

Nissan Engineering Standard

NES	Polyvinylchloride Compound
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1. SCOPE

This Standard applies to polyvinylchloride molded materials used for automotive interiors, with the exception of items (materials and quality) specified in the following four Nissan Engineering Standards.

NES M 7081 (Polyvinylchloride Coated Fabric for Automobiles)

NES M 7083 (Vinyl Sheet - Automotive)

NES M 7084 (Vacuum-formed Sheet for Instrument Panel Pad)

NES M 8022 (Slush- and Spray-Skin-Formed Instrument Panel Padding)

Remark: Units and numerical values given in { } in this Standard are based on the conventional unit system and are included for reference purposes.

2. CLASSIFICATION

Polyvinylchloride materials for automotive interior use are classified in five categories according to forming process incorporated. They are further classified by formed grade characteristics (Hardness, tensile strength, etc.). Refer to Table 1 for details.

Table 1

Classification			Application examples
Category	Symbol	Characteristics	
Injection molding	PVC-(X)-IA1-1	Low hardness, low tensile strength	Knob cushioning material (A/T models), door pull handle covering, etc.
	PVC-(X)-IB1-1	Medium hardness, low tensile strength	Rear door partitions, R/S lock knob finisher, modular windows, assist grip covering, seat belt protectors, etc.
	PVC-(X)-IB2-1	Medium hardness, medium tensile strength	Knob cushioning material (M/T models)
	PVC-(X)-IC2-1	High hardness, medium tensile strength	Side molding, device knobs, etc.
Extrusion molding	PVC-(X)-EA1-1	Low hardness, low tensile strength	Knob cushioning material, inside seals, shift boots, etc.
	PVC-(X)-EB1-1	Medium hardness, low tensile strength	Welt body sides, inside seals, etc.
	PVC-(X)-EB2-1	Medium hardness, medium tensile strength	Door O/S molding, flush mount molding, trim ends, welt body sides, etc.
	PVC-(X)-EC2-1	High hardness, medium tensile strength	Side molding, welt headlinings, trim ends, trim cords, sheet beading core material, harness covering, etc.
	PVC-(X)-EC3-1	High hardness, high tensile strength	Trim ends, trim cords, sheet beading core materials, harness covering, etc.
Calender molding	PVC-(X)-CB1-1	Medium hardness, low tensile strength	Ceiling sheets, leatherette sheets, door sheets, etc.
	PVC-(X)-CB2-1	Medium hardness, medium tensile strength	Door pocket leatherette, wheel cover leatherette, ceiling sheets, door sheets, sunvisor sheets, rear corner sheets, etc.
	PVC-(X)-CC2-1	High hardness, medium tensile strength	Formed sunvisor sheets, instrument panel padding, etc.

Applicable Standards: See page 22.

Table 2

∗: I, E, C, P, S

Test item	Appli- cable stan- dard	Mea- sure- ment unit	Classification								
			PVC- (X)- ∗A1-1	PVC- (X)- ∗A2-1	PVC- (X)- ∗A3-1	PVC- (X)- ∗B1-1	PVC- (X)- ∗B2-1	PVC- (X)- ∗B3-1	PVC- (X)- ∗C1-1	PVC- (X)- ∗C2-1	PVC- (X)- ∗C3-1
Specific gravity	NES M 8020	—	To be reported.								
Hardness	NES M 0142	HS	60 max.	60 to 80	80 min.	60 max.	60 to 80	80 min.	60 max.	60 to 80	80 min.
Tensile strength	JIS K 6723	MPa {kgf/ mm ² }	15 max. {1.5 max.}	15 to 30 {1.5 to 3.1}	30 min. {3.1 min.}	15 max. {1.5 max.}	15 to 30 {1.5 to 3.1}	30 min. {3.1 min.}	15 max. {1.5 max.}	15 to 30 {1.5 to 3.1}	30 min. {3.1 min.}
Tensile elongation	↑	%	To be reported								
Tensile strength (after heating)	↑	MPa {kgf/ mm ² }	As agreed upon between concerned parties. If necessary, report.								
Tensile elongation (after heating)	↑	%									
Flexural modulus	JIS K 6740	MPa {kgf/ mm ² }									
Izod impact	↑	kJ/m ² {kgfcm/ cm ² }									
Vicat softening point	↑	℃									
Volatile loss (after heating)	—	%									
Thermal deformation rate	JIS K 6723	↑									
Cold weather resistance	↑	℃									
Thermal stability	↑	Hr.									
Volume resistivity	↑	Ω cm									
Oil resistance	↑	%									
Fogging	DIN 75 201	%									

1. TEST METHOD CLASSIFICATION

Test method classifications are listed in Appendix Table 1. Other necessary test items must be determined as agreed upon between concerned parties.

Appendix Table 1

Test item	Test application
Density Hardness Tensile strength Tensile elongation	Perform tests listed at left.
Tensile strength (after heating) Tensile elongation (after heating) Bending elastic modulus Izod impact strength Vicat softening point Volatile (Thermal) loss Thermal deformation Cold weather resistance Thermal stability Volume resistivity Oil resistance Fogging	Perform tests listed at left (as required).

2. GENERAL TEST INFORMATION

2.1 Test room conditions

Unless otherwise specified, the standard test room conditions must conform to grade 2 (Temperature range: $23\pm 2^{\circ}\text{C}$, humidity: $50\pm 5\%$) as specified in JIS K 7100 (Standard atmospheres for conditioning and testing of plastics).

2.2 Test specimen preparation

2.2.1 For injection molding, extrusion molding and stamp molding materials, injection molding processes must be performed as a general rule. Molding conditions (such as, injection pressure, injection time period, cylinder temperature, die temperature, etc.) must be determined as agreed upon between concerned parties and must be reported.

2.2.2 For calender molding, dipping molding and slush molding, punched-out pieces must be used as test specimens. Molding conditions must be determined as agreed upon between concerned parties and must be reported.

2.2.3 The shape, dimensions and quantity of required test specimens are shown in Appendix Table 2.

3. DENSITY TEST METHOD (IN CONFORMITY WITH NES M 8020)

3.1 Test equipment

Test equipment shall be used as follows:

- (1) Chemical balance (Sensitivity: 1 mg)
- (2) Beaker
- (3) Tray or fixture

Test liquid must be new distilled water or distilled water boiled in advance to purge air from it.
An in-water substitution method must be used for density measurements.

3.2 Test specimens

Use three type 1 test specimens. Smooth test specimen surfaces before testing so that air bubbles are not produced when immersed in distilled water.

3.3 Test procedure

Procedure is as follows:

- (1) Tie test specimens using 0.1 mm diameter (max.) metal wire and accurately measure the weight of the specimens in 1 mg units.
- (2) Pour distilled water (free from air bubbles) into the beaker maintained at room temperature. Place the beaker on the tray or fixture. Do not allow the beaker to come in contact with the moving part of the chemical balance.
- (3) Immerse the tied specimens in distilled water with the open end of the metal wire suspended from the balance.
- (4) If air bubbles are produced during immersion, completely purge them using thin metal wire or similar object. Measure the weight of the specimens in 1 mg units.
- (5) Calculate the specific gravity using the following formula:

$$S = \frac{a}{a - b}$$

where S: Specific gravity
 a: Specimen weight in air (g)
 b: Specimen weight immersed in distilled water (g)

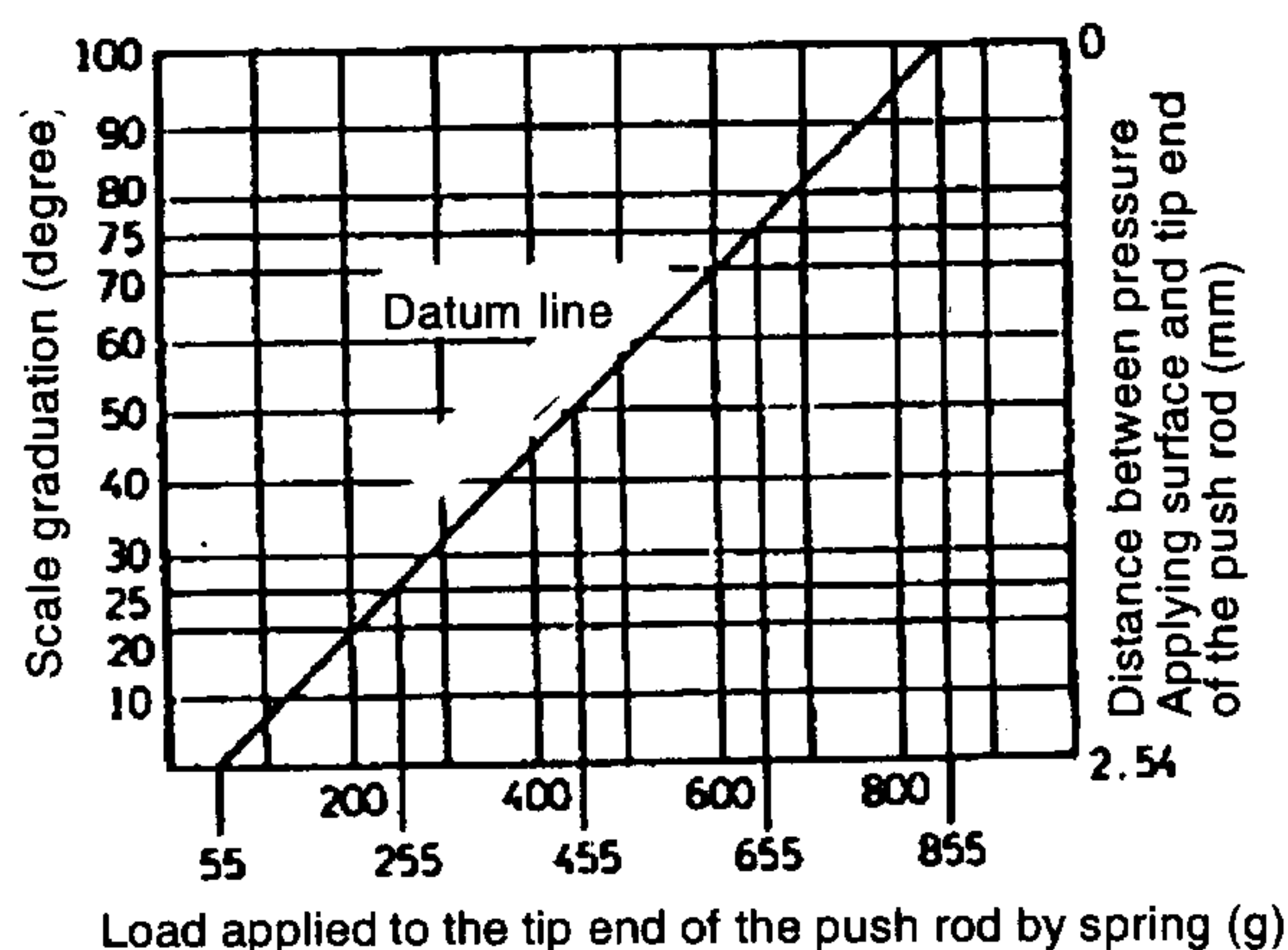
3.4 Test result indication

- (1) To calculate the specimen density, use the following formula using specific gravity S obtained in step (5) above and water (or ethanol) density K under test temperature t°C. (Refer to Appendix Table 3)
 $\rho = S \times K$ (ρ : Specimen density at t°C)
- (2) Perform the density tests 3 times, then calculate the mean value of the 3 measurements to three decimal places.

Appendix Table 3

t°C	Specimen density (kg/cm ³) {kgf · s ² /m ⁴ }
	Water
21	0.9980
23	0.9975
25	0.9970

Appendix Figure 3 Type 3A hardness tester



4.2 Test specimens

Use type 2 specimens whose thicknesses are at least 12 mm. If the specimen thickness is less than 12 mm, place one specimen upon another so that the total thickness is at least 12 mm. The surface⁽⁵⁾ of the specimen to be measured must be smooth. If the surface is rough, dress until smooth.

Note ⁽⁵⁾: The surface area to be measured must be large enough to accommodate the pressure-applying surface of the hardness tester.

4.3 Test procedure

- (1) Set the tester vertical. Allow the surface of the specimen to be measured to come in contact with the pressure-applying surface, then read the pointer indication. The pointer indication refers to specimen hardness.
- (2) If the pointer indication is to be read after the specimen has been in contact with the pressure-applying surface for some length of time, it is advisable to use a suitable auxiliary device. The auxiliary device must be fabricated before hardness tests so that the push rod is placed vertical to the measuring surface with the tester set vertical). In this case, apply a vertical load of 1,000 g to the pressure-applying surface with the auxiliary device, then read the pointer indication.
- (3) Number of measurements
Measure specimen hardness at 5 different contacting points.

4.4 Test result indication

Indicates the mean value of the 5 measurements, along with the test method used or the following symbol, in the test report.

Spring hardness: Hs

4.5 Indication

Specify the following items in the test report.

- (1) Hardness (Hs)
- (2) Hardness tester type
- (3) Ambient temperature during tests
- (4) Other necessary items or data

5. TENSILE PROPERTY TEST METHOD (IN CONFORMITY WITH JIS K 6723)

Perform tensile property tests as specified in JIS K 7113 (Testing method for tensile properties of plastics). Use five type 3 test specimen sheets. These specimens must be punched out after they are left for at least 12 hours at room temperature. Perform tensile property tests at a speed of 200 mm/minute $\pm$ 10% in a room maintained at $23 \pm 2^\circ\text{C}$. Calculate the mean value of the 5 specimen measurements.

7.2 Test specimens

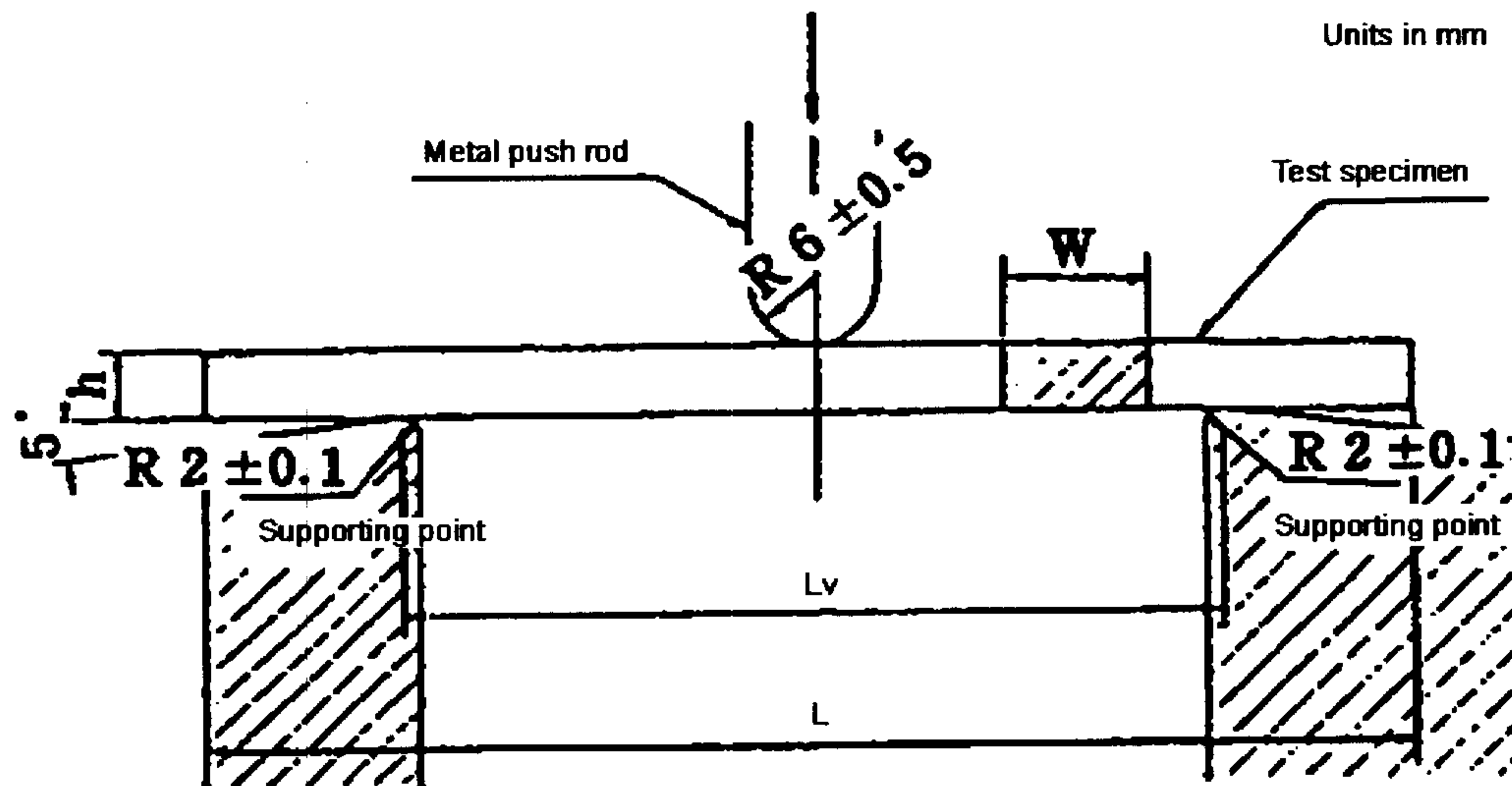
Use three type 4 test specimens.

7.3 Test procedure

Measure the height and width of the three specimens in 0.01 mm units using an external micrometer. Support each test specimen at two points. The distance (L_r) between the two supporting points must be $16 h \pm 0.5$ mm. With the crosshead speed set at $h/2 \pm 0.2$ mm/minute under no load, apply push rod load to the middle point of the specimen until the specimen fractures or yields. Refer to Appendix Figure 4 for the location of the push rod. Using suitable deflection measuring equipment, note the relationship between push rod load and specimen deflection. Draw a load-deflection curve using the above load-deflection relationship so that the inclination of the first linear part of the curve is equal to formula 30 to 60° $\{(\pi/6$ to $\pi/3)$ rad $\}$.

Calculate the inclination of the first linear part of the curve.

Appendix Figure 4 Bending elastic modulus test



7.4 Test result indication

Calculate elastic modulus E_B (N/mm^2) $\{\text{kgf/mm}^2\}$ using the following formula, then calculate the mean value of the 3 specimen measurements down to the first digit.

$$E_B = \frac{F \cdot L_v^3}{4 \cdot b \cdot h^3} \times \frac{1}{Y}$$

where E_B : Flexural modulus (N/mm^2) $\{\text{kgf/mm}^2\}$

L_v : Distance between two supporting points (mm)

b : Test specimen width (mm)

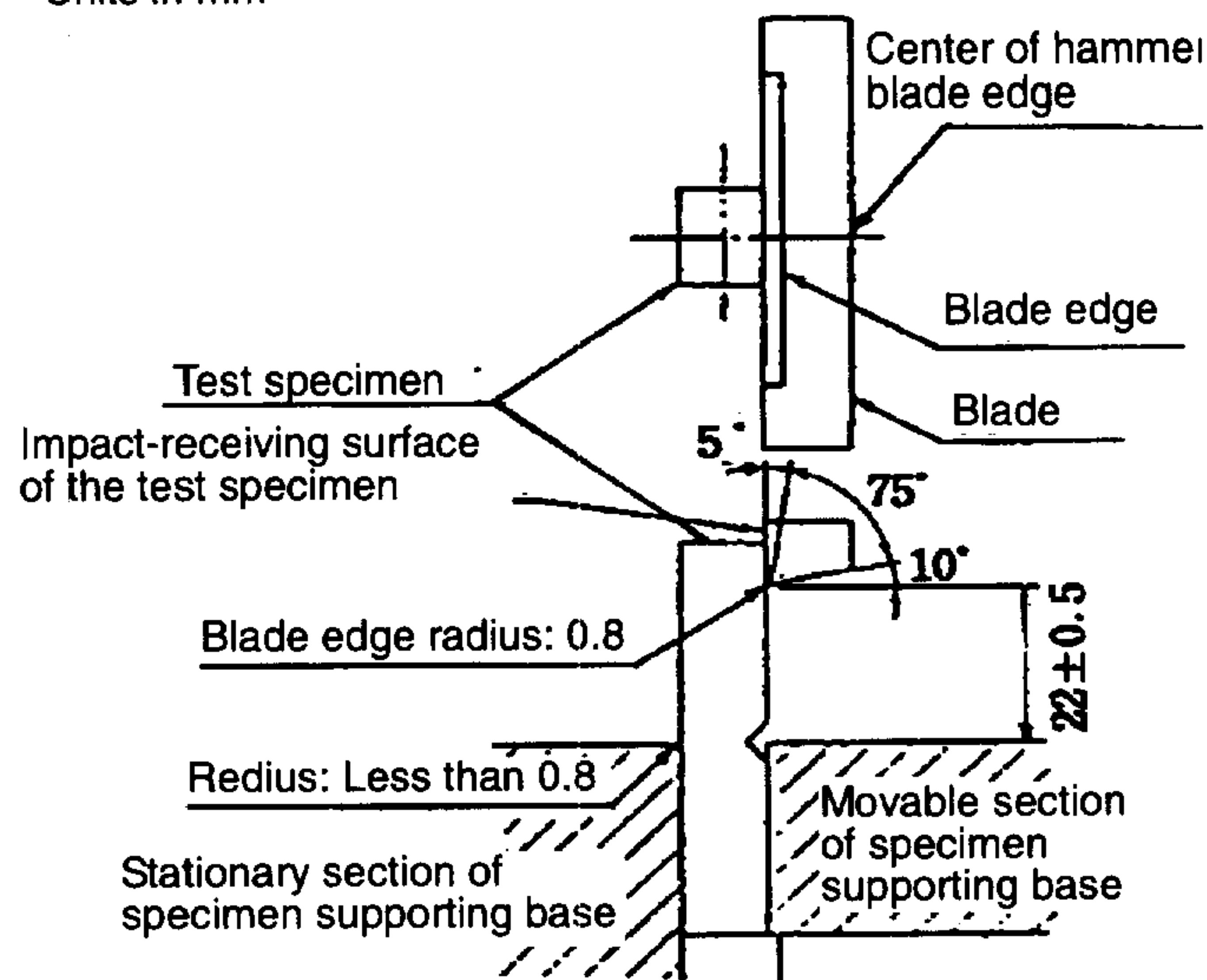
h : Test specimen height (mm)

F : Load (N) $\{\text{kgf}\}$ applied to an optional point on a linear part of the load-deflection curve (N) $\{\text{kgf}\}$

Y : Deflection caused by load F (mm)

Appendix Figure 6 Installation of a test specimen on the Izod impact testing machine

Units in mm

**8.4 Test result indication**

Calculate Izod impact strength " a_{KJ} " (J/cm) {kgf ·cm/cm} using the following formula, then calculate the mean value of measurements for 5 test specimens.

$$a_{KJ} = \frac{W}{E}$$

where E: One hammer impact energy causing specimen fracture (J) {kgf ·cm}
 W: Notch width of the test specimen (cm)

9. VICAT SOFTENING POINT TEST METHOD (IN CONFORMITY WITH JIS K 6740)**9.1 Test equipment**

- (1) The Vicat softening point testing machine consists essentially of a load-applying rod, frame and oil bath. The load-applying rod has a needle⁽⁶⁾ on the bottom end. The frame supports a test specimen and the load rod. The oil bath temperature increases at a constant speed. Refer to Appendix Figure 7 for the Vicat softening point testing machine.
- (2) The load-applying rod is installed to the frame which moves freely in the vertical direction. The lower end of the rod is provided with a 3-mm long needle which has a circular cross-sectional area of $1,000 \pm 0.015 \text{ mm}^2$. The lower surface of the needle is finished flat and set vertical to the load-applying rod axis: the upper side is designed to accommodate a fixed weight.
- (3) A dial gauge scale, which is used to measure the penetration distance of the needle, must be read in 0.01 mm units.
- (4) Load applied to the test specimen must be $1,000^{+50}_0$ grams (including loads applied by a weight, load-applying rod, needle and dial gauge spring pressure).
- (5) Both the load-applying rod and the vertical section of the frame must be made from metal material having the same thermal expansion coefficient.
- (6) The oil bath must be provided with a stirring rod and heater. Silicone oil, glycerin or electrical insulating oil⁽⁷⁾ must be used in the oil bath as a thermal transmission medium. The heater must be capable of increasing the oil temperature at a rate of $50 \pm 5^\circ\text{C}$ per hour.
- (7) The thermometer must be a mercury type and read in 0.5°C units. It must be calibrated in advance and its error must not exceed 0.5°C .

Note ⁽⁶⁾: Use hard steel wire as needle material.

Note ⁽⁷⁾: Use type 2 oil as specified in JIS C 2320 (Electrical insulating oils).

10.3 Test conditions

- (1) Standard conditions [as specified in item 2.1(1)]
- (2) Heating temperature: $120 \pm 2^\circ\text{C}$
- (3) Heating time period: 100 and 400 hours
- (4) No. of air-exchanges inside the temperature controlled chamber: Approx. 6 times/hour

10.4 Test procedure

- (1) Allow the test specimens to stand in dessicator for approximately 24 hours.
- (2) Remove the test specimens. Using a chemical balance, measure the weight of each test specimen in 0.1 mg.
- (3) Suspend the six test specimens in the temperature controlled chamber adjusted to the specified test conditions. Ensure that each test specimen is not in contact with any other object. Heat three of the specimens for 100 hours and the remaining three specimens for 400 hours.
- (4) After heating, remove the specimens and place in dessicator and allow to stand for approximately 2 hours. Remove the specimens and measure each specimen in 0.1 mg units using a chemical balance.

10.5 Test result indication

Calculate the volatile loss (after heating) for each set of 3 specimens using the following formula.

$$\text{Volatile loss (\%)} = \frac{(W_1 - W_2)}{W_1} \times 100$$

where W_1 : Weight before heating (g)
 W_2 : Weight after heating (g)

Calculate the mean value of each set of 3 measurements.

10.6 Indication

- (1) Round off the respective mean values to two decimal places.
- (2) Volatile loss is indicated in %.

11. THERMAL DEFORMATION TEST METHOD (IN CONFORMITY WITH JIS K 6723)**11.1 Test equipment**

The thermal deformation testing machine must have the following functions.

- (1) The thermal deformation testing machine must be a parallel plate, plastimeter or equivalent, which is able to apply a load of 9,806.7 mN {1,000 gf} to test specimens accurately.
- (2) The parallel plate design must be equipped with a dial gauge or an equivalent measuring device (as specified in JIS B 7503) which is able to measure the relative displacement of the specimen upper and lower surfaces in 0.01 mm units.

11.2 Test specimens

Use 3 type 8 test specimens.

11.3 Test procedure

Using the dial gauge (or equivalent), measure the thickness of each specimen at room temperature before heating. Preheat the test specimen and the interior of the thermal deformation testing machine to $120 \pm 3^\circ\text{C}$.

Clamp a metal rod (refer to Appendix Figure 8 for the dimensions) between the parallel plates on the machine as shown in Appendix Figure 9(a), then read the dial gauge indication. Unclamp the metal rod. Place the pre-heated test specimen onto the metal rod, then clamp the metal rod and test specimen using the parallel plates as shown in Appendix Figure 9(b). Apply a load of 9,806.7 mN {1,000 gf} to the upper parallel plate. Heat the metal rod and test specimen to a test temperature of $120 \pm 3^\circ\text{C}$ for one hour, leaving the two unattended. After heating, read the dial gauge indication and regard the dial gauge indication difference as the thickness of the test specimen.

12.3 Test procedure

Perform cold-weather-resistant tests at a temperature of -15°C . Use liquid as a thermal transmission medium⁽⁹⁾ (hereafter called the medium) which will not affect specimen tests. Pour the liquid into the test bath and adjust to the test temperature. Install a test specimen to the clamps, then immerse in the liquid for 3.0 ± 0.1 minutes. Remove the test specimen and record the specimen temperature. Apply a hammer impact to the test specimen. Perform the above test on the remaining two test specimens. Ensure that the three specimens are free from "breakage" at the test temperature. The word "breakage" refers to the test specimen broken into two or more pieces. It does not include any other damage such as traces of cracks, cleaves, etc.

Note ⁽⁹⁾: Methanol or ethanol is used as the medium or mixed with water.

Remark: If possible, use a torque driver or torque wrench to tighten each test specimen to the clamps with a torque of approximately 0.19 J { $2 \text{ kgf} \cdot \text{cm}$ }.

13 THERMAL STABILITY TEST METHOD (IN CONFORMITY WITH JIS K 6723)

13.1 Reagents and test equipment

Reagents and test equipment shall be used as follows.

- (1) Glycerin: Use special-grade glycerin as specified in JIS K 8295 (Glycerin).
- (2) Test tube: Use a hard-glass test tube which measures 15 mm (outside diameter) by 150 mm (length) as specified in JIS R 3503 (Glass apparatus for chemical analysis).

13.2 Test specimens

Use 2 grams of type 6 test specimen.

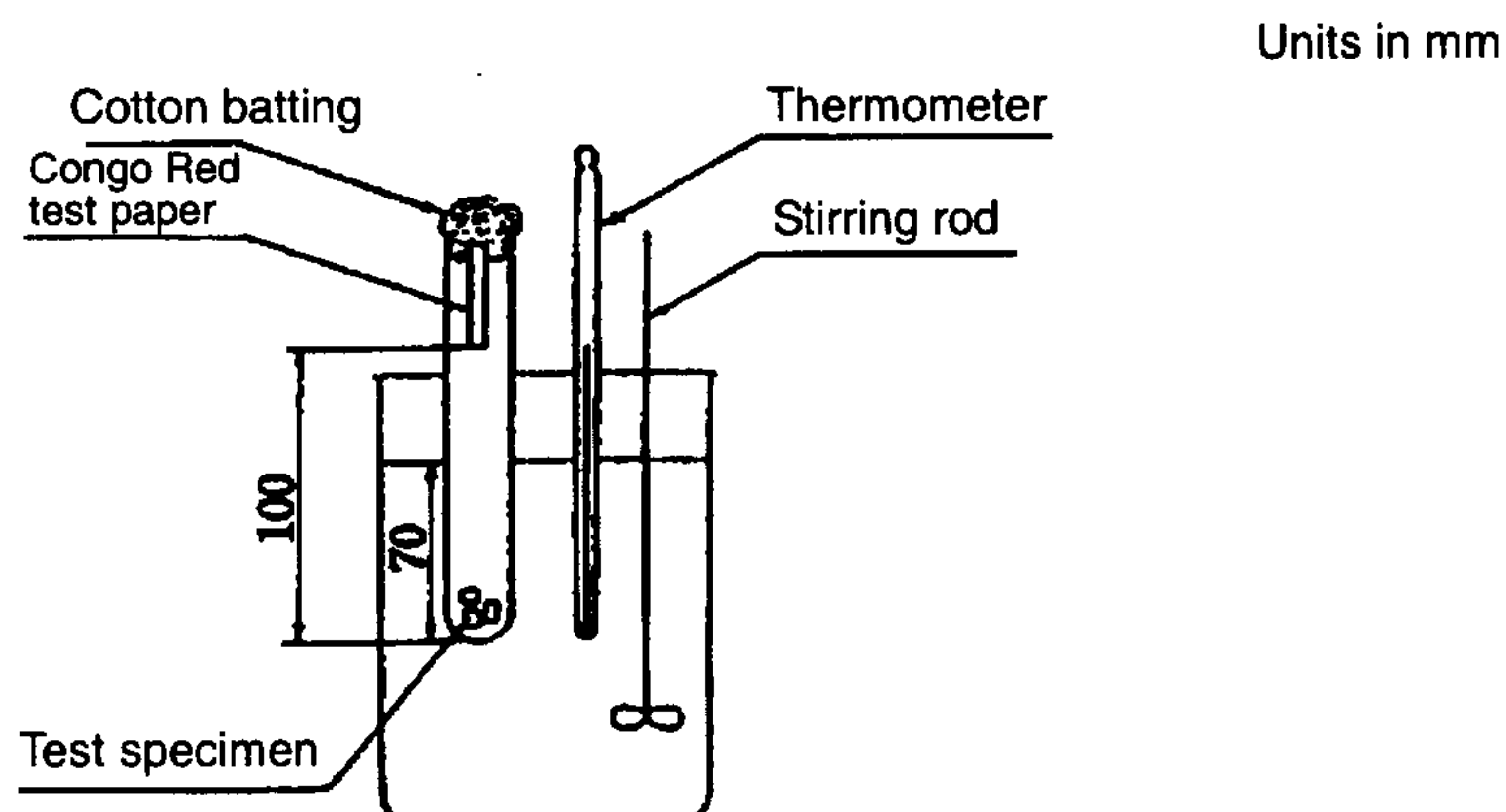
13.3 Test procedure

Moisten Congo Red test paper (7 mm wide x 40 mm long) with the specified glycerin. Place the moistened test paper in two-folded filter paper to wipe off excess glycerin. While holding 10 mm (max.) of the test paper upper edge using cotton batting, place it vertically as close to the middle of the test tube as possible so that the lower edge is 100 mm above the bottom of the test tube. Secure the test paper. Refer to Appendix Figure 11.

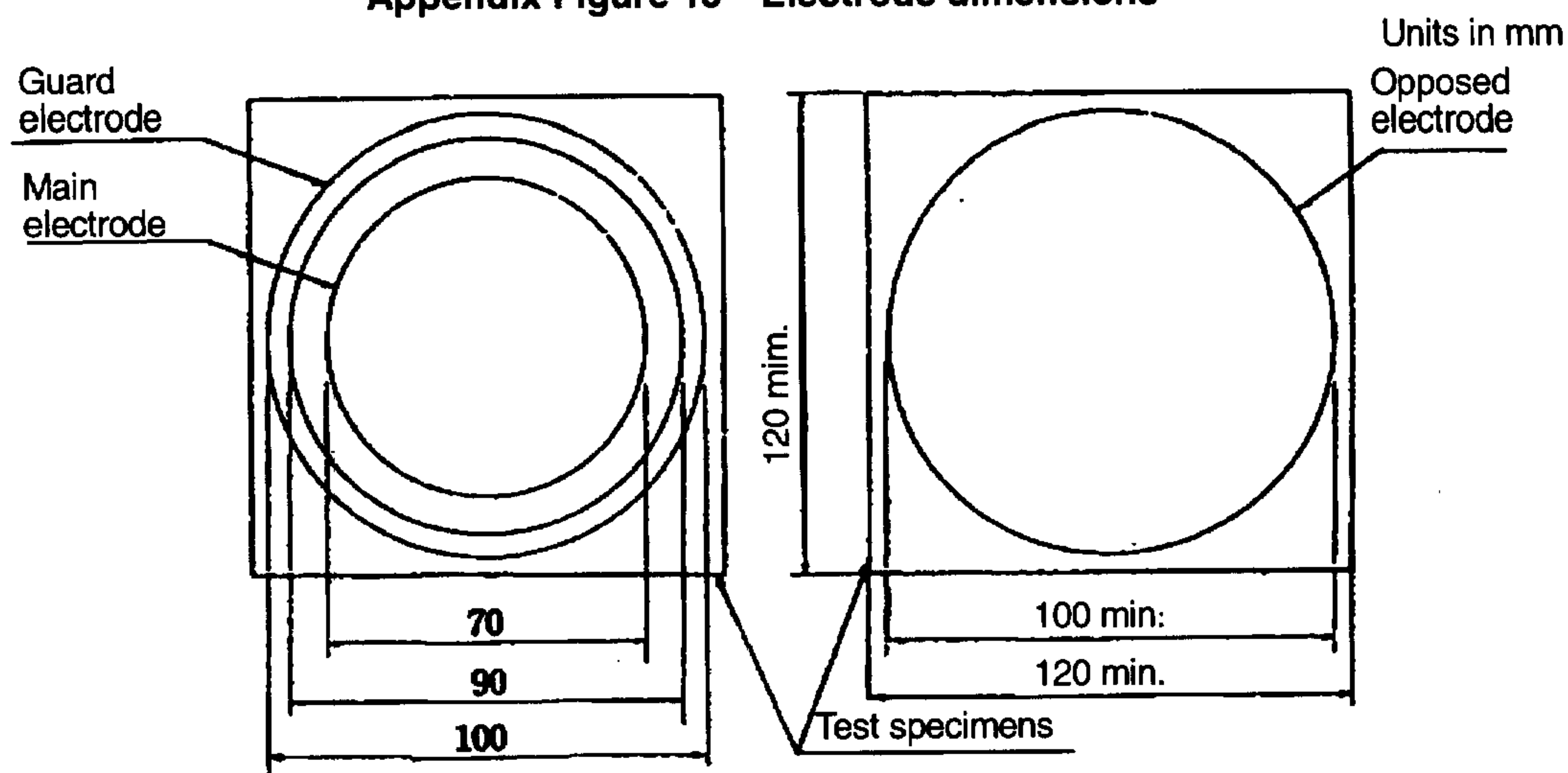
Immerse the test tube with the test paper in the oil chamber maintained at $180 \pm 3^{\circ}\text{C}$ until the test tube bottom is 70 mm below the oil surface. Hold the test tube using suitable means. The test tube must be vertically set in the oil. Measure the time required for the test paper edge to turn clear blue. This measurement time period may be shortened as agreed upon between concerned parties.

Remark: The test paper edge can sometimes turn into purple or other color rather than clear blue, which is caused by stabilizers, etc. If this occurs, the test paper may be replaced with a new one. Specify the duration of time required for the test paper to start to turn color in the test report, as well as other necessary data.

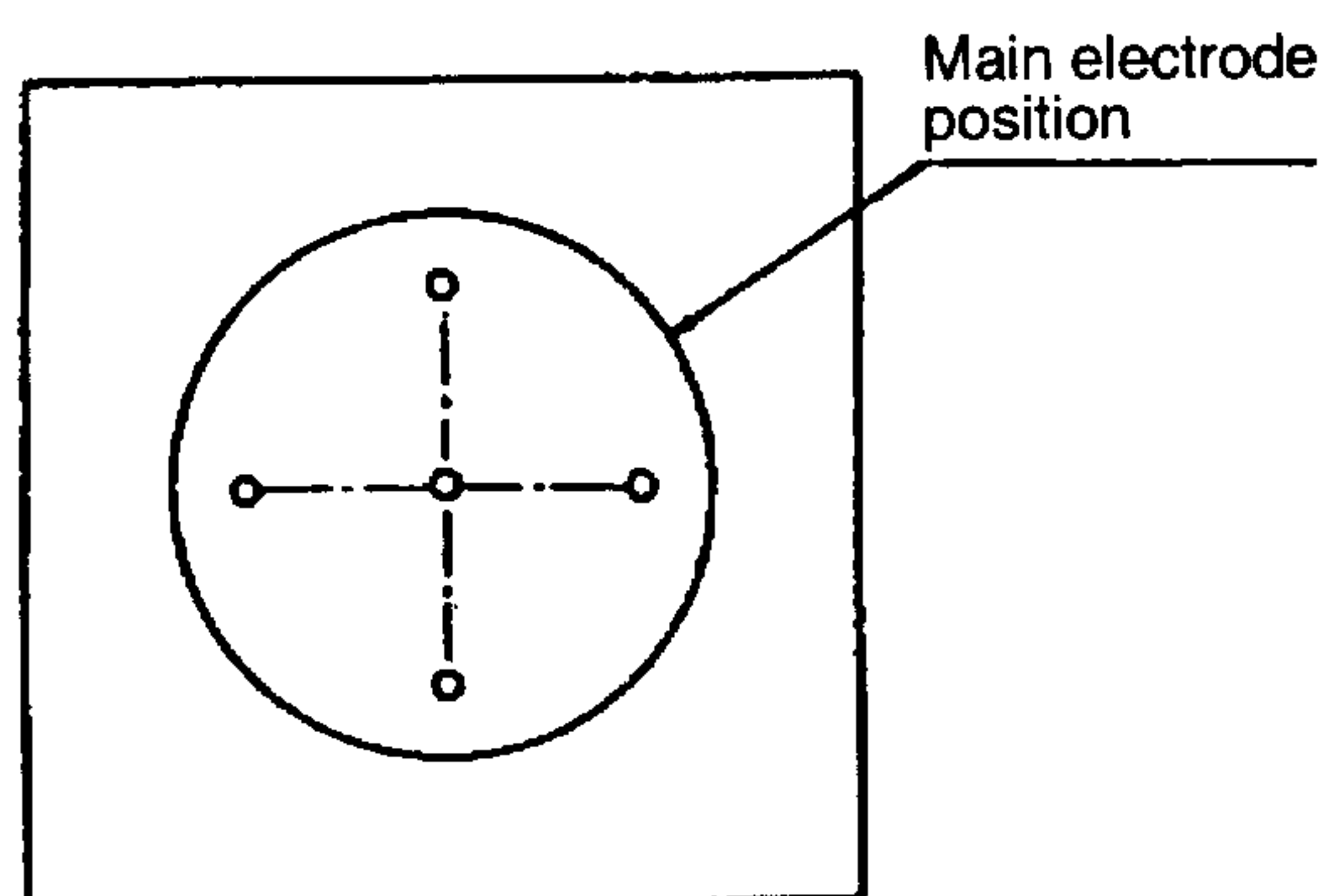
Appendix Figure 11 Thermal stability testing machine



Appendix Figure 13 Electrode dimensions



Appendix Figure 14 Thickness measuring points



15. OIL-RESISTANT TEST METHOD (IN CONFORMITY WITH JIS K 6723)

15.1 Test oil

Use class 1 type 2 insulating oil as specified in JIS C 2320 (Electric insulating oils). However, test oil No. 2 as specified in NES M 0142 (Physical Testing Methods for Vulcanized Rubber), can be used as agreed upon between concerned parties. When test oil No. 2 is used, record test results.

15.2 Test specimens

Use five No. 3 test specimens.

15.3 Test procedure

Measure the thickness of test specimens. Immerse the test specimens in the test oil maintained at $70 \pm 2^\circ\text{C}$ for 4 hours, then remove them. Lightly wipe excess oil from the surfaces of the test specimens, then let stand at $23 \pm 2^\circ\text{C}$ for at least 12 hours. Place an index line on the test specimens, then perform tensile property tests within 48 hours as specified in item 5.

15.4 Test result indication

After removing the test specimens from the test oil, calculate the residual tensile strength and elongation using the following formulas.

$$\gamma_r = \frac{T_2}{T_1} \times 100$$