

**Pendulum impact testing machines with a rated  
initial potential energy of 50 J or less**  
Requirements and verification

**DIN**  
**51 222**

ICS 19.060; 77.040.10

Descriptors: Materials testing machines, testing, Impact testing, pendulum impact testing machines, requirements, verification.

Prüfung metallischer Werkstoffe; Kerbschlagbiegeversuch; besondere Anforderungen an Pendelerschlagwerke mit einem Nennarbeitsvermögen  $\leq 50$  J und deren Prüfung

This standard, together with EN 10 045-2, January 1993 edition, supersedes DIN 51 222, January 1985 edition, and DIN 51 306, September 1983 edition, which were withdrawn in 1983.

*In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.*

Clause 9 of this standard includes safety requirements within the meaning of the *Gerätesicherheitsgesetz* (German Equipment Safety Law).

### Foreword

This standard has been prepared by Technical Committee *Prüfverfahren mit schlagartiger Beanspruchung für Metalle* of the *Normenausschuß Materialprüfung* (Materials Testing Standards Committee).

Although DIN EN 10 045-2 applies in general to pendulum impact testing machines with a rated initial potential energy lower than 300 J, it does not contain any detailed specifications relating to very small machines of this type. This new edition of DIN 51 222 includes requirements for the types of machine not covered in detail by the European Standard.

### Amendments

In comparison with the 1985 edition, the requirements specified there and in DIN 51 306 for pendulum impact testing machines with a rated initial potential energy of 50 J or less have been combined into this standard.

### Previous editions

DIN 51 222: 1954-08, 1957-01, 1968-11, 1973-11, 1979-01, 1985-01; DIN 51 306: 1983-09.

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## 1 Scope and field of application

This standard specifies requirements for and the verification of pendulum impact testing machines with a rated initial potential energy of 50 J or less.

The pendulum impact testing machines specified in this standard are used for notched bar impact testing in accordance with: LM 10 045-1, DIN 50 115, DIN 52 189-1 and DIN 53 453.

As opposed to EN 10 045-2, which includes specifications for indirect verification, this standard covers direct verification only, since reference test pieces for rated energies less than 50 J are not available.

## 2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated into it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 50 115

Notched bar impact testing of metallic materials using test pieces other than ISO test pieces

DIN 51 233

Materials testing machines; general information on safety requirements

DIN 52 189-1

Determination of impact bending strength of wood

DIN 53 453

Impact testing of plastics by the torsion pendulum test

EN 10 045-1

Charpy impact test on metallic materials; test method

EN 10 045-2

Charpy notched bar impact test on metallic materials; verification of pendulum impact testing machines

## 3 Concepts

For the purposes of this standard, the definitions listed in EN 10 045-2 apply.

## 4 Symbols and designations

See table 1 of EN 10 045-2.

## 5 Direct verification of pendulum impact testing machines

Verification shall comprise the inspection, testing or determination of the following:

- machine frame;
- 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 frame

Pendulum impact testing machines shall not show any visible movement when striking a test piece, whose indicated absorbed energy is greater than the initial potential energy of the machine. This requirement is deemed to be fulfilled when the base of the machine is either attached to a solid foundation (for machines with a rated energy of 50 J) or is permanently fixed to a sturdy table (for machines with a rated energy from 7,5 to 25 J). Machines with a rated energy of 4 J or less may be placed on a worktable.

## 5.2 Pendulum

Pendulums shall fulfil the requirements listed in table 1.

Table 1: Geometric parameters for testing machines

	Rated initial potential energy of machine, in J	0,5	1	2	4	7,5	15	25	50	
		Clearance angle	$5^\circ \pm 1^\circ$							
Anvils	Distance between anvils, in mm	$22 \cdot \sqrt[3]{E} \cdot 1$								
		$40 \cdot \sqrt[3]{E} \cdot 1$		$30 \cdot \sqrt[3]{E} \cdot 1$			$30 \cdot \sqrt[3]{E} \cdot 1$			
		$70 \cdot \sqrt[3]{E} \cdot 1$		$40 \cdot \sqrt[3]{E} \cdot 1$		$40 \cdot \sqrt[3]{E} \cdot 1$				
		$100 \cdot \sqrt[3]{E} \cdot 1$		$70 \cdot \sqrt[3]{E} \cdot 1$						
Pendulum	Thickness of striker, in mm	$\leq 10$			$\leq 12$					

## 5.3 Framework/pendulum position

As in EN 10 045-2, except for the following changes:

- a) The first NOTE shall be replaced by the following text: "This may be verified by means of a rectangular bar about as long and as wide as the test piece, and 0,5 mm shorter than the test piece. The distance between the striking edge and the bar shall be measured."
- b) The last paragraph shall be replaced by the following: "The radial play for pendulum impact testing machines with an initial potential energy of 50 J or less has not been specified."

## 5.4 Test piece supports and anvils

The top surfaces of the test piece supports shall lie in the same plane to within 0,1 mm.

The supports shall be placed so that the test piece axis is parallel to the axis of rotation of the pendulum to within 3%.

The top surfaces of the anvils shall also lie in the same plane to within 0,1 mm.

See table 1 for additional required geometric parameters for the testing machine.

NOTE: DIN 52 189-1 specifies a radius of curvature of  $(15 \pm 0,1)$  mm for testing machines used to test wood specimens.

## 5.5 Clearance between anvils and pendulum

For machines with a rated energy of 15 J or less, no part of the pendulum which passes between the anvils shall be thicker than 10 mm; for machines with a rated energy from 25 to 50 J, this part shall be no thicker than 12 mm (cf. table 1).

### 5.6 Position of centre of percussion

The distance from the centre of percussion to the axis of rotation,  $l_1$ , is equal to the length of the simple synchronous pendulum of the testing machine. Therefore, determine the period of swing of the pendulum,  $T$ , and calculate  $l_1$  using the following equation:

$$l_1 = \frac{g \cdot T^2}{4\pi^2}$$

where  $g = 9,806 7 \text{ m/s}^2$  and  $\pi^2 = 9,869 6$ .

The value for  $l_1$  can be accurately determined by taking the mean of three measurements, each measuring the total duration,  $T$ , of 50 complete swings, provided the pendulum did not deviate from its initial position by more than  $5^\circ$  and the difference between the highest and lowest values for  $T$  (i.e.  $T_M$  and  $T_m$ ) did not exceed 0,2 s. For machines with a rated energy of 0,5 J, it may not be possible to reach 50 swings (due to the relatively high amount of friction), in which case 25 swings shall suffice.

Table 2 gives limit deviations for  $l_1$ .

Table 2: Limit deviations for  $l_1$

Rated initial potential energy, $A_N$ , in J	Nominal value for $l_1$	Limit deviations for $l_1$ , as a percentage of $L$
0,5; 1; 2; 4	$L$	$\pm 0$
7,5; 15; 25; 50	$0,995 \times L$	$-0,5$

### 5.7 Energy indicator

The energy indicator shall be graduated either in degrees (for rise angle measurement) or in J (for measuring absorbed energy).

#### 5.7.1 Analogue scales

As in EN 10 045-2 except that the last paragraph should read:

"One scale division shall not be more than 1/100 of the initial potential energy and shall permit readings to be estimated in increments no more than 1/500 of the initial potential energy."

#### 5.7.2 Digital scales

As in EN 10 045-2 except that the last sentence should read: "The resolution shall be at least 1/500 of the initial potential energy."

### 5.8 Potential energy

As in EN 10 045-2.

### 5.9 Indicated energy error

As in EN 10 045-2.

### 5.10 Friction loss

As in EN 10 045-2 except that subclause 5.10.3 should read: "The total losses,  $p + p'$ , shall not exceed the values listed in table 3."

Table 3: Permissible total losses

Rated initial potential energy, $A_N$ , in J	Permissible total loss, as a percentage of $A_N$
0,5	2,0
1; 2	1,0
4; 7,5; 15; 25; 50	0,5

### 5.11 Impact velocity

As in EN 10 045-2 except that the last paragraph should read:

"The values for impact velocity shall not exceed those given in table 4."

Table 4: Limit values for impact velocity

Rated initial potential energy, $A_N$ , in J	Limit values for impact velocity, in m/s
0,5; 1; 2; 4	2,8 to 3,1
7,5; 15; 25; 50	3,6 to 4,0

## 6 Indirect verification of pendulum impact testing machines

(Not relevant.)

## 7 Verification report

As in EN 10 045-2 except that the information regarding indirect verification does not apply.

## 8 Frequency of verification

### 8.1 Direct verification

As in EN 10 045-2.

## 9 Safety requirements

Pendulum impact testing machines shall be provided with additional safety devices and installed in such a manner that operators and all other parties are protected against hazards as long as the machine is used as intended (cf. DIN 51 233).

## 10 Designation

Designation of a pendulum impact testing machine with a rated initial potential energy of 50 J in compliance with this standard:

Pendulum impact testing machine DIN 51 222 – 50