
**Non-destructive testing of steel tubes —
Part 4:
Liquid penetrant inspection of seamless
and welded steel tubes for the detection
of surface imperfections**

iTeh STANDARD PREVIEW —
Essais non destructifs des tubes en acier —

(standards.iteh.ai) *Partie 4: Contrôle par ressuage des tubes en acier sans soudure et
soudés pour la détection des imperfections de surface*

ISO 10893-4:2011

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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 10893-4 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 12095:1994, 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 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 4:

Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections

1 Scope

This part of ISO 10893 specifies requirements applicable to liquid penetrant testing of seamless and welded tubes for the detection of surface imperfections.

It is applicable to all or any part of the tube surface as required by the relevant product standards.

It can also be applicable to the testing of hollow sections.

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2 Normative references (standards.iteh.ai)

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 3059, *Non-destructive testing — Penetrant testing and magnetic particle testing — Viewing conditions*

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 3452-2, *Non-destructive testing — Penetrant testing — Part 2: Testing of penetrant materials*

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 3452-1 and ISO 11484 and the following apply.

3.1

tube

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

3.2

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

3.3 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

3.4 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)

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

4 General requirements

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

4.2 The surface of the tube being tested shall be sufficiently clean and free of oil, grease, sand, scale or any other foreign matter which can potentially interfere with the correct interpretation of the indications obtained from liquid penetrant testing. The type of indications, as well as the minimum dimension of the surface imperfections detected, depends on the specific tube manufacturing process and the surface finish.

4.3 This inspection shall be carried out by 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 between the purchaser and manufacturer.

The operating authorization issued by the employer shall be according to a written procedure. 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 General

5.1.1 A liquid penetrant is applied to the surface being examined and allowed to enter the surface imperfections. All excess penetrant is then removed; the surface of the part is dried and a developer is applied. The developer functions both as a blotter to absorb penetrant that has been trapped in imperfections and as a contrasting background to enhance the visibility of penetrant indications. The dyestuffs in penetrants are either colour-contrast (visible under white light) or fluorescent (visible under ultraviolet light). For both penetrant techniques, the following three types of penetrant systems can be used:

- a) water washable;
- b) post emulsifying;
- c) solvent removable.

Where the term “penetrant materials” is used in this part of ISO 10893, it is intended to include all penetrants, solvents or cleaning agents, developers, etc., used in the testing process.

5.1.2 For each tube or each part of the tube under test, either a colour-contrast penetrant technique or a fluorescent penetrant technique, both techniques with one of the three types of penetrant systems, shall be used.

The general principles and the methods of verification of liquid penetrant testing as described in ISO 3059, ISO 3452-1 and ISO 3452-2 shall be applied (see 5.3).

5.2 Detection of imperfections and their classification

The liquid penetrant method is an effective means of detecting imperfections which are open to the surface (called surface imperfections in this part of ISO 10893). Typical surface imperfections detectable by this method are cracks, seams, laps, cold shuts, laminations and porosity.

The liquid penetrant method does not make it possible to determine the nature, shape and, more generally, the dimensions of the surface imperfections revealed. The dimensions of the penetrant indication do not directly represent the actual dimensions of the surface imperfection causing this indication. That is why the classification of liquid penetrant indications shall be the following:

- a) linear indications — indications where the length of the indication is equal to or more than three times the width of the indication;
- b) rounded indications — indications which are circular or elliptical in shape, where the length of the indication is less than three times the width of the indication;
- c) accumulated indications — indications which are linear or rounded and are aligned or clustered with a separation of not more than the length of the smallest indication and consisting of at least three indications;
- d) non-relevant indications — indications which may result from localized surface irregularities to a particular tube-making process, for example machining marks, scratches and sizing/straightening marks.

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The minimum dimension of indications that shall be considered during the evaluation shall be as given in Table 1, in relation to the acceptance level specified.

Table 1 — Minimum dimension of indications that shall be considered for evaluation

Acceptance level	Diameter, D , or length, L , of the smallest indication that shall be considered
	mm
P1	1,5
P2	2,0
P3	3,0
P4	5,0

5.3 Procedure

The liquid penetrant testing shall be in accordance with the following operational conditions:

- a) for the choice of the penetrant system, the tube surface condition as well as the test category shall be taken into account;
- b) for stainless steel tubes, low halogen (chlorine/fluorine) and low sulphur penetrant materials shall be applied;