

SLOVENSKI STANDARD

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Neporušitveno preskušanje jeklenih izkovkov - 4. del: Ultrazvočno preskušanje avstenitnih in avstenitno-feritnih nerjavnih jeklenih izkovkov

Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings

Zerstörungsfreie Prüfung von Schmiedestücken aus Stahl - Teil 4: Ultraschallprüfung von Schmiedestücken aus austenitischem und austenitisch-ferritischem nichtrostendem Stahl
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Essais non destructifs des pièces forgées en acier - Partie 4 : Contrôle par ultrasons des pièces forgées en aciers inoxydables austénitiques et austéno-ferritiques
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EUROPEAN STANDARD

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Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings

Essais non destructifs des pièces forgées en acier -
Partie 4: Contrôle par ultrasons des pièces forgées en
aciers inoxydables austénitiques et austéno-ferritiques

Zerstörungsfreie Prüfung von Schmiedestücken aus
Stahl - Teil 4: Ultraschallprüfung von Schmiedestücken
aus austenitischem und austenitisch-ferritischem
nichtrostendem Stahl

This European Standard was approved by CEN on 3 October 2015.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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EN 10228-4:2016 (E)**European foreword**

This document (EN 10228-4:2016) has been prepared by Technical Committee ECISS/TC 111 “Steel castings and forgings”, 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of an identical text or by endorsement, at the latest by December 2016 and conflicting national standards shall be withdrawn at the latest by December 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10228-4:1999.

Annex C provides the significant technical changes to the previous version EN 10228-4:1999.

EN 10228 consists of the following parts under the general title *Non-destructive testing of steel forgings*:

- *Part 1: Magnetic particle inspection;*
- *Part 2: Penetrant testing;*
- *Part 3: Ultrasonic testing of ferritic or martensitic steel forgings;*
- *Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings.*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard describes techniques for the manual, pulse-echo, ultrasonic testing of forgings manufactured from austenitic and austenitic-ferritic stainless steels. Mechanized scanning techniques, such as immersion testing, may be used but should be agreed between the purchaser and supplier (see Clause 4).

This part of EN 10228 applies to four types of forgings, classified according to their shape and method of production. Types 1, 2 and 3 are essentially simple shapes. Type 4 covers complex shapes.

This part of EN 10228 does not apply to:

- closed die forgings;
- turbine rotor and generator forgings.

Ultrasonic testing of ferritic and martensitic steel forgings is the subject of Part 3 of this European Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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*

EN ISO 2400, *Non-destructive testing - Ultrasonic testing - Specification for calibration block No. 1 (ISO 2400)*

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 16811, *Non-destructive testing - Ultrasonic testing - Sensitivity and range setting (ISO 16811)*

EN ISO 16827, *Non-destructive testing - Ultrasonic testing - Characterization and sizing of discontinuities (ISO 16827)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1330-1 and EN 1330-4 apply.

EN 10228-4:2016 (E)**4 Mandatory information**

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 9);
- b) the volume(s) to be tested and whether grid scanning coverage or 100 % scanning coverage is required (see Clause 12);
- c) whether near surface testing is required (see 7.2.6);
- d) the quality class required, or the quality classes and the zones to which they apply (see Clause 14);
- e) the applicable recording/acceptance criteria if different from those detailed in Table 5, Table 6 or Table 7;
- f) whether any special scanning coverage, equipment or couplant is required in addition to that detailed in Clauses 7 and 12;
- g) the scanning technique to be used if not manual (see Clause 1);
- h) the sizing techniques to be used for extended discontinuities (see Clause 15);
- i) the technique(s) to be used for setting sensitivity (see Clause 11);
- j) whether the test shall be conducted in the presence of the purchaser or his representative;
- k) whether a written procedure shall be submitted for approval by the purchaser (see Clause 5);
- l) whether testing by angle-beam probes is required (see 11.3);
- m) the remaining test requirements for complex forgings (type 4) (see 12.2).

5 Test procedure**5.1 General**

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

5.2 Form

The written test procedure shall be one of the following:

- a) a product specification;
- b) a test procedure written specifically for the application;
- c) this part of EN 10228 may be used if it is accompanied by examination details specific to the application.

5.3 Content

The written test procedure shall contain the following details as minimum requirements:

- a) description of the forgings to be tested;
- b) reference documents;
- c) qualification of testing operator;
- d) stage of manufacture at which the test is carried out;
- e) testing zones specified in terms of the applicable quality classes;
- f) preparation of scanning surfaces;
- g) couplant;
- h) description of the test equipment;
- i) calibration and checking of the test equipment;
- j) scanning plan;
- k) description and sequence of testing operations;
- l) recording levels;
- m) characterization of discontinuities;
- n) acceptance criteria;
- o) test report.

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6 Personnel qualification

Personnel shall be qualified in accordance with the requirements detailed in EN ISO 9712.

7 Equipment and accessories

7.1 Instrument

The ultrasonic instrument shall feature A-scan presentation and shall conform to EN 12668-1.

7.2 Probes

7.2.1 General

Probes used for the initial detection of discontinuities shall conform to EN 12668-2. Where supplementary probes are used for purposes other than the initial detection of discontinuities, they need not conform to EN 12668-2.

EN 10228-4:2016 (E)**7.2.2 Contouring**

When required, probes shall be contoured in accordance with EN ISO 16811.

7.2.3 Nominal frequency

Probes shall have a nominal frequency in the range from 0,5 MHz to 6 MHz.

7.2.4 Normal-beam probes

Effective transducer diameter shall be in the range from 10 mm to 40 mm.

7.2.5 Angle-beam probes

For the transverse waves, the angle-beam probes shall be in the range from 35° to 70°.

Effective transducer area shall be in the range from 20 mm² to 625 mm².

7.2.6 Dual-element probes

If near-surface testing is required, then dual-element probes shall be used.

7.3 Calibration blocks

Calibration blocks shall conform to the requirements detailed in EN ISO 2400.

7.4 Reference blocks

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Reference blocks shall be used when sensitivity shall be established by the distance-amplitude curve (DAC) technique and/or when discontinuities shall be sized in terms of amplitude relative to reference reflectors by the DAC technique. The surface condition of the reference block shall be representative of the surface condition of the object to be tested. Unless otherwise specified the reference block shall contain at least three reflectors covering the entire depth range being tested.

The reference block shall be manufactured from one of the following:

- a) an excess length of the object to be tested;
- b) a part of the same material and with the same heat treatment condition as the object to be tested;
- c) a part having similar acoustic properties to the object to be tested.

The choice of a test block with similar acoustic properties should be to the appreciation of a Level 2 qualified person.

Reference blocks shall not be used for the distance-gain-size (DGS) technique other than for checking the accuracy of a particular DGS diagram.

Reflector sizes different from those detailed in Tables 5 and 6 may be used as long as the test sensitivity is corrected accordingly.

7.5 Couplant

The same type of couplant shall be used for the setting of range and sensitivity, for scanning and for the assessment of discontinuities.

NOTE Examples of suitable couplants are: water (with or without corrosion inhibitor or softener), grease, oil, glycerol and water cellulose paste.

After the test, couplant shall be removed if its presence could adversely affect later manufacturing or testing operations or the integrity of the test object.

8 Routine calibration and checking

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

9 Stage of manufacture

Ultrasonic testing shall be performed after the final heat treatment unless otherwise agreed at the time of enquiry or order (see Clause 4), e.g. at the latest possible stage of manufacture for areas of the forging which are not practicable to test after the final heat treatment.

For both cylindrical and rectangular forgings, which shall be bored, it is recommended to carry out ultrasonic testing before boring.

10 Surface condition

10.1 General

Surfaces to be scanned 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. (standards.iteh.ai)

10.2 Surface finish related to quality class

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In the machined condition, for testing to quality classes 1 and 2, a surface finish corresponding to a roughness $R_a \leq 12,5 \mu\text{m}$ shall be produced and for testing of quality class 3, a surface finish corresponding to a roughness $R_a \leq 6,3 \mu\text{m}$ shall be produced.

Table 1 — Surface finish related to quality class^a

Surface finish	Quality class and roughness R_a		
	1	2	3
	$\leq 12,5 \mu\text{m}$		$\leq 6,3 \mu\text{m}$
Machined	X		X
^a "X" signifies the quality class that can be achieved in machined conditions.			

10.3 As-forged surface condition

Where forgings are supplied in the as-forged surface condition they shall be considered acceptable providing the specified quality class can be achieved. When it is not practical to perform a comprehensive test on as-forged surfaces, shot blasting, sand blasting or surface grinding shall be used to ensure that acoustic coupling can be maintained.

NOTE Only quality class 1 is normally applicable.