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NATIONAL METROLOGICAL VERIFICATION STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

JJG 145-2007

Replacing JJG 145-1982

Pendulum Impact Testing Machines

摆锤式冲击试验机

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Table of Contents

1 Scope	5
2 Normative references	5
3 Terminology and units of measurement	5
4 General.....	8
5 Metrological performance requirements.....	8
5.1 Machine framework.....	8
5.2 Pendulum	9
5.3 Anvils and supports	10
5.4 Indicator	10
5.5 Indirect verification using reference test pieces	11
6 General technical requirements	12
7 Control of measuring instruments	12
7.1 Verification conditions	12
7.2 Verification items	13
7.3 Verification methods.....	14
7.4 Usable range of the testing machine.....	22
7.5 Handling of the verification results	22
7.6 Verification cycle	22
Annex A Arc and rectangular reference impact test pieces	23
Annex B Constituent parts of the testing machine.....	26
Annex C Striker, test piece support and anvil of the testing machine.....	27
Annex D Structure of test piece supports and anvils of the working testing machine.....	30
Annex E Measurement of the initial potential energy	31
Annex F Format of the inside page of the verification certificate	33
Annex G Verification records of the pendulum type impact testing machine	35

Verification Regulation of Pendulum Impact Testing Machines

1 Scope

This Regulation applies to the first verification, subsequent verification and in-service verification of pendulum impact testing machines (hereinafter referred to as testing machines).

2 Normative references

The following documents are referenced in this Regulation:

GB/T 229, *Metallic materials – Charpy pendulum impact test method*

GB/T 1043-1993, *Plastics – Determination of Charpy impact strength of rigid materials*

GB/T 3808-2002 (ISO 148-2:1998, *Metallic materials – Charpy pendulum impact test – Part 2: Verification of test machines*, MOD), *Verification of pendulum-type impact testing machines*

GB/T 18658-2002, *Charpy V reference test pieces for verification of pendulum-type impact testing machines*

GB/T 15000.3-1994, *Directives for the work of reference materials (3) – General principles and statistic methods for certification of reference materials*

JJG 2077-1990, *Measuring instruments for pendulum impact energy*

ASTM E23-05, *Standard test methods for notched bar impact testing of metallic materials*

When this Regulation is used, attention shall be paid to the use of the currently effective editions of the above-mentioned documents referenced.

3 Terminology and units of measurement

3.1 Terminology related to testing machines

3.1.1 Anvil faces

18658.

3.2 Terminology related to energy

3.2.1 Actual absorbed energy (absorbed energy) K_v

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.

3.2.2 Initial potential energy K_P

The horizontal static energy where the center of mass is located, relative to the free position of the hammer, when the hammer is in the initial position.

3.2.3 Indicated absorbed energy (indicated energy) K_S

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

3.2.4 Nominal initial potential energy (nominal energy) K_N

Energy attributed by the manufacturer of the pendulum hammer.

3.2.5 Reference energy K_R

The value of the energy absorbed supplied with reference test pieces.

3.2.6 Reference test pieces

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.

3.3 Definitions related to the test piece (the test piece being placed on the supports in the test position) (see Figure D.1).

3.3.1 Height

Distance between the notched face and the opposite face.

3.3.2 Width

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

3.3.3 Length

potential energy/%					
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5.2.6 The precision of the scale graduation marks: when less than 50% of the nominal energy K_N , the largest allowable value of the relative error of the indicated energy K_S and the initial potential energy K_P is $\pm 0.5\%$; when 50% ~ 80% of the nominal energy, the largest allowable value of the relative error of the indicated energy K_S and the absorbed energy K_V is $\pm 1\%$.

5.2.7 The impact velocity is preferably 5 m/s ~ 5.5 m/s, but values between 3 m/s ~ 6 m/s is permitted and shall be noted.

5.2.8 The angle between the line of contact of the striker and the horizontal axis of the test pieces shall be $90^\circ \pm 2^\circ$.

5.2.9 The main dimensions of the striker shall be as required by related test methods and technical standards, such as GB/T 229, GB/T 1043 and GB/T 3808 (see Annex C).

5.3 Anvils and supports

5.3.1 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 the plane, where the two support places of the support are located, and the plane, where the two planes of the anvils are located, shall be $90^\circ \pm 0.1^\circ$.

(For the detailed requirements for dimensions see Annexes C and D.)

5.3.2 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 3/1 000.

5.3.3 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.

5.4 Indicator

5.4.1 Checking of analogue scale

The analogue scale shall be scaled in the unit of angle or energy.

A scale division shall be equal to 1/100 of the initial potential energy at most and shall permit the energy to be estimated by an increment of at least 0.25 % of the initial potential energy.

5.4.2 Checking of digital scale

(4) Use the centering template and calipers to verify the coincidence of the center of the pendulum striking edge with the center of the anvil span, as specified in Annex B; then wrap the V-type notched test piece in carbon paper, and after aligning the test piece between the anvils, make the pendulum striking edge to strike the test piece lightly, to measure the distance from the center line of the mark on the test piece left by the striking edge to the top of the V-type notch.

(5) Verification of the transverse and radial clearance of the shaft:

- ① place the thrust piece of the percussion point between the supports of the test piece, making the striking edge lie in the V-type groove tightly, and add several drops of glue 502 to bond the striking edge and the V-type groove point. (After testing, dismantle the thrust piece and use acetone to clean all residues of glue 502.)
- ② place the magnet stand installed with a dial indicator in place on the main framework: a) when the dial indicator aims at the striking edge perpendicularly, it is used to measure the transverse clearance of the shaft; b) when the dial indicator aims at the upper center of the shaft, it is used to measure the radial clearance of the shaft.
- ③ main the measuring cell to the center of the thrust piece of the percussion point to apply force: a) apply 4% of the effective gravity of the pendulum W (see Figure E.1) to measure the transverse clearance of the shaft; b) apply a force $150\text{ N} \pm 10\text{ N}$ to measure the radial clearance of the shaft.

NOTE: For testing machines of nominal energy less than 60 J, etc., the test can be carried out using hand to hold the connecting part of the rod and the shaft to pull and push the pendulum along the axis of rotation; from the end of the shaft, read out the difference between the largest value and the smallest value of the dial indicator; only verify the transverse clearance of the shaft.

(6) The free swing zero returning of the pendulum is checked by visual inspection.

(7) Verification of energy loss:

- ① the energy loss resulted from the friction of the pointer:

Operate the testing machine using a normal method, placing no test pieces on the supports; record the lift angle β_1 or the energy E_1 indicated by the pointer. Do not adjust the position of the pointer; then lift the pendulum once again to carry out the second test; record the lift angle β_2 or the energy E_2 indicated by the pointer. During the lift of the pendulum, the energy loss resulted from the friction of the pointer p is calculated as follows:

when reading out in the angular units,

The impact velocity is preferably taken as 5 m/s ~ 5.5 m/s, but any value within the range 3 m/s ~ 6 m/s can be taken, which shall be indicated.

- (13) Use general measuring implements, calipers, radius gauges, etc. to carry out the measurement of the angle between the contact line of the striking edge and the horizontal axis of the test piece, and the main dimensions of the striking edge.
- (14) Use general measuring implements, calipers, radius gauges, etc. to carry out the measurement of anvils and supports.
- (15) Carry out visual inspection for the indicator

The analogue indicator shall be scaled in the angular unit or energy unit.

The width of the scale graduation marks shall be uniform; the width of the pointer shall be approximately equal to the width of one graduation mark. The pointer shall permit a reading free from parallax.

The resolution r of the indicator is obtained from the ratio of the pointer width and the minimum distance between the centers of two adjacent graduation marks. The recommended ratios are either 1:4 or 1:5 or 1:10. The distance between two adjacent marks shall be at least 2.5 mm in order to be able to estimate 1/10 of a scale division.

A scale division shall be equal to 1/100 of the initial potential energy at most, and shall permit the energy to be estimated by an increment of at least 0.25% of the initial potential energy.

The digital indicator shall be scaled in the angular unit or energy unit.

The resolution r of the scale is regarded as one increment of last significant digit of the number on the digital indicator, provided that the indication does not fluctuate by more than one increment. When the readings fluctuate by more than one increment, the resolution is taken to be equal to half the range of the fluctuation.

The resolution shall be at least 1/400 of the initial potential energy.

7.3.1.2 Indirect verification method

It is the method for verification, where reference test pieces are used for impact energy, i.e. the indication verification method. The purpose of the indirect verification method is to ensure the accuracy of the indication of the impact of the testing machine. The indirect verification using reference test pieces, is actually the comprehensive performance verification for the testing machine, the verification of the indication

testing machine shall be within the allowable range.

When replacing worn parts, a direct verification shall be carried out in accordance with the relevant clauses of this Regulation and the specifications related to it, where the results are unsatisfactory using reference impact test pieces for the verification; then an indirect verification shall be carried out using reference impact test pieces. The indication error and repeatability of the testing machine shall be within the allowable range. For the testing machine undergoing a major repair replacing parts, it shall be verified as in the first verification.

7.4 Usable range of the testing machine

For the testing machine ≥ 150 J, it is calculated as follows:

$$\text{lower limit} = \text{resolution} \times 25 \text{ (in the position of 15 J)} \quad (21)$$

$$\text{upper limit} = \text{the nominal energy value of the testing machine} \times 80\% \quad (22)$$

For the use range of the testing machine having small energy, it is 10% ~ 90% of the nominal energy.

7.5 Handling of the verification results

For the testing machine verified to be satisfactory, issue a verification certificate. For the format of the inside page of the certificate see Annex F.

For the testing machine verified to be unsatisfactory, issue a verification result notification. For the format of the inside page of the notification, refer to Annex F, and indicate the unsatisfactory items.

7.6 Verification cycle

The verification cycle is generally not exceeding 1 year.

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