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Testing methods for water resistance of textiles

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Textile Evaluation Technology Council (JTETC)/ Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS L 1092** : 1998 is replaced with this Standard.

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Testing methods for water resistance of textiles

Introduction

This Japanese Industrial Standard has been prepared based on the first editions of **ISO 811** and **ISO 4920** published in 1981 and the first edition of **ISO 9865** published in 1991, adopting, for the corresponding parts, the technical contents without any modifications, while adding some specifications and technical contents conventionally applied in the previous Japanese Industrial Standard that are not included in the corresponding International Standards.

The portions with continuous sidelines or dotted underlines are the matters in the contents of the corresponding International Standards have been modified. A list of modifications with explanations is given in Annex JD.

1 Scope

This Standard specifies the testing methods for water resistance of textiles.

Water resistance is a generic term for water proofing, resistance of surface wetting, water leakage, etc.

NOTE : The International Standards corresponding to this Standard and the symbol of degree of contents are as follows:

ISO 811 : 1981 *Textile fabrics—Determination of resistance to water penetration—Hydrostatic pressure test*

ISO 4920 : 1981 *Textiles—Determination of resistance to surface wetting (Spray test) of fabrics*

ISO 9865:1991 *Textiles—Determination of water repellency of fabrics by the Bundesmann rain-shower test*
(Overall evaluation : MOD)

The symbols which denote the degree of correspondence in the contents between the corresponding International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS K 1521 *Perchloroethylene*

JIS K 2201 *Gasoline for industrial purpose*

JIS K 2246 *Rust preventive oils*

JIS L 0105 *General principles of physical testing methods for textiles*

NOTE : The corresponding International Standard: **ISO 139 : 2005** *Textiles—Standard atmospheres for conditioning and testing* (MOD)

JIS L 0208 *Glossary of terms used in textile industry—Testing*

JIS L 0217 *Care labelling of textile goods*

JIS L 1096 *Testing methods for woven fabrics*

JIS Z 8401 *Guide to the rounding of numbers*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS L 0105** and **JIS L 0208** apply.

4 Testing location

The testing location shall be in accordance with **5.1** of **JIS L 0105**.

5 Types of tests

The types of tests shall be as follows.

- a) **Test for water penetration (Hydrostatic pressure method)** This method is mainly applied to textile fabrics with no air permeability.
 - 1) **Method A (Low hydraulic pressure method)** This method is mainly applied to waterproof canvas, duck for tent, duck for shoes and waterproofed fabrics.
 - 2) **Method B (High hydraulic pressure method)** This method is mainly applied to test specimens which can be tested by applying a hydraulic pressure of not less than 10 kPa.
- b) **Test for resistance to surface wetting (Spray method)** This test is mainly applied to textile fabrics with air permeability.
- c) **Rain test (Shower test) method A** This test is mainly applied to textile fabrics that require confirmation of their resistance to surface wetting or leakage by natural rain.

NOTE 1 Rubber coated fabric, plastics coated fabric, etc. should be tested according to the methods specified in **JIS K 6404-7**.

NOTE 2 Method B described in **JA.3.2** is a rain test (Shower test).

6 Sampling and conditioning of test specimens

6.1 Sampling and preparation of test specimens

Sampling and preparation of test specimens and test pieces shall be in accordance with clause **6** of **JIS L 0105**.

6.2 Pretreatment of test specimens

Perform, where required, one or a combination of the following conditionings on the test specimens specified in 6.1 before subjecting them to the test in clause 7.

The water retention of the conditioned test specimens shall be calculated by the following formula from the test values obtained before conditioning and after conditioning, and the result shall be rounded to one decimal place in accordance with rule B of **JIS Z 8401**.

$$RW = \frac{A}{A_0} \times 100$$

where, RW : water retention (%)

A_0 : test value of test specimen before conditioning

A : test value of conditioned test specimen

6.2.1 Laundry treatment

One of the following methods shall be used:

- a) **Method A (method to use a stirring type washing machine)** Use the method specified in 8.23.1 of **JIS L 1096**. Perform drying by drip drying method.
- b) **Method B (method to use a cylinder type washing machine)** Use the method specified in 8.23.2 of **JIS L 1096**.
- c) **Method C (method to use an electric washing machine for domestic use)** Use the method specified in NO.103 of attached table 1 of **JIS L 0217**.

6.2.2 Dry cleaning treatment

The dry cleaning treatment shall be performed according to one of the following methods.

Warning : Persons using this Standard, even if they are familiar with normal laboratory practice, should take adequate measures for safety and health. Special attention should be paid to handling of perchloroethylene, which can be hazardous to human health if inhaled or taken in other forms, and the gasoline for industrial purpose, which may cause fire ignition or other hazards if improperly handled.

- a) **Method A (Perchloroethylene method)** Put approximately 4 L of perchloroethylene specified in **JIS K 1521** at approximately 30 °C in the cylinder of wash cylinder type washer as shown in figure 1. Put into it an approximately 500 mm × 500 mm test specimen and a load cloth¹⁾ adjusting the combined mass to be approximately 450 g, and operate the washer for 10 min.

Note ¹⁾ Cotton cloth (standard adjacent fabric No.3-1) specified in **JIS L 0803** having the same size as the test piece and having its periphery stitched shall be used.

- b) **Method B (Petroleum series method)** This method shall be basically performed in the same way as in 6.2.2 a), but the solvent for test solution shall be No. 5 (cleaning solvent) specified in **JIS K 2201** instead of perchloroethylene.

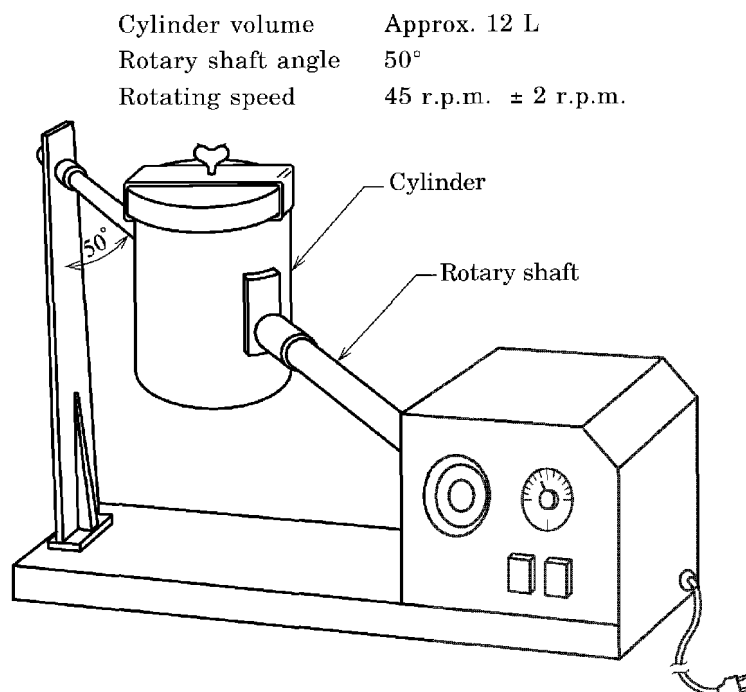


Figure 1 Example of wash cylinder type washer

- c) **Dehydration and drying in dry cleaning treatment** Perform dehydration by a centrifuge until almost all water is removed. If this is impossible, after pressing lightly to remove some water, place between filter papers ²⁾ or cloths to further remove water. Squeezing with a mangle for this purpose is not permissible.

Perform drying according to any one method selected from among the following four:

- 1) **Screen drying** After dehydration, smooth out unnatural wrinkles without twisting or elongating, and dry naturally by spreading it on a flat screen mesh or a surface drilled with similar holes.
- 2) **Line drying** After dehydration, grip several corners of the test piece so that the warp or the wale direction is vertical and dry naturally by suspending.

NOTE 1 Line drying should not be used for fabrics likely to be elongated easily in the wale direction.

- 3) **Drip drying** Without dehydrating the test piece, grip several corners so that the warp or the wale direction is vertical and dry naturally by suspending.

NOTE 2 Drip drying is used for wash and wear fabrics.

- 4) **Tumble drying** After dehydrating, put in a tumble dryer and operate at the temperature of 50 °C to 70 °C for 30 min or until the test piece dries. Test pieces treated according to method B (petroleum method) shall not be tumble dried to avoid the possibility of catching fire.

Note ²⁾ Filter paper of "Class 2" for qualitative analysis, specified in **JIS P 3801**.

6.2.3 Weathering treatment

Perform the method specified in **6.36** of **JIS K 2246**. Time required for one treatment shall be 20 h.

7 Test methods

7.1 Test for water penetration (Hydrostatic pressure method)

The test shall be carried out by the hydrostatic pressure method in accordance with either the following method A (low hydraulic pressure method) or method B (high hydraulic pressure method).

NOTE : Examples of this hydrostatic pressure method are the constant hydraulic pressure method and the water leakage method as described in Annex JA.

7.1.1 Method A (low hydraulic pressure method)

7.1.1.1 Apparatus and materials

The apparatus and materials to be used shall be as follows.

- a) **Water penetration test apparatus (for low hydraulic pressure)** The apparatus shown in figure 2 or those equivalent thereto which is capable of increasing the water pressure at the rate of 600 mm/min $\pm$ 30 mm/min or 100 mm/min $\pm$ 5 mm/min. The clamp shall be of such size that the part of the test piece which touches the water is 100 cm².
- b) **Hydraulic pressure gauge (manometer)** With 5 mm scale and of approximately 1 000 mm or higher in the maximum water level when raising the water levelling apparatus.
- c) **Water** The ion-exchange water or any water equivalent to this shall be used by being maintained at 20 °C $\pm$ 3 °C for the test. In the case of selecting other temperature than this, the adopted temperature shall be noted in the test report.

NOTE : Water temperature can influence the test results.

7.1.1.2 Procedure

From the test specimens specified in clause 6, sample five test pieces each measuring approximately 150 mm $\times$ 150 mm. Mount the test piece on the water penetration test apparatus shown in figure 2 in such a way that its front surface ³⁾ touches the water. Raise the water level by the water levelling apparatus containing water at a speed of 600 mm/min $\pm$ 30 mm/min or 100 mm/min $\pm$ 5 mm/min and measure the water level to an accuracy of mm at the time when the water appears at three places on the reverse surface of the test pieces. The accuracy of the water level to be recorded shall be:

- up to 1 000 mm : 5 mm
- 1 000 mm or over to and excl. 2 000 mm : 10 mm
- 2 000 mm or over : 20 mm

Round the average of five measurements to an integer according to rule B of **JIS Z 8401**. If the water does not come out of three places even when the water level is raised, measure the water level at the time when water comes out from the first or second place and state that effect in the test report.

Do not take into account very fine droplets which do not grow after being formed and do not count the subsequent drops which penetrate through the same place.

NOTE : The test for water penetration method A (low hydraulic pressure method) is equivalent to the method in **ISO 811**.

Note ³⁾ The front surface is the waterproofed surface or the surface that the water touches during use.

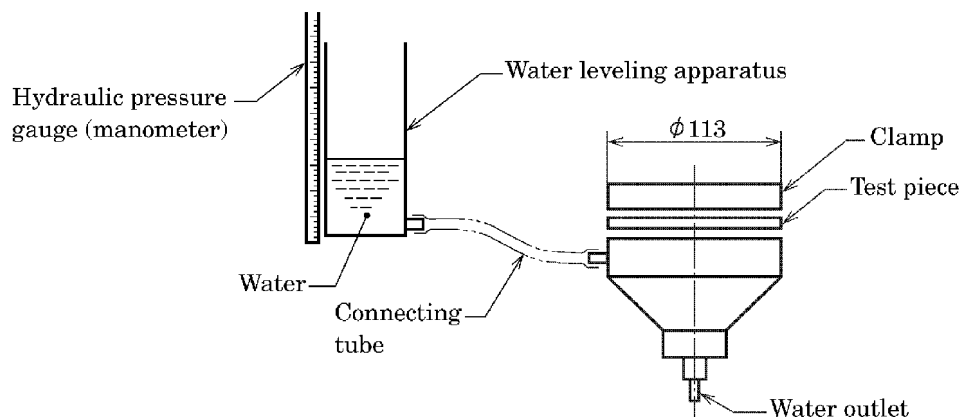


**Figure 2 Example of water penetration test apparatus
(for low hydraulic pressure)**

7.1.2 Method B (high hydraulic pressure method)

7.1.2.1 Apparatus and materials

The apparatus and materials shall be as follows.

- a) **Water penetration test apparatus (for high hydraulic pressure)** The apparatus as shown in figure 3 or any apparatus equivalent to this, capable of applying water pressure at the rate 100 kPa per min.
- c) **Water** The ion-exchange water or any water equivalent to this shall be used by being maintained at $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for the test. In the case of selecting other temperature than this, the adopted temperature shall be noted in the test report.

7.1.2.2 Procedure

From the test specimens specified in clause 6, sample five test pieces each measuring approximately $150\text{ mm} \times 150\text{ mm}$. Mount the test piece on the water penetration test apparatus shown in figure 3 in such a way that its front surface ³⁾ touches the water. Fill the cylinder with water, and turn the piston handle to apply hydraulic pressure at a rate of 100 kPa per minute. Measure the water pressure (kPa) to an accuracy of $1/2$ of the scale of the pressure indicator at the time when the water appears at three places on the reverse surface of the test piece.

Round the average of five measurements to one decimal place according to rule B of **JIS Z 8401**. If the water does not come out of three places even when the water level is raised, measure the water level at the time when water comes out from the first or second place and state that effect in the test report.

Do not take into account very fine droplets which do not grow after being formed and do not count the subsequent drops which penetrate through the same place.

Unit: mm

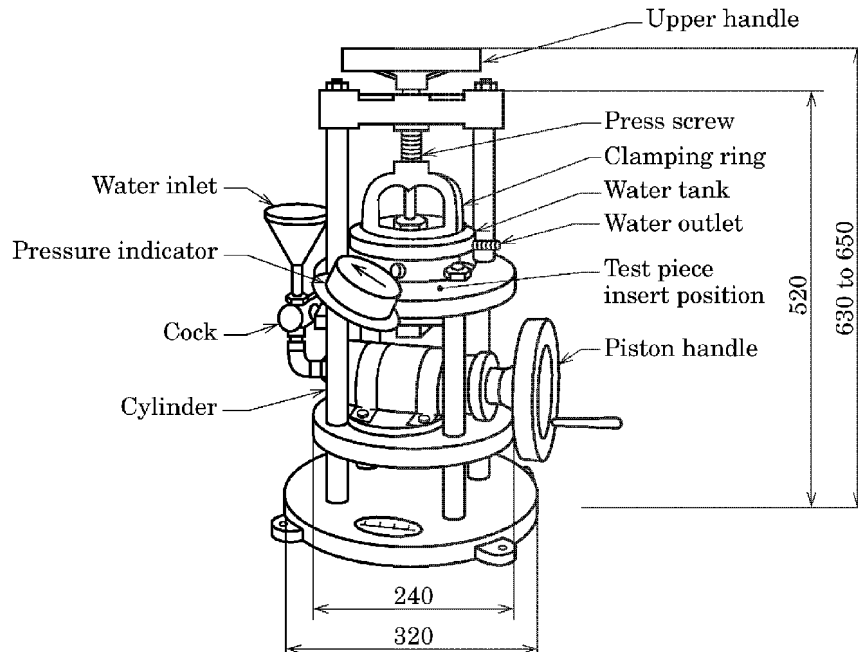


**Figure 3 Example of water penetration test apparatus
(for high hydraulic pressure)**

7.2 Test for resistance to surface wetting (Spray test)

7.2.1 Apparatus and materials

Apparatus and materials shall be as follows.

- Apparatus for test for resistance to surface wetting** The apparatus shown in figure 4 or any apparatus equivalent to this, having a glass funnel 250 ml or greater in volume, and a spray nozzle capable of spraying 250 ml of water in 25 s to 30 s.
- Test piece holder** The metal holder of 150 mm diameter or any other holder equivalent to this.
- Comparison examples for wetting condition** The comparison examples, each of which is given a specified grade according to the wetting conditions, as shown in figure 5.
- Water** The ion-exchange water or any water equivalent to this shall be used by being maintained at $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for the test. In the case of selecting other temperature than this, the adopted temperature shall be noted in the test report.

7.2.2 Procedure

From the test specimen specified in clause 6, sample three test pieces each measuring approximately $200\text{ mm} \times 200\text{ mm}$ and mount on the test piece holder without creasing. Place it in the apparatus for test for resistance to surface wetting shown in figure 4

such that the centre of the spraying coincides with the centre of the test piece holder, and that the warp direction of the test piece is parallel to the flow of the water down the test piece. Pour 250 ml of water in the funnel to spray on the test piece for 25 s to 30 s.

Then, remove the test piece holder from the stand, and holding it horizontally by the end with the front surface of the test piece facing downwards, tap the other end against a solid object to swish off excessive water drops. Hold the other end of the test piece holder by turning it by 180°, and repeat the same procedure as before to drop the excessive water drops. Compare the wetting condition of the test piece as attached to the holder with that of the comparison sample of wetting condition shown in figure 5 to assess the grade. No middle rating is taken.

NOTE : The test for resistance to surface wetting (spray test) is a test method equivalent to that of **ISO 4920**.

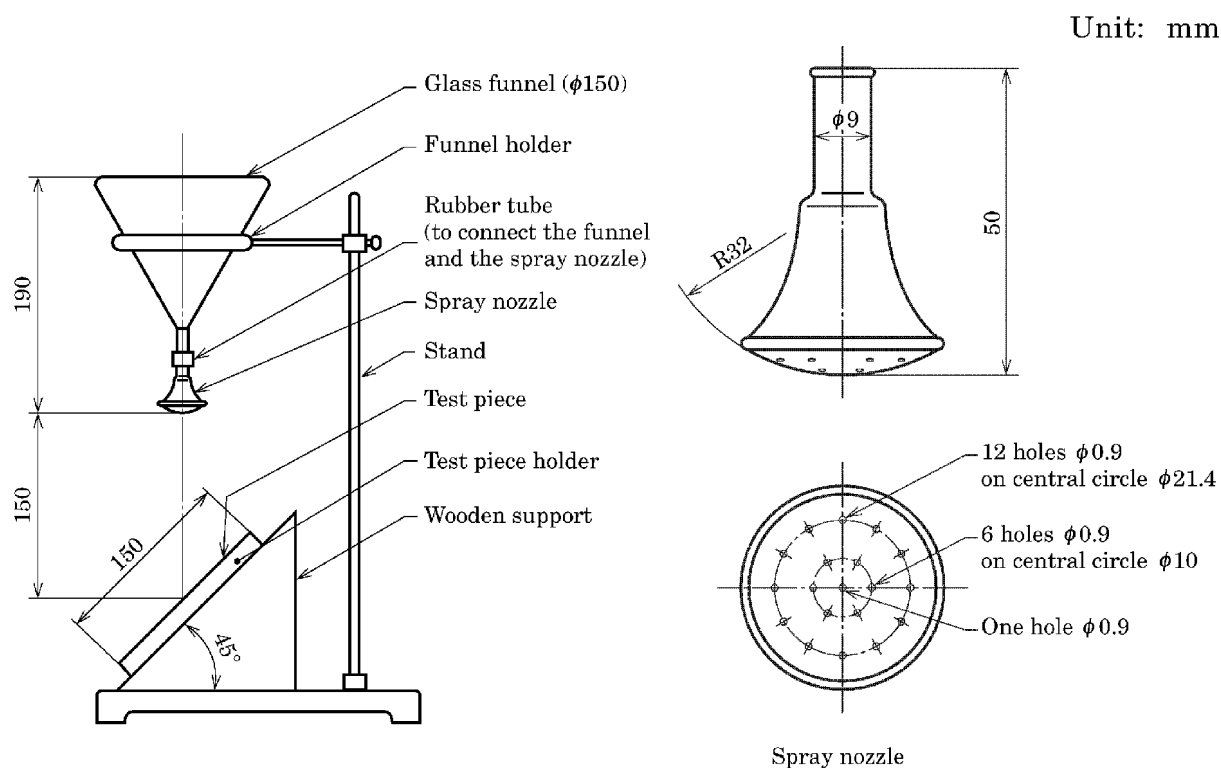
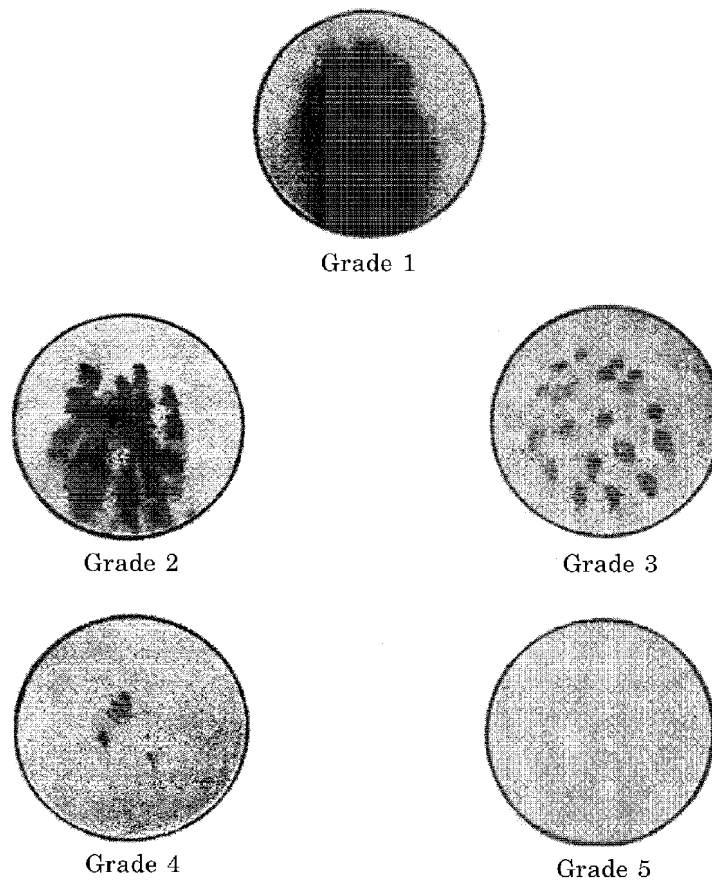


Figure 4 Example of apparatus for the test for resistance to surface wetting



- Grade 1 : Wetting of the whole of the sprayed surface
Grade 2 : Wetting of half of the sprayed surface. This usually occurs through the merging of small discrete wetting areas.
Grade 3 : Wetting of the sprayed surface only at small discrete areas.
Grade 4 : No wetting of, but adherence of small drops to, the sprayed surface.
Grade 5 : No wetting of, and no adherence of small drops to, the sprayed surface.

Figure 5 Comparison sample of wetting condition

7.3 Rain test (Shower test) method A

The rain test (shower test) method A shall be as follows.

7.3.1 Apparatus and materials

The apparatus and materials shall be as follows.

- a) **Bundesman rain-shower test apparatus** The apparatus shown in figure 6 or any apparatus equivalent to this, which consists of rain shower equipment and testing device. The rain shower equipment comprising a system of about 300 identical drop-forming nozzles (nozzle of 4 mm diameter to produce a water drop of approximately 0.07 ml) equally distributed over a circular surface of diameter 406 mm (area approximately 1 300 cm²) shall be capable of producing rain shower of 100 ml/min $\pm$ 5 ml/min for a surface area of 100 cm².

The testing device shall be so constructed that four cups are mounted on the stand for the centreline of the cup to be inclined at 15° from the vertical and the stand shall rotate approximately six turns per minute. Each test cup shall have an outer diameter of 100 mm, and its top serving to clamp the test piece (tested area 80 cm^2) in place by means of a clamping ring, it shall enable the water passing through the test piece to be collected. In addition, each test cup shall comprise a wiper of polished scraping surface of stainless steel, 48 mm in length⁴⁾, approximately 5 mm in width and rounded on the scraper edge with a radius of 5 mm. The wiper shall be pressed against the underside of the test piece during test with a force of 2.5 N to describe 20 reciprocating rotary movements per minute at an angle of 100° . The distance between the water drop-forming nozzle of rain shower equipment and the centre of the test piece mounted on the testing device shall be 1 500 mm.

Note ⁴⁾ Curved slightly to the top in the longitudinal direction (radius of curvature approximately 630 mm).

- b) **Comparison samples of wetting condition** The reference samples specifying the assessment according to the wetting conditions as illustrated in figure 7.
- c) **Centrifuge**, comprising a disc with a horizontal test piece mounting surface of diameter 175 mm rotating at 700 rpm (the time required to attain this speed is 2 s or less). The total mass of the rotating part shall be 410 g. On the test piece mounting surface, approximately 50 ribs (1 mm in height) are provided in a radial arrangement, and four steel pins of 6 mm in length spaced 60 mm away from the centre of the rotary axis are provided in an equally spaced arrangement to secure the test piece.
- d) **Balance**, capable of weighing to an accuracy of 0.01 g.
- e) **Water**, of a temperature of $20^\circ\text{C} \pm 3^\circ\text{C}$. In the case of selecting other temperature than this, the adopted temperature shall be noted in the test report.

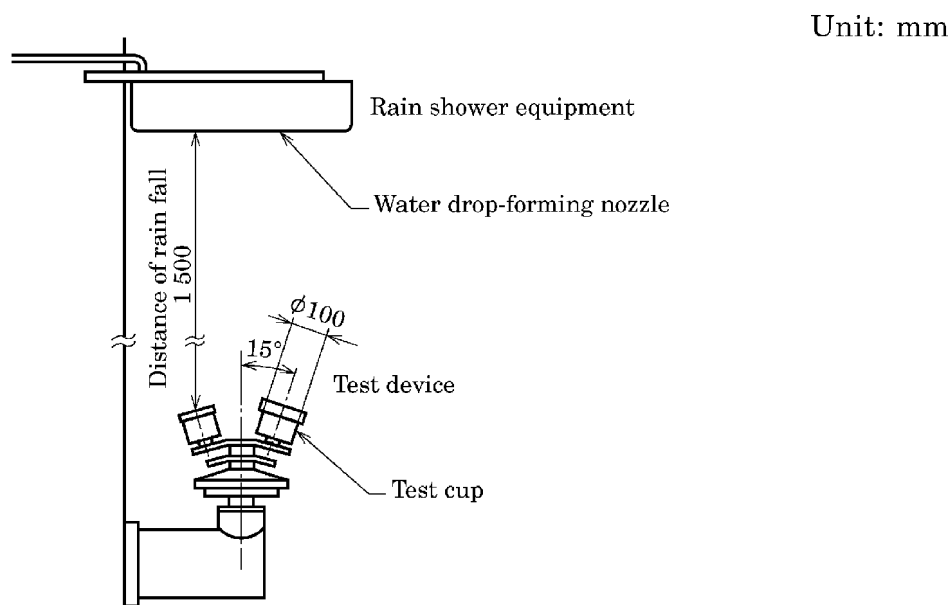


Figure 6 Bundesmann rain-shower test apparatus

7.3.2 Preparation of rain-shower

After checking each part of the test apparatus, switch on the rain shower equipment for approximately 15 min to set the rain flow control valve of the rain shower equipment so that 200 ml $\pm$ 10 ml of water is collected in each cup after 2.5 min.

7.3.3 Procedure

From the specimens specified in clause 6, sample four sheets of circular test pieces of 140 mm diameter, weigh their mass to an accuracy of 0.01 g, and mount them on the test cups. Start the operation after fixing them on the stand of the test device. After exposing the test pieces to the rain-shower for 10 min (rain falling time may be 1 min or 5 min), stop rain falling. Assess the wetting condition of upper surface of the test pieces by visual comparison with the reference samples. Remove the test pieces from the cups, mount them on the centrifuge, and after operating for 15 s to remove the excessive drops on the test pieces, immediately weigh the mass to an accuracy of 0.01 g. Measure the volume of the water which has passed through the test pieces and is collected in the cups to determine the leakage (ml).

7.3.4 Test results

7.3.4.1 Amount of water absorption and rate of water absorption

The test results shall be expressed, by calculating the amount of water absorption V (g) and the rate of water absorption R (%) by the following formulas, with the average of four sheets rounded, according to rule B (half adjust method) of **JIS Z 8401**, to two decimal places for the amount of water absorption and to one decimal place for the rate of water absorption.

$$V = M - M_0$$

where, V : amount of water absorption (g)
 M_0 : mass of test pieces before test (g)
 M : mass of test pieces after test (g)

$$R = \frac{M - M_0}{M_0} \times 100$$

where, R : rate of water absorption (%)
 M_0 : mass of test pieces before test (g)
 M : mass of test pieces after test (g)

7.3.4.2 Water repellency

The water repellency shall be graded based on the comparison with the reference samples shown in figure 7. The average of four test pieces shall be rounded to an integer according to rule B (half adjust method) of **JIS Z 8401**.

NOTE : The rain test (Shower test) method A is an equivalent test method to that of **ISO 9865**.