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(JLWA)

Methods of radiographic examination for welded joints in aluminium

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Light Metal Welding and Construction Association (JLWA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS Z 3105 : 1993** is revised, and further, **JIS Z 3108 : 1986** and **JIS Z 3109 : 1988** are withdrawn and integrated into this Standard.

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In the event of any doubts arising as to the contents,
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Methods of radiographic examination for welded joints in aluminium

1 Scope This Japanese Industrial Standard specifies the methods of radiographic examination for welded joints of aluminium and aluminium alloys (hereafter referred to as “aluminium”), where the X-ray or γ -ray (hereafter referred to as “radiation”) is carried out by the direct photographing method with the industrial X-ray film.

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) indicated below shall be applied.

- JIS H 4000 *Aluminium and aluminium alloy sheets and plates, strips and coiled sheets*
- JIS K 7627 *Non-destructive testing—Industrial radiographic films—Part 1 : Classification of film systems for industrial radiography*
- JIS Z 2300 *Terms and definitions of nondestructive testing*
- JIS Z 2306 *Radiographic image quality indicators for non-destructive testing*
- JIS Z 3861 *Standard qualification procedure for radiographic testing technique of welds*
- JIS Z 4560 *Industrial γ -ray apparatus for radiography*
- JIS Z 4561 *Viewing illuminators for industrial radiograph*
- JIS Z 4606 *Industrial X-ray apparatus for radiographic testing*

3 Definitions For the purposes of this Standard, the definitions given in **JIS Z 2300** and the following definitions apply.

- a) **thickness of base metal** Nominal thickness of aluminium plate to be used. In the case where the thickness of the base metal is different for fusion welded butt joint, the small thickness shall be used.
- b) **test part** Parts where the weld metal and the heat affected zone for test target.

4 Type of image quality of radiographs The image quality of the radiograph is classified into 6 classes such as Class A, Class B, Class P0, Class P1, Class P2 and Class F. These image qualities shall be applied according to table 1 for each shape of the welded joints.

Table 1 Applicable range for image quality of radiographs

Shape of welded joint	Annex	Type of image quality
Fusion welded butt joints of aluminium plates and welded joints whose geometrical condition at photographing are equal to them	Annex 1	Class A, Class B
Circumferential welded joint of aluminium pipes and tubes	Annex 2	Class A, Class B, Class P0, Class P1, Class P2
T welded joint of aluminium plates	Annex 3	Class F

5 Test engineer The engineers to carry out the radiographic test shall be those who have passed the test specified in **JIS Z 3861** or those with the capability equal to or higher than them.

6 Radiographic devices and attachment

6.1 Radiographic devices The radiographic devices shall be an X-ray devices specified in **JIS Z 4606**, and a γ -ray devices specified in **JIS Z 4560** or the devices with the performance equal to or higher than those.

6.2 Photo-sensitive materials Industrial X-ray film (hereafter referred to as "film") shall be used film system Class T1 (low sensitivity, super ultra-fine particles), Class T2 (low sensitivity, ultra-fine particles), Class T3 (medium sensitivity, fine particles), or Class T4 (high sensitivity, fine particles) specified in **JIS K 7627**. A lead foil intensifying screen shall be used for the intensifying screen. However, the intensifying screen shall not be used in the case of photography with the tube voltage less than 80 kV.

6.3 Penetrameter A penetrameter shall be employed type A of general type penetrameter specified in **JIS Z 2306** or the meter with the performance equal to or higher than above.

For taking photographing of the circumference welded joint, type A of strip penetrameter is employed. Type A of the general penetrameter and the meter which has the performance equal to or higher than above may be employed.

6.4 Contrastmeter The type, construction, dimensions and materials of the contrastmeter shall be as follows:

- a) The type, construction, dimensions of the contrast-meter shall be according to figure 1.

The tolerance of the dimensions of the contrastmeter shall be $\pm 5\%$ or less in the thickness, and ± 0.5 mm or less in the length of the side.

- b) The materials of the contrastmeter shall be A1080P, A1070P, A1050P, A1100P, A1200P, A5052P or A5083P specified in **JIS H 4000**.

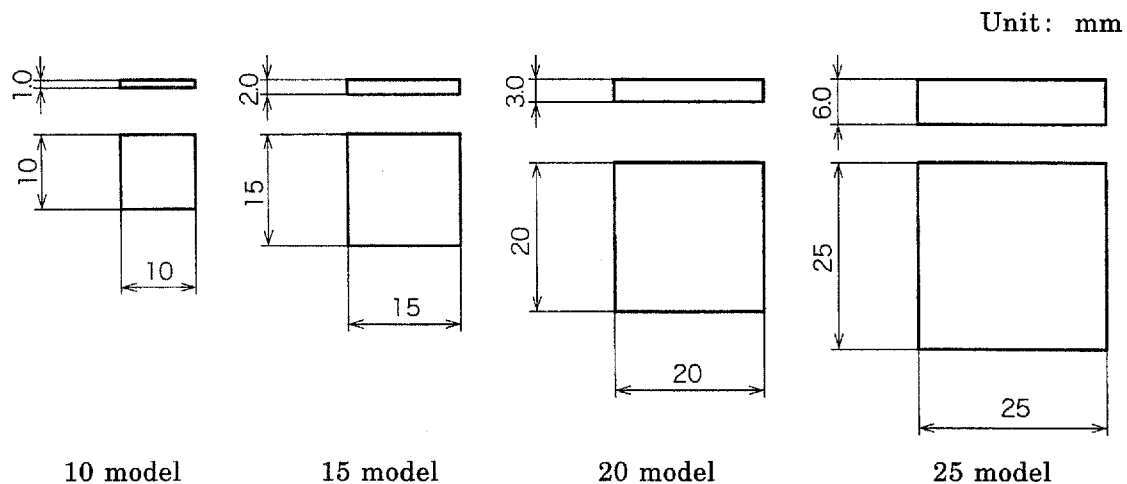


Figure 1 Type, construction and dimensions of the contrastmeter

6.5 Viewing illuminator The viewing illuminator shall be one specified in **JIS Z 4561** or those with the performance equal to or higher than above.

6.6 Densitometer The densitometer shall be one which is confirmed with appropriate means.

7 Photographing method of the radiographs

7.1 Combination of the radiation sources and the sensitive materials Radiation source and the sensitive material shall be combined so that the minimum wire diameter to be discriminated of the penetrameter can be identified.

7.2 Symbols The symbols shall be simultaneously photographed so that the radiographs may be collated with the records.

7.3 Irradiation field In photographing, an iris and irradiation cylinder should be used so as not to make the irradiation field larger than required.

7.4 Photographing method Photographing method of radiographs depend on the annex in table 2 according to the shape of the welded joint.

8 Necessary conditions of radiographs The necessary conditions of radiographs depend on the annex in table 2 according to the shape of the welded joint.

The radiographs shall not contain non-uniformity developer stains, flaws on the film or the like which may prevent the evaluation of image quality and the classification of images of defects.

Table 2 Annex specified the photographing method and necessary condition of the radiograph

Shape of welded joint	Annex
Fusion welded butt joints of aluminium plates and welded joints whose geometrical conditions at photographing seem to be equal to them	Annex 1
Circumferential welded joint of the aluminium pipe and tubes	Annex 2
T welded joint of aluminium plates	Annex 3

9 Observation of radiographs

9.1 Viewing illuminator In observation of radiograph, the viewing illuminator specified in 6.5 shall be used according to the classification in table 3.

Table 3 Applicable range of the viewing illuminator

Type of the viewing illuminator	Maximum density of radiographs ⁽¹⁾
D10 model	1.5 or under
D20 model	2.5 or under
D30 model	3.5 or under
D35 model	4.5 or under

Note (1) In the individual radiograph, the maximum value of density shown by the test part.

9.2 Observation method Observation of radiograph shall be performed in a dark room with a fixed mask that suits the size of a radiograph.

10 Classification method of defect image Classification of defect images by radiographs shall be in accordance with the annex 4.

11 Records In a report of the test results, the following items shall be provided. The records shall be able to collated with the records.

a) **Items related to the test part**

- 1) Name of builder or manufacturer
- 2) Name of work or product
- 3) Symbol or number of the test part
- 4) Material
- 5) Thickness of base metal (wall thickness and outside diameter of tube)
- 6) Shape of weld part (existence/absence of reinforcement of weld)

b) **Date of photographing**

c) **Position and name of test engineer**

d) Conditions of test

- 1) Device for use and materials
 - 1.1) Name of radiographic device and dimension of the radiation source
 - 1.2) Type of film and intensifying screen
 - 1.3) Type of penetrameter
 - 1.4) Type of contrastmeter
- 2) Photographing condition
 - 2.1) Type of applied tube voltage or radioisotope
 - 2.2) Strength of applied X-ray tube current or radiation source
 - 2.3) Exposure time
- 3) Arrangement of photographing
 - 3.1) Distance between the radiation source and the film ($L_1 + L_2$)
 - 3.2) Distance between the surface of radiation side at test part and the film (L_2)
 - 3.3) Effective length of test part L_3 (double wall-double image: $L_3 = L_3' + L_3''$)
- 4) Development condition
 - 4.1) Developer, developing temperature and developing time (manual development)
 - 4.2) Name of automatic development machine and developer (automatic development)

e) Confirmation of necessary conditions of radiographs

- 1) Type of viewing illuminator and observation condition
- 2) Type of image quality (Class A, Class B, Class P0, Class P1 Class P2 or Class F)
- 3) Minimum diameter of wire to be discriminated of penetrameter
- 4) Density of test part
- 5) The value of the contrastmeter
- 6) Acceptance or rejection of radiographs

f) Date of classification of defect images by radiographs

g) Result of classification of defect image

- 1) Results of classification by the defect point number
- 2) Results of classification by the defect length
- 3) Existence of cracks and inclusion of copper

h) Other necessary items

i) Remarks

Annex 1 (normative)

Photographing method for fusion welded butt joint of aluminium plates and necessary conditions of radiographs

1 Scope This Annex specifies the direct photographing method by radiation and the necessary conditions of radiographs for fusion welded butt joints of aluminium plates and welded joint whose geometrical condition of photographing are equal to them.

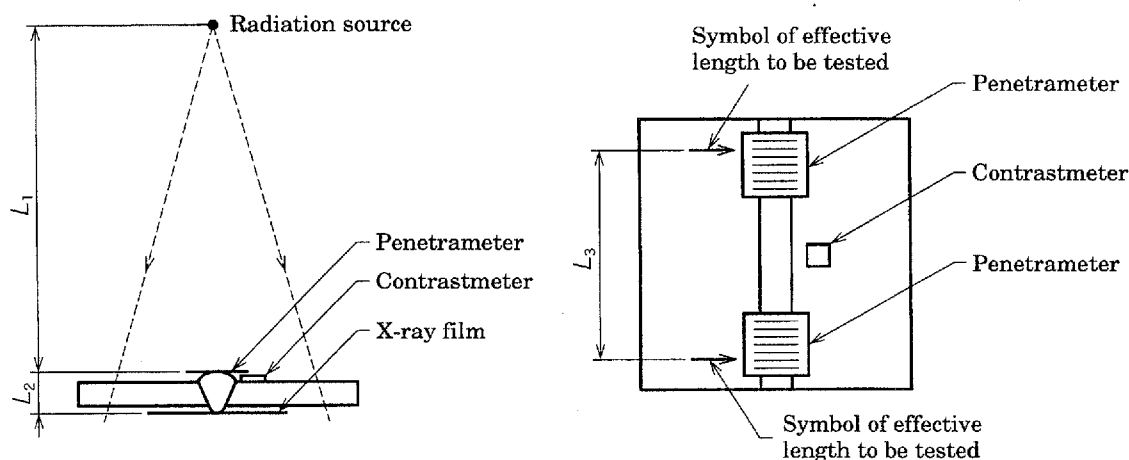
2 Photographing method of radiographs

2.1 Type of image quality of radiographs The image quality of the radiograph is classified into Class A and Class B. Class A is a image quality obtained by a general photographing technology, while Class B is a image quality obtained by the photographing technology where the degree of detection of the defects is particularly high.

2.2 Irradiating direction of radiation Radiographs shall be photographed by irradiating radiation from the direction where the transmission thickness of the test part may be the minimum as a rule

2.3 Penetrameter to be used As shown in annex figure 1, each of the penetrameter which contain the minimum wire diameter to be discriminated (refer to annex 1 table 4) shall be placed in the vicinity of each end of the effective length L_3 of the test part, across the weld part on the surface of the radiation source side of the test part. The finest wire of the penetrameter may be placed outermost. If the distance between the penetrameter and the film is shall be prepared by ten times or more the minimum wire diameter to be discriminated, the penetrameter can be put on the film side.

One penetrameter may be put on, when effective length of the test part is at most 3 times in the width of the penetrameter.



Annex 1 Figure 1 Arrangement of photographing