

# JIS

**JAPANESE INDUSTRIAL STANDARD**

**Testing methods for  
thermosetting plastics**

**JIS K 6911<sup>-1995</sup>**

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## JAPANESE INDUSTRIAL STANDARD

J I S

Testing methods for thermosetting plastics

K 6911-1995

1. Scope This Japanese Industrial Standard specifies the general methods of testing thermosetting plastics.

Remarks 1. The following standards are cited in this Standard.

JIS B 1352	Taper pins
JIS B 4410	Taper pin reamers
JIS B 7502	Micrometer callipers
JIS B 7503	Dial gauges
JIS B 7507	Vernier, dial and digital callipers
JIS B 7512	Steel tape measures
JIS B 7513	Precision surface plates
JIS B 7514	Steel straightedges
JIS B 7516	Metal rules
JIS B 7601	Trip balances
JIS B 7726	Rockwell and Rockwell superficial hardness testing machines
JIS C 1102	Electrical indicating instruments
JIS C 1302	Insulation resistance testers
JIS C 2320	Electrical insulating oils
JIS G 4051	Carbon steels for machine structural use
JIS K 8034	Acetone
JIS K 8951	Sulfuric acid
JIS R 3503	Glass apparatus for chemical analysis
JIS R 6252	Abrasive papers
JIS Z 8101	Glossary of terms used in quality control
JIS Z 8401	Rules for rounding off of numerical values
JIS Z 8801	Test sieves

2. The units and numerical values given in { } in this Standard are in accordance with the traditional unit system and appended for informative reference.

2. Definitions For the purpose of this Standard, the definitions of principal terms are as follows:

- (1) apparent density The mass of moulding material per unit volume.
- (2) bulk factor The quotient of the density of moulding product divided by the apparent density of the moulding material used for the moulding product. The bulk factor is equal to the quotient of the volume of the moulding material required for moulding divided by the volume of the moulded product.

- (3) free water content The water to be lost from a moulding material when the material is dried at room temperature.
- (4) warping rate The concave or convex deformation of material in the direction parallel to the edge, represented by the maximum warp for a length of 1000 mm in percent.
- (5) twisting rate The concave or convex deformation of material in the diagonal direction, represented by the maximum twist of a length of 1000 mm in percent.
- (6) mould shrinkage coefficient Moulding material shrinks smaller than the mould dimension when it is taken away after moulded from a mould and allowed to cool down in the air. The difference between the mould dimension and the dimension of the moulding product is called "mould shrinkage". And the percentage of the mould shrinkage to the mould dimension is the mould shrinkage coefficient.
- (7) rate of shrinkage on heating The shrinkage on heating is the difference between the dimension of the moulding product which has been moulded from a moulding material in a mould, taken out of the mould, allowed to cool down in the air (the dimension of the product in this state is termed initial dimension), and that of the product further conditioned in a thermostatic oven maintained at a specified temperature, its rate is the ratio of the shrinkage to the initial dimension in percent.
- (8) withstand voltage The property of a material such that its test piece withstands without breakdown the specified voltage (the specified potential gradient  $\times$  the thickness of test piece) applied for 1 min.
- (9) flatwise withstand voltage The withstand voltage of a laminate when the voltage is applied vertically to its laminae.
- (10) edgewise withstand voltage The withstand voltage of a laminate when the voltage is applied parallel to its laminae.
- (11) dielectric breakdown strength Under the specified test conditions, the quotient of the minimum effective voltage at the breakdown of the test piece (breakdown voltage) divided by the distance between the two electrodes (thickness of test piece).
- (12) insulation resistance The quotient of the d.c. voltage applied between two electrodes divided by the total current flowing between them. It includes both the volume resistance and surface resistance of the test piece. In the case of laminates, it indicates the edgewise insulation resistance when the voltage is applied parallel to laminae.
- (13) volume resistance The quotient of the d.c. voltage applied between the two electrodes divided by the current through a unit volume of the test piece placed between the electrodes.
- (14) surface resistance The quotient of the d.c. voltage applied between two electrodes attached on one side of the test piece divided by the current flowing along the surface layer.
- (15) volume resistivity The quotient of the potential gradient parallel to the current within the test piece divided by the current density. This value equals the volume resistance between the two electrodes forming the two opposite sides of a cube with 1 cm edges.

- (16) surface resistivity The quotient of the potential gradient parallel to the current along the surface of the test piece divided by the current per unit width of the surface. This value equals the surface resistance between the two electrodes forming the opposite two sides of a square with 1 cm sides.
- (17) dielectric constant The amount of electrostatic energy stored in a unit volume of a substance in a unit electric field. It is called "dielectric constant ( $\epsilon$ )" and expressed as the quotient of equivalent parallel capacitance of a capacitor employing the test piece as the dielectric ( $C_x$ ) divided by that of the same capacitor when air (under the standard condition the dielectric constant of air can be taken for that of vacuum) is used as the dielectric ( $C_0$ ), measured under a specified frequency.

$$\text{i.e., } \epsilon = \frac{C_x}{C_0}$$

- (18) dielectric dissipation factor Dielectric dissipation factor is the tangent of complementary angle to a dielectric phase angle ( $\tan \delta$ ). The dielectric phase angle is the phase difference angle ( $\theta$ ) between the sine-wave voltage applied to the test piece and the current component having the same frequency as the applied voltage caused by the voltage application.

Remarks: The cosine of the dielectric phase angle ( $\theta$ ), i.e., dielectric power factor, is sometimes used in place of dielectric dissipation factor, since dielectric power factor can be regarded nearly equal to dielectric dissipation factor, if  $\tan \delta < 0.1$ .

- (19) arc resistance The period of time for which the test piece can withstand the exposure to arc.
- (20) Rockwell hardness A number calculated by the following equation from the net increase in the depth of impression when the load on a steel ball indenter is increased from a fixed minor load to a major load and then returned to the minor load, by employing an appropriate ball indenter specified depending on the hardness of the test piece.

$$H_R = 130 - 500h$$

where,  $H_R$  : Rockwell hardness

$h$  : net increase in the depth of impression (mm)

In the above procedure, use a steel ball of 6.350 mm diameter for the measurement of M scale, with the minor load of 98 N {10 kgf} and major load of 980 N {100 kgf}, and use a steel ball of 12.700 mm diameter for the measurement of R scale, with the minor load of 98 N {10 kgf} and major load of 590 N {60 kgf}.

- (21) Barcol hardness The maximum reading of a Barcol impressor of Type 934-1, when the test piece is indented by applying a load on the indenter of the instrument.

- (22) flexural strength The maximum flexural stress in the test piece when it is supported at both ends as a both-end-supported beam and applied with a concentrated load on the upper face at the centre of span. However, for a laminated tube of not more than 100 mm inside diameter, the flexural strength is the maximum breaking stress in the test piece when it is placed between two parallel boards and uniformly loaded on the axis.
- (23) bending modulus of elasticity The resistivity of the test piece against deformation by flexural stress, in the straight portion of the load-strain curve within the elastic range. It is expressed in the flexural stress per unit strain.
- (24) tensile strength The quotient of the maximum tensile breaking load applied on the test piece divided by the minimum original cross-sectional area of the test piece, i.e., the maximum tensile stress.
- (25) compressive strength The quotient of the maximum compressive breaking load applied on the test piece divided by the compressed original cross-sectional area of the test piece, i.e., the maximum compressive stress.
- (26) Charpy impact strength The quotient of the total impact energy absorbed when the test piece is broken in a Charpy impact testing machine divided by the original cross-sectional area of the test piece under the notch.
- (27) Izod impact strength The quotient of the total impact energy absorbed when the test piece is broken in Izod impact testing machine divided by the original width of the test piece at the notch.
- (28) bonding strength The load at the break of the laminated sheet when the load is applied parallel to its laminae by using a steel ball.
- (29) deflection temperature under load The temperature of the heat-transfer medium when the deflection of the test piece at the centre of span reaches a fixed amount, when a bar-shape test piece is supported at two points, applied with a fixed load at the centre of span and is heated from outside at a constant speed.
- (30) burning resistance The grade of burning resistance and self-extinguishing property of plastics. It is expressed by the duration of burning after ignition and burning distance.
- (31) flaming The state of burning with flames.
- (32) glowing The state of red-heating without flames.
- (33) water absorption The percentage of the mass of test piece which has increased by immersion in water for 24 h to its mass before immersion.
- (34) boiling water absorption The percentage of the mass of test piece which has increased by immersion in boiling water for 1 h to its mass before immersion.
- (35) boiling water resistance The resistivity of the test piece with appearance against immersion in boiling water for 15 min.
- (36) chemical resistance The resistivity of test piece with mass and appearance against immersion in a testing solution maintained at a constant temperature for a specified period of time.

### 3. Method of sampling and making test pieces

3.1 Method of sampling In the case of testing the quality of product manufactured in lots <sup>(1)</sup>, samples <sup>(2)</sup> shall be taken in accordance with the following, unless otherwise specified.

- (1) Moulding material Make random sampling on a lot whose quality can be regarded as uniform so that the sample will represent the quality of the whole lot. The quantity of the sample shall be about two times as necessary for the test and the sample shall be contained in a vessel which can be closed tight.
- (2) Laminates Sample at random one piece of product as the sample from a lot of laminated sheets, rods or tubes that can be regarded as of the same quality, shape and dimensions.

Notes <sup>(1)</sup> The term lot used here means, as defined in S6 (stratified sampling) of clause 3. (5) in JIS Z 8101, moulding material, laminated sheets, rods and tubes of the same quality produced at the same time under the same conditions.

<sup>(2)</sup> The term sample used here means, as defined in S9 (cluster sampling) of clause 3. (5) in JIS Z 8101, one sampled from the same lot to be subjected to measurements and tests.

### 3.2 Method of making test pieces

- (1) Moulding material When making each test piece by moulding the sample, use the metal mould which meets the requirements for the respective test piece, and mould under the conditions as appropriate to the sample.
- (2) Laminated sheets Unless otherwise specified, cut the test pieces from the ends of the sample lengthwise or crosswise, with care not to produce heat by machining.
- (3) Laminated rods Unless otherwise specified, cut the test pieces from the ends of the sample, with care not to produce heat by machining.
- (4) Laminated tubes Unless otherwise specified, cut the test pieces from the ends of the sample, with care not to produce heat by machining.

Remarks: Unless otherwise specified, the tolerances on the dimensions of test piece shall be  $\pm 5\%$  of the specified dimensions.

4. Test items The test items for each type of thermosetting plastic product shall be as given in Table 1.

Table 1. Test items

Test item	Description	Applicable clause	Times of testing				Size of test piece mm	Preconditioning of test piece	Measured value, unit or method of expression	Expression of test results
			Moulding material	Laminated sheet	Laminated rod	Laminated tube				
Apparent density and bulk factor	Where pouring through funnel is possible	5.2.1	2				—	g/ml coefficient	Mean value	
	Where pouring through funnel is impossible	5.2.2	2				—			
Flow	Extruding method	5.3.1	2				—	g, s/mm	Mean value	
	Circular disc method	5.3.2	2				—			
Mouldability	—	5.4	2				—	—	Occurrence of defects	
Free water content	—	5.33	2				—	%	Mean value	
Dimensions	Length, width, thickness	5.5.1	2				A	mm, mm, 0.01 mm, mm, 0.01 mm, mm, 0.01 mm, 0.01 mm	Mean value	
	Length, diameter	5.5.2		2						
	Length, outside diameter, inside diameter	5.5.3			2					
Warping rate or twisting rate	—	5.6		2			A	%/1000 mm	Max. value	
Mould shrinkage coefficient and rate of shrinkage on heating	After exposure to C-24 ± 1 h/23 ± 2°C/50 ± 5) % RH	5.7	2			Circular disc as Fig. 8 φ 90 × 11	C-24 ± 1 h/23 ± 2°C/ (50 ± 5) % RH	%	Mean value	

Table 1. (continued)

Test item	Description	Applicable clause	Times of testing				Size of test piece mm	Preconditioning of test piece	Measured value, unit or method of expression	Expression of test results
			Moulding material	Laminated sheet	Laminated rod	Laminated tube				
Withstand voltage	In oil, at specified voltage, for 1 min	5.8	2			Circular disc $\phi$ (60 to 100) $\times$ (2 $\pm$ 0.15)	C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH	—	Occurrence of fracture	
		5.9	2							
Flatwise withstand voltage	For less than 200 mm inside diameter For not less than 200 mm inside diameter	5.10.1	2			Square plate $\square$ (70 to 100) $\times$ (2 $\pm$ 0.15)	O-0.5 h/90 $\pm$ 2°C	—		
		5.10.2								
Edgewise withstand voltage	In 90°C oil In oil	5.11.1	2			Machined piece as Fig. 11, 70 square $\times$ (2 $\pm$ 0.15) With electrode hole as Fig. 12, 75 $\times$ 50 $\times$ (3 to 10)	C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH	—		
		5.11.2								
Dielectric breakdown strength	Flatwise, short-time method, in oil After immersion in water Flatwise, 1 min step-by-step method, in oil After immersion in water	5.11.3	3			Circular disc, $\phi$ (80 to 100) $\times$ 2 $\pm$ 0.15 Square plate, $\square$ 100 $\times$ (0.8 to 3.0)	C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH	MV/m	Mean value	
			3				D-48 $\pm$ 2 h/50 $\pm$ 3°C			
			3				C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH			
			3				D-48 $\pm$ 2 h/50 $\pm$ 3°C			
Insulation resistance	After boiling After boiling After boiling	5.12	2			With electrode hole as Fig. 14 (a), 40 $\times$ 20 $\times$ 10 or full thickness With electrode hole as Fig. 14 (a), 40 $\times$ 20 $\times$ 10 or full thickness With electrode hole as Fig. 14 (c), 40 $\times$ full dia. 26 or under With electrode hole as Fig. 14 (c), 40 $\times$ full dia. 15 or under	C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH	M $\Omega$	Mean value	
			2				D-2 h/100°C + D-0.5 h/20 $\pm$ 10°C			
			2				C-90 $^{+4}_{-2}$ h/20 $\pm$ 2°C/(65 $\pm$ 5) % RH			
			2				D-2 h/100°C + D-0.5 h/20 $\pm$ 10°C			