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(JLWA/JSA)

**Specification and qualification of
welding procedures for metallic
materials—Welding procedure test—
Part 2 : Arc welding of aluminium
and its alloys**

ICS 25.160.10; 77.150.10

Reference number : JIS Z 3422-2 : 2003 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from The Japan Light Metal Welding and Construction Association (JLWA)/Japanese Standards Association (JSA), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This Standard has been made based on **ISO/FDIS 15614-2 : 2001** *Specification and qualification of welding procedures for metallic materials—Welding procedure test—Part 2 : Arc welding of aluminium and its alloys* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

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Specification and qualification of welding procedures for metallic materials— Welding procedure test— Part 2 : Arc welding of aluminium and its alloys

Introduction This Japanese Industrial Standard has been prepared based on **ISO/FDIS 15614-2 : 2001** *Specification and qualification of welding procedures for metallic materials—Welding procedure test—Part 2 : Arc welding of aluminium and its alloys* with some modifications of the technical contents.

Portions underlined with dots are the matters in which the contents of original International Standard have been modified. The table of modifications is shown as Annex 3 (informative) with the explanations.

All new welding procedure qualifications are to be in accordance with this Standard from the date of this issue. However, this Standard does not invalidate previous welding procedure qualifications made to former national standards or specifications providing the intent of the technical requirements is satisfied and the previous procedure qualifications 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 qualification technically equivalent, it is only necessary to do the additional tests on a test piece which should be made in accordance with this Standard.

1 Scope This Standard specifies how a preliminary welding procedure specification (hereafter referred to as “pWPS”) is qualified by welding procedure tests. This Standard applies to the arc welding of wrought and cast aluminium and its alloys. In this Standard the term aluminium stands for aluminium and for aluminium alloys. This Standard does not apply to finishing welding of aluminium castings. The principles of this Standard may be applied to other fusion welding processes or other welding applications if required by the design specification.

Information 1 This Standard is a part of a series of standards. It defines the conditions for the execution of welding procedure qualification tests (hereafter referred to as “WPQT”) and the limits of validity of a qualified welding procedure for all practical welding operations within the range of essential variables listed in clause 8.

- 2 Arc welding is covered by the following processes in accordance with appropriate standards:
 - metal inert gas welding (MIG welding);
 - tungsten inert gas welding (TIG welding);
 - plasma arc welding.
- 3 In this Standard, “appropriate standards” mean standards agreed between the parties concerned such as Japanese Industrial Standards, International Standards and Overseas non-national Standards. Examples are shown in Annex 2.

- 4 Specific service, material or manufacturing conditions may require more comprehensive testing in accordance with appropriate standards which meet their target conditions (see Annex C).

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO/FDIS 15614-2 : 2001 *Specification and qualification of welding procedures for metallic materials—Welding procedure test—Part 2 : Arc welding of aluminium and its alloys* (MOD)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) shall be applied.

JIS Z 3001 *Welding terms*

JIS Z 3420 *Specification and approval of welding procedures for metallic materials—General rules*

Remarks : **ISO/DIS 15607** : 2000 *Specification and approval of welding procedures for metallic materials—General rules* is equivalent to the said standard.

JIS Z 3421-1 *Specification and approval of welding procedures for metallic materials—Welding procedure specification for arc welding*

Remarks : **ISO/DIS 15609-1** : 2000 *Specification and approval of welding procedures for metallic materials—Welding procedure specification—Part 1 : Arc welding* is equivalent to the said standard.

3 Definitions For the purposes of this Standard, the definitions given in **JIS Z 3001** and **JIS Z 3420** apply and the following apply.

- a) **finishing welding** welding carried out in order to remove casting defects and core openings to ensure the agreed quality of castings

4 Preliminary welding procedure specification (pWPS) The preliminary welding procedure specification shall be prepared in accordance with **JIS Z 3421-1**. It shall specify the tolerance for all the relevant parameters. Guidance for the welding of aluminium shall be in accordance with appropriate standards.

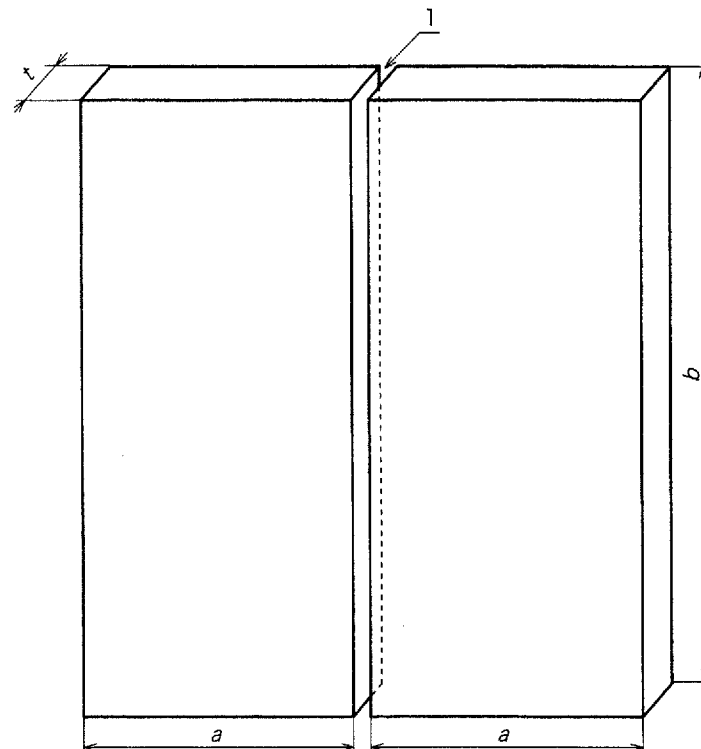
5 Welding procedure test The test pieces representing the type of welding used for production shall be prepared and tested in accordance with clauses 6 and 7 of this Standard.

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. If the requirements for manufacture/shape of joint are not represented by the standardized test piece(s) in this Standard, an appropriate standard shall apply.

6.2 Shape and dimensions of test pieces The test pieces shall be of a sufficient size to ensure a reasonable heat distribution. In Figs. 1 to 4 “ t ” is the thickness of the 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 7.6). If required by the application standard, the direction of working, e.g. extrusion, should be marked on the test piece. 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.

6.2.1 Butt joint in plate The test piece shall be in accordance with Fig. 1.



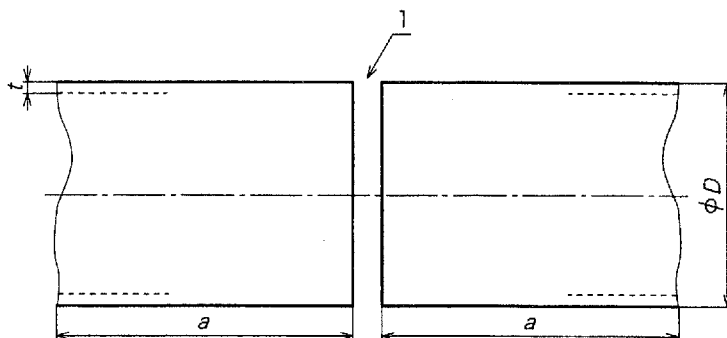
Key

- 1 : edge preparation and fit-up as detailed in the preliminary welding procedure specification (pWPS)
- a : minimum value 150 mm
- b : minimum value 330 mm
- t : wall thickness of plate (mm)

Fig. 1 Test piece for a butt joint in plate

6.2.2 Butt joint in pipe The test piece shall be in accordance with Fig. 2. When small pipe diameters are used, several test pieces may be necessary to meet the test requirements.

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

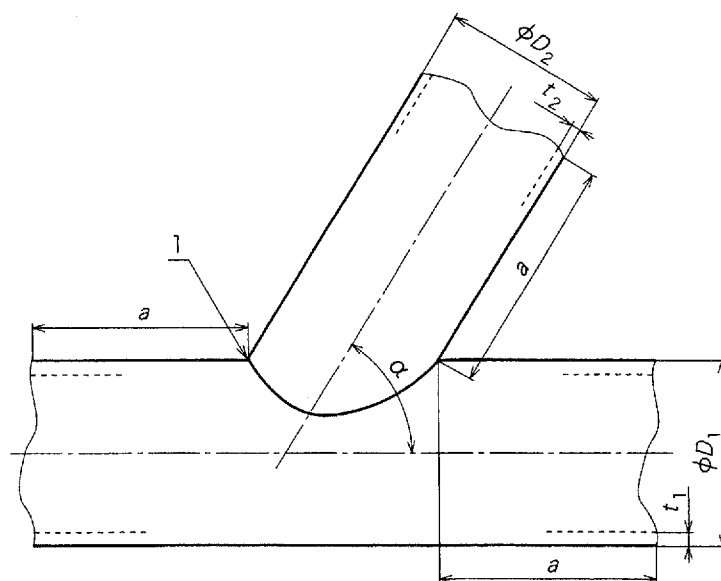


Key

- 1 : edge preparation and fit-up as detailed in the preliminary welding procedure specification (pWPS)
- a : minimum value 150 mm
- D : outside diameter (mm)
- t : wall thickness of pipe (mm)

Fig. 2 Test piece for a butt joint in pipe

6.2.3 Branch connection and fillet weld The test piece shall be in accordance with Fig. 3. 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).

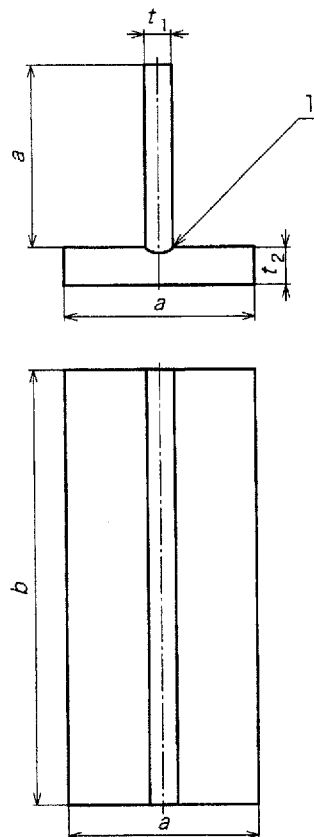


Key

- 1 : edge 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 (mm)
- t_1 : wall thickness of the main pipe (mm)
- D_2 : outside diameter of the pipe (mm)
- t_2 : wall thickness of the branch pipe (mm)

Fig. 3 Test piece for a branch connection or a fillet weld on pipe

6.2.4 Fillet weld or T-joint The test piece shall be in accordance with Fig. 4. These may also be used with an edge preparation to give partial or full penetration.



Key

- 1 : weld one side or both sides and fit-up as detailed in the preliminary welding procedure specification (pWPS)
- a : minimum value 150 mm
- b : minimum value 330 mm
- t_1 and t_2 : thicknesses of the plates (mm)

Fig. 4 Test piece for a fillet weld or T-joint on plate

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 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 appropriate standards.

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

Welding and testing of the test pieces shall be in accordance with JIS Z 3420 and witnessed by an examiner or examining body.

7 Examination and testing

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

Table 1 Examination and testing of the test pieces

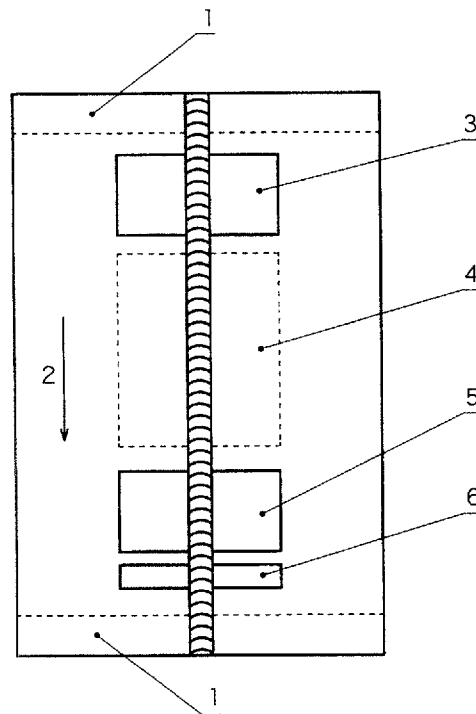
Test piece	Type of test	Extent of testing	Footnote
Butt joint fully penetrated (Figs. 1 and 2)	Visual	100 %	—
	Radiographic or ultrasonic	100 %	—
	Penetrant test	100 %	—
	Transverse tensile test	2 test specimens	—
	Transverse bend test or fracture test for cast materials or wrought/cast combinations	2 root and 2 face test specimens	(¹)
	Macro-examination	1 test specimen	—
	Micro-examination	1 test specimen	(²)
Branch-connection (³) (Fig. 3)	Visual	100 %	—
	Penetrant test	100 %	—
	Macro-examination	4 test specimens	—
	Micro-examination	1 test specimen	(²)
Fillet weld on plate and partial or full penetration joint (³) (Fig. 4) Fillet weld on pipe and partial penetration joint (³) (Fig. 3)	Visual	100 %	—
	Penetrant test	100 %	—
	Macro-examination	2 test specimens	—
	Micro-examination	1 test specimen	(²)

Notes (¹) 2 root and 2 face bend test specimens may be preferably substituted by 4 side bend test specimens for $t \geq 12$ mm.

(²) Only for material group 23 and all casting alloys.

(³) Testing as detailed does not provide information on the mechanical properties of the joint. Where these properties are relevant to the application an additional qualification shall also be held e.g. a butt joint qualification.

7.2 Location and cutting of test specimens The location of test specimens should be in accordance with Figs. 5, 6, 7 and 8. Test specimens shall be taken after NDT has shown satisfactory results. It is permitted to take the test specimens from locations avoiding areas showing acceptable imperfections.



Key

- 1 Discard 25 mm
- 2 Welding direction
- 3 Area for: — 1 tensile test specimen
— bend test specimens or fracture test specimens
- 4 Area for: — additional test specimens if required
- 5 Area for: — 1 tensile test specimen
— bend test specimens or fracture test specimens
- 6 Area for: — 1 macro test specimen
— 1 micro test specimen

**Fig. 5 Location of test specimens for a butt joint in plate
(Not to scale)**