BRITISH STANDARD

BS EN
10246-8:2000

Non-destructive testing of steel tubes —

Part 8: Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections

The European Standard EN 10246-8:1999 has the status of a British Standard

ICS 23.040.10; 77.040.20

National foreword

This British Standard is the official English language version of EN 10246-8:1999.

This British Standard contains elements of BS 3889-1:1983. A complete list of the parts of EN 10246 is given in annex A of this standard. This British Standard partially supersedes BS 3889-1:1983, and when all relevant parts have been published bs 3889-1:1983 will be withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ISE/73, Steels for pressure purposes, to Subcommittee ISE/73/1, Steel tubes for pressure purposes, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

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English version

Non-destructive testing of steel tubes - Part 8: Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections

Essais non destructifs des tubes en acier - Partie 8: Contrôle automatique par ultrasons du cordon de soudure pour la détection des imperfections longitudinales des tubes en acier soudés électriquement

Zerstörungsfreie Prüfung von Stahlrohren - Teil 8: Automatische Ultraschallprüfung der Schweißnaht elektrisch geschweißter Stahlrohre zum Nachweis von Längsfehlern

This European Standard was approved by CEN on 6 October 1999.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 29 "Steel tubes and fittings for steel tubes", the Secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2000, and conflicting national standards shall be withdrawn at the latest by May 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of EN 10246 specifies the requirements for automatic ultrasonic shear wave and Lamb wave testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections. The standard specifies acceptance levels and calibration procedures.

This Part of EN 10246 is applicable to the inspection of tubes with an outside diameter equal to or greater than 10 mm.

European Standard EN 10246 "Non-destructive testing of steel tubes" comprises the Parts shown in annex A.

2 General requirements

2.1 The ultrasonic inspection covered by this Part of EN 10246 is usually carried out on tubes after completion of all the primary production process operations.

2.2 The tubes to be tested shall be sufficiently straight and free from foreign matter as to ensure the validity of the test.

3 Method of test

3.1 The weld seam of tube shall be tested using an ultrasonic shear wave or Lamb wave technique for the detection of predominantly longitudinal imperfections.

3.2 During testing, the tube and the transducer assembly shall be moved relative to each other and the transducer assembly shall be maintained in proper alignment over the whole of the weld seam along the entire tube length.

It is recognized that there may be a short length at both tube ends which cannot be tested. Any untested ends shall be dealt with in accordance with the requirements of the appropriate product standards (see also annex B).

The relative speed during testing shall not vary by more than +10 %.

3.3 During testing, the weld seam shall be scanned, unless otherwise agreed between purchase and manufacturer, in two opposite directions of beam travel at right angles to the weld.

3.4 The ultrasonic test frequency applied shall be in the range of 1 MHz to 15 MHz for shear waves and in the range of 0,3 MHz to 1 MHz for Lamb waves, depending on the thickness and surface finish of the tubes to be tested.

3.5 The maximum width of each individual transducer, measured parallel to the major axis of the weld, shall be 25 mm for shear waves and 35 mm for Lamb waves.

3.6 The equipment shall be capable of classifying tubes as either acceptable or suspect tubes by means of an automatic trigger/alarm level combined with a marking and/or sorting system.

3.7 Where manual ultrasonic testing of untested tube ends and/or local suspect areas is required, this shall be carried out in accordance with annex B.

4 Reference standards

4.1 General

4.1.1 The reference standards defined in this Part of EN 10246 are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size of imperfections detectable by such equipment.

4.1.2 The ultrasonic equipment shall be calibrated using a reference notch on the outside and inside surfaces, or the outside surface only of a tubular test piece.

The internal notch shall not be used when the tube internal diameter is less than 20 mm, unless otherwise agreed between purchaser and manufacturer.

Alternatively, a circular reference hole drilled radially through the full thickness of the test piece may be used for equipment calibration by agreement between the purchaser and the manufacturer. In this case the diameter of the drill required to produce the reference hole for a specific acceptance level shall be agreed upon and the manufacturer shall demonstrate to the satisfaction of the purchaser that the test sensitivity achieved using the reference hole is essentially equivalent to that obtained when using the specified reference notch or notches.

4.1.3 The test piece shall be of the same specified diameter, thickness, surface finish and heat treatment conditions as the tube to be tested and shall have similar acoustic properties (for example velocity, attenuation coefficient).

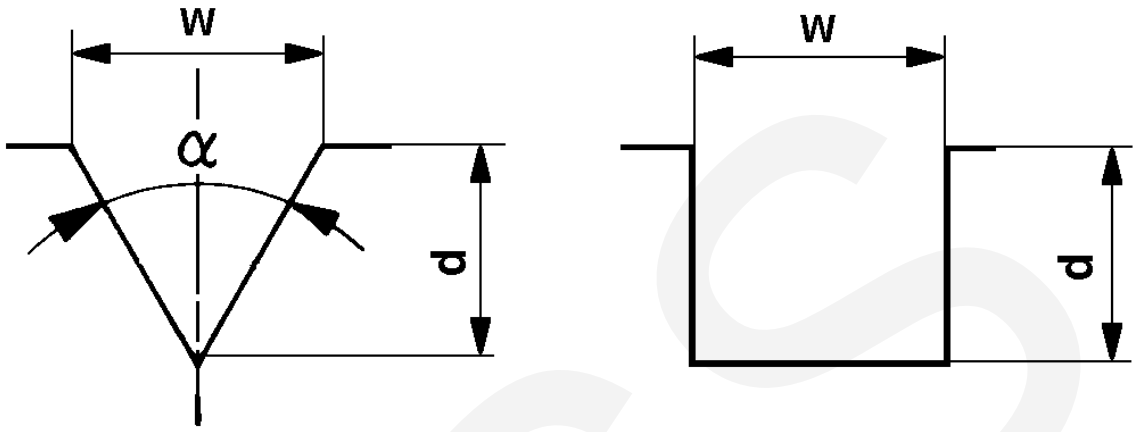
4.1.4 The external notch (and internal notch or reference hole when used) shall be sufficiently separated from the ends of the test piece and from each other (when both notches are used), so that clearly distinguishable signal indications are obtained.

4.2 Types of reference notches

4.2.1 The reference notch(es) shall lie parallel to the major axis of the weld seam. The reference notch(s) shall be of the "N" type except that the "V" type notch may be used at the discretion of the manufacturer when the specified notch depth is less than or equal to 0,5 mm (see figure 1). In the case of the "N" type notch, the sides shall be nominally parallel and the bottom shall be nominally square to the sides.

4.2.2 The reference notch shall be formed by machining, spark erosion or other methods

NOTE: It is recognized that the bottom or the bottom comers of the notch may be rounded.



"**V" type notch**
(only to be used when $d \leq 0{,}5$ mm)

"N" type notch

α= 60 °, w = width, d = depth

Figure 1: Reference notch forms

4.3 Dimensions of reference notch

4.3.1 The width, w (see figure 1), of the reference notch shall not be greater than 1,0 mm.

4.3.2 The reference notch depth shall be as given in table 1 with the following limitations:

- minimum notch depth: 0,3 mm for U2/U3 categories tubes and 0,5 mm for U4/U5/U6 categories tubes;
- maximum notch depth: 1,5 mm for all acceptance levels.

4.3.3 The tolerance on notch depth shall be ± 15 % of the reference notch depth or

± 0,05 mm whichever is the larger.

4.3.4 The length of the reference notch shall be twice the width of each individual transducer, with a maximum of 50 mm.

4.4 Verification of reference notch

The reference notch dimensions and shape shall be verified by a suitable technique.

Table 1: Acceptance level designation and corresponding reference notch depth

Acceptance level	Notch depth in % of the specified thickness (see note 1)
U2	5
U3	10
U4	12,5
U5	15
U6	20
Note. The values of notch depth specified in this table are the same for the corresponding categories, in all European Standards concerning non-destructive testing of steel tubes where reference is made to different acceptance levels. It should, however, be kept in mind that although the reference standards are identical, the various test methods involved can give different test results. Accordingly the acceptance level designation prefix U (ultrasonic) has been adopted to avoid any inferred direct equivalence with other test methods.	

5 Equipment calibration and checking

5.1 The equipment shall be calibrated to produce consistently, (e.g. from three consecutive passes of the test piece through the equipment), clearly identifiable signals from the reference standard (s) (see 4.2). The full amplitude of these signals shall be used to set the trigger/alarm level(s) of the equipment.

Where a single trigger/alarm level is used, the transducer(s) shall be adjusted so that the signals from the internal and external reference notches are as near equal as possible and the full signal amplitude of the lesser of the two signals shall be used to set the trigger/alarm level of the equipment. Where separate trigger/alarm levels are used for internal and external reference notches, the full signal amplitude from each notch shall be used to set the relevant trigger/alarm level of the equipment.

When using the reference hole, the manufacturer shall demonstrate to the satisfaction of the purchaser that the sensitivity achieved at the inner and outer surfaces is essentially equivalent to that achieved when using the specified external and internal reference notches.

5.2 During calibration check, the relative speed of movement between the test piece and the transducer assembly shall be the same as that to be used during the production test. Semi-dynamic calibration checking may be used.

5.3 The calibration of the equipment shall be checked at regular intervals during the production testing of tubes of the same specified diameter, thickness and grade by passing the test piece through the test equipment.

The frequency of checking the calibration shall be at least every four hours but also whenever there is an equipment operator team changeover and at the start and end of production.

5.4 The equipment shall be recalibrated if any of the parameters which were used during the initial calibration are changed.

5.5 If on checking during production testing the calibration requirements are not satisfied, even after increasing the test sensitivity by 3 dB to allow for system drift, then all tubes tested since the previous equipment check shall be retested after the equipment has been recalibrated.

6 Acceptance

6.1 Any tube producing signals lower than the trigger/alarm level shall be deemed to have passed this test.

6.2 Any tube producing signals originating from within $\pm$ 10 mm or $\pm$ $T/2$ of the fusion line whichever is the greater, where T is the specified tube thickness, equal to or greater than the trigger/alarm level shall be designated suspect or, at the manufacturer's option, may be retested.

6.3 If on retesting no signal is obtained equal to or greater than the trigger/alarm level, the tube shall be deemed to have passed this test.

Tubes giving signals equal to or greater than the trigger/alarm level shall be designated suspect.

6.4 For suspect tubes, one or more of the following actions shall be taken, subject to the requirements of the product standard:

a) The suspect area shall be dressed or explored by a suitable method. After checking that the remaining thickness is within tolerance, the tube shall be tested as previously specified. If no signals are obtained equal to or greater than the trigger/alarm level, the tube shall be deemed to have passed this test.

   The suspect area may be retested by other non-destructive techniques and test methods, by agreement between purchaser and manufacturer to agreed acceptance levels.

b) The suspect area shall be cropped off. The manufacturer shall ensure that all the suspect area has been removed.

c) The tube shall be deemed not to have passed this test.

7 Test reporting

When specified, the manufacturer shall provide the purchaser with, at least, the following information:

a) reference to this Part of EN 10246;

b) date of test report;

c) acceptance level;

d) statement of conformity;

e) product designation by grade and size;

f) type and details of inspection technique;

g) description of the reference standard.

Annex A
(informative)

Table of Parts of EN 10246 - Non-destructive testing of steel tubes

Purpose of test	Title of Part	Part no.	ISO ref.
Leak tightness	Automatic electromagnetic testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for verification of hydraulic leak-tightness.	1	9302
	Automatic eddy current testing of seamless and welded (except submerged arc-welded) austenitic and austenitic-ferritic steel tubes for verification of hydraulic leak-tightness.	2	-
Longitudinal and/or transverse imperfections	Automatic eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections	3	9304
	Automatic full peripheral magnetic transducer/flux leakage testing of seamless ferromagnetic steel tubes for the detection of transverse imperfections	4	9598
	Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal imperfections	5	9402
	Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections.	6	9305
	Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal imperfections.	7	9303
	Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections.	8	9764
	Automatic ultrasonic testing of the weld seam of submerged arc-welded steel tubes for the detection of longitudinal and/or transverse imperfections.	9	9765
	Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections	10	12096
Surface imperfections	Liquid penetrant testing of seamless and welded steel tubes for the detection of surface imperfections.	11	12095
	Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections	12	13665
Thickness	Automatic full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes.	13	10543
Laminar imperfections	Automatic ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of laminar imperfections.	14	10124
	Automatic ultrasonic testing of strip/plate used in the manufacture of welded steel tubes for the detection of laminar imperfections.	15	12094
	Automatic ultrasonic testing of the areas adjacent to the weld seam of welded steel tubes for the detection of laminar imperfections.	16	13663
	Ultrasonic testing of the tube ends of seamless and welded steel tubes for the detection of laminar imperfections	17	11496
	Magnetic particle inspection of the tube ends of seamless and welded ferromagnetic steel tubes for the detection of laminar imperfections.	18	13664

Annex B
(normative)
Manual/semi-automatic ultrasonic testing of untested ends/suspect areas

B.1 Untested tube ends

When specified by the relevant product standard, tube weld ends which cannot be tested by the automatic ultrasonic equipment shall be subjected to a manual/semi-automatic ultrasonic test from the ultimate tube ends and over the length of the original untested zone plus 10 %.

The manual/semi-automatic ultrasonic test shall be carried out so that the weld of the untested end is scanned with a 10 % overlap of adjacent scanning paths, with reference to the ultrasonic transducer width used, measured in the direction parallel to the major axis of the tube.

The manual/semi-automatic ultrasonic test shall be carried out using the ultrasonic shear wave technique or Lamb wave technique, test sensitivity (reference notch depth) and general test parameters, as used during the original automatic test on the main tube length, with the restrictions given in B.3 below.

B.2 Local suspect areas

Where appropriate, local areas on the tube deemed suspect by the automatic ultrasonic equipment shall be subjected to a manual ultrasonic test using the ultrasonic shear wave technique or Lamb wave technique, test sensitivity (reference notch depth) and general test parameters, as used during the original automatic test, with the restrictions given in B.3 below, so that the whole of the local suspect area is scanned.

B.3 Manual ultrasonic test restrictions

The following restrictions apply to the application of a manual ultrasonic test to tube weld ends and/or local suspect areas.

B.3.1 The scanning speed over the tube surface shall not exceed 150 mm/s.

B.3.2 Scanning shall be carried out in two opposite directions of ultrasonic beam travel.

B.3.3 The nominal ultrasonic test frequency of the transducer used in manual testing shall not vary from that used during the original automatic test with shear waves by more than $\pm$ 1 MHz. Where Lamb waves have been used in the original automatic test, the frequency shall be in the range of 4 MHz to 5 MHz.

B.3.4 The width of the transducer, measured in the direction parallel to the major axis of the weld, used in the manual ultrasonic test shall not exceed that used during the original automatic test.

B.3.5 The ultrasonic transducer type to be used during manual ultrasonic testing shall be of the contact, gap-scan or immersion type. Means shall be provided to ensure that the transducer is held at the correct attitude in relation to the tube surface, e.g. for contact type transducers, the “wear-face” at the front face of the transducer shall be profiled to the radius of curvature of the tube under test.

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