INTERNATIONAL STANDARD

ISO 148-1

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Metallic materials — Charpy pendulum impact test —

Part 1: Test method

Matériaux métalliques — Essai de flexion par choc sur éprouvette Charpy —

Partie 1: Méthode d'essai

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 148-1 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Toughness testing — Fracture (F), Pendulum (P), Tear (T)*.

This first edition of ISO 148-1 cancels and replaces ISO 148:1983 and ISO 83:1976, which have been technically revised.

ISO 148 consists of the following parts, under the general title *Metallic materials — Charpy pendulum impact test*:

— *Part 1: Test method*

— *Part 2: Verification of test machines*

— *Part 3: Preparation and characterization of Charpy V reference test pieces for verification of test machines*

Metallic materials — Charpy pendulum impact test —

Part 1: Test method

1 Scope

This part of ISO 148 specifies the Charpy pendulum impact (V-notch and U-notch) test method for determining the energy absorbed in an impact test of metallic materials.

This part of ISO 148 does not address instrumented impact testing, which is specified in ISO 14556.

2 Normative references

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

ISO 148-2:1998, *Metallic materials — Charpy pendulum impact test — Part 2: Verification of test machines*

ISO 286-1, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Energy

3.1.1
actual initial potential energy
potential energy
K_p
value determined by direct verification

[ISO 148-2:1998 definition 3.2.2]

3.1.2
absorbed energy
K
energy value indicated by the pointer or other readout device

NOTE The letter V or U is used to indicate the notch geometry, that is: KV or KU. The number 2 or 8 is used as a subscript to indicate striker radius, that is KV_2 for example.

3.2 Test piece

With the test piece placed in the test position on the supports of the machine, the following nomenclature shall apply (see Figure 1).

3.2.1
height
h
distance between the notched face and the opposite face

3.2.2
width
w
dimension perpendicular to the height that is parallel to the notch

3.2.3
length
l
the largest dimension at right angles to the notch

4 Symbols (and abbreviated terms)

The designations applicable to this part of ISO 148 are indicated in Tables 1 and 2, and are illustrated in Figure 2.

Table 1 — Symbols and their unit and designation

Symbol	Unit	Designation
K_p	J	Actual initial potential energy (potential energy)
FA	%	Shear-fracture appearance
h	mm	Height of test piece
KU_2	J	Absorbed energy for a U-notch test piece using a 2 mm striker
KU_8	J	Absorbed energy for a U-notch test piece using an 8 mm striker
KV_2	J	Absorbed energy for a V-notch test piece using a 2 mm striker
KV_8	J	Absorbed energy for a V-notch test piece using a 8 mm striker
LE	mm	Lateral expansion
l	mm	Length of test piece
T_t	°C	Transition temperature
w	mm	Width of test piece

5 Principle

This test consists of breaking a notched test piece by a single blow from a swinging pendulum, under the conditions defined hereafter. The notch in the test piece has specified geometry and is located in the middle between two supports, opposite to the location that is struck in the test. The energy absorbed in the impact test is determined.

Because the impact values of many metallic materials vary with temperature, tests are made at specified temperatures. When this temperature is other than ambient, the test piece shall be heated or cooled to that temperature, under controlled conditions.

6 Test pieces

6.1 General

The standard test piece shall be 55 mm long and of square section with 10 mm sides. In the centre of the length there shall be either a V-notch or a U-notch, as described in 6.2.1 and 6.2.2.

If the standard test piece cannot be obtained from the material, one of the subsidiary test pieces having a width of 7,5 mm, 5 mm or 2,5 mm (see Figure 2 and Table 2) shall be used.

NOTE For low energies, the use of shims is important, as excess energy will be absorbed by the pendulum. For high energies, this might not be important. Shims may be placed on or under the test piece supports so that the mid-height of the specimen is 5 mm above the 10 mm specimen-support surface.

The test pieces shall have a surface roughness better than Ra 5 µm except for the ends.

When a heat-treated material is being evaluated, the test piece shall be finish-machined, including notching, after the final heat treatment, unless it can be demonstrated that there is no difference when machined prior to heat treatment.

6.2 Notch geometry

The notch shall be carefully prepared so that the root radius of the notch is free of machining marks that could affect the absorbed energy.

The plane of symmetry of the notch shall be perpendicular to the longitudinal axis of the test piece (see Figure 2).

6.2.1 V-notch

The V-notch shall have an included angle of 45°, a depth of 2 mm, and a root radius of 0,25 mm [see Figure 2 a) and Table 2].

6.2.2 U-notch

The U-notch shall have a depth of 5 mm (unless otherwise specified) and a root radius of 1 mm [see Figure 2 b) and Table 2].

6.3 Tolerance of the test pieces

The tolerances on the specified test piece and notch dimensions are shown in Figure 2 and Table 2.

6.4 Preparation of the test pieces

Preparation shall be carried out in such a way that any alteration of the test piece, for example, due to heating or cold working, is minimized.

6.5 Marking of the test pieces

The test piece may be marked on any face not in contact with supports, anvils or striker and at a position that avoids the effects of plastic deformation and surface discontinuities on the absorbed energy measured in the test (see 8.7).

7 Test equipment

7.1 General

The equipment used for all measurements shall be traceable to national or International standards. They shall be calibrated within suitable intervals.

7.2 Installation and verification

The testing machine shall be installed and verified in accordance with ISO 148-2.

7.3 Striker

The striker geometry shall be specified as being either the 2 mm striker or the 8 mm striker. It is recommended that the striker radius be shown as a subscript as follows: KV_2 or KV_8.

Refer to the product specification for striker geometry guidance.

NOTE Some materials may give significantly different results (percent difference) at low energy levels, and the 2 mm results can be higher than the 8 mm results.

8 Test procedure

8.1 General

The test piece shall lie squarely against the anvils of the test machine, with the plane of symmetry of the notch within 0,5 mm of the midplane between the anvils. It shall be struck by the striker in the plane of symmetry of the notch and on the side opposite the notch (see Figure 1).

8.2 Test temperature

8.2.1 Unless otherwise specified, tests shall be made at (23 ± 5) °C. When a temperature is specified, the test piece shall be conditioned to that temperature within ± 2 °C.

8.2.2 For conditioning, either heating or cooling, using a liquid medium, the test piece shall be positioned in a container on a grid that is at least 25 mm above the bottom of the container and covered by at least 25 mm of liquid and at least 10 mm from the sides of the container. The medium shall be constantly agitated and brought to the specified temperature by any convenient method. The device used to measure the temperature of the medium should be placed in the centre of the group of test pieces. The temperature of the medium shall be held at the specified temperature within ± 1 °C for at least 5 min.

NOTE When a liquid medium is near its boiling point, evaporative cooling can dramatically lower the test-piece temperature during the interval between removal from the liquid and fracture (see reference [4] in the Bibliography).

8.2.3 For the test at elevated temperatures of not more than 200 °C, the test piece shall be kept at a constant temperature for at least 10 min in a liquid bath maintained at the specified temperature within ± 2 °C. For the test at elevated temperatures over 200 °C, the test piece shall be kept at a constant temperature for at least 20 min in an oven maintained at the specified temperature within ± 5 °C.

8.3 Specimen transfer

When testing is performed at other than ambient temperature, not more than 5 s shall pass from the time the test piece is removed from the heating or cooling medium and it is struck by the striker.

The transfer device shall be designed and used in such a way that the temperature of the test piece is maintained within the temperature range permitted.

The parts of the device in contact with the specimen during transfer from the medium to the machine shall be conditioned with the specimens.

Care should be taken to ensure that the device used to centre the test piece on the anvils does not cause the fractured ends of low-energy, high-strength test pieces to rebound off this device into the pendulum and cause erroneously-high indicated energy. It has been shown that clearance between the end of a test piece in the test position and the centring device, or a fixed portion of the machine, shall be greater than approximately 13 mm or else, as part of the fracture process, the ends may rebound into the pendulum.

NOTE Self-centring tongs, similar to those for V-notched test pieces shown in Annex A, are often used to transfer the test piece from the temperature-conditioning medium to the proper test position. Tongs of this nature eliminate potential clearance problems due to interference between the fractured specimen halves and a fixed centring device.

8.4 Exceeding machine capacity

The absorbed energy, K, should not exceed 80 % of the actual initial potential energy, K_p. If the absorbed energy exceeds this value, the absorbed energy shall be reported as approximate and it shall be noted in the test report that it exceeded 80 % of the machine capacity.

NOTE Ideally, an impact test would be conducted at a constant impact velocity. In a pendulum-type test, the velocity decreases as the fracture progresses. For specimens that have impact energies approaching the capacity of the pendulum, the velocity of the pendulum decreases during fracture to the point that accurate impact energies are no longer obtained.

8.5 Incomplete fracture

If a test piece is not completely broken in a test, the impact energy may be reported or averaged with the results of the completely broken test pieces.

8.6 Test piece jamming

If any test piece jams in the machine, disregard the results and check the machine thoroughly for damage that would affect its calibration.

8.7 Post-fracture inspection

If post-fracture inspection shows that any portion of the marking is in a portion of the test piece that is visibly deformed, the test result might not be representative of the material and this shall be noted in the test report.

9 Test report

9.1 Mandatory information

The test report shall include the following information:

a) a reference to this part of ISO 148;

b) identification of the test piece (e.g. type of steel, cast number, etc.);

c) type of notch;

d) size of the test piece, if other than full size;

e) conditioning temperature of the test piece

f) absorbed energy, KV_2, KV_8, KU_2, or KU_8 as appropriate;

g) any abnormalities that may have affected the test.

9.2 Optional information

The test report may optionally include, in addition to the information in 9.1:

a) test-piece orientation (see ISO 3785);

b) nominal energy of the testing machine, in joules;

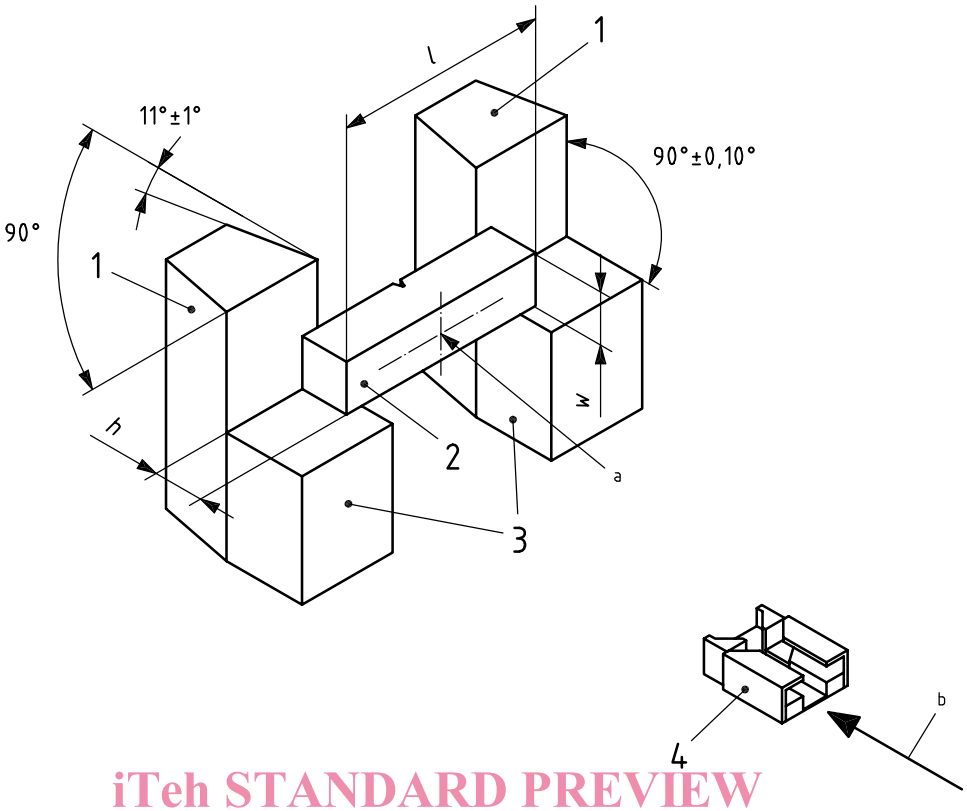
c) lateral expansion (see Annex B);

d) fracture appearance, percent shear (see Annex C);

e) energy absorbed/temperature curve (see D.1);

f) transition temperature, criteria used (see D.2);

g) number of test pieces that were not completely broken in the test.



Key

h height of test piece
l length of test piece
w width of test piece
1 anvil
2 standard-size test piece
3 test piece supports
4 shroud

a Centre of Strike.
b Direction of pendulum swing.

Figure 1 — Test piece terminology showing configuration of test piece supports and anvils of an industrial, pendulum-type impact-testing machine