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**Non-destructive testing of steel tubes —**

Part 10:

**Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections**

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*Essais non destructifs des tubes en acier —*

*Partie 10: Contrôle automatisé par ultrasons sur toute la circonférence des tubes en acier sans soudure et soudés (sauf à l'arc immergé sous flux en poudre) pour la détection des imperfections longitudinales et/ou transversales*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10893-10 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 19, *Technical delivery conditions for steel tubes for pressure purposes*.

This first edition cancels and replaces ISO 9303:1989 and ISO 9305:1989, which have been technically revised.

ISO 10893 consists of the following parts, under the general title *Non-destructive testing of steel tubes*:

- *Part 1: Automated electromagnetic testing of seamless and welded (except submerged arc-welded) steel tubes for the verification of hydraulic leaktightness*
- *Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections*
- *Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections*
- *Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections*
- *Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections*
- *Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections*
- *Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections*
- *Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections*
- *Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes*
- *Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections*

- *Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections*
- *Part 12: Automated full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes*

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# Non-destructive testing of steel tubes —

Part 10:

## Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections

### 1 Scope

This part of ISO 10893 specifies requirements for automated full peripheral ultrasonic shear wave (generated by conventional or phased array technique) testing of seamless and welded [except submerged arc-welded (SAW)] steel tubes, for the detection of longitudinal and/or transverse imperfections.

Unless otherwise specified in the purchase order, the testing method is applicable to the detection of predominantly longitudinal imperfections.

In the case of testing on longitudinal imperfections, Lamb wave testing can be applied at the discretion of the manufacturer.

For seamless tubes, by agreement between the purchaser and manufacturer, testing principles of this part of ISO 10893 can be applied to detect imperfections having other orientations.

This part of ISO 10893 is applicable to the inspection of tubes with an outside diameter greater than or equal to 10 mm, normally with an outside diameter-to-thickness ratio greater than or equal to 5.

This part of ISO 10893 can also be applicable to the testing of circular hollow sections.

NOTE For options for testing tubes with an outside diameter-to-thickness ratio less than 5 on longitudinal imperfections, see Annex A.

### 2 Normative references

The following referenced documents are indispensable for the application 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 5577, *Non-destructive testing — Ultrasonic inspection — Vocabulary*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 11484, *Steel products — Employer's qualification system for non-destructive testing (NDT) personnel*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577 and ISO 11484 and the following apply.

#### 3.1

##### **reference standard**

standard for the calibration of non-destructive testing equipment (e.g. drill holes, notches, recesses)

#### 3.2

##### **reference tube**

tube or length of tube containing the reference standard(s)

#### 3.3

##### **reference sample**

sample (e.g. segment of tube, plate or strip) containing the reference standard(s)

NOTE Only the term “reference tube” is used in this part of ISO 10893, also covering the term “reference sample”.

#### 3.4

##### **tube**

hollow long product open at both ends, of any cross-sectional shape

#### 3.5

##### **seamless tube**

tube made by piercing a solid product to obtain a tube hollow, which is further processed, either hot or cold, into its final dimensions

#### 3.6

##### **welded tube**

tube made by forming a hollow profile from a flat product and welding adjacent edges together, and which after welding can be further processed, either hot or cold, into its final dimensions

#### 3.7

##### **manufacturer**

organization that manufactures products in accordance with the relevant standard(s) and declares the compliance of the delivered products with all applicable provisions of the relevant standard(s)

#### 3.8

##### **agreement**

contractual arrangement between the manufacturer and purchaser at the time of enquiry and order

#### 3.9

##### **average of the specified thickness range**

average of the specified thickness range given by:

$$\frac{T_{\max} + T_{\min}}{2}$$

where  $T_{\max}$  and  $T_{\min}$  are the maximum and the minimum thicknesses allowed by the standard when taking into account the wall thickness tolerances



## 4 General requirements

**4.1** Unless otherwise specified by the product standard or agreed on by the purchaser and manufacturer, this ultrasonic testing shall be carried out on tubes after completion of all the primary production process operations (rolling, heat treating, cold and hot working, sizing and straightening, etc.).

**4.2** The tubes under test shall be sufficiently straight to ensure the validity of the test. The surfaces shall be sufficiently free of foreign matter which can interfere with the validity of the test.

**4.3** This test shall be carried out by suitable trained operators qualified in accordance with ISO 9712, ISO 11484 or equivalent and supervised by competent personnel nominated by the manufacturer. In the case of third-party inspection, this shall be agreed on by the purchaser and manufacturer.

The operating authorization issued by the employer shall be according to a written procedure. Non-destructive testing (NDT) operations shall be authorized by a level 3 NDT individual approved by the employer.

NOTE The definition of levels 1, 2 and 3 can be found in appropriate International Standards, e.g. ISO 9712 and ISO 11484.

## 5 Test method

**5.1** The tubes shall be tested by using an ultrasonic shear wave technique for the detection of longitudinal and transverse imperfections. Lamb wave technique may be applied for the detection of longitudinal imperfections.

**5.2** During testing, the tubes and the transducer assembly shall be moved relative to each other such that the whole of the tube surface is scanned, with coverage calculated on the dimension of the transducer(s). The relative speed of movement during testing shall not vary by more than  $\pm 10\%$ . There can 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 standard (see Annex B).

**5.3** Unless otherwise agreed on by the purchaser and manufacturer, testing shall be carried out in two opposite directions of sound propagation for the requested type of inspection, clockwise and anticlockwise for the detection of longitudinal defects and forward and backward for the detection of transversal defects.

**5.4** For the detection of longitudinal imperfections, the maximum width of each individual transducer, measured parallel to the major axis of the tube, shall be 25 mm. For U1 category tubes with an outside diameter equal to or less than 50 mm, the width of any one transducer unit shall normally be restricted to a maximum of 12,5 mm.

In the case of use of the Lamb wave technique or phased array technique, the maximum width of transducer or active aperture, measured parallel to the major axis of the tube, shall be limited to 35 mm.

For the detection of transversal imperfections, the maximum width of each individual transducer, measured perpendicular to the major axis of the tube, shall be 25 mm.

**5.5** The ultrasonic test frequency of transducers that shall be used shall be in the range 1 MHz to 15 MHz for shear wave technique and in the range 0,3 MHz to 1 MHz for Lamb wave technique, depending on the product condition and properties, the thickness and surface finishing of tubes under examination.

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