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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 148-1

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

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ISO/TC 164/SC 4

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Fatigue, fracture and toughness testing*.

This fourth edition cancels and replaces the third edition (ISO 148-1:2016), which has 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 testing machines*
- *Part 3: Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines*
- *Part 4: Testing of miniature Charpy test pieces (in preparation).*

Metallic materials — Charpy pendulum impact test —

Part 1: Test method

1 Scope

This part of ISO 148 specifies the Charpy (V-notch and U-notch) pendulum impact test method for determining the energy absorbed in an impact test of metallic materials. This part of ISO 148 does not cover instrumented impact testing, which is specified in ISO 14556^[1].

[Annexes B](#) and [C](#) are based on ASTM E23^[2] and are used with the permission of ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, USA.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and 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, *Metallic materials — Charpy pendulum impact test — Part 2: Verification of testing machines*

ISO 286-1, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits*

3 Terms and definitions

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

3.1 Definitions pertaining to the machine

3.1.1

pendulum impact testing machine

testing machine equipped with a swinging hammer (pendulum) that is used to perform impact tests on Charpy test pieces

Note 1 to entry: For the sake of simplicity, the term “machine” is often used in this document to generically indicate a pendulum impact testing machine.

3.2 Definitions pertaining to energy

3.2.1

initial potential energy

potential energy

K_p

potential energy of the machine hammer prior to its release for the impact test, as determined by direct verification

3.2.2**absorbed energy** K

energy required to break a test piece with a pendulum impact testing machine, after correction for friction

Note 1 to entry: The subscript V or U is used to indicate the notch geometry, that is: K_V or K_U . The number 2 or 8 is used as a subscript to indicate the radius of the striker, for example K_{V2} .

3.2.3**nominal initial potential energy****nominal energy** K_N

energy assigned by the manufacturer of the pendulum impact testing machine

3.2.4**total absorbed energy** K_T

total absorbed energy spent to break a test piece with a pendulum impact testing machine, which is not corrected for any losses of energy

Note 1 to entry: It is equal to the difference in the potential energy from the starting position of the pendulum to the end of the first half swing during which the test piece is broken.

3.3 Definitions pertaining to test piece**3.3.1****width** W

distance between the notched face and the opposite face

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: Prior to 2016, the distance between the notched face and the opposite face was specified as “height”. Changing this dimension to “width” made this part of ISO 148 consistent with the terminology used in other ISO fracture standards.

3.3.2**thickness** B

dimension perpendicular to the width and parallel to the notch

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: Prior to 2016, the dimension perpendicular to the width that is parallel to the notch was specified as “width”. Changing this dimension to “thickness” made this part of ISO 148 consistent with the terminology used in other ISO fracture standards.

3.3.3**length** L

largest dimension perpendicular to the notch

Note 1 to entry: See [Figure 1](#).

4 Symbols and abbreviated terms

The symbols and designations applicable to this part of ISO 148 are indicated in [Tables 1](#) and [2](#), and are illustrated in [Figure 2](#).

Table 1 — Symbols/abbreviated terms and their designations and units

Symbol	Unit	Designation
B	mm	thickness of test piece
α	°	angle of fall of the pendulum
β_1	°	angle of rise when the machine is operated without a test piece in position
β_2	°	angle of rise when the machine is operated without a test piece in position and without resetting the indication mechanism
β_3	°	angle of rise recorded after the pendulum starts its 11 th half swing and the indicating mechanism has been moved to about 5 % of the scale-range capacity
GUM	—	guide to the expression of uncertainty in measurement ^[3]
L	mm	length of test piece
l_2	m	distance to the point of application of the force F from the axis of rotation
LE	mm	lateral expansion
K	J	absorbed energy (expressed as K_{V2} , K_{V8} , K_{U2} , K_{U8} , to identify specific notch geometries and the radius of the striking edge)
K_1	J	indicated absorbed energy when the machine is operated without a test piece in position
K_2	J	indicated absorbed energy when the machine is operated without a test piece in position and without resetting the indication mechanism
K_3	J	indicated absorbed energy after the pendulum starts its 11 th half swing and the indicating mechanism has been moved to about 5 % of the scale-range capacity
K_N	J	nominal initial potential energy assigned by the manufacturer
K_p	J	initial potential energy (potential energy)
K_T	J	total absorbed energy
K_{V2}	J	absorbed energy for a V-notch test piece using a 2 mm striker
K_{V8}	J	absorbed energy for a V-notch test piece using an 8 mm striker
K_{U2}	J	absorbed energy for a U-notch test piece using a 2 mm striker
K_{U8}	J	absorbed energy for a U-notch test piece using an 8 mm striker
M	N·m	moment equal to the product $F \cdot l_2$
p	J	absorbed energy loss caused by pointer friction
p'	J	absorbed energy loss caused by bearing friction and air resistance
p_β	J	correction of absorbed energy losses for an angle of rise β
SFA	%	shear fracture appearance
T_t	°C	transition temperature
W	mm	width of test piece
T_{t27}	°C	transition temperature defined at a specific value of absorbed energy; for example, 27 J
$T_{t50 \%US}$	°C	transition temperature defined at a particular percentage of the absorbed energy of the upper shelf; for example, 50 %
$T_{t50 \%SFA}$	°C	transition temperature defined at a particular proportion of shear fracture; for example, 50 %
$T_{t0,9}$	°C	transition temperature defined at a particular amount of lateral expansion; for example, 0,9 mm

5 Principles of the test

This test consists of breaking a notched test piece with a single blow from a swinging pendulum, under the conditions defined in [Clauses 6, 7](#) and [8](#). The notch in the test piece has a specified geometry and is located in the middle between two supports, opposite to the location which is impacted in the test. The

energy absorbed in the impact test, the lateral expansion and the shear fracture appearance are normally determined.

Because the Charpy test results of many metallic materials vary with temperature, tests shall be carried out at a specified temperature. When this temperature is other than ambient, the test piece shall be heated or cooled to that temperature, under controlled conditions.

The Charpy pendulum impact test is often used in routine, high-throughput pass/fail acceptance tests in industrial settings. For these tests, it may not be important whether the test sample is completely broken, partially broken, or simply plastically deformed and dragged through the anvils. In research, design, or academic settings, the measured energy values are studied in more detail, in which case it can be highly relevant whether the sample is broken or not.

It is important to note that not all Charpy test results can be directly compared. For example, the test can be performed with hammers having strikers with different radii, or with different test piece configurations. Tests performed with different strikers can give different results^[4], and test results obtained from test pieces having different notch configurations or cross section dimensions can also be different. This is why not only the adherence to ISO 148 but also a clear and complete reporting of the type of instrument, the test piece configuration and the details of the broken test pieces are crucial for comparability of results.

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](#), respectively.

If the standard test piece cannot be obtained from the material, one of the subsize test pieces, having a thickness of 7,5 mm, 5 mm or 2,5 mm (see [Figure 2](#) and [Table 2](#)), shall be used, if not otherwise specified.

NOTE 1 For low energies (20 J or less), shims can be used to better position subsize test pieces relative to the centre of strike in order to avoid excess energy absorption by the pendulum. For high energies (100 J or more), this might not be as important. Shims can be placed on or under the test piece supports, with the result that the mid-thickness of the test piece shall be 5 mm above the 10 mm supports. Shims can be temporarily fixed to the supports using tape or other means.

NOTE 2 Direct comparison of results is only of significance when made between test pieces of the same form and dimensions^[5].

When a heat-treated material is being evaluated, the test piece shall be finish-machined and notched after the final heat treatment, unless it can be demonstrated that machining before heat treatment does not affect test results.

6.2 Notch geometry

The notch shall be carefully prepared so that the root radius of the notch is free of machining marks which 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° and a root radius of 0,25 mm; the ligament shall be 8 mm [see [Figure 2](#) a) and [Table 2](#)].

6.2.2 U-notch

The U-notch shall have a root radius of 1 mm and the ligament shall be 5 mm (unless otherwise instructed by the customer or in product specifications) [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 executed 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 where plastic deformation and surface discontinuities caused by marking do not affect the absorbed energy (see [8.8](#)).

7 Test equipment

7.1 General

The measurements of the instrument and test piece details shall be traceable to national or international standards. Equipment used for measurements shall be calibrated within prescribed 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. The radius of the striking edge shall be shown as a subscript with the following designations: K_{V2} or K_{V8} and K_{U2} or K_{U8} .

Reference shall be made to the product specification for striker geometry guidance.

NOTE Tests carried out with 2 mm and 8 mm strikers can give different results^[4].

7.4 Verification of temperature measuring system

It shall be demonstrated that the system used for measuring temperature has been verified at the test temperature other than ambient or for a range containing the test temperature. Corrections shall be applied for any known systematic errors, but with no consideration of the uncertainty of the temperature measurement equipment.

8 Test procedure

8.1 General

The test piece shall lie squarely against the anvils of the testing machine, with the plane of symmetry of the notch within 0,5 mm of the mid-plane 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 Friction measurement

The energy absorbed by friction shall be checked on every testing day prior to the first test. The friction losses may be estimated as explained below, but other methods may also be applied.

NOTE The energy absorbed by friction includes, but is not limited to, air resistance, bearing friction and the friction of the indicating pointer. Increases in friction on a machine can influence the measure of absorbed energy.