SLOVENSKI STANDARD
SIST EN 4050-3:2014

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Aeronavtika - Metode za preskušanje kovinskih materialov - Ultrazvočno preskušanje palic, plošč, kovnih materialov in izkovkov - 3. del: Referenčni ingoti

Aerospace series - Test method for metallic materials - Ultrasonic inspection of bars, plates, forging stock and forgings - Part 3: Reference blocks

Luft- und Raumfahrt - Prüfverfahren für metallische Werkstoffe - Ultraschallprüfung von Stangen, Platten, Schmiedevormaterial und Schmiedestücken - Teil 3: Referenzblöcke

Série aérospatiale - Méthode d'essai applicable aux matériaux métalliques - L'inspection par ultrasons des barres, des plaques, des stocks de forgeage et de pièces forgées - Partie 3: Blocs de référence

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Aerospace series - Test method for metallic materials - Ultrasonic inspection of bars, plates, forging stock and forgings - Part 3: Reference blocks

Série aérospatiale - Méthode d'essai applicable aux matériaux métalliques - L'inspection par ultrasons des barres, des assiettes, des stocks de forgeage et de pièces forgées - Partie 3: Blocs de référence

Luft- und Raumfahrt - Prüfverfahren für metallische Werkstoffe - Ultraschallprüfung von Stangen, Platten, Schmiedevormaterial und Schmiedestücken - Teil 3: Referenzblöcke

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Foreword

This document (EN 4050-3:2012) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

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of an identical text or by endorsement, at the latest by March 2013, and conflicting national standards shall be withdrawn at the latest by March 2013.

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According to the CEN/CENELEC Internal Regulations, the national standards organisations 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 specifies the requirements for the manufacture, checking and marking of the series of ultrasonic testing reference blocks containing flat bottom holes (FBH) which define the indicated defect size to which reference is made in EN standards.

2 Generality

The application of ultrasonic testing reference blocks containing side-drilled holes (SDH) which define an indicated defect size shall be agreed between manufacturer and purchaser.

This standard is applicable to the production of master and standard test blocks to be used when carrying out ultrasonic inspection to the requirements of EN 4050-1 (FBH method).

It is recognised that particular difficulties are encountered with round forging stock and bars due to the wide range of curvatures. For this application, only one block shall be produced to act as both master and standard test block.

3 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 2278, *Steel FE-PM 37 — 900 MPa ≤ R_m ≤ 1100 MPa — Bars D_e ≤ 150 mm — Aerospace series*[1)]

EN 2321, *Aluminium alloy 2024-T3 — Bars and section a ≤ 150 mm — Aerospace series*[1)]

EN 3311, *Aerospace series — Titanium alloy TI-64001 — Annealed — 900 MPa ≤ R_m ≤ 1 160 MPa — Bar for machining — D_e ≤ 150 mm*[2)]

EN 4050-1, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of bars, plates, forging stock and forgings — Part 1: General requirements*

EN 4050-2, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of bars, plates, forging stock and forgings — Part 2: Performance of test*

EN 4050-4, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of bars, plates, forgings stock and forgings — Part 4: Acceptance criteria*

ASTM E 127, *Standard practice for fabricating and checking aluminium alloy ultrasonic standard reference blocks*[3)]

4 Terms and definitions

See EN 4050-1.

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1) Published as ASD-STAN Standard at the date of publication of this standard.

2) Published as ASD-STAN Prestandard at the date of publication of this standard.

3) Published by: American Society for Testing and Materials (ASTM) 1916 Race Street, Philadelphia, PA.

5 Master test blocks

5.1 Materials

The materials for master test blocks are given in Table 1.

Table 1

Alloy class	Representative (alloy AECMA designation)		Typical application for	Standard FBH ∅ (mm)[1)]	Correction for attenuation
	Old	New			
A	2024 (EN 2321)	AL-P2024-	Aluminium alloys	0,8	no
B1	FE-PM37 (EN 2278)	FE-PM1502	Nickel-cobalt alloys (grain size ASTM 5 or finer) Martensitic stainless steels P.M. super alloys	0,4	no
B2	FE-PM37 (EN 2278)	FE-PM1502	Nickel-cobalt alloys (grain size ASTM 4 or coarser) Austenitic steels	1,2	yes
C	TI-P63	TI-P64001 (EN 3311)	Titanium or Titanium alloys	0,8	yes

1) Where long metal paths make the standard FBH quoted above impractical then larger sized FBH's shall be used with agreement between manufacturer and purchaser and shall be referenced on the order or in an inspection schedule.

5.2 Flat bottom holes standards

Flat bottom holes in the master test blocks shall be used to calibrate standard test blocks. The master test blocks shall have FBH at different metal paths to suit the product range to be inspected. It shall be ensured however that there is sufficient number with a minimum of three different metal paths to accurately produce the required distance/amplitude curve (see 5.4.2.2).

5.3 Manufacture

5.3.1 Material procurement

Material for each set of master test blocks shall be obtained from the same cast, forging and heat treatment batch.

For longitudinal waves when checking anisotropic materials, the FBH shall be drilled perpendicular to the grain flow, if possible, but always perpendicular to the surface.

Ultrasonic tests shall be carried out on each test block to ensure:

— freedom from defects greater than or equal to – 12 dB below the DAC (see EN 4050-1);

— consistent grass level across each test block and between master test blocks in the vicinity of the FBH. Maximum variation ± 3 dB;

— consistent attenuation across each test block and between master test blocks not to exceed 0,1 dB/cm variation.

5.3.2 Machining

5.3.2.1 Procedures

The machining route shall be initially qualified as meeting the geometric tolerance requirements of ASTM E 127. Changes in the machining route shall not be made without reference to the responsible Level 3 NDT person.

Upon completion of the drilling operations, clean the hole bottom with a suitable cleaning fluid and dry with a fine stream of dried, filtered, compressed air blown through a capillary tube inserted in the hole. Apply injection for small diameters (∅ ≤ 1,2 mm).

After drilling the holes, these shall be plugged. Care shall be taken that a sufficient air gap subsists between plug and the bottom of the hole.

If the hole has to be counterbored to permit this sealing (small standards), a minimum distance of 5 mm is required between the bottom of the counterbore and that of the actual hole. This hole of bigger diameter can also be drilled before to make it easier for the drilling of the smallest standard and/or plugged with a T-thread nylon screw with its countersunk head slightly underflush.

The FBH geometry of the master test block shall be such as to ensure that the amplitude values during the machine qualification will be achieved within an accuracy of ± 3 dB.

5.3.2.2 Tolerances

FBH shall normally be drilled to a minimum remaining metal path of 3 mm and to a tolerance of ± 3 % of diameter. Where low frequencies are used (e.g. 2 MHz), the minimum metal path shall be increased up to 7 mm. Other depths shall be agreed upon by the purchaser and manufacturer.

The FBH interface shall be parallel to the ultrasonic entry face within 1 % of hole diameter and shall be perpendicular to its longitudinal axis, within 0,05 mm per 10 mm depth.

The radius between the FBH interface and the hole cylinder shall be ≤ 5 % of hole diameter.

If more than one hole is to be drilled in a test block, then adjacent holes shall be separated by a distance of not less than 40 mm.

No hole shall be closer than 20 mm to an edge.

Both end faces of the blocks shall be parallel to each other within 0,05 mm and the external surface shall be free from damage and have a surface roughness R_a < 0,8 µm.

Not all tolerances can be measured in the master test blocks. Statistical or destructive method shall be applied to verify the accuracy.

5.3.3 Identification

Each master test block shall be identified and have a serial number followed by the alloy class number or alloy designation.

The permanent marking shall be on the side wall of the test block. The marking shall stipulate the hole diameter(s) in millimetres followed by an oblique and the metal path(s) in millimetres.

5.4 Checking

5.4.1 Electronic equipment

Basic requirements for testing the equipment shall be in accordance with EN 4050-2.

Distance/amplitude curves shall be plotted using the immersion technique preferably with a non focused probe in a range of 5 MHz to 10 MHz, whose diameter shall not be less than 12,5 mm and using a water gap $\geq 1\ N$. N is the near field.

5.4.2 Checking procedures

5.4.2.1 Checking geometric characteristics

At the initial drilling qualification and on the finished master test blocks, geometric characteristics shall be verified and acceptable to the requirements of ASTM E 127.

5.4.2.2 Checking ultrasonic response characteristics

The ultrasonic response from the flat bottom holes of a given set of master test blocks shall be verified by:

— comparison with the amplitude obtained from a set of master test blocks in the same material applying suitable compensations;

— evaluation using the DGS system;

— destructive measurements and statistical techniques.

The method to be used shall be agreed between the manufacturer and the purchaser and shall be recorded on the order or inspection schedule.

6 Standard test blocks

6.1 Material recommended

The materials, mentioned in Table 1, are recommended for standard test blocks. Other materials shall be agreed between manufacturer and purchaser.

6.2 FBH standard

FBH sizes shall be used in accordance with the applicable class of EN 4050-4. Metal paths shall suit the product range to be inspected.

6.3 Manufacture

6.3.1 Material procurement

Material for each set of standard test blocks shall be obtained from the same cast, forging and heat treatment batch.

For longitudinal waves, checking anisotropic materials, the FBH shall be drilled perpendicular to the grain flow, if possible, but always perpendicular to the surface.

Ultrasonic test shall be carried out on each test block to ensure: