SLOVENSKI STANDARD
SIST EN 10045-2:1996

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Kovinski materiali - Udarni preskus po Charpyju - 2. del: Preverjanje preskuševalnega stroja (udarec z nihalom)

Metallic materials - Charpy impact test - Part 2: Verification of the testing machine (pendulum impact)

Metallische Werkstoffe - Kerbschlagbiegeversuch nach Charpy - Teil 2: Prüfung der Prüfmaschine (Pendelschlagwerk)

Matériaux métalliques - Essai de flexion par choc sur éprouvette Charpy - Partie 2: Vérification de la machine d'essai (mouton-pendule)

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CEN

European Committee for Standardization
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Central Secretariat: rue de Stassart,36 B-1050 Brussels

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Foreword

This European Standard has been prepared by ECISS/TC 1A "Mechanical physical tests" the secretariat of which is held by AFNOR.

At its meeting on 25 and 26 January 1990, the TC agreed to publish this text as prEN (yellow proof).

The following member bodies were represented at this meeting : Belgium, France, Germany, Italy, Luxembourg, Netherlands, Portugal, United Kingdom and also the BCR.

At its meeting on 20th June 1991, the TC agreed to submit this document to the COCOR for approval (white proor).

The Coordinating Commission (COCOR) of ECISS agreed on 1991-11-27/28 to submit this draft European Standard to the CEN formal vote.

The document was approved by CEN and according to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard :

Austria, Belgium, Danemark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Introduction

The European Standard EN 10045 concerns metallic materials - Charpy impact test and comprises the following parts.

Part 1: Method of test
Part 2: Verification of pendulum impact testing machines

1. SCOPE

This European standard applies to the verification of (pendulum) impact testing machines used for the Charpy impact test as described in EN 10045/1. It describes 2 methods :

- the direct method allowing the physical and geometrical properties of the different parts of the testing machine to be verified statically and separately,

- the indirect method : global verification method of the pendulum impact testing machine using Charpy V reference test pieces as specified in 6.2.

The direct method shall be used, firstly, when the machine is being installed or repaired and, secondly, if the indirect method gives an incorrect result (see 8.1), in order to find the reason for this.

This standard is also applicable to reference pendulum impact testing machines, the geometrical characteristics of which are defined in Annex B.

This standard is also applicable to pendulum impact machines of different capacities or different design.

The pendulum impact testing machine verified in accordance with this standard and assessed as satisfactory are considered as valid to carry out impact testing with notches of different types.

The apparatus used for the direct method shall have a certified traceability relative to the SI system of units.

Annex A describes, for information purposes, a direct method of verifying certain geometrical properties using a jig.

Annex B describes, for information purposes, a guide to the preparation of reference test pieces and their characteristics.

2. NORMATIVE REFERENCES

This european standard incorporates by dated and 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.

EN 10045/1 : Metallic materials - Charpy impact test - Part 1 : Test method.

3. DEFINITIONS

For the purposes of this European standard, the following definitions shall apply :

3.1 Industrial pendulum impact testing machine

Pendulum impact testing machine used for industrial or laboratory tests, on metallic materials ; these machines shall not be used for determining reference values (see 3.13).

3.2 Reference pendulum impact testing machine

Pendulum impact testing machine used for determining reference values. The requirements for verification of this type of machine are stricter than those for industrial machines (see B 3.1).

3.3 Anvils

Part of the machine forming a vertical plane which holds the test piece when it is broken. The plane of the anvils is perpendicular to the plane of the supports (see figure 1).

3.4 Supports

Part of the machine forming a horizontal plane on which rests a test piece before it is broken by a hammer. The plane of the supports is perpendicular to the plane of the anvils (see figure 1).

3.5 Striker

Part of the hammer which is contact with the test piece.

3.6 Centre of striker

The point on the striking edge of the pendulum which, when the pendulum is released, meets the horizontal plane over half the test piece.

3.7 Centre of percussion

The point on a body where, on impact, the percussion action is the same as if the total mass of the body were concentrated at this point. When a pendulum hammer strikes a blow in a horizontal line passing through the centre of percussion, there shall be no resultant action on the axis of rotation (see figure 2).

3.8 Rated initial potential energy (Rated energy) A_N

Energy attributed by the designer of the pendulum hammer.

3.9 Effective initial potential energy (Potential energy) Ap

The value determined by direct verification.

3.10 Indicated absorbed energy (Indicated energy) As

The value of the energy indicated by the pointer or read from the indicator.

3.11 Effective energy absorbed (Energy absorbed) Av

The total energy required to break a test piece when it is tested on a pendulum impact testing machine. It is equal to the difference in potential energy between the initial position of the pendulum and the end of the first half-swing during which the test piece is broken.

3.12 Reference test piece

Impact test piece used to verify the compliance of a pendulum hammer by comparison of the energy absorbed by the machine with the reference value supplied with the test pieces.

3.13 Reference value

Value of the energy absorbed, supplied with the reference test pieces and determined by test on reference pendulum impact testing machines.

3.14 Geometry of the test piece

The test piece being placed on the supports in the test position :

- height : distance between the notched face and the opposite face
- width : dimension perpendicular to the height that is parallell to the notch.
- lenght : largest dimension at right angles to the notch.

3.15 Base of the frame

Part of the machine framework located below the horizontal plane of the supports.

4. SYMBOLS AND DESIGNATIONS

For the purposes of this European Standard, the symbols and définitions given in table 1 are applicables :

Tableau 1

Symbols (1)	Unit	Définitions
A_N	J	Rated initial potential energy (rated energy)
A_P	J	Effective initial potential energy (potential energy)
A_s	J	Indicated absorbed energy (indicated energy)
A_V	J	Effective energy absorbed (energy absorbed)
F	N	Force exerted by the pendulum on the force-proving device for distance l_2
F_1	N	Weight of pendulum
L	m	Distance between the center of the striker and the axis of rotation of the pendulum (lenght of the pendulum)
ℓ	m	Distance between the centre of gravity of the pendulum and the axis of rotation
ℓ_1	m	Distance between the centre of percussion and the axis of rotation
ℓ_2	m	Distance between the point of application of force F and the axis of rotation
P	J	Friction losses due to the drag of the pointer
P'	J	Friction losses resulting from air resistance and bearing friction
P_β	J	Correction of the energy losses for a rise angle
t	s	Period of swing of the pendulum
T	s	Total duration of 100 swings of the pendulum
T_M	s	Maximum value of T
T_m	s	Minimum value of T
α	°	Fall angle
β	°	Rise angle
E	J	Value of the energy absorbed from the batch of Charpy V reference test pieces
E_{BCR}	J	Certified energy value from the batch of BCR test pieces

(1) See figures 2 and 3

5. DIRECT VERIFICATION OF THE PENDULUM IMPACT TESTING MACHINE

This verification relates to the following points :

- machine framework,
- pendulum,
- framework/pendulum position,
- test piece supports and anvils,
- position of centre of percussion,
- energy indicator,
- initial potential energy,
- indicated energy error,
- friction losses,
- impact velocity.

5.1 Machine framework

- The foundation of the pendulum impact testing machine cannot normally be verified once the machine has been installed. Consequently, the documentation prepared when the machine is installed shall prove that the mass of the foundation is at least 40 times that of the pendulum which shall also be given in the documentation.

  Note : For machines manufactured after the publication of this standard, it is recommended that the mass of the pedestal of the machine should be at least 12 times the mass of the pendulum.

- Verification of the pendulum impact testing machine shall comprise :

  a) verification that the tightening of the bolts complies with that specified by the manufacturer. This value shall be indicated on the documentation provided by the manufacturer.

  b) verification that the pendulum impact testing machine is not subject to any external vibration transmitted by the foundation.

  Note : This may be done, for example, by placing a container of water on the machine framework and checking that there are no ripples on the surface of the water.

5.2 Pendulum

The width of the striker shall be between 10 and 18 mm.

The dimensions of the striker shall be verified using jigs. The angle of the tip of the striker shall be 30° ± 1°, and the radius of curvature of the striking edge shall be

$$2\ ^{+0.5}_{0}\ \text{mm}$$

The angle between the line of contact of the striker and horizontal axis of the test pieces shall be 90° ± 2°.

Note : One possible method of verification is as follows :

Wrap a test piece 55 mm long and of cross-section 10 x 10 mm tightly in a thin sheet of paper and place the test piece on the test piece holder. Also wrap the striking edge in carbon paper, the carbon side facing outwards,. Move the pendulum a few degrees from its equilibrium position and drop it on the test piece, ensuring that it does not make a second contact with the test piece. The mark by the carbon paper on the paper the test piece is wrapped in makes it possible to measure its orientation in relation to the horizontal axis of the test piece. This test may be carried out jointly with verifying the contact of the test piece over its whole length (see 5.3).

The mechanism for releasing the pendulum from its initial position shall be capable of operating freely and releasing the pendulum without any initial jerk, delay or transverse vibration. If this mechanism also includes a braking system, means shall be provided to prevent the brake being applied accidentally.

5.3 Framework/pendulum position

The machines shall have a reference plane on the basis of which the measurements can be taken.

The machine shall be installed so that the reference plane is horizontal to within 2/1000.

The axis of rotation of the pendulum shall be parallel to the reference plan to within 2/1000. This shall be certified by the manufacturer of the machine.

For machines without a reference plane, the axis of rotation shall be horizontal to within 4/1000. This shall be verified by direct measurement, unless a reference plane can be machined on the machine and then the above requirement shall be met.

When free, the pendulum shall hang so that the striking edge is ± 0,5 mm from the point at which the edge touches the test piece.

Note : This may be verified by means of a bar approximately 55 mm long and of rectangular cross-section : height 9,5 mm and width approximately 10 mm. The distance between the striking edge and the bar is measured.

The pendulum shall swing in a plane perpendicular to the axis of rotation to within 3/1000.

The striking edge shall be in contact with the test piece along the whole width of the test piece.

Note : One possible method of verification is that described in 5.2 for verifying the angle between the striker contact and the horizontal axis of the test piece.

The pendulum shall be positioned so that the centre of the striking edge coincides with the median plane, to within ± 0,5 mm between the test piece anvils.

The transverse play of the pendulum bearings, measured at the striker, shall not exceed 0,25 mm when a transverse force of approximately 4 % of the mass of the pendulum is applied to the centre of the striker.

The radial play of the pendulum bearing shall not exceed 0,08 mm when a force of 150 N ± 10 N is applied at a distance L perpendiculary to the plane of swing of the pendulum.

Note : The radial play may be measure, for example, by placing a dial gauge on the framework in order to indicate the movement at the end of the shaft at the point closest to the bearings.

5.4 Test piece supports and anvils

The supports shall lie in one and the same plane : the distance between the support planes shall never exceed 0,1 mm.

The supports shall be such that the axis of the test piece is parallel to the axis of rotation of the pendulum to within 3/1000.

The anvils shall lie in one and the same plane ; the distance between the two planes shall never exceed 0,1 mm.

The angle between this plane and the plane of the supports shall be 90° ± 0,10°.

The distance between the anvils shall be : $40^{+0,20}_{0}$ mm

The radius of curvature of the anvils shall be $1^{+0,5}_{0}$ mm

The angle of taper of the anvils shall be 11 ° ± 1°.

5.5 Clearance between anvils and pendulum

Sufficient clearance shall be provided so as to ensure that the broken parts of the test piece are free to fall from the machine with a minimum of interference and without rebounding onto the hammer before the pendulum has completed its swing. No part of the pendulum which passes between the anvils shall be thicker than 18 mm.

Two types of hammer are generally used. The C-shaped and U-shaped hammer (see figure 4).

For the C-shaped hammers, the broken parts of the test piece will not rebound onto the hammer if the play at each end of the test piece exceeds 13 mm.