INTERNATIONAL STANDARD

ISO 9305

First edition
1989-07-01

Seamless steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of transverse imperfections

Tubes en acier sans soudure pour service sous pression — Contrôle aux ultrasons sur toute la circonférence pour la détection des imperfections transversales

Reference number
ISO 9305 : 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.

International Standard ISO 9305 was prepared by Technical Committee ISO/TC 17, *Steel.*

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Introduction

This International Standard concerns full peripheral ultrasonic testing of seamless tubes for pressure purposes for the detection of transverse imperfections.

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

Seamless steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of transverse imperfections

1 Scope

1.1 This International Standard specifies requirements for full peripheral ultrasonic shear wave testing of seamless tubes for pressure purposes for the detection of transverse imperfections, according to four different acceptance levels (see table 1).

1.2 This International Standard is applicable to the inspection of tubes with an outside diameter greater than or equal to 9 mm.

2 General requirements

2.1 The ultrasonic 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.

2.2 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.

3 Method of test

3.1 The tubes shall be tested using an ultrasonic shear wave technique for the detection of predominantly transverse imperfections.

3.2 During testing, the tubes and/or the transducer assembly shall be moved relative to each other so that the whole of the tube surface is scanned.

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

3.3 During testing, the tubes shall be scanned in two opposing longitudinal directions of beam travel, unless otherwise agreed between purchaser and manufacturer.

3.4 The maximum width of each individual transducer, measured at right angles to the major axis of the tube, shall be 25 mm.

For L1 and L2 category tubes with an outside diameter equal to or less than 50 mm the width of any one transducer is normally restricted to a maximum of 12,5 mm.

3.5 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 marking and/or sorting system.

4 Reference standards

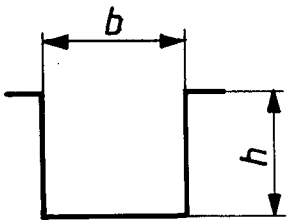
4.1 The reference standards defined in this International Standard are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size of imperfection detectable by such equipment.

4.2 The ultrasonic equipment shall be calibrated using a transverse reference notch on the outside surface of a tubular test piece. By agreement between the purchaser and manufacturer and for internal diameters greater than 15 mm, both external and internal notches may be used.

4.3 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.). However, if the internal surface of the test piece presents difficulties in meeting the tolerance on the internal notch depth, h, (see 5.2.3), the test piece internal surface may be machined such that the remaining thickness is within the specified tube thickness tolerance as given in the relevant product standard.

4.4 The external notch (and the internal notch when used) shall be sufficiently separated from the extremities of the test piece and from each other (when both are used) so that clearly distinguishable signal indications are obtained.

4.5 The reference notch or notches shall be of the "N" type (see figure 1) and shall lie at right angles to the major axis of the tube. The sides shall be nominally parallel and the bottom shall be nominally square to the sides.



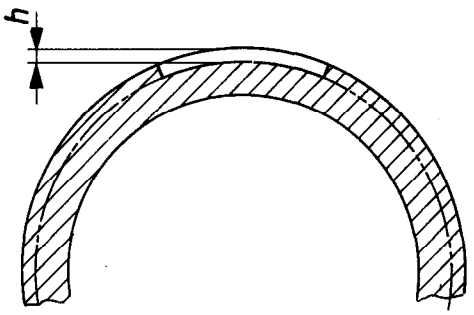
b = width h = depth

Figure 1 — "N"-type notch

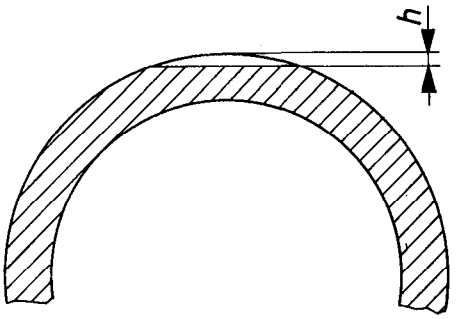
4.6 The reference notch shall be formed by machining, spark erosion or other methods.

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

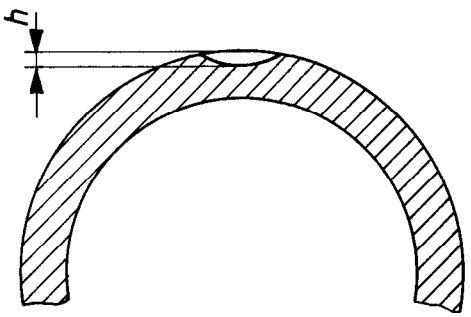
4.7 The reference notch shall be one of the forms shown in figure 2 at the discretion of the manufacturer.



a) Partial circumferential notch (full line)
Full circumferential notch (broken line)



b) Chord notch



c) Arc notch

Figure 2 — Transverse notch forms

5 Dimensions of reference notches

The dimensions of the reference notches shall be as follows.

5.1 Width, *b* (see figure 1)

1,5 mm max.

5.2 Depth, *h* (see figures 1 and 2)

As given in table 1.

Table 1

Acceptance level	Notch depth in % of the specified thickness
L 1	3
L 2	5
L 3	10
L 4	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.

5.2.1 Minimum notch depth

The minimum notch depth is related to the type of tube used (see note below) for a particular application and is denoted by a sub-category as given in table 2, unless otherwise agreed between purchaser and manufacturer.

Table 2

Sub-category	Minimum notch depth	Typical tube condition
A	0,1 mm	Cold-finished and machined tubes
B	0,2 mm	
C	0,3 mm	All other conditions
D	0,5 mm	

NOTE — The minimum notch depth that can be used is related to specific tube manufacturing methods where the surface finish plays a dominant role in the minimum notch depth that can be adopted for ultrasonic equipment calibration in order to achieve an acceptable signal/noise ratio.

5.2.2 Maximum notch depth

The maximum notch depth for all acceptance levels and sub-categories shall be 1,5 mm, with the exception that in the case of tubes with a thickness in excess of 50 mm the maximum notch depth may be extended to 3,0 mm by agreement between purchaser and manufacturer.

5.2.3 Tolerance on depth, *h*

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

5.3 Length

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

5.4 Verification

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

6 Equipment calibration and checking

6.1 The equipment shall be adjusted to consistently produce, to the satisfaction of the purchaser, clearly identifiable signals from the external reference notch (and internal notch when both are used) (see 4.2). These signals shall be used to set the trigger/alarm level(s) of the equipment as follows.

— When using the external reference notch only with

a) a single trigger/alarm level, and the gated time-period encompasses half-skip (internal) and first-skip (external) echoes, the full first-skip signal amplitude from the external notch shall be used to set the trigger/alarm level of the equipment. When the gated time-period encompasses first-skip (external) and one-and-a-half-skip (internal) echoes, the full second-skip signal amplitude from the external notch shall be used to set the trigger/alarm level of the equipment

or

b) separate trigger/alarm levels for segregation of internal and external echoes, the full signal amplitude from the external notch (usually the first full-skip) occurring within the "external" gated time period shall be used to set the "external" trigger/alarm level; while the full signal amplitude of the full-skip external notch (usually either the first or second full-skip) signal occurring immediately after the "internal" gated time-period shall be used to set the internal trigger/alarm level.

— When using both the internal and external reference notches with

a) a single trigger/alarm level, the full signal amplitude of the lesser of the two signals from the internal and external notches shall be used to set the trigger/alarm level of the equipment

or

b) separate trigger/alarm levels for segregation of internal and external echoes, the full signal amplitude from each notch shall be used to set the relevant trigger/alarm level of the equipment.

6.2 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 dynamiic 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.

6.3 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 change-over and at the start and end of the production run.

NOTE — 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.

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

6.5 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.

7 Acceptance

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

7.2 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.

7.3 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.

7.4 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 shall be explored by dressing using an acceptable method. After checking that the remaining thickness is within tolerance, the tube shall be retested as previously specified. If no signals are obtained equal to or greater than the trigger/alarm level, the tube shall be deemed to have passed this test.

The suspect area may be retested by other non-destructive techniques and test methods, by agreement between purchaser and manufacturer 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.

8 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 report;

c) acceptance level and sub-category;

d) statement of conformity;

e) material designation by grade and size;

f) type and details of inspection technique;

g) description of the reference standard.

UDC 669.14-462.3-98 : 620.179.16

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

Price based on 4 pages