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Specification and qualification of welding procedures for metallic materials — Welding procedure test —

Part 6: Arc and gas welding of copper and its alloys

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

Partie 6: Soudage à l'arc et aux gaz du cuivre et de ses alliages

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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 2.

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

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

ISO 15614-6 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding*, in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 15614 consists of the following parts, under the general title *Specification and qualification of welding procedures for metallic materials — Welding procedure test*:

— *Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

— *Part 2: Arc welding of aluminium and its alloys*

— *Part 3: Fusion and pressure welding of non-alloyed and low-alloyed cast irons*

— *Part 4: Finishing welding of aluminium castings*

— *Part 5: Arc welding of titanium, zirconium and their alloys*

— *Part 6: Arc and gas welding of copper and its alloys*

— *Part 7: Overlay welding*

— *Part 8: Welding of tubes to tube-plate joints*

— *Part 9: Underwater hyperbaric wet welding*

— *Part 10: Hyperbaric dry welding*

— *Part 11: Electron and laser beam welding*

— *Part 12: Spot, seam and projection welding*

— *Part 13: Resistance butt and flash welding*

Introduction

ISO 15614 is part of a series of standards. Details of this series are given in ISO 15607:2003, Annex A.

Requests for official interpretations of any aspect of this part of ISO 15614 should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body, a complete listing of which can be found at www.iso.org.

Specification and qualification of welding procedures for metallic materials — Welding procedure test —

Part 6: Arc and gas welding of copper and its alloys

1 Scope

This part of ISO 15614 specifies how a preliminary welding procedure specification is qualified by welding procedure tests. It applies to the arc and gas welding of copper and copper alloys in all product forms.

This part of ISO 15614 defines the conditions for the execution of welding procedure tests and the range of qualification for welding procedures for all practical welding operations within the range of variables listed in Clause 9.

This part of ISO 15614 is applicable to all new welding procedures. However, it does not invalidate previous welding procedure tests made to former national standards or specifications. Where additional tests have to be carried out to make the qualification technically equivalent, it is only necessary to do the additional tests on a test piece made in accordance with this part of ISO 15614.

Additional tests may be required by application standards.

The principles of this part of ISO 15614 may be applied to other fusion welding processes.

2 Normative references

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

ISO 3452, *Non-destructive testing — Penetrant testing — General principles*

ISO 4063:1998, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 4136, *Destructive tests on welds in metallic materials — Transverse tensile test*

ISO 5173, *Destructive tests on welds in metallic materials — Bend tests*

ISO 6520-1*, Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding*

ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation*

ISO 9017, *Destructive tests on welds in metallic materials — Fracture test*

ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys*

ISO 10042:2005, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections*

ISO 14175, *Welding consumables — Shielding gases for arc welding and cutting*

ISO 14732, *Welding personnel — Approval testing of welding operators for fusion welding and of resistance weld setters for fully mechanized and automatic welding of metallic materials*

ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO/TR 15608, *Welding — Guidelines for a metallic material grouping system*

ISO 15609-1, *Specification and qualification of welding procedure for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 15609-2, *Specification and qualification of welding procedure for metallic materials — Welding procedure specification — Part 2: Gas welding*

ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on a pre-production welding test*

ISO 17636, *Non-destructive testing of welds — Radiographic testing of fusion-welded joints*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO 17639, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

ISO 17659, *Welding — Multilingual terms for welded joints with illustrations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15607 apply.

4 Welding processes

Arc and gas welding are covered by the following processes in accordance with ISO 4063:1998.

111 manual metal arc welding;

131 metal inert gas welding, MIG welding;

141 tungsten inert gas welding, TIG welding;

15 plasma arc welding;

311 oxy-acetylene welding.

5 Preliminary welding procedure specification (pWPS)

The preliminary welding procedure specification shall be prepared in accordance with ISO 15609-1 or ISO 15609-2.

6 Welding procedure test

The making and testing of test pieces shall be in accordance with Clauses 7 and 8.

The welder or welding operator who undertakes the welding procedure test satisfactorily, in accordance with this part of ISO 15614, is qualified for the appropriate range of qualification given in ISO 9606-3 or ISO 14732 providing that the relevant testing requirements are met.

7 Test piece

7.1 General

The welded joint to which the welding procedure will relate in production shall be represented by making a standardized test piece or pieces, as specified in 7.2. Where the production/joint geometry requirements do not represent the standardized test pieces as shown in this part of ISO 15614, ISO 15613 shall be used.

7.2 Shape and dimensions of test pieces

7.2.1 General

The length or number of test pieces shall be sufficient to allow all required tests to be carried out.

Additional test pieces, or test pieces longer than the minimum size, may be prepared in order to allow for extra testing and/or for re-testing specimens (see 8.6).

For all test pieces except branch connections (see Figure 5) and fillet welds (see Figure 4), the material thickness, t, shall be the same for both plates/pipes to be welded.

If required by the application standard, the direction of plate rolling shall be marked on the test piece.

The thickness and/or outside pipe diameter of the test pieces shall be selected in accordance with 9.3.2.1 to 9.3.2.4.

The shape and minimum dimensions of the test piece shall be as given in 7.2.2 to 7.2.6.

7.2.2 Butt joint in plate with full penetration

The test piece shall be prepared in accordance with Figure 1.

7.2.3 Butt weld between plates with raised edges

The test piece shall be prepared in accordance with Figure 2.

7.2.4 Butt joint in pipe with full penetration

The test piece shall be prepared in accordance with Figure 3.

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

7.2.5 T-joint

The test piece shall be prepared in accordance with Figure 4.

This may be used for fully penetrated butt welds or fillet welds.

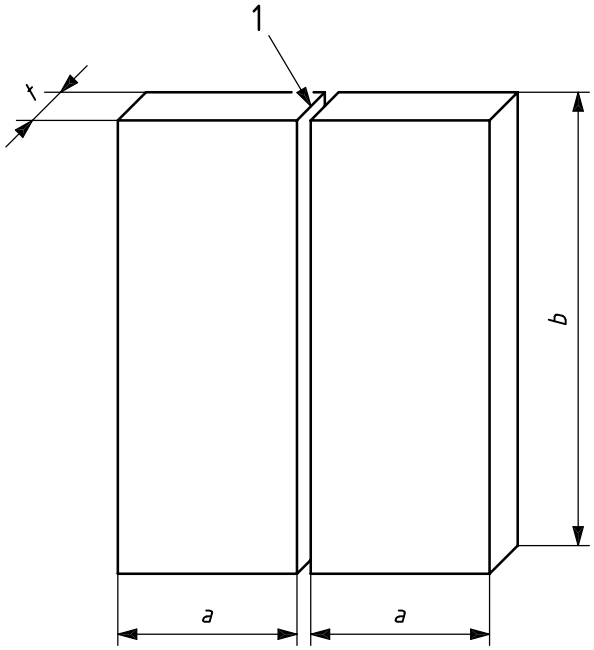
7.2.6 Branch connection

The test piece shall be prepared in accordance with Figure 5. The angle α is the minimum to be used in production. This may be used for fully penetrated joints (set-on or set-in or set-through joint, and for fillet welds).

7.3 Welding of test pieces

The preparation and welding of test pieces shall be carried out in accordance with the pWPS, and under the general conditions of welding in 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.



Key

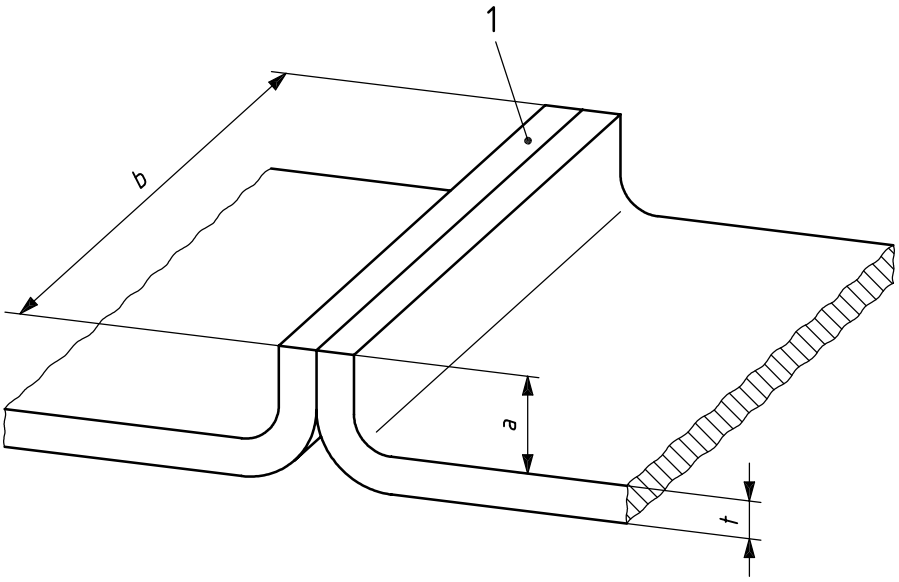
1 joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)

a minimum value 150 mm

b minimum value 300 mm

t material thickness

Figure 1 — Test piece for a butt joint in plate with full penetration



Key

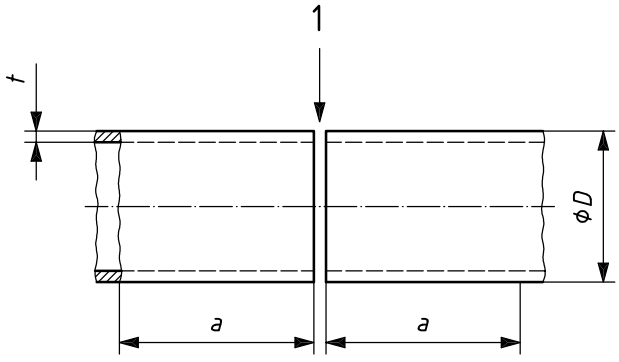
1 joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS) or as shown in ISO 17659

a minimum value 100 mm

b minimum value 300 mm

t material thickness

Figure 2 — Butt welds between plates with raised edges



Key

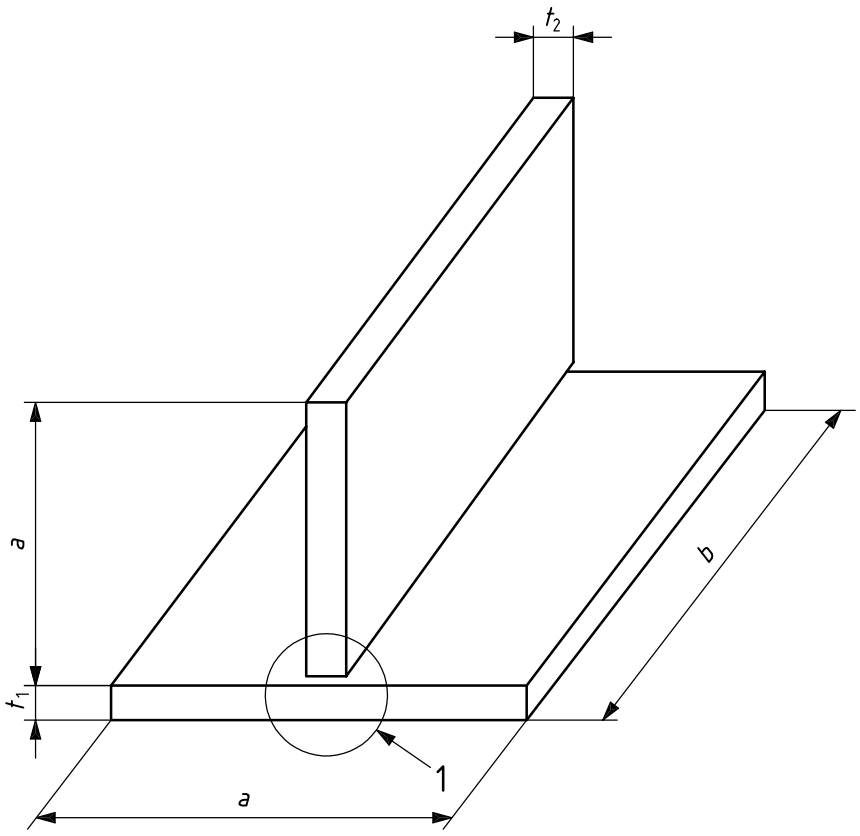
1 joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)

a minimum value 150 mm

D outside pipe diameter

t material thickness

Figure 3 — Test piece for a butt joint in pipe with full penetration



Key

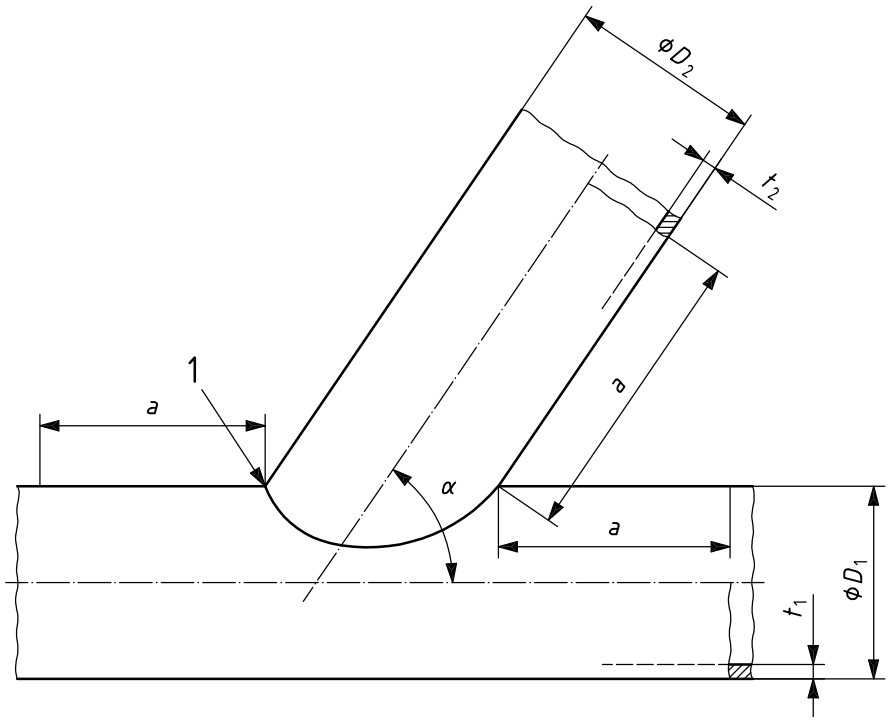
1 joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)

a minimum value 150 mm

b minimum value 300 mm

t_1, t_2 material thicknesses

Figure 4 — Test piece for a T-joint



Key

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

α branch angle

a minimum value 150 mm

D_1 outside diameter of the main pipe

t_1 main-pipe material thickness

D_2 outside diameter of the branch pipe

t_2 branch-pipe material thickness

Figure 5 — Test piece for a branch connection

8 Examination and testing

8.1 Extent of testing

Testing includes both non-destructive testing (NDT) and destructive testing which shall be in accordance with the requirements of Table 1.

An application standard may specify additional tests which may include:

— longitudinal weld tensile test;

— all-weld metal bend test;

— corrosion tests;

— chemical analysis;

— hardness test.

NOTE Specific service, material or manufacturing conditions may require more comprehensive testing than is specified in this part of ISO 15614, in order to gain more information and to avoid repeating the welding procedure test at a later date just to obtain additional test data.

Table 1 — Examination and testing of test pieces

Test piece	Type of test	Extent of testing	Footnote
Butt joint with full penetration — (Figures 1, 2 and 3)	Visual	100 %	—
	Radiographic testing	100 %	—
	Penetrant testing	100 %	—
	Transverse tensile test	2 test specimens	—
	Transverse bend test	2 root and	a, b, c
		2 face test specimens	—
	Macro-examination	1 test specimen	—
T-joint with full penetration — (Figure 4)	Visual	100 %	d
	Penetrant testing	100 %	d
Branch connection with full penetration — (Figure 5)	Macro-examination	2 test specimens	d
Fillet welds — (Figure 4) and (Figure 5)	Visual	100 %	d
	Penetrant testing	100 %	d
	Macro-examination	2 test specimens	d

a For bend tests, see 8.4.3.

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

c For cast materials or wrought/cast combinations, the bend test may be replaced by a fracture test according to ISO 9017.

d Tests as detailed do not provide information on the mechanical properties on the joint. Where these properties are relevant to the application, an additional qualification shall also be held e.g. a butt weld qualification.

8.2 Location and taking of test specimens

The test specimens shall be taken in accordance with Figures 6, 7, 8 and 9.

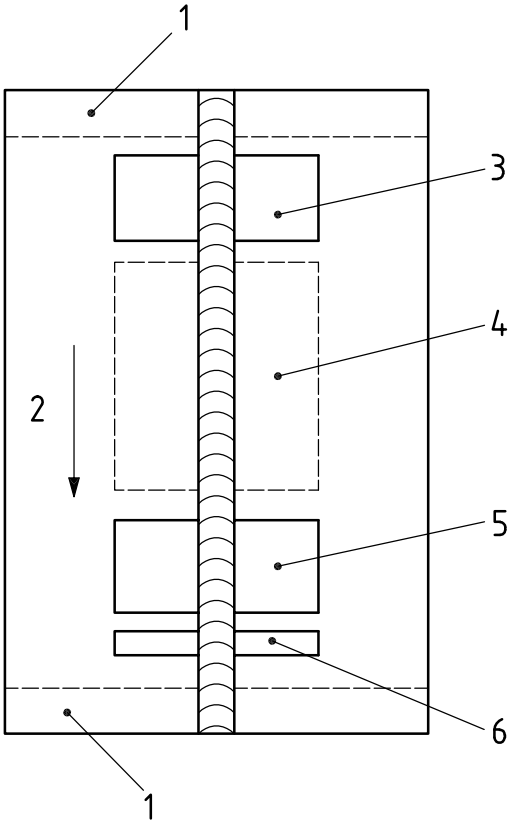
Test specimens shall be taken after all non-destructive testing (NDT) has been carried out and has passed the relevant inspection criteria for the NDT method(s) used.

It is acceptable to take the test specimens outside areas which have imperfections within the acceptance limits for the NDT method(s) used.

8.3 Non-destructive testing

All non-destructive testing in accordance with 8.1 and Table 1 shall be carried out on the test pieces prior to cutting of the test specimens. Any post-weld heat treatment that is specified shall be completed prior to non-destructive testing.

Depending on joint geometry, materials and the requirements for work, the NDT shall be carried out as required in Table 1, in accordance with ISO 17637 (visual testing), ISO 17636 (radiographic testing), and ISO 3452 (penetrant testing).



Key

1 discard 25 mm
2 welding direction
3 area for:
- 1 tensile test specimen;
- bend test specimens.

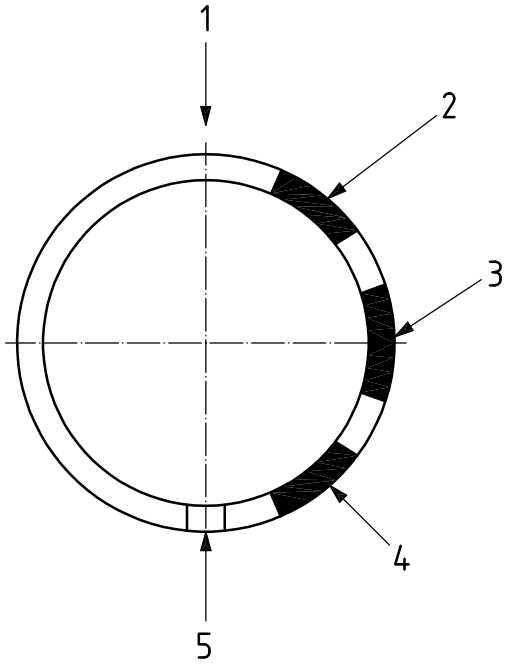
4 area for:
- additional test specimens, if required.

5 area for:
- 1 tensile test specimen;
- bend test specimens.

6 area for:
- macro test specimen.

NOTE Not to scale.

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



Key

1 top for fixed pipe

2 area for:
- 1 tensile test specimen;
- bend test specimens.

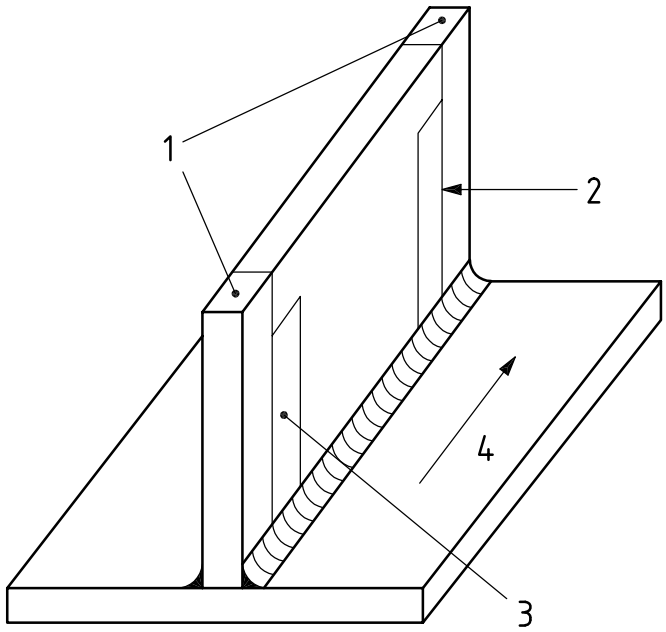
3 area for:
- additional test specimens, if required.

4 area for:
- 1 tensile test specimen;
- bend test specimens.

5 area for:
- macro test specimen.

NOTE Not to scale.

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

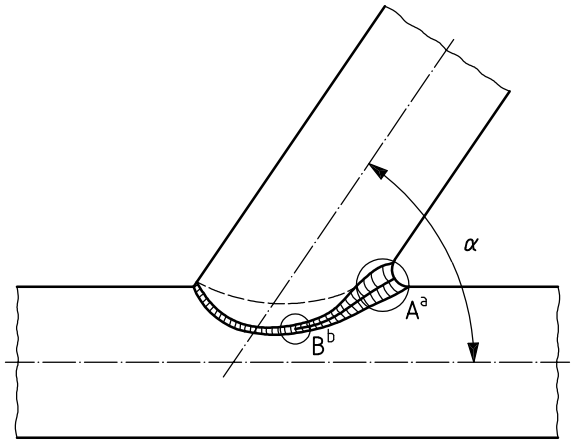


Key

1 discard 25 mm
2 macro test specimen
3 macro test specimen
4 welding direction

NOTE Not to scale.

Figure 8 — Location of test specimens in a T-joint



Key

α branch angle

a Macro test specimen taken in position A.
b Macro test specimen taken in position B.

NOTE Not to scale.

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

8.4 Destructive testing

8.4.1 General

The extent of testing shall be as required by Table 1.

8.4.2 Transverse tensile test

Test specimens and method for transverse tensile testing for butt joints 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 of outside diameter $\leqslant$ 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 not be less than the corresponding specified minimum value for the parent metal.

8.4.3 Bend test

The purpose of this test is to reveal any internal or surface breaking imperfections according to ISO 6520-1.

Test specimens and the procedure for bend testing for butt joints shall be in accordance with ISO 5173.

For all groups, the bending angle shall be 180^{o} using the calculated former diameter based upon material elongation as follows:

a) For elongation $>$ 5 %

$$d = \frac{(100 \times t_{\mathrm{S}})}{A} - t_{\mathrm{S}}$$

where

d is the diameter of the former;

t_{S} is the thickness of the bend test specimen (this includes side bends);

A is the minimum tensile elongation required by the material specification (for a combination of different alloys, the lowest individual value shall be used).

Table 2 gives examples of the maximum calculated former diameter for some elongations and thicknesses.

Values shall be rounded down to aid those performing tests.

A smaller former diameter may be used at the discretion of the testing facility.

b) For elongation $\leqslant$ 5 %, annealing shall be carried out before testing. The former diameter shall be calculated with the elongation given, as specified in Table 2.

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 during the evaluation.

Table 2 — Examples of maximum calculated former diameter for some elongations and thicknesses

Thickness of the bend test specimen	Elongation, A %							
t_s	8	10	12	15	17	20	25	35
mm	Maximum calculated former diameter, d mm							
1,5	17	13,5	11	8,5	7,5	6	4,5	3
3	34	27	22	17	14	12	9	6
4	46	36	29	23	20	16	12	7
6	69	54	44	34	29	24	18	11
8	92	72	59	45	39	32	24	15
10	115	90	73	57	49	40	30	19
12	138	108	88	68	59	48	36	22
15	172	135	110	85	73	60	45	28
20	230	180	147	113	98	80	60	37
25	288	225	183	142	122	100	75	46
30	345	270	220	170	146	120	90	56

8.4.4 Macroscopic examination

The test specimen shall be prepared and examined in accordance with ISO 17639 on one side to clearly reveal the fusion line, the HAZ and the build-up of the runs.

The macroscopic examination shall include unaffected parent metal and shall be recorded by at least one macro-reproduction per procedure test.

The acceptance levels stated in 8.5 shall apply.

8.4.5 Fracture testing

Test specimens and the procedure for fracture testing for butt joints shall be in accordance with ISO 9017.

8.5 Acceptance levels

A welding procedure is qualified if the imperfections in the test piece are within the specified limits of quality level B in ISO 10042:2005, except for imperfection types as follows: excess weld metal, excess convexity, excess throat thickness and excessive penetration, for which quality level C shall apply.

NOTE The correlation between the quality levels of ISO 10042 and the acceptance levels of the different NDT techniques are given in ISO 17635.

8.6 Re-testing

If the test piece fails to comply with any of the requirements for visual examination or NDT specified in 8.5, one further test piece shall be welded and subjected to the same examination. If this additional test piece does not comply with the requirements, the welding procedure test has failed.

If any test specimens fails to comply with the requirements for destructive testing in accordance with 8.4 but only due to weld imperfections, two further test specimens shall be obtained for each one that failed. The

additional test specimens can be taken from the same test piece if there is sufficient material available, or from a new test piece.

If a tensile test specimen fails to meet the requirements of 8.4.2, two further test specimens shall be obtained for each one that failed. Both shall satisfy the requirements of 8.4.2.

Each additional test specimen shall be subjected to the same tests as the initial test specimen that failed. If either of the additional test specimens does not comply with the requirements, the welding procedure test has failed.

9 Range of qualification

9.1 General

Each of the conditions given in this clause shall be met in order to comply with this part of ISO 15614.

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

9.2 Related to the manufacturer

A qualification of a pWPS by a welding procedure test according to this part of ISO 15614 obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of the manufacturer.

Welding is under the same technical and quality control when the manufacturer who performed the welding procedure test retains complete responsibility for all welding carried out to it.

9.3 Related to the parent material

9.3.1 Parent material grouping

In order to minimise the number of welding procedure tests, copper and copper alloys are grouped according to ISO/TR 15608.

Separate welding procedure qualifications are required for each parent material or parent material combinations not covered by the grouping system.

Permanent backing material shall be considered as a parent material within the qualification (sub-)group.

The range of qualification for similar and dissimilar joints is given in Table 3.

Any dissimilar material joint not covered by Table 3 shall require a specific test with no range of qualification for other parent materials.

If one parent material could belong to two groups or sub-groups, then it shall always be classified in the lower numbered group or sub-group.

NOTE Minor compositional differences between similar grades arising from the use of national standards need no requalification.

The ranges of qualification are given in Table 3.

Table 3 — Range of qualification for copper groups and sub-groups

Material group(s) of test joint	Range of qualification
31 – 31	31
32 – 32	32
33 – 33	33
34 – 34	34
35 – 35	34 and 35
36 – 36	32 and 36
37 – 37	37
38 – 38	38

9.3.2 Parent material thickness and pipe diameter

9.3.2.1 General

For single-process qualification, the thickness t shall have the following meanings:

a) For a butt joint:

the parent material thickness.

b) For a fillet weld:

the parent material thickness qualified for joints between different thicknesses is that of the thicker material. For each thickness range qualified as in Table 4 there is also an associated range of qualification for throat thicknesses, a, for single-run fillet welds as given in 9.3.2.3.

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-joint in plate with full penetration:

the thickness of the prepared plate.

For multi-process procedures, the deposited metal thickness for each process shall be used as a basis for the range of qualification for the individual welding process.

9.3.2.2 Range of qualification for parent material thickness

The qualification of a welding procedure test on thickness t shall include qualification for thicknesses in the ranges given in Table 4.

For multi-process procedures, the deposited weld metal thickness for each welding process shall be used as a basis for the range of qualification for the individual welding process.

Table 4 — Range of qualification for thicknesses for plates and pipes

Dimensions in millimetres

Thickness of the test piece, t	Range of qualification
$t \leqslant 3$	0,5 t to 2 t
$3 < t \leqslant 20$	3 to 2 t
$t > 20$	$\geqslant$ 0,8 t

For fully mechanized and automatic single-run processes, the depth of penetration is the maximum depth qualified.

9.3.2.3 Range of qualification for throat thickness of single-run fillet welds

If hardness requirements are specified, a qualification of fillet welds, carried out on plates with thickness equal to or greater than 30 mm, applies for all plate and throat thicknesses.

In addition, for single-run fillet welds, the range of qualification of the throat thickness "a" shall be "0,75a" to "1,5a".

Where a fillet weld is qualified by means of a butt weld test, single-layer welds qualify for single-run and multi-run fillet welds, but multi-run welds qualify only multi-run fillet welds.

9.3.2.4 Range of qualification for plates and pipes

Qualification given for plates also covers pipes and vice versa.

9.3.3 Angle of branch connection

A welding procedure test carried out on a branch connection with angle α shall qualify all branch angles α_1 in the range of $\alpha \leqslant \alpha_1 \leqslant 90°$.

9.4 Common to all welding procedures

9.4.1 Welding process

Each degree of mechanization shall be qualified independently (manual, partly mechanized, fully mechanized and automatic).

The qualification is only valid for the welding process(es) used in the welding procedure test.

For multi-process procedures, the welding procedure qualification may be carried out with separate welding procedure tests for each welding process. It is also possible to carry out the welding procedure test as a multi-process procedure test. The qualification of such a test is only valid for the process sequence carried out during the multi-process procedure test.

NOTE It is not allowed to use a multi-process procedure test to qualify any single process, unless the testing carried out on the process conforms to this part of ISO 15614.

9.4.2 Welding positions

Welding of a test in any position (pipe or plate) qualifies for welding in all positions (pipe or plate).

9.4.3 Type of joint/weld

The range of qualification for the type of welded joints is as used in the welding procedure test subject to limitations given in other clauses (e.g. diameter, thickness) and additionally:

a) Butt welds qualify full and partial penetration butt welds; and fillet welds. Fillet weld tests shall be required where this is the predominant form of production welding.

b) Butt joints in pipe also qualify branch connections with an angle $\geqslant 60°$.

c) T-joints butt welded only qualify T-joints butt welded and fillet welds [see a)].

d) Welds made from one side without backing qualify welds made from both sides and welds with backing.

e) Welds made with backing qualify welds made from both sides.

f) Welds made from both sides without gouging qualify welds made from both sides with gouging.

g) Fillet welding qualifies fillet welding only.

h) It is not permitted to change a multi-run deposit into a single-run deposit (or single run on each side) for a given process.

9.4.4 Filler material, designation

Filler materials cover other filler materials, as long as they have equivalent mechanical properties and the same nominal composition according to the designation in the appropriate standard for the filler material concerned.

9.4.5 Type of current

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

9.4.6 Heat input

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

The upper limit of heat input qualified is 25 % greater than that used in welding the test piece.

The lower limit of heat input qualified is 25 % lower than that used in welding the test piece.

9.4.7 Preheat temperature

When preheating is required, the lower limit of qualification is the nominal preheat temperature applied at the start of the welding procedure test.

9.4.8 Interpass temperature

The upper limit of qualification is the highest interpass temperature reached in the welding procedure test.

9.4.9 Post-weld heat treatment or ageing

Post-weld heat treatment, e.g. artificial ageing, natural ageing, shall be specified in the pWPS.

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

The temperature range and the ageing conditions specified in the pWPS correspond to the range qualified.

9.4.10 Initial heat treatment

A change in the initial heat treatment condition prior to the welding of copper and its alloys is not permitted.

9.5 Specific to processes

9.5.1 Process 131

9.5.1.1 The qualification given to the shielding gas and backing gas is restricted to the symbol of the gas according to ISO 14175. A change of the helium content of more than 25 % necessitates re-qualification. Shielding gases not covered by ISO 14175 are restricted to the nominal composition used in the test.

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

9.5.2 Process 141

9.5.2.1 The qualification given to the shielding gas and backing gas is restricted to the symbol of the gas according to ISO 14175. A change of the helium content of more than 25 % necessitates re-qualification. Shielding gases not covered by ISO 14175 are restricted to the nominal composition used in the test.

9.5.2.2 A weld procedure test made without a backing gas qualifies a welding procedure with backing gas.

9.5.2.3 Welding with filler material does not qualify for welding without filler material or vice versa.

9.5.3 Process 15

9.5.3.1 Welding with filler material does not qualify for welding without filler material or vice versa.

9.5.3.2 The qualification given is restricted to the plasma gas composition used in the welding procedure test.

9.5.3.3 The qualification given to the shielding gas and backing gas is restricted to the symbol of the gas according to ISO 14175. A change of the helium content of more than 25 % necessitates re-qualification. Shielding gases not covered by ISO 14175 are restricted to the nominal composition used in the test.

9.5.4 Process 311

Welding with filler material does not qualify for welding without filler material or vice versa.

10 Welding procedure qualification record (WPQR)

The welding procedure qualification record (WPQR) is a statement of the results of assessing each test piece including re-tests. The relevant items listed for the Welding Procedure Specification (WPS) in ISO 15609-1 and ISO 15609-2 shall be included, together with details of any features that would be rejectable by the requirements of Clause 8. If no rejectable features or unacceptable test results are found, a WPQR detailing the welding procedure test piece results is qualified and shall be signed and dated by the examiner or examining body.

A WPQR 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 WPQR-format is shown in Annex A.

Annex A
(informative)

Welding Procedure Qualification Record form (WPQR)

Welding Procedure Qualification Record form — Test certificate

Manufacturer's WPQR No.:
Manufacturer:
Address:
Code/Testing Standard:
Date of Welding:

Examiner or examining body
Reference No.:

Range of qualification

Welding Process(es):
Type of joint and weld:
Parent material group(s) and sub-group(s):
Parent Material Thickness (mm):
Weld Metal Thickness (mm):
Throat Thickness (mm):
Single run/Multi run:
Outside Pipe Diameter (mm):
Filler Material Designation:
Filler Material Make:
Filler Material Size:
Designation of Shielding Gas/Flux:
Designation of Backing Gas:
Type of Welding Current and Polarity:
Mode of Metal Transfer:
Heat Input:
Welding Positions:
Preheat Temperature:
Interpass Temperature:
Ageing:
Post-Weld Heat-Treatment:
Other Information (see also 9.5):

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 examining body Name, date and signature

Record of weld test

Location:
Manufacturer's pWPS:

Manufacturer's WPQR No:
Manufacturer:
Welder's Name:
Mode of Metal Transfer:
Joint Type and Weld:
Weld Preparation Details (Sketch)*:

Examiner or examining body:
Method of Preparation and Cleaning:
Parent Material Specification:
Material Thickness (mm):
Outside Pipe Diameter (mm):
Welding Position:

Joint Design	Welding Sequences

Welding Details

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

Filler Material Designation and Make:
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:
Post-Weld Heat Treatment:
Time, Temperature, Method:
Heating and Cooling Rates*:

Other information* e.g.:
Weaving (maximum width of run):
Oscillation: amplitude, frequency, dwell time
Pulse welding details:
Distance contact tube/workpiece:
Plasma welding details:
Torch angle:

....

Manufacturer
Name, date and signature

Examiner or examining body
Name, date and signature

* If required.

Test results

Manufacturer's WPQR No.:
Visual:
Penetrant/Magnetic Particle*
Tensile Tests

Examiner or examining body
Reference No.:
Radiography*:
Ultrasonic*:
Temperature:

Type/No.	R_e N/mm^2	R_m N/mm^2	A %	Z %	Fracture Location	Remarks
Requirement						

Bend Tests Former Diameter:

Type/No.	Bend Angle	Elongation*	Results

Macroscopic Examination:

Impact Test* Type: Size: Requirement:

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

Hardness Test* (Type/Load)
Parent Metal:
HAZ:
Weld metal:

Location of Measurements (Sketch*)

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:

* If required.

Bibliography

[1] ISO 3834 (all parts), *Quality requirements for fusion welding of metallic materials*

[2] ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

[3] ISO 17635, *Non-destructive testing of welds — General rules for fusion welds in metallic materials*

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