INTERNATIONAL STANDARD

ISO 15614-8

Second edition
2016-03-01

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

Part 8: Welding of tubes to tube-plate joints

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

Partie 8: Soudage de tubes sur plaques tubulaires

Reference number
ISO 15614-8:2016(E)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

This second edition cancels and replaces the first edition (ISO 15614-8:2002), which has been technically revised.

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 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: Upset (resistance butt) and flash welding*

— *Part 14: Laser-arc hybrid welding of steels, nickel and nickel alloys*

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Introduction

All new welding procedure tests are to be carried out in accordance with this part of ISO 15614 from the date of its issue. However, this part of ISO 15614 does not invalidate previous welding procedure tests made to former national standards or specifications or previous issues of this part of ISO 15614.

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

Part 8: Welding of tubes to tube-plate joints

1 Scope

This part of ISO 15614 specifies requirements for the qualification testing of welding procedures for the arc welding of tube to tube-plate joints in metallic materials by manual, partly mechanized, fully mechanized, or automatic processes.

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

Qualification by tube to tube-plate joint tests can be used for all joints even if they are fully loaded or only seal welded as required in application standards.

This part of ISO 15614 applies to fusion welding of metallic materials for tube to tube-plate joints with a remaining gap between the tube and the tube-plate for some length of the tube-plate thickness. This part of ISO 15614 does not apply to tube-sheets with forged end connections with welded tubes (external/internal bore welds).

For welding of tube to tube-plate joints with mechanical expansion which is load bearing, welding procedure test is to be defined.

For other applications and/or requirements, this part of ISO 15614 can be used if required by the specification.

Repair welding is to be considered in the welding procedure test.

2 Normative references

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

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

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

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

ISO 9015-1, *Destructive tests on welds in metallic materials — Hardness testing — Part 1: Hardness test on arc welded joints*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*

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

ISO 9606-4, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys*

ISO 9606-5, *Approval testing of welders — Fusion welding — Part 5: Titanium and titanium alloys, zirconium and zirconium alloys*

ISO 9692-1, *Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels*

ISO 14175, *Welding consumables — Gases and gas mixtures for fusion welding and allied processes*

ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials*

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

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

ISO 15614-1, *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*

ISO 17636-1, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film*

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

3 Terms and definitions

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

4 Symbols and abbreviated terms

a	throat thickness (mm) (in this case, the minimal distance between root point and weld surface)
b	width of the weld reinforcement (mm)
d_p	pore size (mm)
d_a	tube-outside diameter (mm)
d_l	minimum distance between two pipes (mm)
g	gap between tube and tube plate (mm)
h	height or width of imperfection (mm)
s_p	starting point of the root run
t	tube-wall thickness (mm)
t_1	cladding thickness (mm)
t_2	tube-plate thickness (mm)
x	overlap (mm)

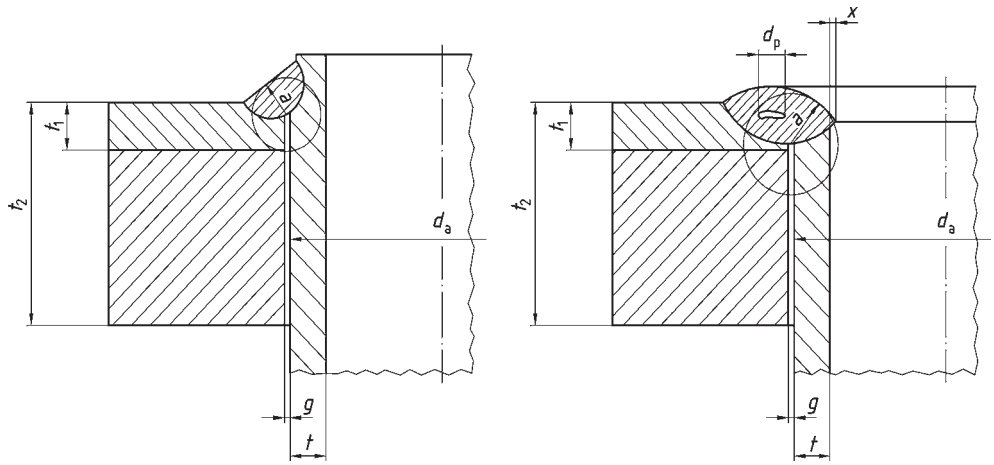


Figure 1 — Presentation of symbols in an example

5 Preliminary welding procedure specification (pWPS)

5.1 General

The qualification for tube to tube-plate welding tests shall be based on a pWPS in accordance with ISO 15609-1. It shall specify the relevant parameters listed in 5.2 and 5.3.

5.2 Parameters for all welding process

Details relating to the following parameters shall be recorded for all welding processes:

a) welding process, or processes, when more than one is used in making a complete joint;

b) tube-plate specification and thickness and details of any cladding and its thickness;

c) tube specification, thickness, and outside diameter;

d) pitch type (square or triangular) and distance between pipes;

e) joint geometry, actual borehole, diameter and fit-up tolerances (sketch);

f) cleaning and degreasing (time during the fabrication steps and type);

g) jigging or tacking, tacking position, and expansion (before welding);

h) tube-plate and welding position;

i) type and/or trade name of welding consumables;

j) size (diameter) and wire feed speed or rate of wire addition per run;

k) pre-heating and interpass temperature, including method of control;

l) if necessary, travel speed;

m) number and arrangement of runs, starting points of runs, and weld dimensions (sketch);

n) welding sequence;

o) post-weld heat treatment, including method of control;

p) if necessary, the temperature and time recommended for drying/backing of welding consumables before use;

q) any special features, including heat input control requirements, any heat sinks effects.

5.3 Parameters for particular welding processes

Details relating to the following parameters given in 5.3 a) to 5.3 d) shall be recorded for these particular processes, in addition to the parameters given in 5.2. The reference numbers of welding processes relate to ISO 4063.

a) Manual metal arc welding (111)

- alternating or direct current and polarity
- current

b) MIG welding, MAG welding, solid wire, or cored wire with or without separate gas shield (114), (131), (132), (133), (135), (136), (138)

- manufacturer of the power source, type (analogue, digital, electronically regulated)
- shielding gas designation in accordance with ISO 14175 and flow rate
- arc voltage
- nozzle size/diameter
- wire feed speed or current
- for pulsed welding: the pulse time and frequency, pulsed current, and background current

c) TIG welding (141)

- manufacturer of the power source, type (analogue, digital, electronically regulated)
- shielding gas designation in accordance with ISO 14175 and flow rate
- alternating current (AC) or direct current (DC) and polarity
- current
- nozzle size/diameter
- shape of the end of tungsten electrode
- for pulsed welding: the pulse time and frequency, pulsed current, and background current
- whether filler metal is used

d) Mechanized or automatic welding

- All parameters detailed in b) or c) and the following parameters if necessary:
  - arc length or arc voltage;
  - where filler metal is used, wire feed speed, wire diameter;
  - other pre-programmed welding variables such as the following:
    - pre- and post-gas purge times;
    - changes in current level;

- current slope up and down rates;
- welding travel speed and degree of overlap;
- when considering front face welding, the following additional information:
  - radius of electrode rotation;
  - electrode angle relative to the tube axis;
  - distance between the work piece and the electrode.

For all other welding processes, the welding parameters shall be specified.

6 Qualification of welding procedure

The qualification of welding procedure for the tube to tube-plate welding shall be carried out by an examiner or examining body related to the appropriate application standard or specification.

7 Welding of test pieces

7.1 General

Procedure test pieces shall be produced in accordance with 7.2 and shall simulate the joint geometry to be used in production or a similar geometry within the requirements of the pWPS. Welders shall be qualified in accordance with ISO 9606-1, ISO 9606-2, ISO 9606-3, ISO 9606-4, or ISO 9606-5. For welding operators and weld setters, the qualification can be carried out during the tests in accordance with ISO 14732.

7.2 Type of test piece

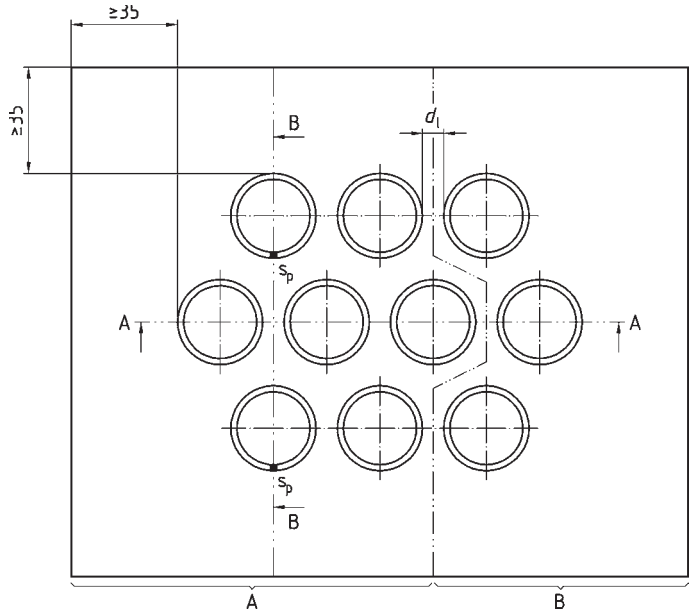
7.2.1 Joint preparation and joint construction

For examples of joint preparation based on ISO 9692-1 and joint construction, see EN 1708-1 [1].

7.2.2 Tube ends welded on triangular pitch

Where tube end welds are involved on a triangular pitch, a minimum of 10 tube ends with an outside diameter smaller than 40 mm (<40 mm) or a minimum of seven tube ends (area A) with an outside diameter greater than or equal to 40 mm (≥40 mm) shall be welded as shown in Figure 2.

Dimensions in millimetres



Key

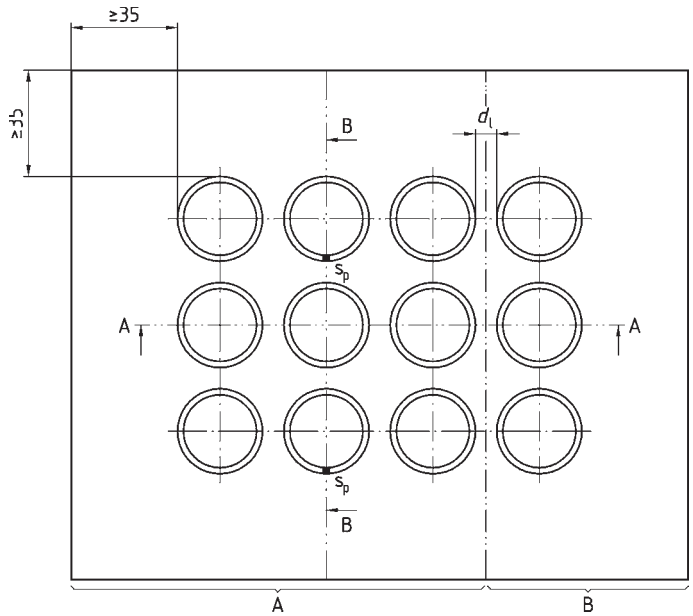
A-A/B-B ground sections of a test specimen (examples for the location of the cut lines)

Figure 2 — Test piece for tube ends on triangular pitch

7.2.3 Tube ends welded on square pitch

Where tube end welds are involved on a square pitch, a minimum of 12 tube ends with an outside diameter smaller than 40 mm (<40 mm) or a minimum of nine tube ends (area A) with an outside diameter greater than or equal to 40 mm (≥40 mm) shall be welded as shown in Figure 3.

Dimension in millimetres



Key

A-A/B-B ground sections of a test specimen (examples for the location of the cut lines)

Figure 3 — Test piece for tube ends on square pitch

8 Examination and testing

8.1 Performance

8.1.1 General

For a welding procedure to be qualified, the same test piece representing the welding procedure test shall comply with 8.1.2 to 8.1.6 and, when specified, with the push-out tests described in 8.1.7.

Table 1 — Examination and testing of the test pieces

Tube arrangement in the tube plate	Number of welds and type of test	Extent of testing
Triangular pitch (see Figure 2)	— d_a < 40 mm (10 tube ends) — d_a ≥ 40 mm (seven tube ends)	
	— Visual testing	100 %
	— Penetrant testing	100 %
	— Radiographic testing[a]	100 %
	— Macroscopic examination	Six specimens (d_a < 40 mm) Five specimens (d_a ≥ 40 mm)
	— Hardness test (row)[b, c]	One specimen at the first tube end which was welded
	— Push-out or pull-out test	If required by specification
Square pitch (see Figure 3)	— d_a < 40 mm (12 tube ends) — d_a ≥ 40 mm (nine tube ends)	
	— Visual testing	100 %
	— Penetrant testing	100 %
	— Radiographic testing	100 %
	— Macroscopic examination	Seven specimens (d_a < 40 mm) Six specimens (d_a ≥ 40 mm)
	— Hardness test (row)[b, c]	One specimen at the first tube end which was welded
	— Push-out or pull-out test	If required by specification

[a] Except those for push-out or pull-out test.

[b] Not required for steel sub-group 1.1 and 7.1, groups 8, 10, and 41 to 48 except for dissimilar joints between subgroup 1.1 and group 8.

[c] For cladded tube ends, the hardness test shall also cover the area of the parent material under the cladding.

8.1.2 Visual testing

After appropriate cleaning and if required, any post-weld heat treatment and prior to the cutting of test specimens, the test piece shall be tested visually according to ISO 17637.

The welds shall show uniform contour without excessive reinforcement with the bores of the tube free from any spatter and shall be in accordance with Table 2.

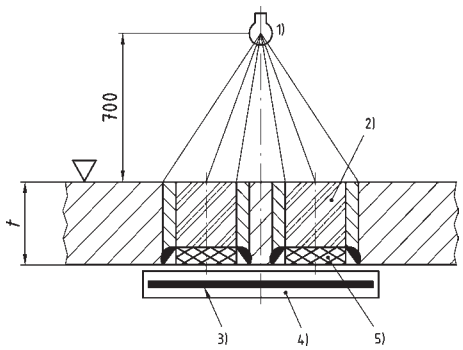
8.1.3 Penetrant testing

The external surfaces of all welds shall be subjected to penetrant examination in accordance with ISO 3452-1.

8.1.4 Radiographic testing

All test welds, except those for push-out tests, shall be radiographed in accordance with ISO 17636-1. An example is given in Figure 4. In the case of push out tests, the tube-plate shall be reduced in thickness to between 5 mm and 12 mm.

Dimensions in millimetres



Key

1) ray source
2) radiated marcasite (steel/lead)
3) film
4) film cassette
5) stopper

Figure 4 — Performance of the radiographic testing

8.1.5 Macroscopic examination

After visual and non-destructive testing, the test piece shall be sectioned as shown in Figures 2 and 3 by sawing or machining and exposing two starting points of the root runs. The macroscopic examination specimens shall be prepared and examined in accordance with ISO 17639.

Macroscopic examinations of additional sections to assess compliance with the acceptance levels in 8.2 shall be carried out where radiography reveals imperfections other than gas pores.

8.1.6 Hardness test

A hardness row, normally HV 10 in accordance with ISO 9015-1, shall be carried out for the cases identified in Table 1. The hardness shall be recorded for the weld metal, both parent metals and the heat-affected zones. The hardness values under cladding shall be recorded, if applicable.

8.1.7 Push-out or pull-out test

The requirements should be defined in the specification.

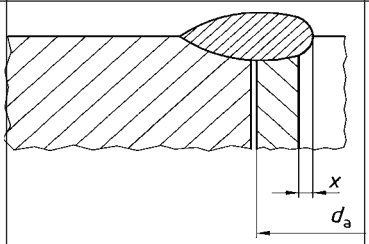
8.2 Acceptance levels

8.2.1 General

The following details are to be used for the qualification testing of welding procedures and as such, may be different from those specified for a particular application.

8.2.2 Visual testing

Table 2 — Visual testing

No.	Imperfection/ designation	ISO 6520-1 reference no.	Remarks	Limits for imperfections
1	Cracks	100	All types of cracks	Not permitted
2	Crater crack	104		Not permitted
3	Surface pore open end crater pipe	2017 2024	All types of pores, they are visible on the surface	Not permitted
4	Burn through of tube wall			Not permitted
5	Overlap	506		$x \leq 0{,}5$ mm for tubes, $d_a \leq 25$ mm outside diameter and $x \leq 1$ mm for tubes, $d_a > 25$ mm outside diameter
6	Burn down of tube end (only fillet welds)			Not permitted, where it reduces the weld below its required dimensions
7	Undercut	5011		0,1 t
8	Excess weld metal	502		$h \leq 1$ mm + 0,1 b Where b is the width of the weld reinforcement

8.2.3 Penetrant testing

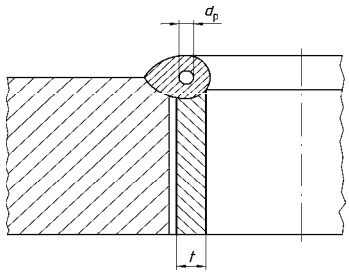
Any indication of dimensions in the weld metal or heat-affected zone is not acceptable.

8.2.4 Radiographic testing

Table 3 — Radiographic testing

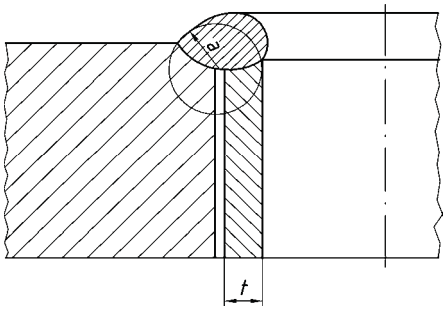
No.	Imperfection/ designation	ISO 6520-1 reference no.	Remarks	Limits for imperfections
9	Cracks	100	All types of cracks	Not permitted
		1001	In case of micro cracks, the dimensions and frequency of the cracks should be agreed.	
10	Elongated cavities, wormholes	2015 2016		Not permitted
11	Clustered (localized) cavities	2013		Not permitted

Table 3 *(continued)*

No.	Imperfection/ designation	ISO 6520-1 reference no.	Remarks	Limits for imperfections
12	Gas pores uniformly distributed, porosity, linear porosity	2011 2012 2014	 — Per tube joint max. two pores with pore size d_p permitted as measured on the image — Distance between two pores min. distance 2 × d_p around the circumference	$d_p \leq 0{,}25\ t$ max. 1 mm
13	Solid inclusions	300		Not permitted
14	Lack of fusion	401		Not permitted
15	Lack of penetration	402		Not permitted

8.2.5 Macroscopic examination

Table 4 — Macroscopic examination

No.	Imperfection/ designation	ISO 6520-1 reference no.	Remarks	Limits for imperfections
9 to 15	see Table 3			
16	Weld thickness		 The throat dimension, *a*, is equal to the radius of the largest circle totally inscribed in the weld whose centre is situated in the root of weld	$a \geq 0{,}9\ t$

8.2.6 Hardness values

The results from the hardness test shall meet the requirements given in ISO 15614-1.

8.2.7 Push-out or pull-out load

The requirements should be defined in the specification.

8.3 Re-test

If the test piece fails to comply with any of the requirements for examination and testing specified in 8.1, one further test piece shall be welded and subjected to the same examination/testing. If this additional test piece does not comply with the requirements, the welding procedure test has failed.

9 Range of qualification

9.1 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.

9.2 Related to the manufacturer

A qualification of a WPS obtained by a manufacturer is valid for welding in workshops and sites under the same technical conditions and quality control of that manufacturer.

9.3 Related to the material

9.3.1 Parent metal

For the purposes of this part of ISO 15614, the groups of materials listed in ISO/TR 15608 shall apply. Only those materials groups according to ISO/TR 15608 used in this qualification test in combination with each other are qualified.

9.3.2 Tube-plate and tube dimensions

For all geometrical details, the ranges of qualification are given in Table 5.

Table 5 — Range of qualification for geometrical details

Designation	Test piece mm	Range of qualification mm
Cladding thickness	$t_1 < 3$ $t_1 \geq 3$	$\geq t_1$ ≥ 3
Tube-plate thickness	$t_2 < 35$ $t_2 \geq 35$	$\geq t_2$ ≥ 35
Tube-wall thickness	t	0,5 t to 2 t
Tube-outside diameter	d_a	$\geq d_a$

9.3.3 Tube pitch

The qualification of a welding procedure using a particular pitch of tubes shall include qualification for any other type of pitch provided that the minimum distance between two pipes, d_1 (see Figures 2 and 3), is not reduced to below that used in the qualified welding procedure.

9.4 Common to all welding procedures

9.4.1 Welding process

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

Qualification in a multi-process procedure test is only valid for that multi-process procedure.

9.4.2 Welding position of tube-plate

The qualification is only valid for the welding position used in the welding procedure test.

9.4.3 Type of joint

The qualification is only valid for the type of welded joints used in the welding procedure test.

9.4.4 Filler metal, classification

The qualification range of filler metals covers other filler metals as long as they are

— either in the same group of tensile properties. Change in the type of a covered electrode or a change in a type of electrode core requires a new welding procedure qualification, or

— within the same nominal chemical composition.

9.4.5 Filler metal, dimensions

The qualification given is for the diameters of electrodes or for the diameters of wires or for special consumables, e.g. inserts, used in the welding procedure test.

9.4.6 Type of current

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

9.4.7 Arc energy (heat input)

The requirements of this subclause apply in case of welding without filler material or in other cases when the control of heat input is specified.

The lowest limit of heat input is that used in welding procedure test or may be 25 % greater than that used in welding the test piece.

9.4.8 Pre-heat temperature

The lower limit of qualification is the pre-heat temperature used at the start of the welding procedure test.

9.4.9 Interpass temperature

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

9.4.10 Post-weld heat treatment

Welding procedure test with heat treatment does not include welding procedure test without heat treatment and vice versa. The temperature range used for the welding procedure test is the range qualified. Where required, heating rates, cooling rates, and holding time shall be related to the production component.

9.4.11 Shielding gas

The qualification given to the shielding gas is restricted to the type of gas (nominal composition) in accordance with ISO 14175 used in the welding procedure test.

10 Welding procedure qualification record form (WPQR)

A welding procedure qualification record (WPQR) is a statement of the results of assessment of each test piece including re-tests. The relevant parameters listed for the WPS in Clause 5 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 parameters.

An example of the WPQR form is shown in Annex A.

Annex A
(informative)

Welding procedure qualification record form for tube to tube-plate joints (WPQR)

Welding procedure qualification – Test certificate

Manufacturer's welding procedure
Reference no. : .....

Examiner or examining body
Reference no. : .....

Manufacturer : .....
Address : .....
.....
Code/Testing standard : .....
Date of welding : .....

Extent of qualification

Welding process : .....
Joint type : .....
Parent metal (s) : tube plate : ..... Cladding : ..... Tube : .....
Thickness of tube plate (mm) : ..... Cladding (mm) : ..... Tube (mm) : .....
Tube outside diameter (mm) : ..... Gap (g)(mm) : .....
Filler metal type : .....
Shielding gas : .....
Type of welding current : .....
Welding positions : .....
Pre-heat : .....
Post-weld heat treatment : .....
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 issued	Examiner or examining body Name, date and signature

Details of tube-to-tube plate joint tests

Location: .....
Manufacturer's welding procedure
Reference no. : .....
WPQR no. : .....
.....

Examiner or examining body: .....

Method of preparation and cleaning:

Parent material specification: - tube-plate: .....
- cladding: .....
- tube: .....

Manufacturer: .....

Material thickness (mm) : - tube-plate : .....
- cladding: .....
- tube: .....

Welder's name: .....
Welding process: .....
Joint type: .....

Tube outside diameter (mm): .....
Welding position: .....

Sketch of test piece in accordance with Clause 7	Sketch of the joint preparation

Welding details

Run	Process	Size of filler metal mm	Current A	Voltage V	Type of current/ polarity	Wire feed speed m/min	Travel speed [1] cm/min	Heat imput[1] kJ/cm

Cleaning and degreasing:
Filler metal classification and trade name:
Any special baking or drying:
Gas shielding:
Gas flow rate – shielding:
Tungsten electrode type/size:
Details of fastening of tubes before welding:
Preheat temperature:
Interpass temperature:
Post-weld heat treatment and/or ageing:
Time, temperature, method:
Heating and cooling rates [1] :

Remarks: .....

Further information[1]:
(see on a separate sheet)

Manufacturer
.....
Name, date, and signature

Examiner or examining body
.....
Name, date, and signature

1) If required.

Further information

Oscillation (amplitude, frequency): .....
Distance contact tube/ workpiece: .....
Torch angle: ....
Current increase (A) from ..... to: ..... in: ..... (s)
Pool formation (A): ..... Time (s): .....
Wire rate (mm/s): ....
for 1st run[2]: ..... for 2nd run [2]: .....
Min. current (A): .....
for 1st run[2]:..... for 2nd run [2]: .....
Max. current (A):
for 1st run[2]:..... for 2nd run [2]: .....
Pulse frequency: .....
Circulation time (s): .....
for 1st run[2]:..... for 2nd run [2]: .....
Current decrease (A) from: ..... to: ..... in: ..... (s)
Pulse, wire: yes ☐ no ☐
Pulse, rotary: yes ☐ no ☐
Manufacturer of weld machine: [2] .....
.....
.....
.....
Current:[2] .....
Polarity:[2] .....

Test results

Manufacturer's welding procedure
Reference no. : .....

Examiner or examining body
Reference no. : .....

Visual testing

without objections ☐	with objections ☐	Remarks

Penetrant testing

without objections ☐	with objections ☐	Remarks

Radiographic testing

without objections ☐	with objections ☐	Remarks

2) Welding data for automatic welding.

Macroscopic examination

Weld thickness	Assessment	Remarks
required measured min. (mm) max. (mm) acceptable yes ☐ no ☐	without objections ☐ with objections ☐	

Hardness test [3)]

Type/load: .....

Parent metal: .....

HAZ: .....

Weld metal: .....

Push-out or pull-out test [3)]

	Re (N/mm^2)	Rm (N/mm^2)	Fracture location	Remarks
Requirements				

Other tests: .....

Remarks: .....

.....

.....

Tests carried out in accordance with the requirements of: .....

Laboratory report reference no. : .....

The test results are – acceptable ☐ not acceptable ☐

Test carried out in the presence of

Examiner or examining body

.....

Name, date, and signature

3) If required.

Bibliography

[1] EN 1708-1, *Welding — Basic weld joint details in steel — Part 1: Pressurized components*

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