

JIS

JAPANESE INDUSTRIAL STANDARD

**Methods of Performance
Test of Panels for
Building Construction**

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JAPANESE INDUSTRIAL STANDARD

J I S

Methods of Performance Test of
Panels for Building Construction

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(Reaffirmed: 1983)

1. Scope

This Japanese Industrial Standard specifies the methods of performance test of panels and assembled panels ⁽¹⁾ for building construction.

Note ⁽¹⁾ Mainly those which have been assembled in plane, including joints and jointing members.

2. Definitions

For the purposes of this standard, definitions (1) to (5) apply.

- (1) panel for proof stress That panel which mainly bears the constructional proof stress of a building.
- (2) panel for non-proof stress That of other than the panel for proof stress.
- (3) single material system panel A panel which is composed of the single material such as ordinary concrete, light-weight concrete or cellular concrete. It includes that reinforced with steel bars and the like, that with ribs, that hollow or that to which thermal insulating material and the like are stucked or in which these are embedded.
- (4) sandwich system panel A panel consists of the facing materials of surface and back or inside and outside and the core material, and these have been constituted into a composite by adhesives and others.
- (5) frame-work system panel That has been constituted into an integral panel, attaching appropriate facing material or facing material and core material to the skeleton ⁽²⁾ of wooden frame, steel frame or aluminium alloy frame.

Note ⁽²⁾ The skeleton includes the outer peripheral frame and muntins in the frame.

Applicable Standards:

JIS B 7503-Dial Gauges Reading in 0.01 mm

JIS C 1102-Electrical Indicating Instruments

JIS C 7514-Infrared Lamps

JIS Z 8703-Standard Atmospheric Conditions for Testing

JIS Z 8704-Electrical Methods of Temperature Measurements

3. Types of Tests

The types of tests shall be as given in 3.1 to 3.3.

3.1 Physical Tests of Panel

- (1) Surface water absorption test (6.1) ⁽³⁾
- (2) Cut-end water absorption test (6.2)
- (3) Horizontal static pressure permeability test (6.3)
- (4) Watertightness test (6.4)
- (5) Overall heat transmission test (6.5)
- (6) Deformation tests due to temperature and humidity (6.6)

3.2 Strength Tests of Panel

- (1) Axial direction compression test (6.7)
- (2) Local compression test (6.8)
- (3) Simple bending test (6.9)
- (4) Bending creep test (6.10)
- (5) Local load bending test (6.11)
- (6) Repeated bending test (6.12)
- (7) In-face shearing test (6.13)
- (8) Impact test (6.14)

3.3 Performance Test of Assembled Panel

- (1) Watertightness test of assembled panel (6.15)
- (2) In-face shearing test of assembled panel of assembled panel (6.16)
- (3) In-face shearing and bending test of assembled panel for proof stress (6.17)
- (4) Deformability test by in-face shearing and bending of assembled panel for non-proof stress (6.18)

Note ⁽³⁾ Numerals given in parentheses indicate the clause numbers of the testing methods.

4. Moisture Content Conditions of Specimen

- (1) The moisture content conditions shall be classified as given in Table 1.
- (2) Unless otherwise specified, each test shall be carried out under the air dried condition. However, in the case where it is anticipated that the test results are not influenced remarkably due to the moisture content rate of air dried condition, it is permissible that the air dried condition does not necessarily conform to the condition given in Table 1.

Table 1

Conditions of moisture content	Explanation
Air dried condition	The air dried condition means the condition under which the specimens have been left alone for 14 days and over in a well ventilated room, taking appropriate intervals of specimens to each other. However, for those of wet process such as concrete and cement rendering, these shall be those which have been left for 2 months and over in summer, and 3 months and over in winter. Furthermore, in the case where the specimens have been dried to not less than the condition mentioned above by an artificial drying, or where it has been confirmed that these are under air dried condition by an appropriate testing method, these periods may be shortened.
Dried condition	The dried condition means the condition under which the specimens have been placed in a drying room with air stirrer or in an oven at $60 \pm 2^{\circ}\text{C}$ for 72 h and over, and have been placed until these become approximately a constant mass.
Moistened condition	The moistened condition means the condition under which the specimens have been preserved in a room or a vessel of a temperature at $20 \pm 3^{\circ}\text{C}$ and humidity at 90% and over, and have reached approximately a constant mass.
Saturated condition	The saturated condition means the condition under which the specimens have been preserved in warm water of approximately 10 cm under water level for 48 h and over.

5. Types of Specimens

The types of the specimens shall be classified as given in (1) to (4), and shall generally be in accordance with Table 2 according to each type of test.

- (1) No. 1 Specimen A complete panel.
- (2) No. 2 Specimen A specimen which has been cut out from a panel. However, the frame-work system panel shall be that having the plane of which size is not smaller than one lattice composed of a frame or rib.
- (3) No. 3 Specimen A specimen which has been manufactured in the case where any particular shape and dimensions are required. In this case, the size of the specimen shall be similar to an actual size in use as far as possible corresponding to the capacity of test apparatus, and in manufacturing this, the same raw material, the same form and section and the same manufacturing method shall be used, so that this has the same performances with the No. 1 specimen.
- (4) No. 4 Specimen A specimen which has been assembled, in general, from not less than 2 sheets of the No. 1 or No. 3 specimen panels.

Furthermore, the construction of joints and others shall be so manufactured as same with the actual working conditions, and in the case where a panel is being divided into storey height direction, the specimen shall be so constructed as to have an equivalent height to the height of storey.

Table 2

	Types of tests	Type of specimens
Physical tests of panel	Surface water absorption	No. 1, No. 2 or No. 3
	Cut-end water absorption	No. 1, No. 2 or No. 3
	Horizontal static pressure permeability	No. 1 or No. 3
	Watertightness	No. 1 or No. 4
	Overall heat transmission	No. 1, No. 2, No. 3 or No. 4, and 180 cm x 180 cm or over in size.
	Deformation due to temperature and humidity	No. 1 or No. 3, and 180 cm or over in height.
Strength tests of panel	Axial direction compression	No. 1
	Local compression	No. 1 or No. 2, and 30 cm x 30 cm or over in size.
	Simple bending	No. 1 or No. 3. However, the size of No. 3, 240 cm in length and 90 cm to 120 cm in width for wall panel, and 300 cm in length and 90 cm to 120 cm in width for floor panel.
	Bending creep	
	Local load bending	No. 1 or No. 3. However, the size of No. 3 shall be 180 cm, 240 cm and 300 cm in length, and 90 cm to 120 cm in width.
	Repeated bending	
	In-face shearing	No. 1 or No. 3. However, the size of No. 3 shall be 240 cm in length, 90 cm to 120 cm and 180 cm to 240 cm in width.
	Impact	No. 1, No. 2 or No. 3

Table 2 (continued)

Types of tests		Type of specimens
Performance tests of assembled panel	Watertightness	No. 4
	In-face shearing	No. 4
	In-face shearing/bending of panel for proof stress	No. 4
	Deformability of panel for non-proof stress	No. 4

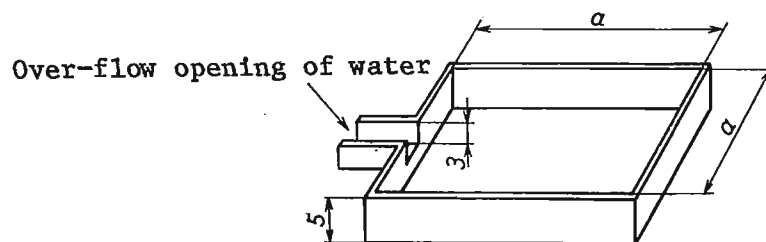
6. Tests

6.1 Surface Water-Absorption Test

6.1.1 Testing Apparatus The shape of the frame for testing shall be as given in Fig. 1, and its inside dimension "a" shall be approximately 10 cm shorter in length than that of the shorter side of the specimen. Material to be used for the frame for testing shall be that of impermeable which does not absorb water such as metal and the like.

Fig. 1

Unit: cm



6.1.2 Test Place The test place shall be a high humid place as far as possible so that no rapid drying could cause on the specimen. However, in the case where a high hygroscopic specimen is tested, humidity shall generally be taken as 70%.

6.1.3 Testing Method

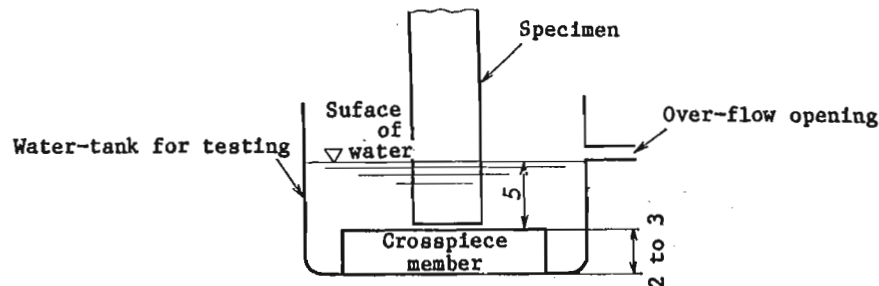
- (1) **Mounting Method of Frame for Testing** Fix the frame for testing on the upper face of a specimen placed horizontally, as given in Fig. 2, using oily clay, sealing material and the like so that no water leakage could take place. Next, pour water quietly into the frame. Maintain the depth of water during testing always at 2 cm.
- (2) **Measurement of Surface Water Absorption** Carry out the measurements of the surface water absorption at lapse of time of 1, 4, 24 and 48 h after pouring of water. In this case, discharge the water in the frame quietly on every measurement, and after water drops have been wiped off with cloths measure the mass in attached condition of frame as it is.

6.2 Cut-end Water-Absorption Test

6.2.1 Testing Equipment The size of the water tank for testing shall be such that the specimen is capable of being immersed with on its end laying and is capable of keeping the depth of water to a constant value as given in Fig. 3.

Fig. 3

Unit: cm



6.2.2 Test Place The test place shall be a high humid place, as far as possible, so that no rapid drying could cause on the specimen.

6.2.3 Testing Method

- (1) Immersing Method Hold the specimen, as given in Fig. 3, vertically on a crosspiece member, and adjust the immersing depth to 5 cm. However, in the case where the No. 2 Specimen has been used, adjust so that the cut out face is not immersed in water. In addition, in a specimen of using the frame-work system panel, of which frame member of bottom face does not be immersed in water, adjust, using the overflow opening or crosspiece member, until the frame member becomes immersed in water.
- (2) Measurement of Cut-end Water Absorption Amount In the measurement of the cut-end water absorption amount, after the specimen has been immersed in water, take this out of the water after lapse of times of 30 min, 1 h, 2 h, 4 h, 8 h and 24 h, wipe the immersed faces rapidly with wet cloths, and measure masses immediately.
- (3) Observation of Water-Absorption Condition Cut the specimen which has finished the water-absorption measurement at a lapse of time of 24 h after immersion at approximately centre of widthwise direction in vertical direction to the surface of water, measure the height of water absorption (cm), and observe its condition.

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6.2.4 Calculation of Results The cut end water absorption amount shall be obtained from the following:

$$S_2 = \frac{W_h - W_1}{L}$$

where S_2 : cut end water absorption amount (g/m) per 1 m of width of the specimen, being indicated to 2 places of significant figures.

L : width of the specimen (m)

W_h : specimen mass after h hours of water absorption (g)

W_1 : specimen mass before immersion (g)

6.2.5 Record of Results In the record of results, the following items shall be stated. However, the appended matters in common shall be in accordance with 7.

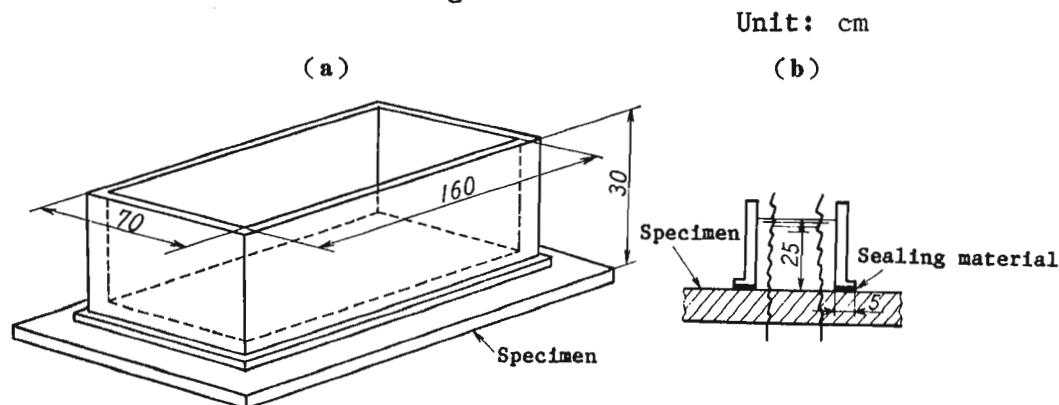
- (1) Schematic drawing of testing apparatus
- (2) Water absorption amounts at lapse of times of 30 min, 1 h, 2 h, 4 h, 8 h and 24 h
- (3) Height of water absorption and illustration of condition of water absorption

6.3 Horizontal Static Pressure Permeability Test

6.3.1 Testing Equipment

- (1) The frame for water storage shall be made of steel as given in Figs. 4 (a) and (b), and be withstandable against the water pressure of 25 cm in depth.
- (2) The inside dimension of the frame for water storage shall be 160 cm in length, 70 cm in width and 30 cm in height. However, for the specimen of less than 180 cm in length or less than 90 cm in width, the length and width of frame for water storage shall be approx. 20 cm smaller than the specimen in length and width.

Fig. 4



6.3.2 Test Place The test place shall be the place where the specimen is not subjected to the direct solar radiation, and shall be the place where rapid drying is avoidable.

6.3.3 Testing Method

- (1) Spread the elastic sealing material approx. 5 cm in width on the part of the specimen which touches with the frame for water storage, and mount the frame for water storage on it.
- (2) In the case where the face of the specimen is not flat, seal up the clearance between the specimen and the frame for water storage, using the frame for filling up clearances which has been fabricated from the material not liable to generate cracks. To the inside of the frame for capping (the part which touches with water), apply paint and the like for water proof treatment. Sealings between the specimen and the frame for capping and between the frame for capping and the frame for water storage shall be in accordance with 6.6.3 (1), as appropriate.
- (3) Pour water into the frame for water storage so that the height of water becomes 25 cm. In the case where the specimen is of a rugged feature (⁴), the height of water shall be that measured from the lowest part of the specimen.

Note (⁴) In the case where leakage of water is anticipated to cause between the frame for water storage and the specimen, causing deflection due to pouring of water, the frame for water storage and the specimen shall be fastened together using a vice and the like, or the back face of the specimen shall be reinforced.

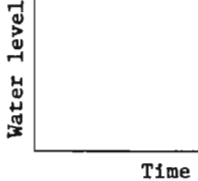
- (4) After pouring of water, measure the lowering of water column at lapse of times of 5 min, 10 min, 30 min, 1 h, 2 h, 3 h and 24 h, as well as observe the conditions of back face. Furthermore, the measuring time shall be 24 h at the longest.

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6.3.4 Record of Results The test results shall be recorded in accordance with the form of Table 3, and in the record the following matters shall be stated. However, the appended matters in common shall be in accordance with 7.

- (1) The conditions of the permeation and transmission of water in the specimen at the time of completion of the test:

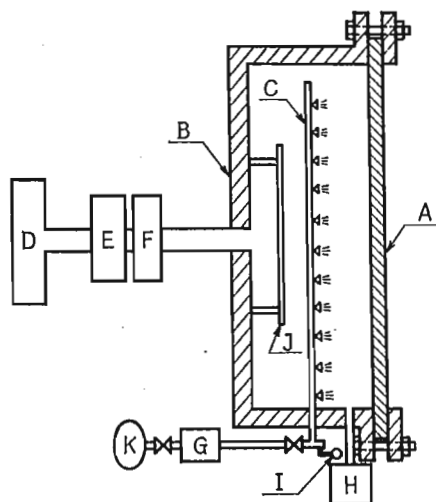
Table 3

Test results of horizontal static pressure permeability test				
Name of specimen		Manufacturer's name		Change in water level 
Date of manufacture		Date of test		
Temperature and humidity		Person in charge of test		
Water level		Time duration of pressure		
Component of panel	Surface material			
	Core material			
Position of leakage of water (at the time of completion of the test)				
☒ Oozing out ☒ Stagnant ☐ Flowing out				
Time	Leakage condition of water		Remark	

6.4 Watertightness Test

6.4.1 Testing Apparatus The testing apparatus shall consist of the pressure box, water-spray device, blower, pressure regulator, pulsation generating device and pressure measuring device, and it shall be capable of applying uniformly distributed load vertically, by pneumatic pressure, to the specimen, while spraying water on the overall surface of the specimen.

Fig. 5



- A: Specimen
- B: Pressure box
- C: Water-spray nozzle
- D: Blower
- E: Pressure regulator
- F: Pulsation generating device
- G: Water-meter
- H: Pressure measuring device
- I: Water pressure gauge
- J: Baffle board
- K: Water pump

- (1) **Pressure Box** The pressure box shall have an opening to which the specimen is capable of being attached in accordance with the attaching method at site, as appropriate, and in its interior the water-spray device shall have been installed.
- (2) **Blower** The capacity of the blower shall be such that it is capable of loading up to an anticipated wind pressures ⁽⁵⁾, to the specimen.

Note ⁽⁵⁾ Since the specimen is designed considering an anticipated wind load on each type of product, the capacity of the blower shall be that of capable of applying the pressure equivalent to this. There are positive pressure and negative pressure in the wind pressures, and it shall be capable of loading to both of these. For that purpose, either 2 sets of blower shall be used, or the duct shall be so made as to be switched.

- (3) **Pressure Regulator and Pulsation Generating Device**
The pressure regulator and pulsation generating device shall have a mechanism which is capable of generating the mean pressure specified in Table 4 and pulsating pressures, taking that pressure as the centre.

- (4) Water-spray Device The water-spray device shall be that of capable of spraying the water quantity of 4 l per min per 1 m² on overall surface of the specimen, and shall consist of the water-spray nozzle, water-meter and water pump.
- (5) Pressure Measuring Device The pressure measuring device shall be an electric pressure gauge having the response characteristic of 4 Hz and over and the accuracy of 1 kg/cm² and over.

6.4.2 Testing Method

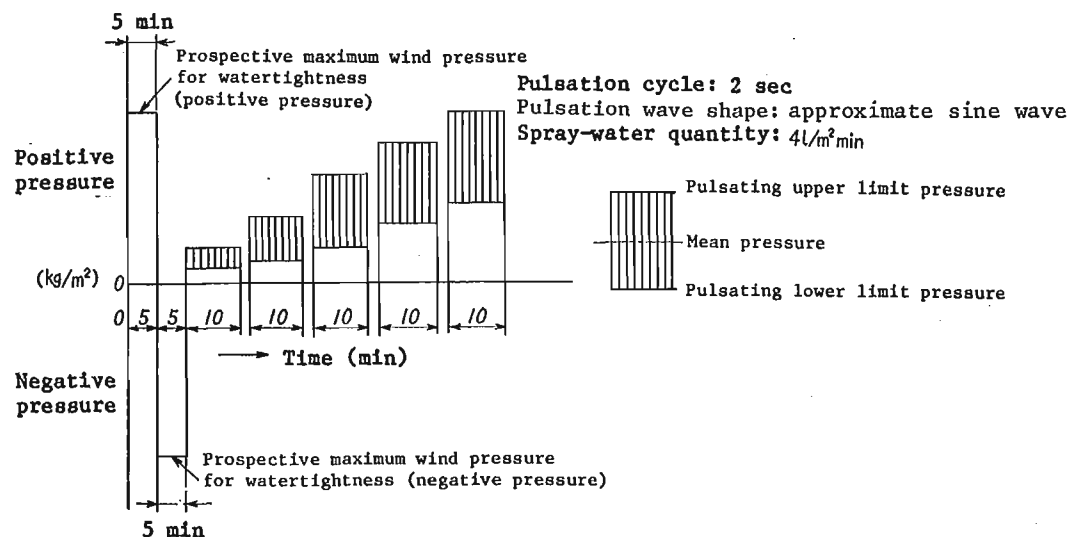
- (1) Mounting Method of Specimen The mounting of the specimen onto the pressure box shall be in accordance with the mounting method at site, as appropriate. The clearance between the specimen and the periphery of pressure box shall be so taken as not causing air leakage, as far as possible.
- (2) Pressurizing Method After prospective maximum wind pressures (positive and negative pressure) under which watertightness can be maintained on the specimen have been applied for 5 min, while spraying the water quantity of 4 l/m² per min uniformly on overall surface of the specimen, apply the pulsating pressure of 2 sec cycle approximate sine wave, of which centre is at the mean pressure given in Table 4, for 10 min and depressurize for 1 min in turn, as given in Fig. 6. However, the maximum pressure shall be the equivalent value to the prospective maximum wind pressure of the specimen in its pulsating upper limit pressure. For that exceeding 160 kg/m² in mean pressure, the numerical values shall be determined appropriately. In this case, the pulsating upper limit pressure and the pulsating lower limit pressure shall be ± 75 kg/m² of the mean pressure.

Table 4

Unit: kg/m²

Mean pressure	5	15	25	40	55	75	100	125	160
Pulsating upper limit pressure	8	23	38	60	83	112	150	187	235
Pulsating lower limit pressure	2	7	12	20	27	38	50	63	85

Fig. 6



- (3) Observation on Condition of Leakage of Water Observe the position and degree of the leakage of water to the side face of room of the specimen by visual inspection.

In the case where any sash and other opening are included in the specimen, measure the water level of water accumulated in the lower frame part of opening.

6.4.3 Record of Test Results The test results shall be recorded in accordance with the form of Table 5, and regarding the opening such as the sash, the test results shall be recorded in accordance with the form of Table 6, and the following matters shall be stated. However, the appended matters in common shall be in accordance with 7.

- (1) The permeating condition of the water of the specimen at the time of completion of the test should preferably be illustrated as far as possible.
- (2) The presence of the residual deformation of the specimen at the time of completion of the test.

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Table 5

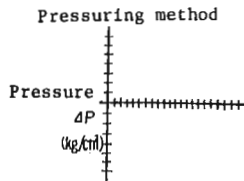
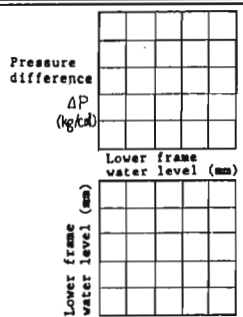
Test results of watertightness (panel)					
Name of specimen		Manufacturer's name		Pressuring method 	
Date of manufacture		Date of test			
Temperature and humidity		Person in charge of test			
Quantity of water	l/m²min	Time duration of pressure	minute		
Component of panel	Surface material				
	Core material				
Position of leakage of water				Mechanism of leakage of water	
Symbol  Oozing out ☐ Flowing out ☒ Generation of bubbles  Stagnant in inside					
Pressure difference ΔP (mean pressure)	Leakage condition of water			Remark	

Table 6

Test results of water-tightness (on parts of sash and door)	Name	Material	Outside dimension (mm)	Depth of frame (mm)	Rise of lower frame (mm)	Air tightness material (weather strip)	Pressurizing method	Time duration of pressure (min)	Quantity of sprinkled water (l/min·m²)	Date of test
								10	4	
Pressure difference ΔP (Mean pressure)	Between lower frame and stile	Between upper frame and stile	Between vertical frame and stile	Meeting stile part		Position of water leakage	Mechanism of water leakage			
kg/cm²										
kg/cm²										
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kg/cm²										
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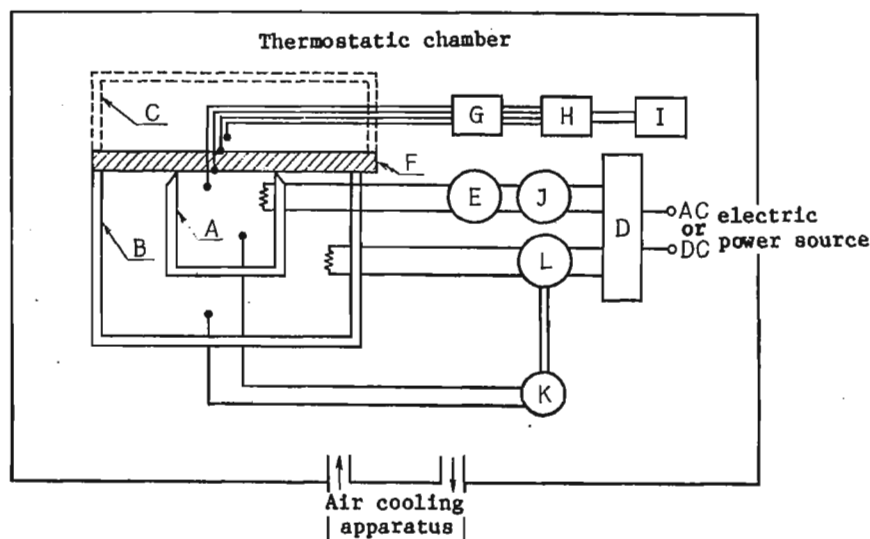
☐: no abnormality
☒: bubbling
☒: spray (inside of frame)
☒: spray (outside of frame)
☒: full of water
☒: over flow
☒: flowing out, blowing out (inside of frame)
☒: flowing out, blowing out (outside of frame)
☒: stable

6.5 Overall Heat Transmission Test

6.5.1 Testing Equipment

- (1) Constitution of Testing Equipment The testing equipment shall be constituted of the heating apparatus, cooling apparatus, temperature measuring instruments, electric power measuring instruments, electric power source stabilizing apparatus and temperature regulator.

Fig. 7. Constitutional Diagram of Testing Equipment



- | | | | |
|--|------------------------------------|--|-------------------------------------|
| A: Heating box | } Heating apparatus | F: Specimen | } Temperature measuring instruments |
| B: Guarded hot box | | G: Freezing point type reference contactor | |
| C: Cooling box or thermostatic chamber equipped with air cooling apparatus (Cooling apparatus) | H: Changeover switch | | |
| D: Electric power source stabilizing apparatus | I: Temperature measuring meter | | |
| E: Watt meter or ammeter and voltmeter (Electric power measuring instruments) | J: Slide regulator | } Temperature regulator | |
| | K: Automatic temperature regulator | | |
| | L: Automatic slide regulator | | |

- (2) Heating Apparatus The heating apparatus shall be constituted of the heating box and the guarded hot box surrounding this, and its dimensions shall be those which are capable at testing the specimen of which size is subject to practical use. The construction of the heating apparatus shall be as given in (a) to (c).

- (a) Surrounding walls of the heating box and the guarded hot box shall be not more than $0.4 \text{ kcal/m}^2 \text{ h deg}$ in thermal conductance, as well as be so constructed as to be large in humidity permeable resistance.
 - (b) Sheath wires shall be used for heat sources to be wired in the heating apparatus, so that the effect of the radiation on the specimen is minimized as far as possible. In addition, the sheath wires shall be so arranged that the distribution of temperature in the apparatus becomes uniform as far as possible, and that minimizes the difference between its surface temperature and the air temperature as smaller as possible.
 - (c) The face of the heating apparatus which contacts with the specimen shall be made airtight as far as possible, using a packing material.
- (3) Cooling Apparatus The cooling apparatus shall either be so constructed as a thermostatic and hygrostatic chamber equipped with an air cooling apparatus, or a cooling box having equivalent dimensions to the heating apparatus. The temperature and wind velocity in the cooling apparatus shall be so arranged as to be distributed as uniform as possible. In the case of the cooling box, packing material shall be stuck to the contacting face with the specimen, to ensure airtightness as far as possible.
- (4) Temperature Measuring Instruments The temperature measuring instruments shall be that of for "the grade A measuring method using a thermocouple" specified in JIS Z 8704. However, for the thermocouple, the CC thermocouple of not more than 0.2 mm in diameter ⁽⁶⁾ which has been treated with the calibration to within 0.1 deg may also be used.
- Note ⁽⁶⁾ In the measurement of the air temperature, the CC thermocouple of not less than 0.2 mm in diameter may also be used.
- (5) Electric Power Measuring Instruments The electric power measuring instruments shall be as given in the following:
- (a) The electric power source shall be of a.c. or d.c.
 - (b) Instruments to be used in the power measurements shall be those having the accuracy of not less than grade 0.5 specified in JIS C 1102 ⁽⁷⁾.

Note ⁽⁷⁾ In a measurement, the instrument of which capacity is such that the measurement can be carried out at the position of not less than 50% the scale of the instrument used shall be used.