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

Part 9:

**Automated ultrasonic testing for  
the detection of laminar imperfections  
in strip/plate used for the manufacture  
of welded steel tubes**

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*Essais non destructifs des tubes en acier —*

*Partie 9: Contrôle automatisé par ultrasons pour la détection  
des dédoubleures dans les bandes/tôles fortes utilisées  
pour la fabrication des tubes en acier soudés*

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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 10893-9 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 12094:1994, which has 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 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 9:

# Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes

## 1 Scope

This part of ISO 10893 specifies requirements for the automated ultrasonic testing of strip/plate used in the manufacture of welded tubes for the detection of laminar imperfections carried out in the pipe mill before or during pipe production.

NOTE 1 For welded tubes, an alternative ultrasonic testing specification for the detection of laminar imperfections is available, which can be applied, at the discretion of the manufacturer, by ultrasonic testing of the tubes subsequent to seam welding according to ISO 10893-8.

NOTE 2 By agreement between the purchaser and manufacturer, the requirements of this part of ISO 10893 can be applied on strips/plates of SAW tubes in the pipe form after seam welding.

This part of ISO 10893 can also be applicable to the testing of strips/plates used in the manufacture of circular hollow sections.

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## 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 sample

sample (e.g. segment of plate/strip) containing the reference standard(s)

### 3.3

#### tube

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

**3.4  
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

**3.5  
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

**3.6  
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)

**3.7  
agreement**

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

**3.8  
laminar imperfection**

imperfection located in the wall thickness and generally parallel to the pipe surfaces

NOTE Its extension can be calculated by measuring its outlined area on the external surface.

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**4 General requirements**

**4.1** An ultrasonic test of the strip/plate shall be carried out before or during pipe production in the flat form.

**4.2** The strip/plate under test shall be sufficiently free of surface irregularities and foreign matter as to ensure 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 strip/plate shall be tested using an ultrasonic pulse echo technique for the detection of laminar imperfections, with ultrasound transmitted in the direction normal to the strip/plate surface or using the ultrasonic through-transmission technique at the discretion of the manufacturer.

**5.2** During testing, the strip/plate and the probe assembly shall be moved relative to each other such that the strip/plate surface is scanned along equidistant scan lines parallel or transverse to the principal rolling direction of the strip/plate, with a minimum coverage and a maximum allowable gap between adjacent scanning tracks, as given in Table 1. For the oscillating technique, the minimum coverage shall be half of the values given in Table 1. The relative speed of movement during testing shall not vary by more than  $\pm 10\%$ .



**Table 1 — Acceptance levels and minimum coverage of the strip/plate and maximum gap between adjacent scanning tracks**

Acceptance level	Minimum coverage	Maximum gap between adjacent scanning tracks
	%	mm
U1	20	100
U2	10	150
U3	5	200

**5.3** The longitudinal strip/plate edges shall be 100 % ultrasonically tested for the detection of laminar imperfections over a width of at least 15 mm, plus, if appropriate, the total width of edge material which shall be removed from each original strip/plate prior to seam welding, in order to detect the relevant minimum imperfection length,  $L_{\min}$ , as given in Table 2.

For determining the extent of the laminated suspect area, adjacent suspect areas separated by less than the smaller of the two minor axes of the laminations shall be considered as one lamination.

NOTE The longitudinal edges are defined as those parallel to the principal rolling direction.

**Table 2 — Acceptance levels and minimum detectable and maximum acceptable size of laminar imperfections at strip/plate edges**

Acceptance level	Minimum individual size of laminar imperfections that shall be considered  Length  $L_{\min}$ mm	Maximum acceptable size of laminar imperfections		
		Individual dimension		Maximum number of laminar imperfections <sup>a</sup> per metre of edge length, where  $L_{\min} \leq L \leq L_{\max}$ and $E \leq E_{\max}$
		ISO 10893-9:2011 Length	Size (product of length and width) $E_{\max}$ mm <sup>2</sup>	
U1	10	20	250	3
U2	20	40	500	4
U3	30	60	1 000	5

<sup>a</sup> Only laminar imperfections exceeding 6 mm in width ( $C_{\min}$ ) shall be considered.

**5.4** The suggested maximum width of each probe, or each active aperture when using phased array probes, should be 25 mm measured in any direction. However, manufacturers may use larger transducers providing their capability for detecting the adopted reference standard; on request, this capability shall be demonstrated.

In the case of dual transducer probes with different sizes of transducers within the transducer assembly, the dimension of the smallest transducer shall be used to calculate the coverage.

**5.5** The equipment for automated testing shall be capable of classifying strip/plate as either acceptable or suspect by means of an automated trigger/alarm level combined with a marking and/or sorting system.