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JAPANESE INDUSTRIAL STANDARD

Methods of ultrasonic angle beam examination for welds of aluminium pipes and tubes

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Methods of ultrasonic angle beam examination for Z 3081-1994
welds of aluminium pipes and tubes

1. Scope This Japanese Industrial Standard specifies the method of ultrasonic angle beam examination from outer surface of pipes by the pulse echo technique using an ultrasonic test instrument having A scope display on full penetration welds of aluminium and aluminium alloy pipes and tubes (hereafter called "aluminium pipes"). However, this Standard is applied to the joint welds with the ratio $\frac{t}{D}$ of wall thickness t to outer diameter D of less than 16 %, among the circumferential joint welds of aluminium pipes with outer diameter of 100 mm or more to 1500 mm or less and wall thickness of 5 mm or more, and longitudinal joint welds of aluminium pipes with outer diameter of 300 mm or more to 1500 mm or less and wall thickness of 5 mm or more.

Remarks: The standards cited in this Standard are shown in the following.

- JIS Z 2300 Glossary of terms used in nondestructive testing
- JIS Z 2345 Standard test blocks for ultrasonic testing
- JIS Z 2352 Method for assessing the overall performance characteristics of ultrasonic pulse echo testing instrument
- JIS Z 3080 Method of ultrasonic angle beam testing and classification of test results for butt welds in aluminium plates
- JIS Z 3871 Standard qualification procedure for ultrasonic testing technique of aluminium and aluminium alloy welds

2. Definitions The terms defined by JIS Z 2300 are used in this Standard except the following terms.

- (1) reference level (H_{R1}) A level of echo height is used as the reference at the time when an echo height is evaluated. In the case of circumferential joint welds, the reference level is the echo height of reference hole (side drilled hole of 5.0 mm in diameter) of RB-A4AL specified in JIS Z 3080, and in the case of longitudinal joint welds, it is a level by 4 dB higher than the echo height of reference hole (side drilled hole of 2.0 mm in diameter) of RB-A7AL shown in Fig. 1.
- (2) equivalent size of transducer An apparent transducer size observed from the propagating direction of ultrasonic wave refracting and transmitting in the test object. It is divided from actual transducer size shown by [].

- (3) ultrasonic discontinuity length An apparent length of discontinuity given by the travelling distance of the probe.

3. Engineer The engineers to be engaged in this ultrasonic testing should be the personnel who have passed T level examination in accordance with JIS Z 3871 or who have had the technical skills equivalent or more to that of the abovementioned personnel.

4. Ultrasonic test equipment and its performance characteristics

4.1 Requirements for ultrasonic test instrument

4.1.1 Amplitude linearity The amplitude linearity shall be within $\pm 3\%$ by the measurement method specified in 4.1 of JIS Z 2352.

4.1.2 Time base linearity The time base linearity shall be within $\pm 1\%$ by the measurement method specified in 4.2 of JIS Z 2352.

4.1.3 Value of sensitivity margin The value of sensitivity margin shall be not less than 40 dB by the measurement method specified in 4.3 of JIS Z 2352.

4.1.4 Check of performance characteristics Three items mentioned above shall be checked at the start time of use of the instrument and every 12 months in accordance with JIS Z 2352.

4.2 Requirements for angle probe

4.2.1 Transducer and refraction angle The nominal frequency of probe shall be 5 MHz and test frequency shall be within the range of 4.5 MHz to 5.5 MHz. The transducer sizes and the nominal refraction angles shall be combined in accordance with Table 1.

Furthermore, the difference between nominal refraction angle and actual refraction angle shall be within the range of $\pm 2^\circ\text{C}$.

Table 1. Combination of transducer size and nominal refraction angle of angle probes

Transducer size (mm)	Nominal refraction angle (degree)
Equivalent size	40
[5 × 5]	45
[10 × 10]	50
	55
Actual size	60
5 × 5	65
10 × 10	70

4.2.2 Contact surface An angle probe shall be used with an adaptor for stabilizing the contact with the test object or an angle probe having the contact surface processed to fit the curve of the test surface shall be used in the case of testing the longitudinal joint welds of aluminium pipes with outside diameter of 500 mm or less.

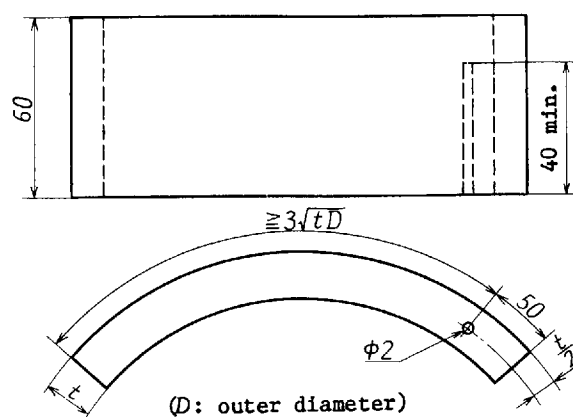
4.3 Calibration blocks (STB) and reference blocks (RB)

4.3.1 Calibration blocks STB-A1 or STB-A3 specified in JIS Z 2345 shall be used.

4.3.2 Reference blocks RB-A4AL specified in JIS Z 3080 shall be used for testing the circumferential joint welds and RB-A7AL shown in Fig. 1 shall be used for testing the longitudinal joint welds.

Fig. 1. Shape and dimensions of RB-A7AL

Unit: mm



4.4 Couplant The glycerol water solution of 75 % or more, glyserol paste or other mediums having acoustic characteristics equivalent to the above mentioned mediums shall be used as the couplant.

5. Preparations of testing

5.1 The case of circumferential joint welds

5.1.1 Selection of probe The angle probe used for testing the circumferential joint welds shall be selected in Table 1 according to Table 2. An angle probe with nominal refraction angle of 70° shall be used in general and nominal refraction angle shall be decided considering the shape of groove in the case of specially aiming detection of incomplete fusion and the like on groove face.

Table 2. Angle probe for testing circumferential joint welds

Objective discontinuity	General	Incomplete fusion on groove face
Nominal refraction angle θ (degree)	70	$\theta \approx 90 - \alpha$ ⁽¹⁾
Transducer size (mm)	Outer diameter	Under 300 [5 × 5] or 5 × 5 300 or more [5 × 5], [10 × 10], 5 × 5 or 10 × 10

Note ⁽¹⁾ α (degree): bevel angle