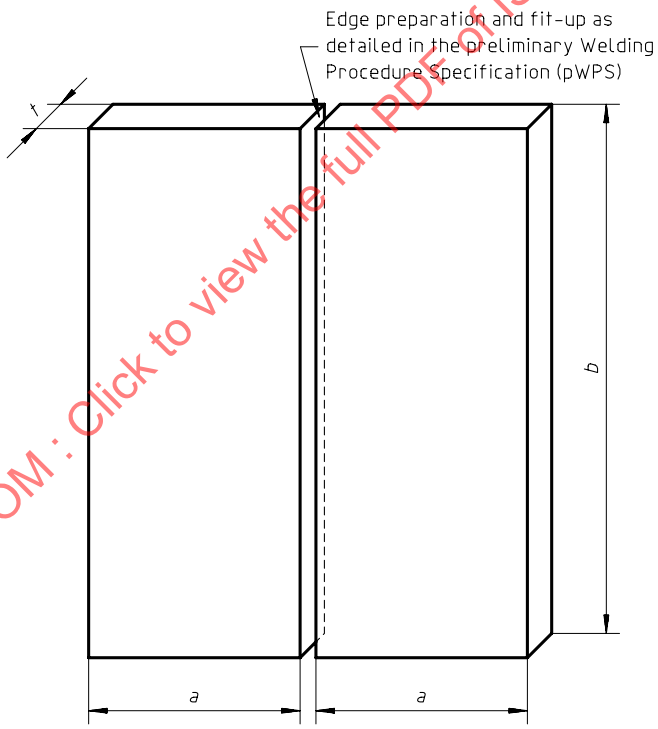
Delete the text of 6.2.5 and replace by the following:

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

These may also be used for partial penetration joints (with or without edge preparation).

Page 4, figure 1

Amend as follows:



a = 3t; minimum value 150 mm

b = 6t; minimum value 350 mm

Figure 1 — Test piece for a butt weld in plate

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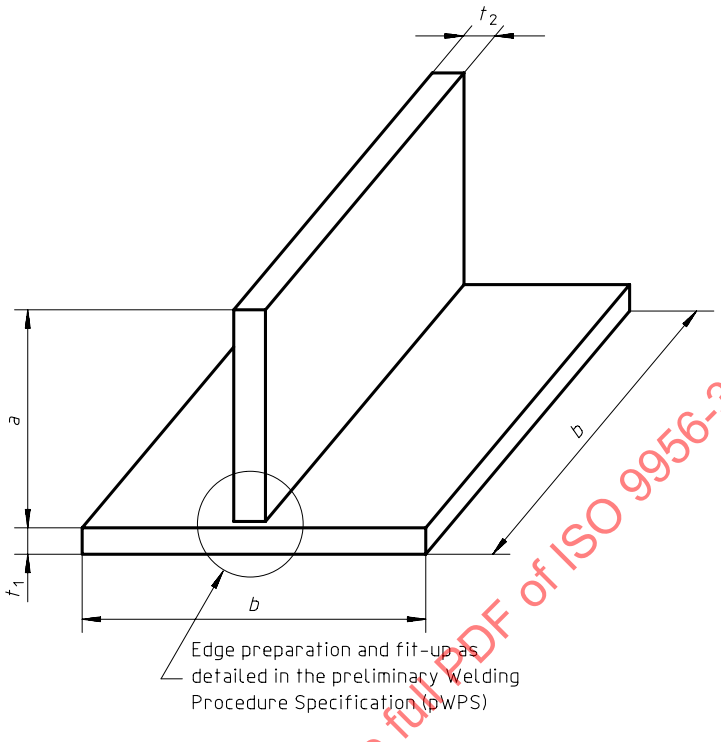
Page 5, figure 3

Amend as follows:



a = 3t; minimum value 150 mm

b = 6t; minimum value 350 mm

Figure 3 — Test piece for a T-butt joint

Page 7, subclause 6.3

Delete the text of 6.3 and replace by the following:

Preparation and welding of test pieces shall be carried out in accordance with the pWPS, and under the general conditions of welding in the production 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 examining body.

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Page 8, table 1

Amend as follows:

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 %	d
	Surface crack detection	100 %	a
	Transverse tensile test	2 specimens	–
	Transverse bend test	2 root and 2 face specimens	b
	Impact test	2 sets	f
	Hardness test	required	c
	Macro-examination	1 specimen	–
T-butt joint [e] figure 3 Branch connection [e] figure 4	Visual	100 %	–
	Surface crack detection	100 %	a
	Ultrasonic or radiographic	100 %	d and g
	Hardness test	required	c
	Macro-examination	2 specimens	–
Fillet weld on plate [e] figure 5 Fillet weld on pipe [e] figure 4	Visual	100 %	–
	Surface crack detection	100 %	a
	Macro-examination	2 specimens	–
	Hardness test	required	c

a Penetrant testing or magnetic particle testing.

For non-magnetic materials, penetrant testing.

b 2 root and 2 face bend test specimens may preferably be substitued by 4 side bend test specimens for $t \geqslant 12$ mm.

c Not required for parent metals:

— ferritic steels with $R_m \leqslant 430$ N/mm^2 ($R_e \leqslant 275$ N/mm^2);
— group 9 steels.

R_e is defined in the relevant product standard.

d Ultrasonic testing is only applicable for ferritic steels and for $t > 8$ mm.

e Testing as detailed does not provide information on the mechanical properties of the joint. Where these properties are relevant to the application an additional approval shall also be held e.g. a butt weld approval.

f One set in the weld metal and one set in the HAZ. Required only for $t \geqslant 12$ mmn 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.

g For outside diameter $\leqslant 50$ mm no ultrasonic test is required.

For outside diameter > 50 mm and where it is not technically possible to carry out ultrasonic examination, a radiographic examination shall be carried out provided that the joint configuration will allow meaningful results.

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Page 8, subclause 7.3.1

Delete the text of 7.3.1 and replace by the following:

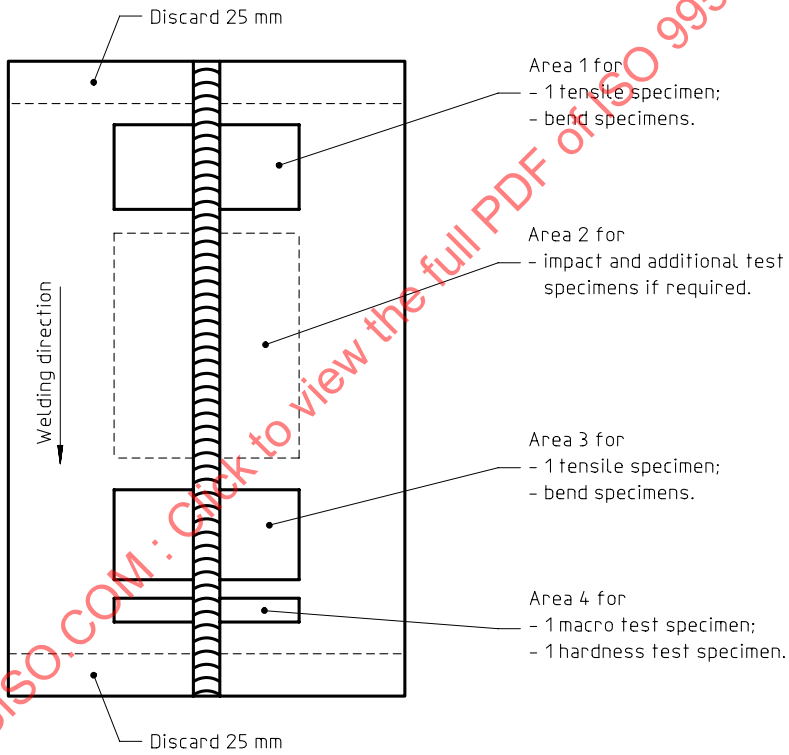
After any required post-weld heat treatment and prior to the cutting of test specimens, all test pieces shall be examined visually and non-destructively in accordance with 7.1.

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 work, the NDE shall be carried out in accordance with EN 970 (visual examination), EN 1435 (radiographic examination), EN 1714 (ultrasonic examination), ISO 3452 (penetrant testing) and EN 1290 (magnetic testing).

Page 9, figure 6

Amend the notes on the figure as follows:



NOTE Not to scale.

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

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Page 9, figure 7

Amend the notes on the figure as follows:

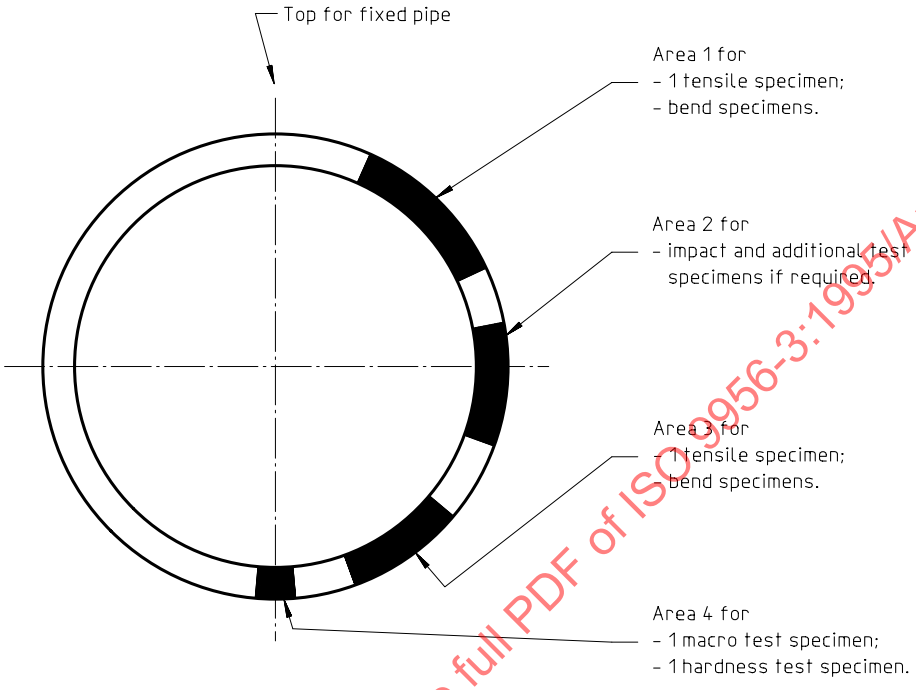

Figure 7 — Location of test specimens for a butt weld in pipe

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Page 10, figure 8

Amend as follows:

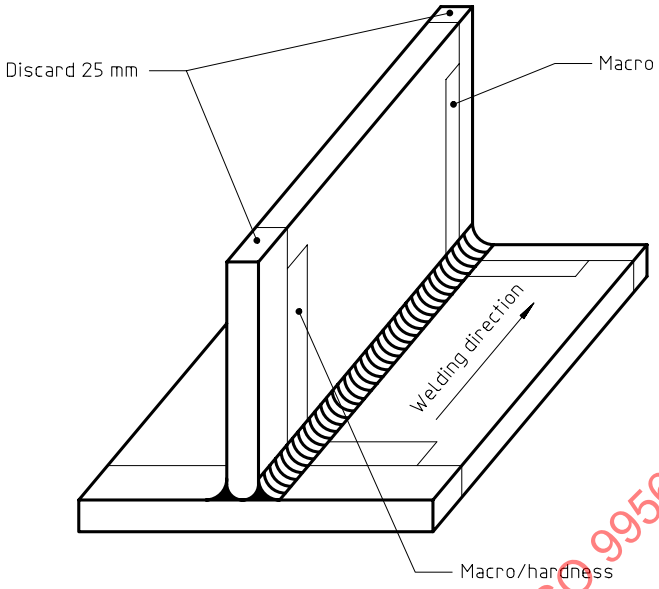
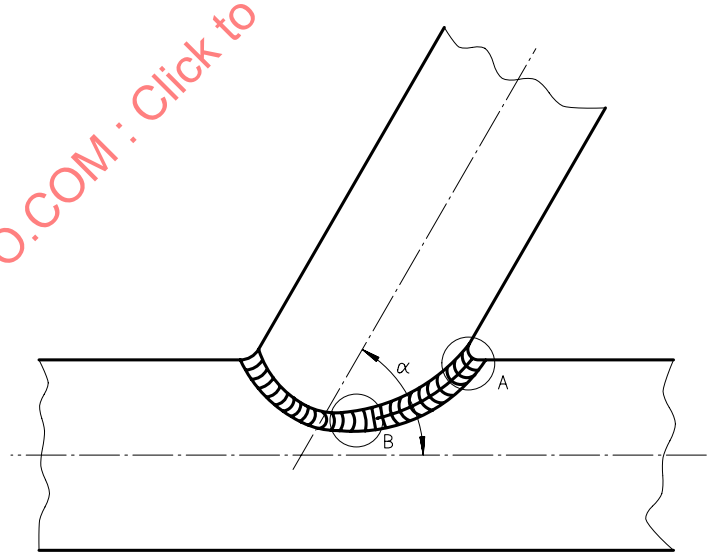


Figure 8 — Location of test specimens in a T-butt joint or a fillet weld on plate

Page 10, figure 9

Amend as follows:



Macro and hardness to be taken in position A

Macro only in position B

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

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Pages 10 and 11, subclause 7.4

Delete the text of 7.4 and replace by the following:

7.4.1 Transverse tensile testing

Specimens and testing for transverse tensile testing for butt joint shall be in accordance with ISO 4136.

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

For pipes ofoutside diameter ⩽ 50 mm, and when full section small diameter pipes are used, the excess weld metal 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.

When the value to be obtained is less than the minimum value specified for the parent metal, it shall be specified prior to testing and included in the pWPS.

7.4.2 Bend testing

Specimens and testing for bend testing for butt joints shall be in accordance with ISO 5173.

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

The diameter of the former or the inner roller shall be 4t and the bending angle shall be a minimum of 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 in accordance with EN 1321 , 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 part of ISO 9956 for position of specimens and temperature of testing, and with ISO 9016 for dimensions and testing.

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 comprise three test specimens.

Specimens with Charpy V-notch shall be used and sampled a maximum of 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.

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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 test specimens from each HAZ in each parent metal.

7.4.5 Hardness testing

The method of hardness testing shall be in accordance with ISO 9015. 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. For material less than 5 mm thick one row of indentations shall be carried out 2 mm maximum below the surface. For material over 5 mm thick two rows of indentations shall be carried out 2 mm maximum below each surface. For double sided welds, for fillet and T-butt welds one additional row of indentations shall be taken through the root area. Typical examples are shown in figures 1a), b), e) and f) of ISO 9015:—.

For each row of indentation there shall be a minimum of three individual indentations in each part of the weld, the HAZ (both sides) and the parent metal (both sides). A typical example is show in figure 10.

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.

Page 12, figure 10

Amend as follows:

Dimensions in millimetres

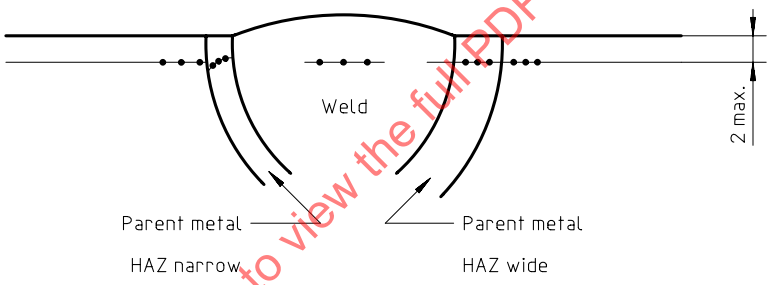

Figure 10 — Typical example of hardness testing

Page 12, table 2

Amend as follows:

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 [a], 2	380	320	350	320
3 [b]	450	c	420	c
4,5	c	320	c	320
6	c	350	c	350
7 — Ni ⩽ 4 % Ni > 4 %	c c	300 c	320 400	300 c
8	c	c	c	c

a If hardness tests are required.

b For steels with min R_e > 885 N/mm^2 special agreements are required.

c Special agreements are required.

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Page 13, subclause 7.5

Delete ''geometric'' in the second paragraph.

Page 13, subclause 8.3.1.1

Delete the text of 8.3.1.1 and replace by the following:

In order to minimise the 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 equal or lower specified yield strength 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.

Page 13, table 3

Amend as follows:

Table 3 — Grouping system for steel

Group	Type of steel[a]
1	Steels with a minimum yield strength $R_{eH} \leqslant 360$ N/mm^2 and with analysis not exceeding, in %: C = 0,24 (0,25 for castings) Si = 0,60 Mn = 1,70 Mo = 0,70 S = 0,045 P = 0,045 Any other single element = 0,3 (0,4 for castings) All other element total = 0,8 (1,0 for castings)
2	Normalized or thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 360$ N/mm^2
3	Quenched and tempered steels and precipitation hardened steels except stainless steels
4	Steels with Cr max. 0,75 %, Mo max. 0,6 %, V max. 0,3 %
5	Steels with Cr max. 10 %, Mo max. 1,2 %
6	Cr Mo V steels with Cr max. 12,2 %, Mo max 1,2 %, V max. 0,5 %
7	Nickel alloyed steels with Ni max 10 %
8	Ferritic or martensitic stainless steels with 10,5 % $\leqslant$ Cr $\leqslant$ 30 %
9	Austenitic steels
10	Austenitic ferritic stainless steels (duplex)
11	Steels not covered by groups 1 to 10 and with 0,25 % $<$ C $\leqslant$ 0,5 %

[a] In accordance with the definition in the material standard, R_{eH} can be replaced by $R_{p0,2}$.

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Page 14, table 4

Amend as follows:

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	9 welded to 1 9 welded to 2
9 welded to 3	9 welded to 1 9 welded to 2 9 welded to 3
NOTE For dissimilar metal joints the yield or alloying element criteria given in 8.3.1.1 shall be applied to each material group.	

Page 14, subclause 8.3.2.2

Amend the title to "Range of approval for butt welds and T-butt joints"

Page 14, table 5

Amend as follows:

Table 5 — Range of approval for thickness

Dimensions in millimetres

Thickness of the test piece, t [a]	Range of approval [b]	
	Butt, T-butt and branch connections for single run or single run from both sides	Butt, T-butt and branch connections for multi-run welding and all fillet welds
$t \leqslant 3$	0,8t to 1,1t	t to 2t
$3 < t \leqslant 12$	0,8t to 1,1t	3 to 2t
$12 < t \leqslant 100$	0,8t to 1,1t	0,5t to 2t (max. 150)
$t > 100$	0,8t to 1,1t	0,5t to 1,5t

[a] For multi process procedures, the recorded thickness contribution of each process may be used as a basis for the range of approval for the individual welding process.

[b] For grade where impact test is required below the impact limit (12 mm) approval is $<$ 12 mm without impact testing.

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