

ISO

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

**ISO RECOMMENDATION
R 946**

**BEAM UNNOTCHED IMPACT TEST
FOR GREY CAST IRON**

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BRIEF HISTORY

The ISO Recommendation R 946, *Beam unnotched impact test for grey cast iron*, was drawn up by Technical Committee ISO/TC 25, *Cast iron*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1958 and led, in 1964, to the adoption of a Draft ISO Recommendation.

In April 1967, this Draft ISO Recommendation (No. 1197) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	India	Romania
Belgium	Ireland	South Africa, Rep. of
Brazil	Israel	Sweden
Canada	Italy	Switzerland
Chile	Korea, Rep. of	Thailand
Finland	Netherlands	Turkey
France	Norway	U.A.R.
Germany	Poland	United Kingdom
Greece	Portugal	Yugoslavia

One Member Body opposed the approval of the Draft :

Czechoslovaia

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in January 1969, to accept it as an ISO RECOMMENDATION.

BEAM UNNOTCHED IMPACT TEST FOR GREY CAST IRON

1. SCOPE

This ISO Recommendation specifies requirements for the determination of the impact strength of grey cast iron containing graphite in flake form.

2. PRINCIPLE OF TEST

- 2.1 The test consists in breaking, by a single blow from a swinging hammer, a series of unnotched machined cylindrical test pieces resting freely between supports, and measuring the difference between the kinetic energy of the hammer immediately before fracture and its residual energy after the fracture of the test piece.
- 2.2 The impact strength of the grey cast iron is the apparent energy absorbed in fracture denoted by the symbol *KG*, and is expressed in kilogramme-force metres (see also Appendix Y).

3. SYMBOLS AND DESIGNATIONS

Number	Symbol	Designation
1	<i>l</i>	Length of test piece
2	<i>d</i>	Diameter of test piece
3	<i>A</i>	Initial potential energy of the testing machine
4	<i>L</i>	Distance between supports
5	—	Radius of curvature of supports
6	—	Taper of supports
7	—	Angle at tip of hammer
8	—	Radius of curvature of hammer
9	<i>v</i>	Speed of hammer at instant of striking
10	<i>KG</i>	Apparent energy absorbed in fracture

4. MACHINED STANDARD TEST PIECES

- 4.1 The test bars are cast as cylindrical bars having a diameter of

$$30 \begin{matrix} + 2 \\ 0 \end{matrix} \text{ mm}$$

and a *minimum* length of 150 mm.

- 4.2 The machined standard test piece is of the dimensions shown in Table 1. The test piece should be well machined with a good surface finish.

TABLE 1 – Dimensions of test pieces

Number	Symbol	Designation	Nominal dimension	Machining tolerance
1	<i>l</i>	Length of test piece	120 mm	± 2 mm
2	<i>d</i>	Diameter of test piece	20 mm	± 0.2 mm

5. METHOD OF CASTING GREY IRON TEST BARS

- 5.1 The test bars are cast in dry sand and their structure should be entirely grey.
- 5.2 Each bar should be separated from its neighbour or any other casting in the same mould by not less than 50 mm.
- 5.3 The test bars are cast from the same metal as that used for the castings they represent. Precautions should be taken to ensure sound test bars.
- 5.4 The test bars should not be removed from the mould as long as the temperature is above 500 °C.
- 5.5 If any test piece shows defective machining or obvious lack of continuity in the metal, it should be discarded and replaced by another test piece.
- 5.6 If the castings represented are heat treated, the test bars should be heat treated at the same time and under the same conditions as the castings.

6. TESTING MACHINE

- 6.1 The testing machine should be constructed and installed steady and rigid.
- 6.2 The conditions shown in Table 2 should be satisfied.

TABLE 2 – Characteristics of testing machine

Number	Symbol	Designation	Nominal values and tolerances
3	<i>A</i>	Initial potential energy of the testing machine	5 ± 0.2 kgf·m
4	<i>L</i>	Distance between supports	100 ^{+0.5} ₀ mm
5	–	Radius of curvature of supports	1 to 1.5 mm
6	–	Taper of supports	1 : 5
7	–	Angle at tip of hammer	30 ± 1°
8	–	Radius of curvature of hammer	2 to 2.5 mm
9	<i>v</i>	Speed of hammer at instant of striking	3.60 to 4.20 m/s

- 6.3 The plane of swing of the hammer should be vertical. The machine should be constructed so that the loss of energy (such as from translation, rotation or vibration) in the machine framework during a test is negligible.
- 6.4 The height of the centre of percussion above the point of impact of the hammer should be 3 ± 3 mm.
- 6.5 The accuracy of the graduation of the scale of the machine should be ± 0.5 % of the maximum striking energy of the machine.

7. TEST REQUIREMENTS

- 7.1 The test piece should lie squarely against the supports with the plane of symmetry of the hammer midway between them (see the Figure).
- 7.2 The test should be carried out at a temperature between 10 and 30 °C.

8. METHOD OF TESTING

- 8.1 An impact test should consist of the fracture of at least four test pieces (see Appendix Z).
- 8.2 After breaking the four test pieces under the conditions described above, the arithmetical average m of the values obtained and the difference w between the greatest and the least should be calculated.
- 8.3 If w is not more than $0.4 \times m$, the impact strength should be expressed as
- $$KG = m$$
- 8.4 If w is greater than $0.4 \times m$, the test should be repeated with a fifth test piece held in reserve. The arithmetical average m' of the values obtained and the difference w' between the greatest and the least should be calculated.
- 8.5 If w' is not more than $0.5 \times m'$, the impact strength should be expressed as
- $$KG = m'$$
- 8.6 If w' is greater than $0.5 \times m'$, the test should not be considered significant enough to give an acceptable estimate of KG .
- 8.7 The test should also be discarded if obvious flaws on the surface or on the broken face of certain test pieces have made it impossible to obtain the required number of values.

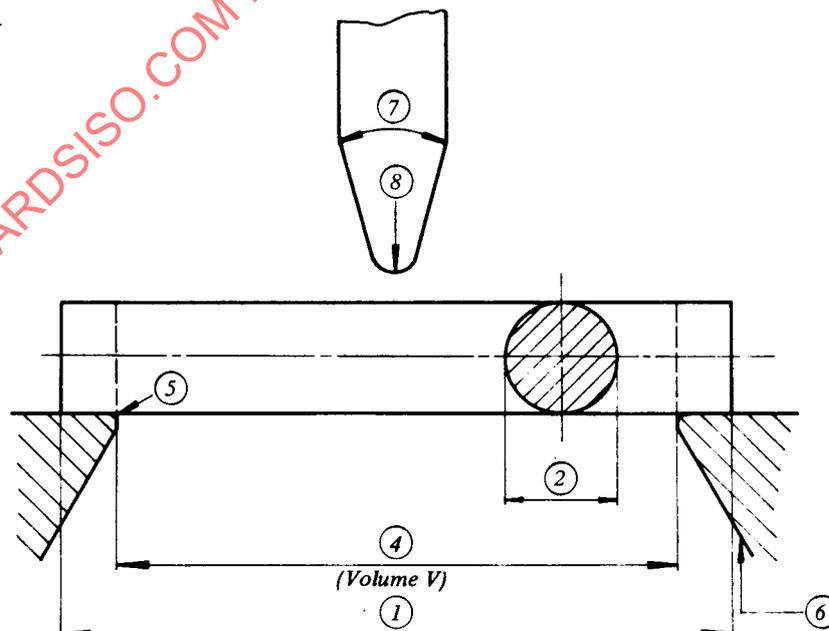


FIGURE – Positioning of test piece

APPENDIX Y

If it is found necessary to carry out the impact test on test pieces not of the standard size recommended in section 4, it may be useful to calculate the "impact modulus" MC , i.e. the ratio $\frac{KG}{V}$, where KG is the apparent energy absorbed in fracture, expressed in this case in kilogramme-force centimetres, and V is the volume of test piece between supports, expressed in cubic centimetres.

It has been found that, within acceptable practical limits, for the same grade of iron (same material), the impact modulus is independent of the diameter of the machined test piece, if the following conditions are observed :

- (a) the test pieces are of proportional dimensions, $l = 6d$;
- (b) the distance between supports is proportional to the dimensions of the test piece, $L = 5d$;
- (c) the value of $\frac{KG}{A}$ remains above 0.4;
- (d) the diameter d is between 12 and 29 mm;
- (e) all the other conditions of test and particularly the velocity of impact v and the diameter of the original bar or the mass of the test piece remain unchanged.

In this case the impact modulus of the standard test piece ($d = 20$ mm) should be calculated according to the formula

$$MC \text{ kgf}\cdot\text{cm}/\text{cm}^3 = \frac{10}{\pi} KG \text{ kgf}\cdot\text{m}$$