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**Charpy pendulum impact test —
Verification of testing machines**

ICS 77.040.10

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS B 7722:1990** is replaced with **JIS B 7722:1999**.

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Charpy pendulum impact test — Verification of testing machines

Introduction This Japanese Industrial Standard has been prepared based on **ISO/FDIS 148-2** *Metallic materials — Charpy pendulum impact test — Part 2: Verification of testing machines* published in 1994 without modifying the technical contents.

In the Remarks of **10.2**, the provision concerning the taper of the anvils derived from the former **JIS** is added.

The portions with dotted underlines in this Standard are the matters not included in the original International Standard.

1 Scope This Standard covers the direct and indirect methods for the verification of the constructional elements of pendulum-type impact testing machines which are used for the impact test of **JIS Z 2202** carried out in accordance with **JIS Z 2242**.

The direct method shall be used when a machine is being installed or repaired, or if the indirect method gives an incorrect result.

The indirect method shall use reference test pieces specified in **JIS B 7740**.

It is applicable to industrial machines used for industrial, general or research laboratory testing of metallic materials with 2 mm or with 8 mm strikers used for pendulum impact tests. It can analogously be applied to pendulum impact testing machines of other capacities and of different design.

However, the specification of taper of the anvils " $10^\circ \pm 1^\circ$ " in the Remarks of **10.2** shall be eliminated as of April 1, 2000.

Remarks: The corresponding International Standard to this Standard is as follows:

ISO/FDIS 148-2 *Metallic materials — Charpy pendulum impact test — Part 2: Verification of testing machines*

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards indicated below shall be applied.

JIS B 7740 *Charpy pendulum impact test — Reference test pieces for verification of testing machines*

Remarks: **ISO/FDIS 148-3:1994** *Metallic materials — Charpy pendulum impact test — Part 3: Preparation and characterization of Charpy V reference test pieces for verification of testing machines* is identical with the said standard.

JIS Z 2202 *Test pieces for impact test for metallic materials*

Remarks: **ISO/DIS 148-1:1996** *Metallic materials — Charpy impact test (V-notch and U-notch)* is identical with the said standard.

JIS Z 2242 Method of impact test for metallic materials

Remarks: ISO 83:1976 Steel — Charpy impact test (U-notch) and ISO 148:1983 Steel — Charpy impact test (V-notch) are identical with the said standard.

3 Definitions For the purposes of this Standard, the following definitions apply.

3.1 Definitions pertaining to the machine

3.1.1 anvil The portion of the base of the machine forming a vertical plane which restrains the test piece when it is struck by the pendulum (see Attached Figs. 1 to 3), the plane of the supports being perpendicular to the plane of the anvil.

3.1.2 base That part of the framework of the machine located below the horizontal plane of the supports.

3.1.3 centre of percussion That point in a body at which, on striking a blow, the percussive action is the same as if the whole mass of the body was concentrated at the point, when a simple pendulum delivers a blow along a horizontal line passing through the centre of percussion, there is no resulting horizontal reaction at the axis of rotation (see Attached Fig. 4).

3.1.4 centre of strike That point on the striking edge of the pendulum at which, in the free hanging position of the pendulum, the vertical edge of the striker meets the upper horizontal plane of a test piece of half standard height (i.e. 5 mm) or equivalent gauge bar resting on the test piece supports (see Attached Fig. 2).

3.1.5 industrial machine Impact machine used for industrial, general, or most research-laboratory testing of metallic materials. These machines are not used to establish reference values. Industrial machines are verified using the procedures described in this Standard.

3.1.6 reference machine Pendulum impact testing machines used to determine the reference energy of a reference test piece. The verification requirements for this grade of machine are more stringent than those for industrial machines and are contained in **JIS B 7740**.

3.1.7 striker The portion of the hammer that contacts the test piece. The edge that actually contacts the test piece may have a radius of 2 mm (the 2 mm striker) or a radius of 8 mm (the 8 mm striker).

3.1.8 test piece supports The portion of the base of the machine forming a horizontal plane upon which the test piece rests prior to being struck by the hammer (see Attached Figs. 2 and 3). The plane of the supports is perpendicular to the plane of the anvil.

3.2 Definitions pertaining to energy

3.2.1 actual absorbed energy (absorbed energy), A_v The total energy required to break a test piece when tested by a pendulum impact testing machine. 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 (see Attached Fig. 5).

3.2.2 actual initial potential energy (potential energy), A_P The value determined by direct verification (see clause 9.1).

3.2.3 indicated absorbed energy (indicated energy), A_S The energy value indicated by the pointer or other readout device.

3.2.4 nominal initial potential energy (nominal energy), A_N The energy assigned by the manufacturer of the pendulum impact testing machine.

3.3 Definitions pertaining to test pieces

3.3.1 reference test pieces Impact test pieces used to verify the suitability of an industrial grade, pendulum impact testing machine by comparing the indicated energy measured by that machine to the reference energy associated with the test pieces. Reference test pieces are prepared in accordance with **JIS B 7740**.

3.3.2 reference energy, A_R The absorbed energy value associated with reference test pieces, determined from tests made using reference machines.

3.3.3 test pieces (placed in the test position of the supports of the machines) (see Attached Figs. 2 and 3).

3.3.3.1 height Distance between the notched face and the opposite face.

3.3.3.2 width Dimension perpendicular to the height that is parallel to the notch.

3.3.3.3 length Dimension perpendicular to the height and width of the test pieces. (i.e., largest dimension at right angles to the notch).

4 Symbols and designations For the purposes of this Standard, the symbols and designations in Table 1 are applicable.

Table 1 Symbols and their meanings

Symbol	Unit	Meaning
A_v	J	Actual absorbed energy (absorbed energy)
A_P	J	Actual initial potential energy (potential energy)
A_S	J	Indicated absorbed energy (indicated energy)
A_N	J	Nominal initial potential energy (nominal energy)
A_R	J	Reference energy of a set of Charpy reference test pieces
F	N	Force exerted by the pendulum when measured at a distance of l_2
W	N	Weight of the pendulum
l	m	Distance to centre of test piece (centre of striker) from the axis of rotation (length of pendulum)
l_1	m	Distance to the centre of percussion from the axis of rotation
l_2	m	Distance to the point of application of the force F from the axis of rotation
p	J	Energy loss caused by pointer friction

Table 1 Symbols and their meanings (concluded)

Symbol	Unit	Meaning
p'	J	Energy loss caused by bearing friction and air resistance
E_1 or β_1	J or degree	Indicated energy or angle of rise when the machine is operated in the normal manner without a test piece in position
E_2 or β_2	J or degree	Indicated energy or angle of rise when the machine is operated in the normal manner without a test piece in position and without resetting the indication mechanism
E_3 or β_3	J or degree	Indicated energy or angle of rise after 11 half swings when the machine is operated in the normal manner without a test piece in position and without resetting the indication mechanism
P_β or E_β	J or degree	Correction of energy losses for an angle of swing β
t	s	Period of the pendulum
T	s	Total time for 100 swings of the pendulum
$T_{\max}$	s	Maximum value of T
$T_{\min}$	s	Minimum value of T
α	degree	Angle of fall of the pendulum
β	degree	Angle of rise of the pendulum
h	m	Height of fall of pendulum
h'	m	Height of rise of pendulum

5 Testing machine A pendulum impact testing machine consists of the following parts (see Attached Figs. 1 to 3):

- foundation/installation;
- machine framework — the structure supporting the pendulum, excluding the foundation;
- pendulum including the hammer and the striker;
- anvils and supports (see Attached Figs. 2 and 3);
- indicating equipment for the absorbed energy (e.g. scale and friction pointer or electronic readout device).

6 Verification The verification of the machine can occur only after installation and involves the inspection of the following items:

- foundation/installation;
- machine framework;
- pendulum, including the hammer and the striker;
- anvils and supports;
- indicating equipment.

7 Foundation/installation The foundation to which the machine is fixed and the method(s) of fixing the machine to the foundation are of utmost importance.

7.1 Inspection of the machine foundation usually cannot be made once the machine has been installed, thus documentation made at the time of installation shall be produced to provide assurance that the mass of the foundation is not less than 40 times that of the pendulum.

7.2 Inspection of the installed machine shall consist of the following.

- a) Ensuring that the bolts are torqued to the value specified by the machine manufacturer. The torque value shall be noted in the document provided by the manufacturer of the machine (see 7.1). If other mounting arrangements are used or selected by an end user, equivalency must be demonstrated.
- b) Ensuring that the machine is not subject to external vibrations transmitted through the foundation at the time of the impact test.

Remarks: This can be accomplished, for example, by placing a small container of water on any convenient location on the machine framework. Absence of ripples on the water surface indicates that this requirement is met.

8 Machine framework Inspection of the machine framework (see Attached Fig. 1) shall consist of determining the following items:

- a) free position of the pendulum;
- b) location of the pendulum in relation to the supports;
- c) transverse and radial play of the pendulum bearings;
- d) clearance between the hammer and the framework.

Machines manufactured after the original publication date of this Standard shall have a reference plane from which measurements can be made.

8.1 The axis of rotation of the pendulum shall be parallel to the reference plane to within $\frac{2}{1000}$. This shall be certified by the manufacturer.

8.2 The machine shall be installed so that the reference plane is horizontal to within $\frac{2}{1000}$.

For pendulum impact testing machines without a reference plane, the axis of rotation shall be established to be horizontal to within $\frac{4}{1000}$ directly or a reference plane shall be established from which the horizontality of the axis of rotation can be verified as described above.

8.3 When hanging free, the pendulum shall hang so that the striking edge is within ± 0.5 mm of the position where it would just touch the test specimen.

8.4 The plane of the swing of the pendulum shall be $90^\circ \pm 10'$ ($\frac{3}{1000}$) to the axis of rotation.

8.5 The striker shall make contact over the full width of the test piece.

8.6 The pendulum shall be located so that the plane of the swing including striker and the centre of the gap between the anvils are coincident to within 0.50 mm.

8.7 Axial play in the pendulum bearings shall not exceed 0.25 mm measured at the striker under a transverse force of approximately 4 % of the effective weight of the pendulum, W , applied at the centre of strike.

8.8 Radial play of the shaft in the pendulum bearings shall not exceed 0.08 mm.

8.9 For new machines, it is recommended that the mass of the base of the machine framework should be at least 12 times that of the pendulum.

Remarks: The base of the machine is that portion of the framework located below the plane(s) of the supports.

9 Pendulum The verification of the pendulum (including striker) shall consist of determining the following quantities:

- a) potential energy, A_P ;
- b) error in the indicated energy, A_S ;
- c) velocity of the pendulum at instant of impact;
- d) energy absorbed by friction;
- e) position of centre of percussion (i.e. distance from centre of percussion to axis of rotation);
- f) type of striker and
 - 1) radius of curvature of the tip of the striker;
 - 2) angle of tip of striker;
- g) angle of the line of contact of the striker and the horizontal axis of the test piece.

9.1 The potential energy, A_P , shall not differ from the nominal energy, A_N , by more than ± 1.0 %.

The potential energy A_P shall be determined as follows:

The moment of the pendulum is determined by supporting the pendulum at a chosen distance, l_2 , from the axis of rotation by means of a knife edge on a balance or dynamometer in such a manner that the line through the axis of rotation which joins the centre of gravity of the pendulum is horizontal within $\frac{15}{1000}$.

The force, F , and the length, l_2 , shall each be determined to an accuracy of ± 0.2 %. The moment, M , is the product $F \times l_2$.

Remarks 1 Length l_2 can be equal to length l . In this case, the accuracy of l shall be equivalent to that of l_2 .

The angle of fall, α , shall be measured to an accuracy of $\pm 0.4^\circ$; this angle can be greater than 90° .

The potential energy, A_P , is then calculated by the following formula

$$A_P = M (1 - \cos \alpha)$$