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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 29711-2023

Replacing GB/T 29711-2013

Non-destructive testing of welds - Ultrasonic testing - Characterization of discontinuities in welds

焊缝无损检测 超声检测 焊缝内部不连续的特征

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Foreword

This document was issued on 27 November 2023 by the State Administration for Market Regulation; Standardization Administration of the PRC and takes effect on 1 June 2024.

It is a GB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies.

The document runs to 15 pages in translation. The identification, the dates, the table of contents and the clauses reproduced on this page are taken from the standard itself.

Non-destructive testing of welds - Ultrasonic testing - Characterization of discontinuities in welds

It replaces GB/T 29711-2013, which is superseded.

1 Scope

GB/T 29711-2023 specifies how a discontinuity found by ultrasonic testing of a weld is characterised. Detecting an indication is the easy part; deciding what it is, whether the reflector is a pore, a slag inclusion, a lack of fusion, a lack of penetration or a crack, is what determines whether the weld is repaired, accepted or condemned, and it has traditionally depended on the experience of the individual operator. This standard sets out the systematic basis for it: the characterisation techniques and the probe arrangements used, the assessment of the indication by its echo dynamic pattern as the probe is moved, by the directional reflectivity, by the shape and by the length and height measured with the stated sizing techniques, and the classification of the discontinuity that follows from those observations, together with the reporting. It is the companion to the acceptance standards, which decide what may be tolerated once the discontinuity has been characterised. The 2023 edition replaces GB/T 29711-2013. For an NDT service provider, a fabricator or an inspection body in China, this is the reference.

This document specifies how to characterize indications from discontinuities by classifying

them as originating from planar or non-planar embedded discontinuities.

This procedure is also suitable for indications from discontinuities that break the surface after removal of the weld reinforcement.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 11666 Non-destructive testing of welds - Ultrasonic testing - Acceptance levels

Note: GB/T 29712-2023, Non-destructive testing of welds - Ultrasonic testing - Acceptance levels (ISO 11666:2018, IDT)

ISO 17640 Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment

Note: GB/T 11345-2023, Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment (ISO 17640:2018, IDT)

3 Terms and definitions

No terms and definitions are listed in this document.

4 Principle

Classification of discontinuities as planar or non-planar is based on several parameters:

a) welding techniques;

b) geometrical position of the discontinuity;

c) maximum echo amplitude;

d) directional reflectivity;

e) echo static pattern (i.e. A-scan);

f) echo dynamic pattern (envelope).

The process of classification involves examining each of the parameters against all the others in order to arrive at an accurate conclusion.

For guidance, Figure A.1 gives the classification of indications from internal weld discontinuities suitable for general applications. Figure A.1 should be applied in conjunction with the two parameters a) and b) listed above and not taken in isolation.

The classification procedure specified in this document is also suitable for indications that come from surface breaking discontinuities after removal of the weld reinforcement (see Figure 1).

5 Criteria

5.1 General

The classification is carried out by the successive application of several discriminatory criteria to:

a) echo amplitude;

b) directional reflectivity;

c) echo static pattern (A-scan);

d) echo dynamic pattern (envelope).

These criteria shall be applied using the flowchart procedure according to Annex A and as described in Clause 5.

It is recommended that the same probes be used for detection and for classification of discontinuities. The flowchart procedure standardizes a system of classification. Several thresholds are defined in decibels by a comparison with the distance-amplitude curve (DAC) or by a comparison of the maximum echo heights from the discontinuity when tested from different directions.

Proposed thresholds for the different stages in the flowchart procedure are given in Table A.1.

The flowchart procedure calls for five stages:

--stage 1: to avoid the classification of indications with very low echo amplitudes;

--stage 2: to classify all indications with high echo amplitude as associated with planar discontinuities;

--stage 3: primarily to classify lack of fusion;

--stage 4: primarily to classify inclusions;

--stage 5: primarily to classify cracks.

Note: Indications resulting from a combination of an inclusion and lack of fusion are classified as originating from a planar discontinuity by the flowchart procedure. An example of this type of discontinuity is given in Figure A.2.

5.2 Echo amplitude criteria (stages 1 and 2)

5.2.1 Low amplitudes (stage 1)

It is accepted that an indication with an echo amplitude lower than the evaluation level as specified in ISO 11666 (defined as T1 in Figure A.1) is not significant and shall not be characterized.

For special applications, this value, T1, may be lowered, if defined by specification.

5.2.2 High amplitudes (stage 2)

It is assumed that an indication with an echo amplitude that is at least equal to the reference level plus 6 dB (defined as T2 in Figure A.1) is associated with a planar discontinuity.

5.3 Directional reflectivity criteria (stage 3)

5.3.1 Applicability based on length

Stage 3 of the flowchart procedure shall be applied only to those indications exceeding:

a) thickness t for the range 8 mm <= t <= 15 mm;

b) t/2 or 15 mm, whichever is larger, for thicknesses over 15 mm.

For indications not exceeding the specified length, proceed to stage 4.

5.3.2 Application conditions

The following application conditions apply:

a) Echoes compared shall be obtained from the same reflector.

b) The comparison shall be made at the position where echo height, Hd, max, is the highest along the indication.

c) When a normal-beam probe and an angle-beam probe are used, their frequencies shall be chosen to give similar wavelengths (e.g. 4 MHz for longitudinal waves and 2 MHz for transverse waves for steel).

d) When two or more beam angles are used, the differences between the nominal refracted beam angles shall be equal to or greater than 10°.

e) If the comparison is made between a beam passing through the weld and a beam passing through the base material only, the attenuation of the weld material shall be taken into account.

5.3.3 Criteria

The highest echo amplitude, Hd, max, obtained from the discontinuity is compared with the minimum echo amplitude, Hd, min, obtained from all the other directions.

To satisfy the directional reflectivity, the following conditions shall be fulfilled simultaneously:

a) Hd, max is greater than or equal to T3 (the reference level - 6 dB).