TC 17

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Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Electromagnetic testing for verification of hydraulic leak-tightness

Tubes en acier sans soudure et soudés (sauf à l'arc immergé) pour service sous pression — Contrôle électromagnétique pour vérification de l'étanchéité

Reference number
ISO 9302 : 1989 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Electromagnetic testing for verification of hydraulic leak-tightness

1 Scope

This International Standard specifies requirements for electromagnetic testing of seamless and welded tubes (ferromagnetic steels), for pressure purposes, with the exception of submerged arc-welded (SAW) tubes, for verification of hydraulic leak-tightness. It is applicable to the inspection of tubes with an outside diameter greater than or equal to 4 mm.

2 Normative references

The following standards contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 235 : 1980, *Parallel shank jobber and stub series drills and Morse taper shank drills.*

ISO 286-2 : 1988, *ISO system of limits and fits — Part 2 : Tables of standard tolerance grades and limit deviations for holes and shafts.*

ISO 4200 : 1985, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length.*

3 General requirements

3.1 The electromagnetic inspection covered by this International Standard is usually carried out on tubes after completion of all the production process operations.

This inspection shall be carried out by suitably trained operators and supervised by competent personnel nominated by the manufacturer. In the case of third-party inspection, this shall be agreed between the purchaser and manufacturer.

3.2 The tubes to be tested shall be sufficiently straight to ensure the validity of the test. The surfaces shall be sufficiently free from foreign matter which would interfere with the validity of the test.

4 Method of test

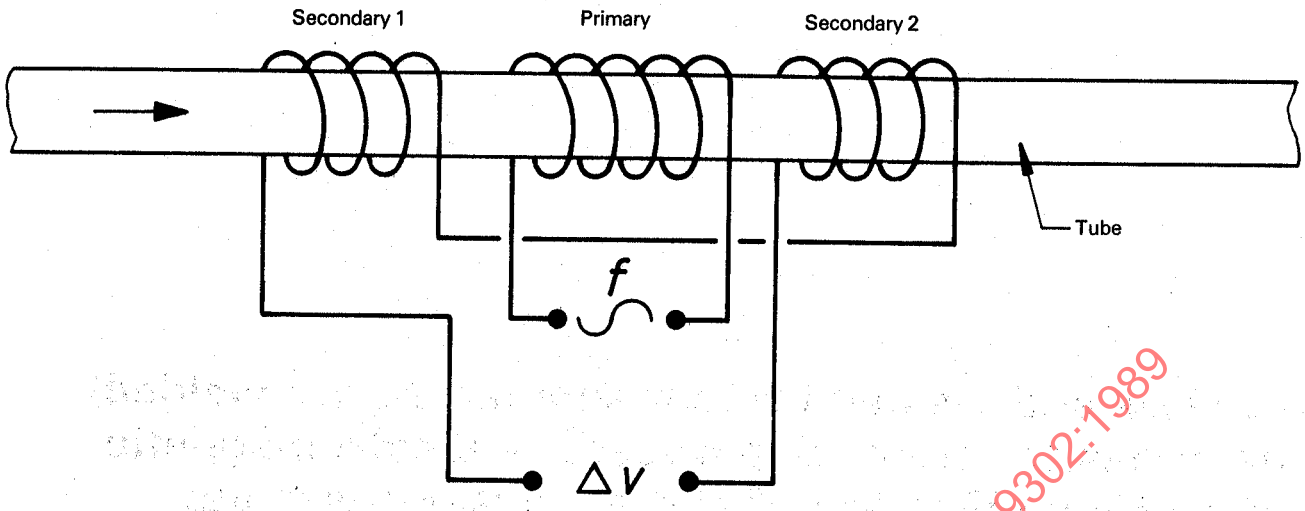
4.1 The tubes shall be tested for verification of hydraulic leak-tightness using a concentric coil or a rotating tube/pancake coil eddy current technique, or a rotating tube/magnetic transducer flux leakage technique. See figures 1, 2 and 3.

NOTE — It is recognized that there is a short length at both tube ends which may not be able to be tested.

4.1.1 When testing seamless or welded tubes using the eddy current concentric coil technique, the maximum outside diameter of tube to be tested is restricted to 177,8 mm.

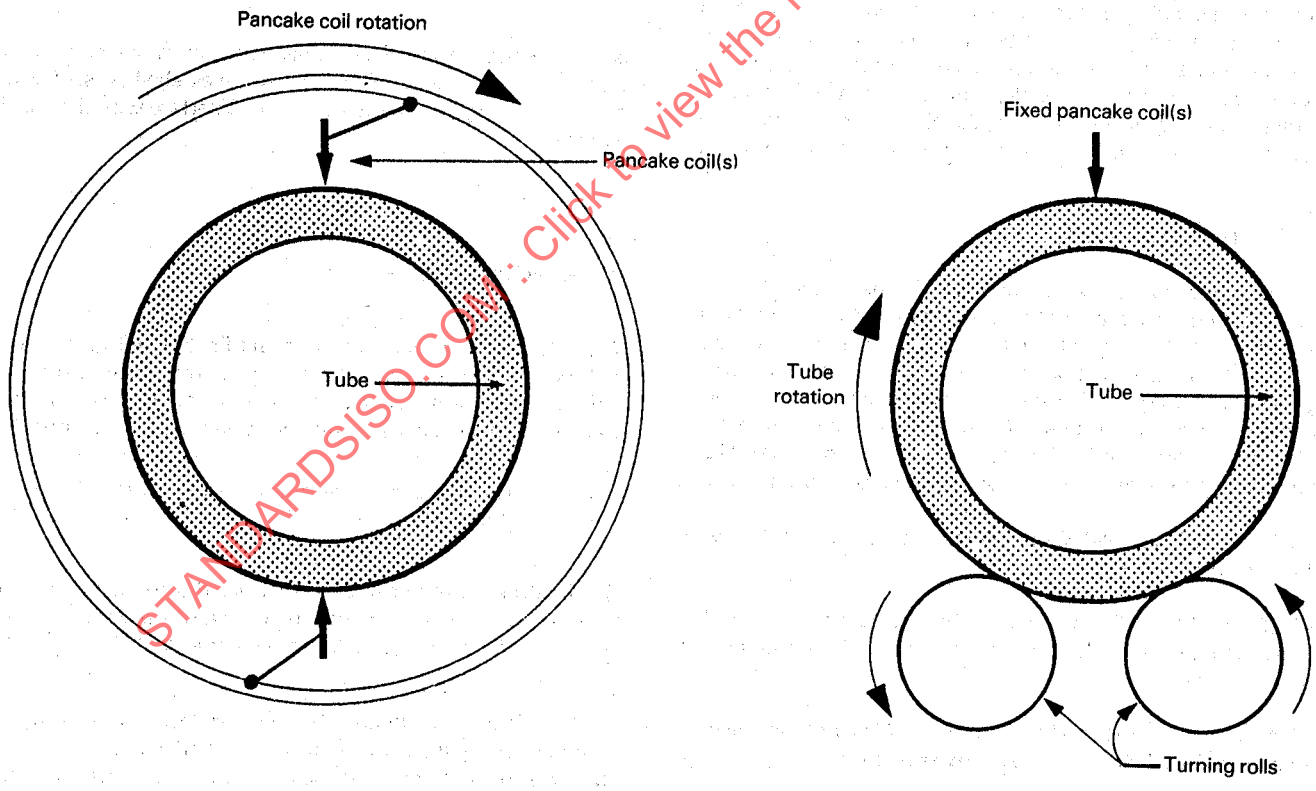
4.1.2 When testing seamless or welded tubes using the rotating tube/pancake coil eddy current technique or rotating tube/magnetic transducer flux leakage technique, the tube and/or the pancake coils/magnetic transducers shall be moved relative to each other so that the whole of the tube surface is scanned. There is no restriction on the maximum outside diameter using these techniques.

4.2 The equipment for automatic testing shall be capable of differentiating between acceptable and suspect tubes by means of an automatic trigger/alarm level combined with a marking and/or sorting system.



NOTE — The above diagram is a simplified form of a multi-coil arrangement which may contain, for example, split primary coils, twin differential coils, calibrator coil, etc.

Figure 1 — Simplified diagram of concentric coil eddy current technique

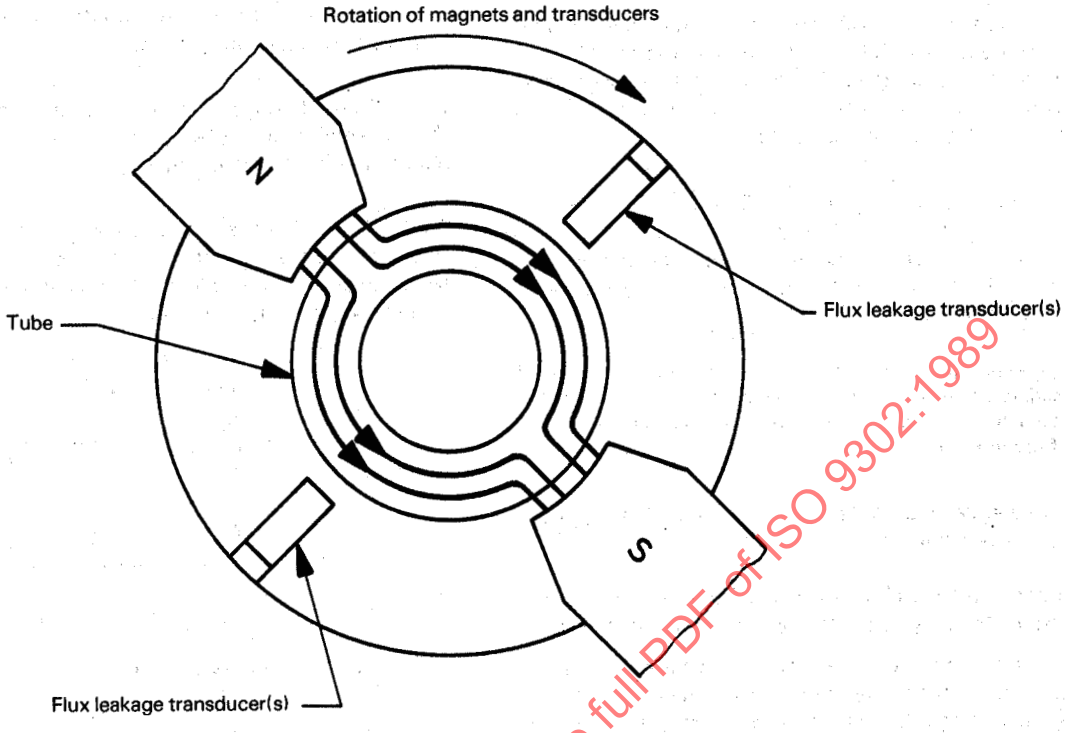


a) Rotating pancake coil technique (linear tube movement through the rotating pancake coil assembly)

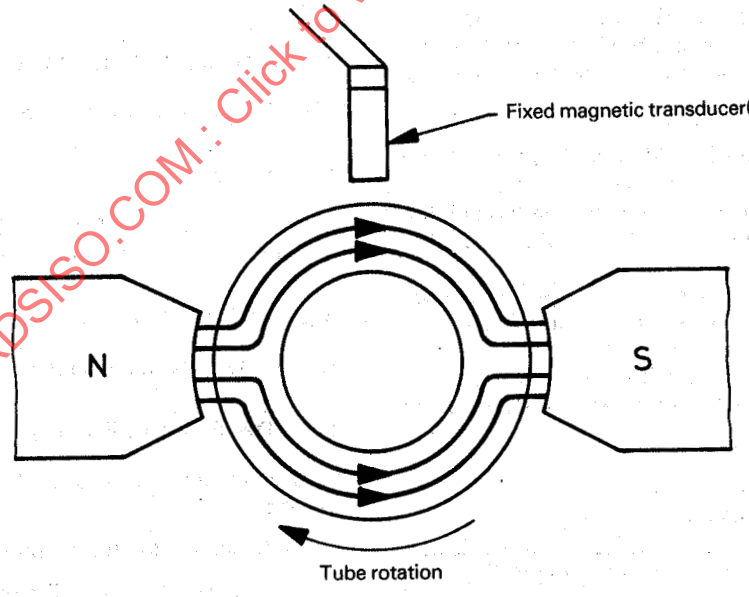
b) Rotating tube technique (linear pancake coil traverse along the tube length)

NOTE — The pancake coils used in a) and b) above take many forms, for example, single coil, multi-coil of various configurations, depending on the equipment used and other factors.

Figure 2 — Simplified diagram of rotating tube/pancake coil eddy current technique (helical scan)



a) Rotating magnetic transducer technique (rotating magnets and transducers)



b) Rotating tube technique [fixed magnets and magnetic transducer(s)]

NOTE — The magnetic transducers used in a) and b) above may take many forms, for example absolute, differential, multidifferential, etc., depending on the equipment used and other factors.

Figure 3 — Simplified diagram of rotating tube/magnetic transducer flux leakage technique

5 Reference standards

5.1 The reference standards defined in this International Standard are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size of imperfection detectable by such equipment.

5.2 The testing equipment shall be calibrated using reference standards introduced into a tubular test piece. The test piece shall be of the same nominal diameter, thickness and surface finish as the tube to be tested and shall have similar electromagnetic properties.

NOTE — In special cases, for example testing hot tubes, a modified testing procedure can be used where it can be demonstrated that the calibration parameters are at least equivalent to the electromagnetic condition of the tubes under test.

5.3 The reference standards for the various testing techniques shall be as follows :

a) a reference hole or reference holes as defined in 5.4 when using the eddy current concentric coil technique;

b) a reference notch as defined in 5.5 when using the rotating tube/pancake coil eddy current technique or the rotating tube/magnetic transducer flux leakage technique.

5.4 When using the eddy current concentric coil technique, the test piece shall contain three circular holes, drilled radially through the full thickness of the test piece. The three holes shall be circumferentially displaced 120° from each other, and shall be sufficiently separated longitudinally and from the extremities of the test piece so that clearly distinguishable signal indications are obtained.

Alternatively, only one hole shall be drilled radially through the full thickness of the test piece and during calibration and calibration checking the test piece shall be passed through the equipment with the hole positioned at 0°, 90°, 180° and 270°.

The diameter of the drill required to produce these holes depends on the tube outside diameter as shown in table 1.

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

Table 1

Tube outside diameter D[1)] mm	Drill diameter[2)] mm
$D \leqslant 26,9$	1,20
$26,9 < D \leqslant 48,3$	1,70
$48,3 < D \leqslant 63,5$	2,20
$63,5 < D \leqslant 114,3$	2,70
$114,3 < D \leqslant 139,7$	3,20
$139,7 < D \leqslant 177,8$	3,70

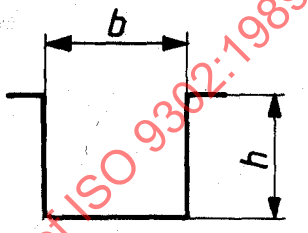
1) See ISO 4200.

2) Tolerances according to ISO 235 (jobber series) and ISO 286-2 (h8).

5.5 When using the rotating tube/pancake coil eddy current technique, or rotating tube/magnetic transducer flux leakage technique, the test piece shall contain a longitudinal reference notch on the external surface.

5.5.1 The reference notch shall be sufficiently separated from the extremities of the test piece, so that a clearly distinguishable signal indication is obtained.

5.5.2 The reference notch shall be of the "N" type (see figure 4) and shall lie parallel to the major axis of the tube. The sides shall be nominally parallel and the bottom shall be nominally square to the sides.



b = width h = depth

Figure 4 — "N"-type notch

5.5.3 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.

6 Dimensions of reference notch

The dimensions of the reference notch shall be as follows.

6.1 Length

50 mm minimum (at full depth) or a minimum of twice the width of each individual transducer.

6.2 Width, b (see figure 4)

Not greater than the reference notch depth.

6.3 Depth, h (see figure 4)

12,5 % of the specified thickness with the following limitations :

— Minimum depth : 0,5 mm

— Maximum depth : 1,5 mm

6.4 Tolerance on depth, h

± 15 % of reference notch depth or ± 0,05 mm, whichever is the larger.

6.5 Verification

The reference notch dimensions and shape shall be verified by a suitable technique.