BRITISH STANDARD

BS EN
10246-9:2000

Non-destructive testing of steel tubes —

Part 9: Automatic ultrasonic testing of the weld seam of submerged arc welded steel tubes for the detection of longitudinal and/or transverse imperfections

The European Standard EN 10246-9:2000 has the status of a British Standard

ICS 23.040.10; 25.160.40; 77.040.20

National foreword

This British Standard is the official English language version of EN 10246-9:2000.

This British Standard contains elements of BS 3889-1, *Non-destructive testing of pipes and tubes — Part 1: Methods of ultrasonic testing for the detection of imperfections in wrought steel tubes*. A complete list of the parts of EN 10246 is given in annex A of this standard. When all relevant parts have been published BS 3889-1:1983 will be withdrawn.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 subcommittee can be obtained on request to its secretary.

Cross-references

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Summary of pages

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EUROPEAN STANDARD

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English version

Non-destructive testing of steel tubes – Part 9: Automatic ultrasonic testing of the weld seam of submerged arc welded steel tubes for the detection of longitudinal and/or transverse imperfections

Essais non destructifs des tubes en acier – Partie 9: Contrôle automatique par ultrasons du cordon de soudure pour la détection des imperfections longitudinales et/ou transversales des tubes soudés à l'arc immergé sous flux en poudre

Zerstörungsfreie Prüfung von Stahlrohren – Teil 9: Automatische Ultraschallprüfung der Schweißnaht unterpulvergeschweißter Stahlrohre zum Nachweis von Längs – und/oder Querfehlern

This European Standard was approved by CEN on 25 December 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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

Ref. No. EN 10246-9:2000 E

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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 August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.

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 the automatic ultrasonic testing of the weld seam of submerged arc-welded (longitudinally or helically) tubes for the detection of imperfections oriented predominantly parallel to and/or at right angles to the weld seam. The standard specifies acceptance levels and calibration procedures.

European Standard EN 10246, Non-destructive testing of steel tubes, comprises the parts shown in Annex A.

2 NORMATIVE REFERENCES

This part of EN 10246 incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of those publications apply to this part of EN 10246 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 10246-10:1999	Non-destructive testing of steel tubes - Part 10: Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections
EN 20286-2	ISO system of limits and fits - Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts (ISO 286-2:1988)
ISO 235	Parallel shank jobber and stub series drills and Morse taper shank drills

3 GENERAL REQUIREMENTS

3.1 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.

For cold-expanded tubes, the ultrasonic testing shall be carried out after expansion.

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

4 METHOD OF TEST

4.1 The weld of the longitudinally or helically tubes shall be tested using an ultrasonic technique for the detection of imperfections oriented predominantly parallel and/or at right angles to the weld seam.

In both cases, testing shall be carried out in two opposite directions of beam travel, unless otherwise agreed between purchaser and manufacturer.

4.2 During testing, the transducer assembly shall be maintained in proper alignment with the weld so that the whole of the weld seam is scanned.

4.3 The ultrasonic test frequency to be applied shall be in the range of 2 MHz to 10 MHz dependent upon the thickness and surface finish of the tube to be tested.

4.4 The maximum width of each individual transducer, measured parallel to the major axis of the tube, shall be 25 mm.

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

4.6 When the weld seam at the tube ends cannot be tested by automatic ultrasonic equipment, the manufacturer shall otherwise test the weld seam ends. The test method shall, at the manufacturer's discretion be either a manual ultrasonic test in accordance with this part of EN 10246 or a radiographic test in accordance with prEN 10246-10:1999.

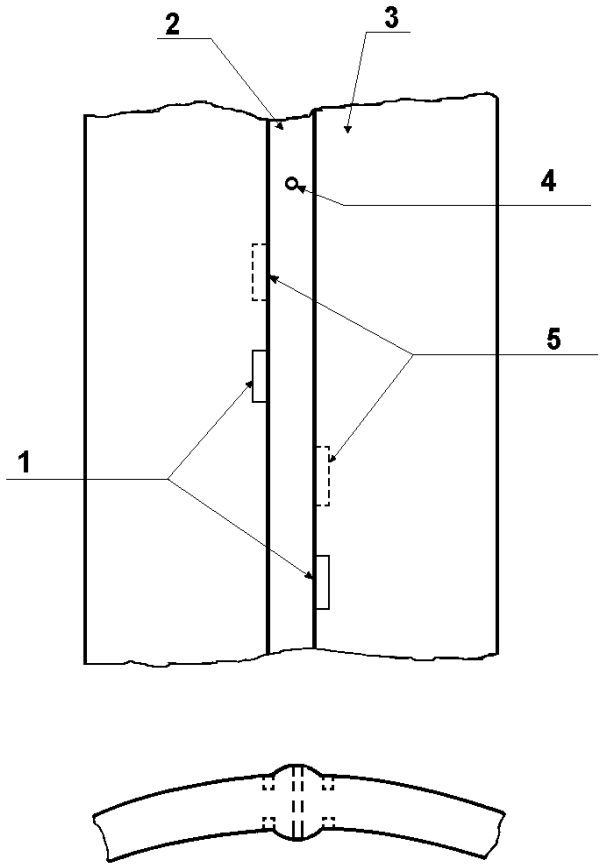
5 REFERENCE STANDARDS

5.1 General

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

5.1.2 The ultrasonic equipment for the detection of longitudinal imperfections shall be calibrated using four longitudinal notches, two on the outside surface and two on the inside surface of a tubular test piece, and/or a reference hole (see figure 1). Transducers for the detection of transverse imperfections shall be calibrated using the hole and/or two notches transverse to the weld, one on the outside and one on the inside of the test piece.

The selection of notches or hole is at the discretion of the manufacturer.



1 = longitudinal internal notches
2 = submerged arc weld seam
3 = tubular test piece or section of tube
4 = through hole
5 = longitudinal external notches

Figure 1 - Arrangement of reference notches and reference hole

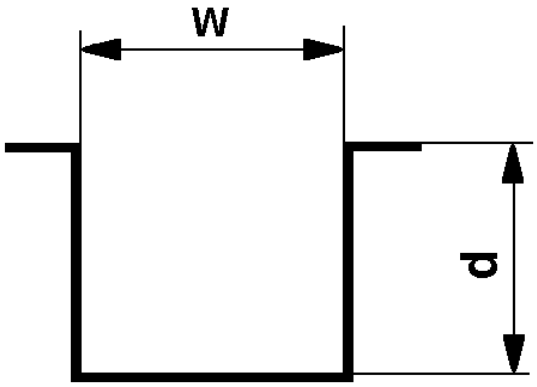
5.1.3 The test piece shall have the same specified diameter, thickness, surface finish and heat treated condition as the tube to be tested and shall have similar acoustic properties (for example, velocity, attenuation coefficient).

The manufacturer shall have the option of removing the weld bead, inside and outside, so that it is in alignment with the curvature of the tube body.

5.1.4 The external and internal notches and the reference hole shall be sufficiently separated from the ends of the test piece and from each other so that clearly distinguishable signal indications are obtained.

5.2 Reference notches

5.2.1 The reference notches shall be of the 'N' type (see figure 2). The sides shall be nominally parallel and the bottom shall be nominally square to the sides.



w = width *d* = depth

Figure 2 – 'N'-type notch

5.2.2 The longitudinal reference notches shall be located in the parent material close to the weld edges and shall lie parallel to the weld seam (see figure 1).

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

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

5.2.4 The dimensions of the reference notches shall be as follows:

a) the width *w* (see figure 2) of the reference notch shall not be greater than 1,5 mm;

b) the depth *d* (see figure 2) shall be as shown in table 1, with the following limitations:

- minimum notch depth: 0,3 mm for U2 and U3 category tubes and 0,5 mm for U4 category tubes;
- maximum notch depth: 2,0 mm for U2 and U3 category tubes and 3 mm for U4 category tubes;

c) the tolerance on depth shall be ±15 % of reference notch depth or ±0,05 mm, whichever is the larger;

d) the length of the reference notches shall be at least twice the width of each individual transducer, with a maximum of 50 mm.

5.2.5 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)
U2	5
U3	10
U4	12,5
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.	

5.3 Reference holes

5.3.1 The reference hole shall be drilled through the wall of the test piece at the centre of the weld, perpendicular to the surface of the test piece (see figure 1).

5.3.2 The diameter of the drill required to produce the reference hole shall be selected from table 2.

5.3.3 The diameter of the reference hole shall be verified and shall not exceed the specified drill diameter by more than 0,2 mm.

Table 2: Acceptance level designation and corresponding drill diameter

Acceptance level	Drill diameter[1)]
U2H	1,6
U3H	3,2
U4H	4,0
[1)] Tolerances according to ISO 235 (jobber series) and EN 20286-2 (h8)	

6 EQUIPMENT CALIBRATION AND CHECKING

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

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

6.3 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 inspection 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.

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

6.5 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 check shall be retested after the equipment has been recalibrated.

7 ACCEPTANCE

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

7.2 Any tube producing signals equal to or greater than the trigger/alarm level shall be designated suspect or, at the manufacturer's option, may be retested.

7.3 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.

7.4 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 may be retested by other non-destructive techniques and test methods (normally radiographic) by agreement between the manufacturer and the purchaser 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 the test.

8 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 A.1: 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

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