INTERNATIONAL STANDARD

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Submerged arc-welded steel tubes for pressure purposes — Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections

Tubes en acier soudés à l'arc submergé pour service sous pression — Contrôle par ultrasons du cordon de soudure pour la détection des imperfections longitudinales et/ou transversales

Reference number
ISO 9765:1990(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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9765 was prepared by Technical Committee ISO/TC 17, *Steel*.

Introduction

This International Standard concerns ultrasonic testing of the weld seam of submerged arc-welded (longitudinally or spirally) tubes for the detection of imperfections oriented predominantly parallel and/or at right angles to the weld seam.

Three different acceptance levels are considered (see table 1 and table 2). The choice between these acceptance levels is within the province of the ISO Technical Committee responsible for the development of the relevant quality standards.

Submerged arc-welded steel tubes for pressure purposes — Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections

1 Scope

1.1 This International Standard specifies requirements for the ultrasonic testing of the weld seam of submerged arc-welded (longitudinally or spirally) tubes for the detection of imperfections oriented predominantly parallel to and/or at right angles to the weld seam, according to three different acceptance levels (see table 1 and table 2).

1.2 This International Standard covers the inspection of tubular products with outside diameter greater than or equal to 150 mm.

2 Normative references

The following standards contain 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 indicated 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.*

3 General requirements

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

For cold-expanded tubes, the ultrasonic testing of the weld shall be carried out after expansion.

In the case of spirally welded tubes, where the tube is not to be subsequently subjected to a hydrostatic test, the acceptance test may be carried out on-line.

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 weld of the longitudinally or spirally welded tube shall be tested using an ultrasonic technique for the detection of imperfections oriented predominantly parallel and/or at right angles to the weld seam.

In both cases, testing shall be carried out in two opposing directions of beam travel, unless otherwise agreed between purchaser and manufacturer.

4.2 During testing, the tubes and/or the transducer assembly shall be maintained in proper alignment with the weld so that the whole of the weld seam is scanned.

4.3 When the weld seam at the tube ends cannot be tested by automatic ultrasonic equipment, the manufacturer shall carry out either a manual ultrasonic test in accordance with this International Standard or a radiographic test of the weld seam which has not been automatically tested.

4.4 The maximum width of each individual transducer, measured parallel to the weld seam, shall be 25 mm.

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

5 Reference standards

5.1 The reference standards defined in this International Standard are convenient standards for establishing the sensitivity 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 ultrasonic equipment shall be calibrated using four longitudinal reference notches, two on the outside surface and two on the inside surface of a tubular test piece, and/or a reference hole (see figure 1). Transducers for detection of longitudinal defects shall be calibrated using the longitudinal notches and transducers for detection of transverse defects shall be calibrated using the hole.

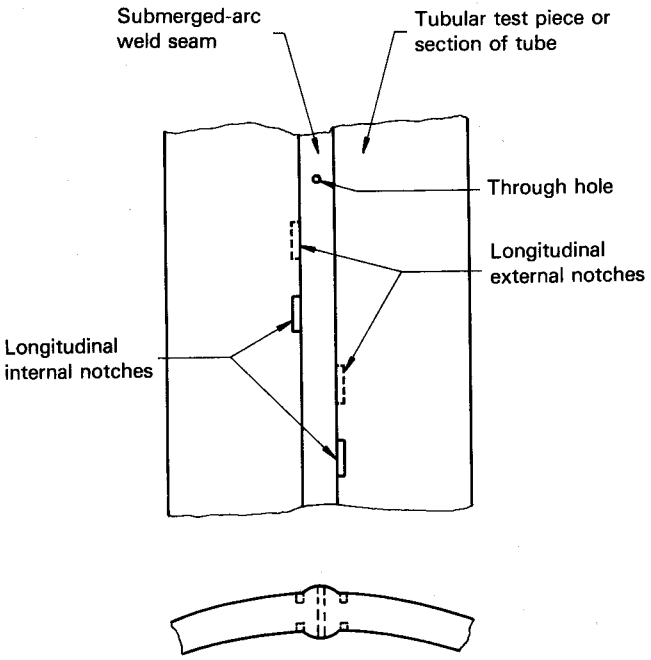

Figure 1

Alternatively, by agreement between the purchaser and manufacturer, the equipment may be calibrated using internal and external notches located on the centre of the weld seam. In this case, the depth of the notches shall be agreed between the purchaser and manufacturer and the manufacturer shall demonstrate that the sensitivity is equivalent to that obtained from the edge notches.

5.3 The test piece shall have the same nominal diameter, thickness, surface finish and heat treated condition as the tube to be tested, and shall have similar acoustic properties (for example velocity, attenuation coefficient, etc.).

The manufacturer shall have the option of removing the weld bead inside and outside so that it is in alignment with the curvature of the pipe body.

5.4 The external and internal notches, and the reference hole, shall be sufficiently separated from the extremities of the test piece and from each other so that clearly distinguishable signal indications are obtained.

5.5 The reference notches shall be of the "N" type (see figure 2). The sides shall be nominally parallel and the bottom shall be nominally square to the sides.

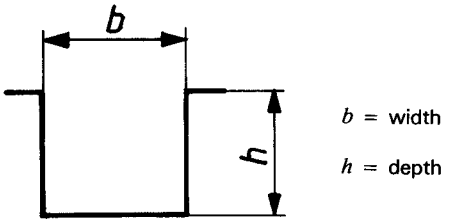

Figure 2 — "N"-type notch

5.6 The reference notches shall be located in the parent material close to the weld edges and shall lie parallel to the weld seam (see figure 1).

5.7 The reference notch shall be formed by machining, spark erosion or other methods.

NOTE 1 It is recognized that the bottom or the bottom corners of the notch may be rounded.

6 Dimensions of reference notches

The dimensions of the reference notches shall be as follows.

6.1 Width, b (see figure 2)

1,5 mm max.

6.2 Depth, h (see figure 2)

As given in table 1.

Table 1

Acceptance level	Notch depth in % of the specified thickness
L2	5
L3	10
L4	12,5
NOTE — The values of notch depth specified in this table are the same, for the corresponding categories, in all International Standards concerning non-destructive testing of steel tubes where reference is made to different acceptance levels. It should, however, be kept in mind that although the reference standards are identical, the various test methods involved can give different test results.	

6.2.1 Minimum notch depth

The minimum notch depth shall be 0,3 mm for L2 and L3 category tubes and 0,5 mm for L4 category tubes.

6.2.2 Maximum notch depth

The maximum notch depth shall be 1,5 mm for L2 and L3 category tubes and 3 mm for L4 category tubes.

6.2.3 Tolerance on depth (h)

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

6.3 Length

The reference notches shall be of a convenient length selected by the manufacturer for calibration and checking purposes.

6.4 Verification

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

7 Dimensions of reference holes

7.1 The reference hole shall be drilled through the full thickness of the test piece at the centre of the weld, perpendicular to the surface of the test piece (see figure 1).

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

7.2 The diameter of the drill required to produce the reference hole shall be as shown in table 2.

Table 2

Acceptance level	Drill diameter[1] mm
L2	1,6
L3	3,2
L4	4,0
NOTE — The values of drill diameter specified in this table are the same as in other International Standards concerning non-destructive testing of steel tubes where reference is made to different acceptance levels. It should, however, be kept in mind that although the reference standards are identical, the various test methods involved can give different test results.	
1) Tolerances according to ISO 235 (jobber series) and ISO 286-2 (H8).	

8 Equipment calibration and checking

8.1 The equipment shall be adjusted to consistently produce, to the satisfaction of the purchaser, clearly identifiable signals from the reference standard(s). These signals shall be used to set the trigger/alarm level of the equipment.

8.2 During calibration, the relative speed of movement between the test piece and the transducer assembly shall be the same as that to be used during the production test, except that semi-dynamic calibration may be used when dynamic calibration is impractical. In this case, any necessary adjustment to sensitivity shall be made to allow for differences in signal magnitude between semi-dynamic and dynamic calibration.

8.3 The calibration of the equipment shall be checked at regular intervals during the production testing of tubes of the same diameter, thickness and grade, by passing the test piece through the inspection equipment.

The frequency of checking the calibration shall be at least every 4 h or once every ten production tubes tested, whichever is the longer time period, but also whenever there is an equipment operator changeover and at the start and end of the production run.

NOTE 2 In cases where a production testing run is continuous from one shift period to the next, the 4 h maximum period may be extended by agreement between purchaser and manufacturer.

8.4 The equipment shall be recalibrated following any system adjustments or whenever the specified nominal tube diameter, thickness, or grade of steel is changed.

8.5 If on checking during production testing the calibration requirements are not satisfied,even after increasing the test sensitivity by 3 dB to allow for system drift, then all tubes tested since the previous check shall be retested after the equipment has been recalibrated.

Retesting shall not be necessary even after a drop in test sensitivity of more than 3 dB since the previous calibration, provided that suitable recordings from individually identifiable tubes are available which permit accurate classification into suspect and acceptable categories.

9 Acceptance

9.1 Any tube producing signals lower than the trigger/alarm level shall be deemed to have passed this test.

9.2 Any tube producing signals equal to or greater than the trigger/alarm level shall be designated suspect or, at the manufacturer's option, may be retested as specified above.

9.3 If on retesting no signal is obtained equal to or greater than the trigger/alarm level, the tube shall be deemed to have passed this test.

Tubes giving signals equal to or greater than the trigger/alarm level shall be designated suspect.

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

a) The suspect area may be retested by other non-destructive techniques and test methods (especially radiographic) by agreement between manufacturer and purchaser to agreed acceptance levels.

b) The suspect area shall be cropped off. The manufacturer shall ensure to the satisfaction of the purchaser that all the suspect area has been removed.

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

10 Test report

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

a) reference to this International Standard;

b) date of test;

c) acceptance level;

d) statement of conformity;

e) material designation by grade and size;

f) type and details of inspection technique;

g) description of the reference standard.

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Descriptors: pipes (tubes), metal tubes, steel tubes, welded tubes, pressure pipes, tests, nondestructive tests, ultrasonic tests, determination, defects.

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