BRITISH STANDARD

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Iron and steel — Ultrasonic testing of H beams with parallel flanges and IPE beams

The European Standard EN 10306:2001 has the status of a British Standard

ICS 77.040.20

National foreword

This British Standard is the official English language version of EN 10306:2001.

The UK participation in its preparation was entrusted to Technical Committee ISE/72, Methods of physical and metallographic testing, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English version

Iron and steel - Ultrasonic testing of H beams with parallel flanges and IPE beams

Produits sidérurgiques - Contrôle par ultrasons des poutrelles à larges ailes à faces parallèles et des poutrelles IPE

Eisen und Stahl - Ultraschallprüfung von H-Profilen mit parallelen Flanschen und IPE-Profilen

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Contents

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 2 "Steel - Physico-chemical and non-destructive testing", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2002, and conflicting national standards shall be withdrawn at the latest by June 2002.

Annex A is informative.

This standard includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a reflection method for the ultrasonic testing of H beams with parallel flanges and IPE beams for the detection of presence of internal discontinuities. Mechanised, semi-automatic or automatic techniques may be used but should be agreed between the purchaser and the supplier.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 473, *Non destructive testing - Qualification and certification of NDT personnel – General principles.*

EN 583-2, *Non-destructive testing - Ultrasonic examination – Part 2: Sensitivity and range setting.*

EN 583-5, *Non-destructive testing - Ultrasonic examination – Part 5: Characterization and sizing of discontinuities.*

EN 1330-4, *Non destructive testing - Terminology - Part 4: Terms used in ultrasonic testing.*

EN 12223, *Non-destructive testing - Ultrasonic examination - Specification for calibration block n°1.*

EN 12668-1, *Non-destructive testing - Characterization and verification of ultrasonic examination equipment – Part 1: Instruments.*

EN 12668-2, *Non-destructive testing - Characterization and verification of ultrasonic examination equipment – Part 2: Probes.*

EN 12668-3, *Non-destructive testing - Characterization and verification of ultrasonic examination equipment – Part 3: Combined equipment.*

3 Terms and definitions

Definitions for general terms of non-destructive testing can be found in other European Standards, e.g. EN 1330-1 and EN 1330-2. For the purposes of this European Standard, the terms and definitions given in EN 1330-4 apply, together with the following :

3.1
manual testing
testing by an operator applying an ultrasonic probe, or probes, to the flat product surface, manually executing the appropriate scanning pattern on the flat product surface and assessing ultrasonic signal indications on the electronic equipment screen either by direct viewing or by built-in signal amplitude alarm devices

3.2
automatic and semi-automatic testing
testing using a mechanised means of applying the ultrasonic probe or probes to, and executing the appropriate scanning pattern on the flat product surface, together with ultrasonic signal indication evaluation by electronic means

NOTE Such testing can be either fully automatic with no operator involvement, or semi-automatic when the operator performs basic equipment operation functions

A list of equivalent terms in several European languages is given in annex A.

4 Items for agreements

The following aspects concerning ultrasonic testing shall be agreed between the purchaser and supplier at the time of the enquiry or order :

a) the manufacturing stage(s) at which ultrasonic testing shall be performed (see clause 10) ;

b) the sounding plan (see clause 13) ;

c) the Quality Class required, or the Quality Classes and the zones to which they apply (see clause 15) ;

d) the applicable evaluation level and acceptance criteria if different from those detailed in Tables 1 and 2 ;

e) whether any special scanning coverage, equipment or couplant is required in addition to that detailed in clauses 8 and 13 ;

f) the scanning technique to be used if not manual ;

g) the technique(s) to be used for setting sensitivity (see clause 12) ;

h) whether the test is to be conducted in the presence of the purchaser or his representative ;

i) whether a written procedure shall be submitted for approval by the purchaser (see clause 6).

5 Principle

The method used is based on the reflection of ultrasonic waves (generally longitudinal), the direction of which is approximately perpendicular to the surface of the product. The examination consists of :

a) locating and evaluation of discontinuity by comparing the amplitude of the discontinuity echo with the amplitude of the echo of flat-bottomed hole of a given diameter and located at the same depth as the discontinuity;

NOTE Only those discontinuities giving an echo amplitude equal to or greater than that obtained with the reference flat-bottomed hole are taken into consideration.

b) determining the area of the discontinuity according to the -6dB beam width technique. The width of the discontinuity shall be determined perpendicular to the rolling direction. The length shall be determined in the rolling direction.

The examination is carried out with a double transducer probe during the first ultrasonic scan (first back wall echo) and from one side only.

6 Procedure

The inspection is normally carried out in the place of production or on the premises of the supplier. If specified on the order, the inspection may take place in the presence of the purchaser or his representative [1)].

Ultrasonic testing shall be performed in accordance with a written procedure. Where specified in the enquiry or order, the written procedure shall be submitted to the purchaser for approval prior to testing.

1) In this case, all steps should be taken to ensure that the production process is not disturbed.

This written procedure shall be in the form of :

a) a product specification ; or,

b) a procedure written specifically for the application ; or,

c) this European Standard may be used if it is accompanied by examination details specific to the application.

The procedure shall contain the following details as a minimum requirement :

a) description of the item to be examined ;

b) reference documents ;

c) qualification and certification of examination personnel ;

d) stage of manufacture at which the examination is carried out ;

e) examination zones specified in terms of the applicable Quality Classes ;

f) any special preparation of scanning surfaces, if applicable ;

g) couplant ;

h) description of examination equipment ;

i) calibration ;

j) scanning plan ;

k) description and sequence of examination operations ;

l) recording levels ;

m) characterisation of discontinuities ;

n) acceptance criteria ;

o) examination report.

7 Personnel qualification

It is assumed that ultrasonic testing is performed by qualified and capable personnel. In order to prove this qualification, it is recommended to certify the personnel in accordance with EN 473 or equivalent.

8 Ultrasonic test equipment

8.1 Instrument

The instrument for manual testing shall feature A-scan presentation and shall comply with the requirements of EN 12668-1.

8.2 Probe

8.2.1 General

The double transducer probes to be used for manual testing shall conform to the requirements of EN 12668-2.

Additionally, other types of probes may be used. Such supplementary probes need not comply with EN 12668-2 requirements.

8.2.2 Nominal frequency

Probes shall have a nominal frequency in the range from 2 MHz to 5 MHz.

8.2.3 Type of probe

The greatest transducer dimension shall be in the range from 9 mm to 25 mm unless otherwise agreed.

8.3 Calibration blocks

Calibration blocks shall conform to the requirements detailed in EN 12223.

8.4 Reference blocks

Reference blocks shall be made from a material having similar acoustic properties to the product to be examined. The surface condition of the reference block shall be representative of the surface condition of the product to be examined. Unless otherwise specified the reference block shall contain at least three reflectors covering the entire depth range under examination.

The form of the reference block will depend upon the application.

The bottom of the holes shall be as flat a practicable, parallel to the ultrasound entry surface and free from pits or score marks that significantly degrade its ultrasonic reflectivity. The tolerances on the diameter of the flat-bottomed hole or width of recess shall be ± 5 %.

8.5 Couplant

The couplant used shall be appropriate to the application. The same type of couplant shall be used for calibration, setting sensitivity, scanning and evaluation of discontinuities.

After examination, couplant shall be removed if its presence could adversely affect later manufacturing or inspection operations or the integrity of the product.

NOTE Water is normally used but other coupling media may be used at the discretion of the supplier.

9 Routine calibration and checking

The combined equipment (instrument and probes) for manual testing shall be calibrated and checked in accordance with the requirements detailed in EN 12668-3.

10 Stage of manufacture

Ultrasonic testing shall be performed in the delivery condition unless otherwise agreed at the time of enquiry and order.

11 Surface condition

The products are normally examined without any special surface preparation. Scanning surfaces shall be free from paint, non-adhering scale, dry couplant, surface irregularities or any other substance which could reduce coupling efficiency, hinder the free movement of the probe or cause errors in interpretation. The surface condition shall be considered acceptable providing the specified quality class can be achieved.

12 Sensitivity setting

Calibration of the ultrasonic test equipment for use particularly requires that the time base, power and amplification be determined according to EN 583-2.

The time base is calibrated to a value at which the distance, on the oscilloscope screen, between the interface echo and back-wall echo is sufficient to allow a defect echo to be clearly detected between them.

The power and amplification shall be calibrated on an area free from discontinuities. The amplitude of the first back-wall echo is set to the maximum screen height.

The system shall be checked at least once every 8 h.

The procedure to be used shall also be in accordance with EN 583-2.

The characterisation curves shall be determined by using steeped reference blocks and shall give :

a) the change in the amplitude of the back-wall echo as a function of the product thickness ;

b) the change in the amplitude of the echo from the 5 mm diameter flat-bottomed hole as a function of its position.

Thus, for a flat product of given thickness, the method consists of adjusting the amplitude of the back-wall echo to the value given by the curve for the variation of the back-wall echo amplitude and comparing the amplitude of the discontinuity echo with the characteristics curves of the 5 mm diameter flat bottomed hole. Only discontinuities for which the amplitude of the echo is greater than that of the characteristic curve shall be taken into account.

13 Scanning

13.1 General

Scanning shall be performed using contact pulse-echo techniques.

According to the requirement indicated in the order, the testing of the product is carried out according to one of the following scanning plans (see Figure 1) :

— plan A : Sounding of the ends of the web ;

— plan B : Sounding of the ends of the flanges ;

— plan C : Sounding of the complete web ;

— plan D : Sounding of the complete flanges.

or a combination of plans A, B, C and D.

Dimensions in millimetres

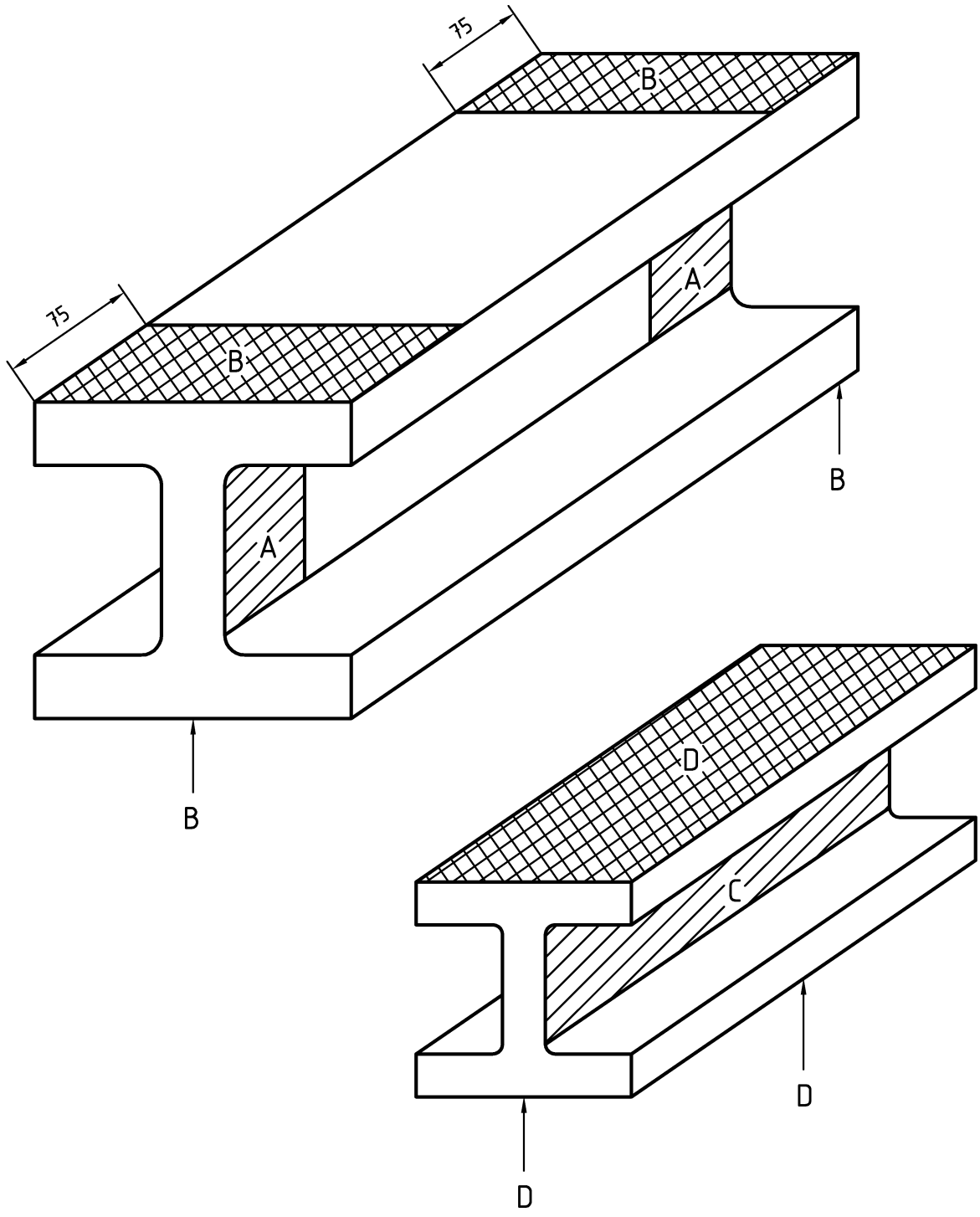

Figure 1 - Scanning plans

The probe may be :

— either hand-held ; or,

— mounted on a continuous testing apparatus with a scanning speed sufficiently low for the discontinuities to be located easily, taking into account the image retention of the screen ; or,

— fitted with a device which automatically indicates the discontinuity.

13.2 Testing of the beams

Scanning can be carried out following a sinusoidal pattern or zigzag line over the complete width of the flange or web ; the half wavelength or scan distance shall be adapted to suit the chosen quality class and shall under no circumstances be greater than 100 mm.

When required, the ends shall be tested up completely over a length of 75 mm and in addition areas awaiting welding or further machining.

Testing of the flange/web junction may only be undertaken subject to special agreement covering the test method, assessment procedure and criteria.

13.3 Scanning speed

Manual scanning speed shall not exceed 150 mm/s.

14 Evaluation of discontinuities

The procedure to be used shall be in accordance with EN 583-5 and with the following.

For discontinuities whose maximum echo amplitude is greater than that of the corresponding 5 mm flat-bottomed hole curve, the area shall be determined in accordance with 5 b).

Delineation consists of determining the area of the discontinuities identified, the contour of the discontinuity being defined by the positions of the centre of the probe corresponding to a defect echo height equal to half the maximum amplitude of the defect echo height of the discontinuity under consideration. Delineation of area is carried out with the same probe or a probe of the same operating conditions as those used for the detection of the discontinuity. For this, it is necessary to mark discontinuities as they are detected.

For the delineation of the discontinuity, the probe is moved in all directions. The width is the dimension determined perpendicularly to the rolling direction, the length is the dimension determined in the rolling direction. The area of the discontinuity is defined as the product of its length and its width. Two adjacent discontinuities shall be considered as forming a single discontinuity of area of the sum of the two, if the distance separating their contours is :

— equal to or less than the length of the smaller of the two for discontinuities in line ;

— equal to or less than the width of the smaller of the two for adjacent discontinuities.

15 Recording level and acceptance criteria

Several Quality Classes may be applied to H beams with parallel flanges and IPE beams. The applicable Quality Class(es) shall be agreed between the purchaser and supplier. Tables 1 and 2 detail recording level and acceptance criteria which shall be applied to Quality classes for normal probes.

Table 1 – Quality classes, recording level and acceptance criteria for testing of ends [a]

Quality class	Minimum width of discontinuity to be taken into consideration mm	Maximum permissible length of the discontinuity mm	Maximum permissible area of the discontinuity mm^2
1.1	20	75	1500
1.2	10	50	500
a See 13.1			

Table 2 – Quality classes, recording level and acceptance criteria for testing of the complete product length

Quality class	Minimum dimensions of the discontinuity to be taken into consideration[a]		Maximum permissible area of the discontinuity mm^2	Permissible frequency of acceptable discontinuities[b]	
	Width mm	Length mm		Local per square metre	Total average number per square metre of the area examined
2.1	20	100	6000	10	5
2.2	20	50	3000	10	5
2.3	10	25	1000	10	5
2.4	8	15	500	10	5
[a] The two dimensions shall be taken into account simultaneously.					
[b] Values to be taken into consideration for each sounding plan specified at the time of ordering.					

16 Test report

The test report shall include the following information as a minimum requirement :

a) name of supplier ;

b) order number ;

c) identification of product(s) under examination ;

d) scope of examination : Examination zones and applicable Quality Classes ;

e) stage of manufacture at which ultrasonic testing was performed ;

f) surface condition ;

g) equipment used (instrument, probes, calibration and reference blocks) ;

h) technique(s) used to set sensitivity ;

i) reference to this standard or reference to the written procedure used (where applicable) ;

j) results of examination : Location, classification of all discontinuities exceeding the appropriate recording level ;

k) details of any restrictions to the scanning coverage ;

l) date of examination ;

m) name, qualification and signature of operator.

Annex A
(informative)

List of equivalent terms in several European languages

English	French	German	Italian	Dutch
Time base	Base de temps	Zeitbasis	Base dei tempi	Tijdbasis
Noise signal	Bruit de fond	Rauschanzeige	Rumore di fondo	Ruis
Discontinuity echo	Echo de défaut	Fehlerecho	Eco del difetto	Foutecho
Back-wall echo	Echo de fond	Rückwandecho	Eco di fondo	Bodemecho
Probe	Traducteur	Prüfkopf	Sonda	Taster
Double transducer probe	Traducteur à émetteur et récepteur séparés	SE-Prüfkopf	Sonda ed emettitore e ricevitore separati (sonda doppia)	Dubbel-Kristaltaster
Transducer	Transducteur	Schwinger	Transduttore	Kristal
Flat-bottomed hole	Trou à fond plat	Flachbodenbohrung	Foro a fondo piatto	Vlakbodemgat

Bibliography

[1] EN 1330-1, *Non destructive testing - Terminology - Part 1: List of general terms*.

[2] EN 1330-2, *Non destructive testing - Terminology - Part 2: Terms common to the non-destructive testing methods.*

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