

JIS

JAPANESE INDUSTRIAL STANDARD

**Method of Izod Impact
Test for Rigid Plastics**

JIS K 7110—1984

Translated and Published

by

Japanese Standards Association

Printed in Japan

K 7110

Full document details: JIS K 7110-1984

AVA

Documents

16 S

Document Sharing Hub

Translation without guarantee
In the event of any doubt arising, the original
standard in Japanese is to be evidence

JAPANESE INDUSTRIAL STANDARD

J I S

Method of Izod Impact Test for Rigid Plastics K 7110-1984

1. Scope

This Japanese Industrial Standard specifies the method of Izod impact test, hereinafter referred to as the "impact test", for rigid plastics.

- Remarks 1. The method specified in this standard is a sort of impact bending test. It is made as follows: Hold a test piece, measuring the specified dimensions and having a specified notch, in cantilever posture, impact its one end with a specified energy, which is larger than that required for the fracture of test piece, at the specified velocity, and measure the magnitude of energy necessary for the fracture of test piece caused by one time impact to measure the impact resistance, bristleness and toughness of the rigid plastics.
2. The units and numerical values given in { } in this standard are in accordance with the customary system of units, and are appended for reference.

2. Definitions

In addition to the definitions provided in JIS K 6900 and JIS Z 8103, the definitions below apply to the principal terms used in this standard.

- (1) Izod impact test This test is defined as follows: Using an Izod impact testing machine, a test piece is held at one end on the side of the notch, and an impact is applied to the test piece at the position, on the plane of the notch, 22 mm apart from the symmetrical plane of the notch by one time impact of hammer to measure the Izod impact value of the test piece.
- (2) absorbed energy Energy (J) {kgf·cm} which is required for the test piece to fracture in the Izod impact test.
- (3) Izod impact value Value (kJ/m²) {kgf·cm/cm²} obtained by dividing the absorbed energy (J) {kgf·cm} by the original sectional area of the notch.
- (4) fracture Separation of test piece into two or more pieces, caused by one time impact.

Remark: A nature of material sometimes makes the fracture of the test piece after applying impact to connect with each other by the existence of very thin surface layer (surface skin formed at the time of moulding). In this case, the test piece shall be deemed as fractured.

Applicable Standards, Corresponding International Standard and Reference Standards: See page 10.

- (5) rigid plastics Plastics which are fractured by the test made under the conditions specified in this standard.
 - (6) edgewise impact Impact given along the direction parallel to the plane of the original plate in the case where the test piece is made by cutting out of the original material of plate form. For the test piece made by injection or compression moulding, impact given along the direction parallel to the long side.
 - (7) flatwise impact Impact given along the vertical direction to the plane of the original plate in the case where the test piece is made by cutting out of the original material of plate form. For the test piece made by injection or compression moulding, impact given along the direction parallel to the short side.
 - (8) weighing capacity Nominal magnitude of the potential energy which the hammer has at the lifting position to the impact position of test piece.
 - (9) edge of impact blade Straight portion of blade crest where the hammer gives the impact to the test piece.
 - (10) centre of impact When the hammer swings around the centre line of horizontal rotary axis, the position where the total mass of the hammer can be deemed as concentrated during the swing motion of the hammer.
 - (11) impact velocity Linear velocity of centre of impact of the hammer at the instant of giving impact to the test piece.
 - (12) energy loss of hammer alone Difference in potential energy between two positions of hammer, one lifting position of hammer without pointer needle ⁽¹⁾ and the other swing up position when swinging wide.
- Note ⁽¹⁾ This means the needle of no motion.
- (13) energy loss of tester Difference in potential energy between two positions of hammer, on the lifting position of hammer with pointer needle ⁽¹⁾ and the other the swing up position when swinging wide.
 - (14) energy loss at impact time Energy loss produced by air resistance and friction resistance of hammer with pointer needle ⁽¹⁾ during the movement of the hammer from the position lifted for the test to that of swing up after impacting the test piece.
 - (15) swinging wide Not putting the test piece on the holder of test piece in the testing machine, to allow the hammer to swing wide to swing up position after falling down from the lifting position.

3. Conditioning of Test Piece, and Temperature and Humidity for Testing

3.1 Conditioning of Test Piece Before the test, the test piece shall be conditioned at Category 2 standard temperature and Category 2 standard humidity specified in JIS K 7100, i.e. $23 \pm 2^{\circ}\text{C}$ in temperature and $50 \pm 5\%$ in relative humidity, for 88 h or longer, as a rule.

3.2 Temperature and Humidity for Testing The test shall be made in a room kept under the condition specified in 3.1, i.e. $23 \pm 2^{\circ}\text{C}$ in temperature and $50 \pm 5\%$ in relative humidity, as a rule.

Remark: For the material of hygroscopicity, care shall be taken for the fact that hygroscopicity may affect the Izod impact value.

3.3 Test, if Made Under Another Condition If the test is made under the condition other than that specified as above, after keeping the test piece in an air or liquid bath kept under the specified condition for necessary hours, the impact shall be given with hammer to the test piece attached to its holder of the testing machine. In this case, the time from taking the test piece out of the air or liquid bath to giving the impact shall be within 5 sec.

4. Testing Machine

The testing machine used shall be as specified below.

- (1) The testing machine to be used for the impact test shall be in compliance with the specification given in Appendix 1, Izod Impact Testing Machine for Rigid Plastics.

Remarks 1. When the main components of the testing machine are disassembled, reassembled or exchanged, and when it is reinstalled, the reinspection on accuracy shall be made to ascertain that the machine complies with the specification of Appendix 1, and thereafter it shall be used.

2. Even when the machine does not fall under the conditions mentioned in the above clause, it shall be subjected to the inspection to ensure the accuracy at a definite interval determined according to the frequency of its use.

- (2) The testing machine shall be installed robustly not to bring forth any trouble such as vibration and the like when the test piece is fractured. Its rotary axis of hammer shall be set horizontal.
- (3) It is recommended that the machine is subjected to the inspection on energy loss of the machine stipulated in Appendix 1 before and after the machine is used.

4
K 7110-1984

5. Test Piece

5.1 Types of Test Piece, and Shapes and Dimensions Thereof The types of test piece, and the shapes and dimensions thereof shall be as specified below.

- (1) The types of test piece, and the shapes and dimensions thereof shall be as specified in Table below and Fig. 1.

Table Dimensions of Test Pieces

Unit: mm

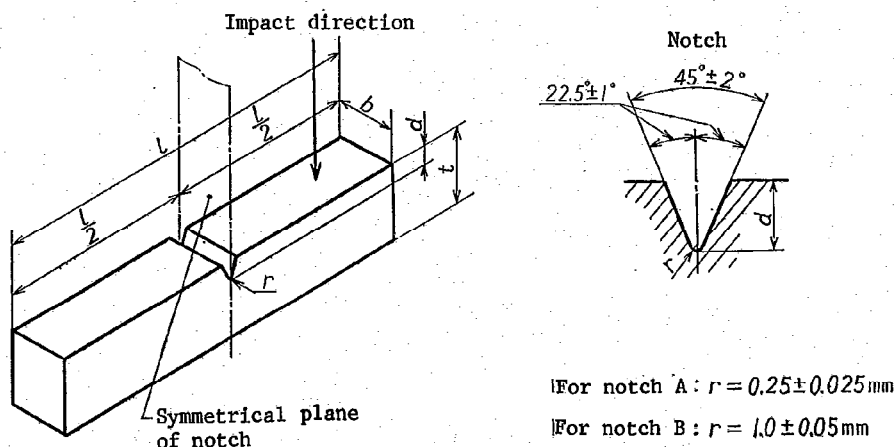
Type of test piece			Dimensions of test piece					
Shape of test piece	Shape of notch	Designation	Length l	Thickness t	Width b		Dimensions of notch	
					Standard dimension	Allowance ⁽²⁾	Radius of bottom r	Notch depth d
Type 1 test piece	Notch A	No. 1 A	80 ± 2	10.0 ± 0.1	4.0 ± 0.2	10 to 2	0.25 ± 0.025	2.0 ± 0.1
	Notch B	No. 1 B					1.0 ± 0.05	
Type 2 test piece	Notch A	No. 2 A	64 ± 2	12.7 ± 0.1	12.7 ± 0.5	13 to 2 ⁽³⁾	0.25 ± 0.025	2.54 ± 0.10
	Notch B	No. 2 B					1.0 ± 0.05	

Notes ⁽²⁾ This means the allowable range to width b according to the condition of the material under test.

- ⁽³⁾ In the case where the test piece is made by injection or compression moulding, it is recommended that the width b be 6.4 ± 0.3 mm or 3.2 ± 0.2 mm.

- Remarks 1. For the material in which the width b of the test piece varies the Izod impact value, the test piece used is advisably presented as exemplified with "Type 1 A Test Piece (5 mm width)" when a Type 1 A test piece of 5 mm width is used.
2. Type 1 A and Type 1 B test pieces have same shape as that of No. 1 E·A and No. 1 E·B test pieces specified in JIS K 7111, respectively.
3. Type 2 A test piece is the customary one of the widest use.

Fig. 1. Test Piece



- (2) Which test piece is to be chosen shall be determined as specified in the relevant standard or as agreed upon between the parties concerned.

5.2 Preparation of Test Piece The preparation of the test piece shall be made as specified below.

- (1) The test piece shall be made by injection or compression moulding or by machining a moulded plate as specified in the relevant standard or as agreed upon between the parties concerned.
- (2) The notch shall be so made by machining that it may be subjected to edgewise impact, as a rule. Since the shape of notch bottom affects the test result greatly, it shall be finished smooth free from such fissure that may affect adversely the test result.

The angle made between the symmetric plane of the notch and the lengthwise central axis shall be within $90^\circ \pm 2^\circ$.

For the test piece made by compression moulding, its notch shall be so made that its direction be parallel with the direction in which the compression force has been applied when moulding.

- (3) When the material under the test has the thickness larger than that of the width b given in Table, its thickness shall be reduced to the width b of the Table by machining. In this case, the same amount shall be removed from both faces, as a rule.

When the material under the test has the thickness within the width b given in the Table, the width b of the test piece shall be taken in the direction of the thickness of the material.

When the material under the test has the thin thickness, some sheets of the material may be laminated to be furnished to the test. In this case, the notch shall be made after the lamination finishes.

- Remarks 1. For the material of a certain nature, care shall be taken for the fact that the width b of the test piece makes the Izod impact value to vary.
2. When testing a test piece laminated with some thin sheets, it shall be avoided to bond each sheet with adhesive to make the test piece, since the bonding affects the test result.
- (4) When subjecting the material having the thickness larger than thickness t given in the Table to the flatwise impact test, the thickness of the material shall be reduced to the thickness t given in the Table by machining. The machining shall be done on one face of the material under the test, and the notch shall be made on the machined face.
- (5) When subjecting the material of anisotropy to the test, individual test pieces shall be made in both directions, lengthwise and lateral.
- (6) Since the dispersed preparation of the test pieces makes the test results to vary markedly, the preparation shall be made by the method and under the conditions specified in the relevant standard or in the agreement between the parties concerned.

When machining, particularly in making the notch, full care shall be taken not to allow the cutting heat, etc. to change the nature of the material.

5.3 Number of Test Pieces The test pieces shall count 10 for every condition, as a rule. The number, however, may be reduced to 5, provided that the small variety ⁽⁴⁾ in the Izod impact value is ensured.

Note ⁽⁴⁾ For the criterion of the small variety, it is recommended to use the coefficient of variation less than 5 %.

6. Test Procedure

The test shall follow the procedure described below.

- (1) Measure the notch depth d and the thickness t and the width b near the notch accurately to the nearest 0.01 mm with a micrometer specified in JIS B 7502.

Remark: The ascertainment of the shape of notch bottom should advisably be made by the measurement or observation using a projector and the like.

- (2) The weighing capacity of the testing machine shall be so chosen that the energy consumed for the fracture of the test piece falls under 10 to 80 % ⁽⁵⁾ of that capacity.

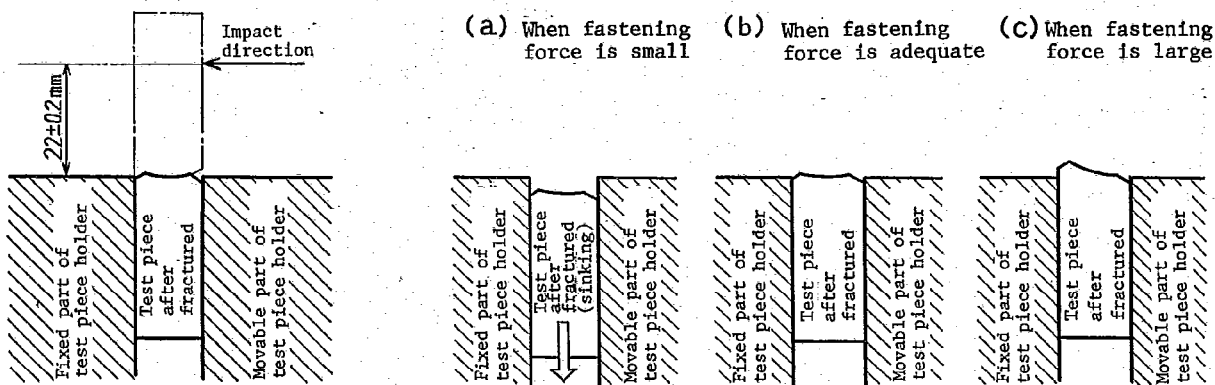
Note ⁽⁵⁾ It is more preferable to make the test in the range of 10 to 70 % of the capacity, if possible, since the actual condition for the test requests so.

- (3) Hold the hammer at the lifting position by the falling device, and make the indicator needle to contact with the needle driving device which is attached to the rotary axis of hammer.
- (4) Attach a test piece vertically to its holder, as shown in Appendix 1 Fig. 2. Settle the position of the test piece accurately so that the symmetrical plane of the notch may align itself with the upper surface of the test piece holder. At this time, the difference between the symmetrical plane of the notch and the upper surface of the test piece holder shall be less than 0.5 mm, and the difference between the middle in the width of the test piece thus attached and the middle of the edge of impact blade shall be less than 1 mm. In order to satisfy the above requirements, it is recommended to use the gauge to set accurately the test piece position.
- (5) In some plastic materials, the fastening pressure by which the test piece is fixed to its holder often affects the Izod impact value. In such cases, since it is necessary to settle the fastening pressure definite, the use of a torque wrench is advisable for attaching the test piece to its holder.

Adequate fastening force varies according to the nature of the material to be tested. For finding this adequate fastening force, the descriptions below is helpful. After the fracture of the test piece, observe the test piece (see Fig. 2), and, if the fraction on the fixed side sinks into the test piece holder remarkably [see Fig. 2 (a)], it shows that the fastening force is small, and, if the fractured face on the fixed side slopes upwards considerably to the horizontal plane of the upper surface of the test piece holder [see Fig. 2 (c)], it shows that the fastening force is too large. It, therefore, is recommended that the fastening force, by which the nearly horizontal fractured face can be obtained and further the fraction on the fixed side does not sink into the test piece holder, [see Fig. 2 (b)], be chosen to fasten the test piece.

- (6) Make the hammer to fall gently to allow it to fracture the test piece by its one time impact, and read its swing up angle at that time.

Fig. 2. Effect of Fastening Force in Izod Impact Test



8
K 7110-1984

7. Calculation

7.1 Calculate the absorbed energy by the use of the following formula:

$$E = WR(\cos \beta - \cos \alpha) - L$$

where

- E : absorbed energy (J){kgf·cm}
- WR : moment of hammer about its rotary axis (N·m){kgf·cm}
- α : lifting angle of hammer (°)
- β : swing up angle of hammer after fracture of test piece (°)
- L : energy loss at the time of impact (J){kgf·cm}

The calculation of energy loss L shall follow Appendix 2.

Remark: Since, in the test made for rigid plastics, the energy loss L is so large to absorbed energy E that it can not be negligible, the correction relating to the energy loss shall be made without fail.

7.2 Obtain the Izod impact value by the use of the following formula:

$$a_{KI} = \frac{E}{b(t-d)} \times 1000$$

where

- a_{KI} : Izod impact value (kJ/m²)
- E : absorbed energy (J)
- b : width of notch of test piece (mm)
- t : thickness near notch of test piece (mm)
- d : depth of notch of test piece (mm)

Reference: The Izod impact value a_{KI} can be obtained in the customary units {kgf·cm/cm²} by the use of the following formula:

$$a_{KI} = \frac{E}{b(t-d)}$$

where

- a_{KI} : Izod impact value {kgf·cm/cm²}
- E : absorbed energy {kgf·cm}
- b : width of notch of test piece {cm}