BRITISH STANDARD

BS EN
10246-12:2000

Non-destructive testing of steel tubes —

Part 12: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections

The European Standard EN 10246-12:2000 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 10246-12:2000.

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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Non-destructive testing of steel tubes – Part 12: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections

Essais non destructifs sur des tubes en acier – Partie 12: Contrôle par magnétoscopie des tubes en acier ferromagnétiques sans soudure et soudés pour la détection des imperfections de surface

Zerstörungsfreie Prüfung von Stahlrohren – Teil 12: Magnetpulverprüfung nahtloser und geschweißter ferromagnetischer Stahlrohre zum Nachweis von Oberflächenfehlern

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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

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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of an identical text or by endorsement, at the latest by August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.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 and the acceptance levels for magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections.

This part of EN 10246 is to be used for the detection of surface imperfections on the entire or any part of the outer surface of tubes, excluding the end bevel/face.

In addition, this standard may be used, as appropriate, to locate the position of external surface imperfections, detected by another non-destructive testing method, e.g. ultrasonic, prior to dressing of the tube surface and to ensure complete removal of the imperfection after dressing is complete.

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 ISO 9934-1:2000[1)]	Non-destructive testing - Magnetic particle testing – Part 1: General principle (ISO/FDIS 9934-1:2000)
prEN ISO 9934-2:1999[1)]	Non-destructive testing - Magnetic particle testing – Part 2: Detection media (ISO/DIS 9934-2:1999)
prEN ISO 9934-3:1998[1)]	Non-destructive testing - Magnetic particle testing – Part 3: Equipment (ISO/DIS 9934-3:1998)

3 GENERAL REQUIREMENTS

3.1 The magnetic particle inspection covered by this part of EN 10246 is usually carried out on tubes after completion of all the primary production process operations.

3.2 The surface of the tubes to be tested shall be sufficiently clean and free from oil, grease, sand or scale or any other foreign matter that would interfere with the correct interpretation of the indications obtained from magnetic particle inspection.

NOTE: The type of indications, as well as the minimum dimension of the surface imperfections to be detected, are dependent on the specific tube manufacturing process and the surface finish.

1) In preparation; until this document is published as a European Standard, the corresponding national standard(s) should be agreed at the time of enquiry and order.

4 METHOD OF TEST

4.1 During the production testing of tubes, magnetization shall be applied in the circumferential direction for the detection of longitudinal surface imperfections or in the direction parallel to the major axis of the tube for the detection of transverse surface imperfections with simultaneous application of the powder or suspension as appropriate to reveal the presence of surface imperfections using an illumination of not less than 350 lux.

In cases where there is insufficient sensitivity due, for example, either to poor contrast between the powder or suspension and the surface of the tube to be inspected or as a result of the magnetization technique adopted, the tube surface shall, prior to inspection, be coated with a white background paint to aid contrast; otherwise fluorescent detection media shall be used. If fluorescent detection media is used, the inspection shall be carried out in a darkened area using a UV(A) radiation source. The background white light level shall not exceed 20 lux and the UV(A) radiation intensity shall be at least 10 W/m^2.

The use of residual magnetism, i.e. application of magnetic particles after initial magnetization is only permitted by prior agreement between the purchaser and the manufacturer.

The entire outer surface of each tube or portion of it, as required, shall be inspected using the magnetic particle method for the detection of longitudinal and/or transverse surface imperfections using a.c. or d.c. magnetization and powder or suspension as appropriate to the magnetic particle technique adopted, generally in accordance with the requirements given in prEN ISO 9934-1:2000, prEN ISO 9934-2:1999 and prEN ISO 9934-3:1998.

The magnetic particle inspection method does not make it possible to determine the nature, shape, orientation, and, more particularly, the depth of surface imperfections revealed as indications. The dimensions and extent of magnetic particle ‘build up’ of indications do not directly represent the actual dimensions of the surface imperfection causing the indication.

4.2 The classification of magnetic particle indications shall be as follows:

a) linear indications in which the length is equal to or more than three times the width;

b) rounded indications which are circular or elliptical in shape where the length of the indication is less than three times the width;

c) accumulated indications which are linear or non-linear and aligned or clustered, arranged with a distance between them of not more than their own size and consisting of at least three indications;

d) non-relevant indications which are similar to indications that may occur from localized surface irregularities due to machining marks, scratches, sizing/straightening marks or other surface conditions.

4.3 The following magnetization methods are applicable to the magnetic particle inspection of tubes:

a) method A - current flow method. In this method, current derived from a.c., d.c., full or half-wave rectified a.c. external power source is passed between two contact areas on the surface of the tube. This method is intended for the detection of imperfections which lie generally parallel to the direction of current flow;

b) method B - threaded bar/cable method. In this method, current (as in method A) is passed through a rigid bar or flexible cable placed within and approximately concentric with the tube bore. This method is intended (like method A) for the detection of imperfections which lie generally parallel to the direction of current flow in the threaded bar/cable;

c) method C - encircling coil method. In this method, a rigid or semi-rigid current-carrying coil is placed around the tube and the surface of the tube within the influence of the coil is magnetized in the direction parallel to the major axis of the tube, favouring the detection of generally transverse imperfections;

d) method D - magnetic flow method. In this method, the tube or part of it forms part of the magnetic circuit of an electromagnet carrying current from an external power supply (as in method A). This method favours the detection of imperfections lying at right angles to an imaginary line connecting the poles of the electromagnet.

NOTE: Other magnetization technique or combination of the techniques given above may be used provided the requirements for field strength and direction are met.

4.4 It is outside the scope of this part of EN 10246 to specify levels of magnetization and current levels required to reveal the presence of unacceptable surface imperfections due to the wide variety of magnetic particle techniques available and permitted for this purpose.

However, in all cases, the magnetization requirements and the use of powders and suspensions given in prEN ISO 9934-1:2000, prEN ISO 9934-2:1999 and prEN ISO 9934-3:1998 shall apply.

4.5 During the production testing of tubes, the level of magnetization achieved using the adopted technique and equipment shall be checked at regular intervals not exceeding four hours using, for example, a flux indicator or magnetic field strength meter, as appropriate.

5 ACCEPTANCE LEVELS

5.1 Four acceptance levels corresponding to four severity levels with the maximum number and/or the maximum permissible dimensions (diameter or length) have been established in accordance with tables 1 and 2.

Table 1: Testing of tube surface - Permissible number and dimension of indications within a frame aperture of 100 mm x 150 mm

Acceptance level	Specified wall thickness	Type of indications					
		Rounded		Linear		Accumulated	
		Number	Diameter	Number	Length	Number	Cumulative length
	T (mm)	max.	max. (mm)	max.	max. (mm)	max.	max. (mm)
M 1	$T \leq 16$	5	3,0	3	1,5	1	4,0
	$16 < T \leq 50$	5	3,0	3	3,0	1	6,0
	$T > 50$	5	3,0	3	5,0	1	10,0
M 2	$T \leq 16$	8	4,0	4	3,0	1	6,0
	$16 < T \leq 50$	8	4,0	4	6,0	1	12,0
	$T > 50$	8	4,0	4	10,0	1	20,0
M 3	$T \leq 16$	10	6,0	5	6,0	1	10,0
	$16 < T \leq 50$	10	6,0	5	9,0	1	18
	$T > 50$	10	6,0	5	15,0	1	30,0
M 4	$T \leq 16$	12	10,0	6	10,0	1	18,0
	$16 < T \leq 50$	12	10,0	6	18,0	1	27,0
	$T > 50$	12	10,0	6	30,0	1	45

Table 2: Testing of the weld seam - Permissible number and dimension of indications within a frame aperture 150 mm long and 50 mm wide in a 25 mm wide area on either side of the weld seam

Acceptance level	Specified wall thickness	Type of indications					
		Rounded		Linear		Accumulated	
		Number	Diameter	Number	Length	Number	Cumulative length
	T (mm)	max.	max. (mm)	max.	max. (mm)	max.	max. (mm)
M 1	≤ 16	1	3,0	1	1,5	1	4,0
	>16	1	3,0	1	3,0	1	6,0
M 2	≤ 16	2	4,0	2	3,0	1	6,0
	>16	2	4,0	2	6,0	1	12,0
M 3	≤ 16	3	6,0	3	6,0	1	10,0
	>16	3	6,0	3	9,0	1	18,0
M 4	≤ 16	4	10,0	4	10,0	1	18,0
	>16	4	10,0	4	18,0	1	27,0

5.2 The inspection shall be carried out without any means of image magnification. Table 3 shows the minimum dimension below which the indications are not to be taken into consideration in the corresponding acceptance level.

Table 3: Minimum dimension of indications to be considered for evaluation

Acceptance level	Diameter or length of the indication min. (mm)
M1	1,5
M2	2,0
M3	3,0
M4	5,0

6 EVALUATION OF INDICATIONS

6.1 Only relevant indications with their major dimensions equal to or greater than the values given in table 3 shall be taken into account when determining their incidence in accordance with the appropriate acceptance level. Non-relevant indications shall not be considered during evaluation.

6.2 Relevant indications obtained by magnetic particle inspection in accordance with this part of this European Standard shall be evaluated and classified as follows:

a) For general tube surface testing, either entire surface or local area, an imaginary frame aperture of 100 mm x 150 mm shall be placed over the area with the highest incidence of relevant indications. The indications shall be classified with regard to type, number and dimensions of the indications according to the appropriate acceptance level given in table 1.

b) For testing the weld seam, an imaginary frame aperture of 50 mm x 150 mm, with the weld centred on the 50 mm side, shall be placed over the area with the highest incidence of indications. The indications shall be classified with regard to type, number and dimensions of the indications within the frame according to the appropriate acceptance level given in table 2.

c) For calculating the cumulative length of accumulated indications, the length along the major axis of linear and rounded indications shall be used. In cases where the separation between two adjacent indications is less than the length or diameter of the larger of the two indications, they shall be considered as one indication and the sum of the individual lengths or diameters plus the separation shall be used to calculate the overall length.

7 ACCEPTANCE

7.1 Any tube producing no indications in excess of that permitted by the corresponding acceptance level shall be deemed to have passed the test.

7.2 Any tube producing indications in excess of that permitted by the corresponding acceptance level shall be deemed suspect.

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

a) The suspect area shall be dressed by a suitable method. After checking that the remaining thickness is within tolerance, the suspect area shall be tested as previously specified to ensure that each imperfection giving rise to the original indications has been completely removed. The tube shall then be deemed to have passed the test.

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

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

8 TEST REPORTING

When specified, the manufacturer shall submit to the purchaser a test report that includes at least the following information:

a) reference to this part of EN 10246;

b) date of test report;

c) statement of conformity;

d) acceptance level;

e) product designation by grade and size;

f) type and details of the inspection technique.

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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