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**Wood preservatives—Performance
requirements and their test methods
for determining effectiveness**

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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 Wood Preserving Association (JWPA)/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 K 1571:2004** is replaced with this Standard.

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Wood preservatives—Performance requirements and their test methods for determining effectiveness

Introduction

This Japanese Industrial Standard was established in 1998 and has gone through two revisions to this day. The last revision involved change of the standard name and standard structure, and addition of performance requirement items.

No corresponding International Standard has been established at this point.

1 Scope

This Standard specifies the performance requirements for wood preservatives, and the test methods for antiseptic performance, termite proofing performance and iron corrosion property of wood preservatives. However, the test methods for antiseptic and termite proofing performance of wood preservatives to be used in the limited service conditions shall be in accordance with Annex A.

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 A 5009 *Vermiculites*

JIS A 5508 *Nails*

JIS K 0557 *Water used for industrial water and wastewater analysis*

JIS K 1570 *Wood Preservatives*

JIS K 6741 *Unplasticized poly (vinyl chloride) (PVC-U) pipes*

JIS K 8284 *Diammonium hydrogen citrate (Reagent)*

JIS K 8824 *D(+)-Glucose (Reagent)*

JIS K 8848 *Hexane (Reagent)*

JIS K 8962 *Potassium sulfate (Reagent)*

JIS P 3801 *Filter paper (for chemical analysis)*

JIS R 1250 *Common bricks*

JIS T 6605 *Dental stone*

JIS Z 9041-1 *Statistical interpretation of data—Part 1: Statistical presentation of data*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS K 1570** and the following apply.

3.1 surface treatment

treatment to apply wood preservatives on a wood surface by using a brush, a sprayer, a vessel or the like

3.2 coating treatment

treatment to coat a wood surface with wood preservatives by using a brush or the like

3.3 spraying treatment

treatment to spray wood preservatives on a wood surface by using a sprayer or the like

3.4 immersion treatment

treatment to sink wood in wood preservatives by using a vessel or the like

3.5 fungus cellar test

the test to evaluate the rotting resistance of wood preservatives in ground contact, in indoor environment by using non-sterilized soil

4 Performance requirements

The performance of wood preservatives shall be determined according to the test methods in clause 5 and shall satisfy the requirements in table 1.

Table 1 Performance requirements for wood preservatives

Item			Performance value		Sub-clause of relevant test method
Antiseptic performance	Indoor test	Injection treatment use	Mass decrease rate (%)	3 max.	5.2.1.1
		Surface treatment use	Mass decrease rate (%)	3 max.	5.2.1.2
	Fungus cellar test	Injection treatment use, culture bottle test	Mass decrease rate (%)	3 max.	5.2.2.1
		Injection treatment use, rot vessel test	Rot resistance ratio	3 min.	5.2.2.2
	Injection treatment use, field test		Rot resistance ratio	3 min.	5.2.3
Termite proofing performance	Indoor test	Injection treatment use	Mass decrease rate (%)	3 max.	5.3.1.1
		Surface treatment use	Mass decrease rate (%)	3 max.	5.3.1.2
	Field test	Injection treatment use	Vermin damage index	Under 10 ^{a)}	5.3.2.1
		Surface treatment use	Vermin damage index	Under 10 ^{a)}	5.3.2.2
Iron corrosion property	Injection treatment use		Iron corrosion ratio	2.0 max.	5.4.1
	Surface treatment use		Iron corrosion ratio	2.0 max.	5.4.2
Note ^{a)} If any specimen among those tested indicates 50 or greater vermin damage index, the product shall be regarded as not satisfying the performance requirements.					

5 Test methods

5.1 Preparation of sample

An appropriate amount shall be sampled from the wood preservatives to be tested so as to represent its performance. In the case of water soluble wood preservatives and emulsified wood preservatives, they shall be conditioned to the designated concentration (mass fraction %) by using the deionized water of A2 specified in **JIS K 0557** to be supplied as a sample. In the case of oil-based wood preservatives, the stock solution shall be supplied as the sample. In the case of oil-soluble wood preservatives, they shall be conditioned to the designated concentration (mass fraction %) for the actual service using the solvent designated for the wood preservative by the manufacturer.

5.2 Antiseptic performance

5.2.1 Indoor test

5.2.1.1 Injection treatment use

5.2.1.1.1 Material

- a) **Wood piece** The wood piece shall be as follows:
- 1) The wood piece shall be a normal and sound cryptomeria sapwood, and shall be taken from the same wood in air dried state.
 - 2) The wood piece shall have straight grain in two ways, and be finished smoothly by planning.
 - 3) The number of annual rings of the wood piece shall be 3 to 5 per 10 mm and the density, when dried, shall be within the range between 0.25 g/cm³ and 0.32 g/cm³.
 - 4) The shape of the wood piece shall be such that it is 20 mm × 20 mm at the end surface and 10 mm in height. The dimensional tolerance on the end surface and the height shall be ±0.5 mm.
 - 5) The wood piece shall be dried for 48 h in a circulating type dryer maintained at a temperature of 60 °C ± 2 °C, left in a desiccator for approximately 30 min, then after its mass is weighed to the nearest 0.01 g, stored in a desiccator so as not to be humidified.
- b) **Test fungus** For the test fungus, the following two classes of strain separated in the Forestry and Forest Products Research Institute (FFPRI) shall be used.
- Fomitopsis palustris* (Berk. et Curt.) Gilbn. & Ryv. FFPRI 0507
- Trametes versicolor* (L.:Fr.) Pilát FFPRI 1030
- c) **Culture bottle** The culture bottle shall be a cylindrical wide-mouthed container having 50 cm² to 100 cm² bottom area and a whole capacity of 500 ml to 900 ml and capable of aerating under near-sterilized condition through a lid attached with cotton stopper, filter, silicone stopper, etc. If the bottle is not provided with such a lid as above mentioned, the lid of the bottle shall be slightly loosened from the completely closed condition for securing air permeability. The same method shall be always used for securing air permeability for the test.

- d) **Culture medium** For the culture medium, approximately 350 g of sea sand 0.6 mm to 1.1 mm in particle diameter shall be put in a culture bottle, 100 ml of culture solution adjusted at pH of 5.5 to 6.0 is added and then an autoclave sterilization is carried out at a temperature of $120\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 30 min. The composition of culture solution shall contain D (+)-glucose with mass fraction 2.0 % to 4.0 % specified in **JIS K 8824**, peptone with mass fraction 0.3 %, malt extracted matter with mass fraction 1.5 %. After sterilized, the surface of sea sand shall be made level so that the surface of culture solution is at the same level as sea sand.
- e) **Culture fungus** The seed fungus shall be placed nearly at the central part of the surface of culture medium and cultured in the test site at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of 70 %. The colony, which spread sufficiently over the culture medium for 7 days to 15 days, shall be taken as culture fungus and used for antibacterial operation. For the seed fungus, that prepared by any one of the following methods may be used. However, the same method shall be always used for preparing the seed fungus to be used for the tests.
- Inoculate the test fungus on gelatin culture medium, culture in a test place at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ until colony spreads sufficiently, and use the gelatin medium which contains the hypha taken from the tip part of this colony.
 - Place a piece of beech which has been allowed to absorb water and sterilized (approximately 2 mm square and approximately 1 mm in thickness) on a colony which has been cultured in the above method, culture for 5 to 6 days and use this beech with propagated test fungus.
 - Inoculate the test fungus in the culture solution and culture at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for about 1 week while agitating, and use approximately 2 ml of the culture solution containing the obtained hypha particle.

5.2.1.1.2 Specimen

Three types of specimen, namely, treated specimen, specimen for correction and non-treated specimen, shall be prepared according to the following respective methods.

- a) **Treated specimen** The treated specimen shall be prepared as follows:
- 1) Put the wood piece which has been placed in a beaker in a vacuum desiccator or an injection apparatus to depressurize, and while allowing it to absorb sample, leave it to stand in the apparatus for 30 min to 1 h under normal pressure or pressurization, so that the specified sample absorption rate is attained. Then, take out the wood piece from the sample, wipe it lightly, and immediately weigh the mass to the nearest 0.01 g.
 - 2) Calculate the sample absorption rate of wood piece according to formula (1), and round the result to an integer.

$$A_1 = \frac{m_2 - m_1}{m_1} \times 100 \dots\dots\dots (1)$$

where, A_1 : sample absorption rate (%)

m_1 : the dry mass of wood piece before injection treatment (g)

m_2 : the mass of wood piece just after injection treatment (g)

- 3) Select a specified number of wood pieces of which the sample absorption rate is $(250 \pm 10) \%$ for water soluble or emulsified sample, or that of $(200 \pm 10) \%$ for oil-based or oil-soluble sample, and leave them at the room temperature for 20 days or longer. The obtained wood pieces shall be supplied as the treated specimens.
- b) **Correction specimen** The specimen treated similarly to the treated specimen in a) shall be used for the correction of test results. The correction shall be performed for specimens whose mass can have been decreased due to vaporization or diffusion of a part of the composition during test, such as of oil-based sample or oil-soluble sample.
- c) **Non-treated specimen** The non-treated specimen shall be the wood piece specified in 5.2.1.1.1 a) and shall be used for the judgment of activity of culture fungus in antibacterial operation.
- d) **Number of specimens** The number of specimens shall be 9 in repetition number, and the number per one sample shall be as shown in table 2.

Table 2 Number of specimens in antiseptic performance test of wood preservatives for injection treatment

Class of specimen	Class of fungus	Repetition number			
		Water soluble or emulsified		Oil-based or oil-soluble	
		Repetition number	Total	Repetition number	Total
Treated specimen	2	9	18	9	18
Correction specimen	—	—	—	9	9
Non-treated specimen	2	9	18	9	18
Number required	—	—	36	—	45

5.2.1.1.3 Test

After carrying out a weathering operation on each specimen, carry out an antibacterial operation. However, for the specimen for correction, the correction operation shall be carried out in place of the antibacterial operation.

- a) **Weathering operation** Take 9 pieces of each specimen as one set, put them in separate 500 ml beakers, add an amount, which is 10 times the volume of the specimen, of the deionized water of A2 specified in **JIS K 0557** to immerse the specimen below the water surface. Agitate for 8 h using a magnetic stirrer by rotating its rotor at 400 r.p.m. to 450 r.p.m. at a temperature of $25^\circ\text{C} \pm 3^\circ\text{C}$ to elute (hereafter referred to as “eluviation”) the sample, and immediately lightly remove the water on the specimen surface. Then, leave to stand for 16 h in a circulating type dryer maintained at a temperature of $60^\circ\text{C} \pm 2^\circ\text{C}$, and volatilize the volatile content. Repeat the above operation 10 times alternately.

For non-treated specimens, this weathering operation may be omitted.

After drying the specimen, on which the weathering operation has been performed, for 48 h in a circulating type dryer maintained at a temperature of $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, leave it to stand in a desiccator for approximately 30 min, and weigh the mass to the nearest 0.01 g.

- b) **Antibacterial operation** For each specimen previously sterilized with ethylene oxide gas at the room temperature for 5 h or longer, place three pieces each on culture fungus per one culture bottle, directly, in the case of *Trametes versicolor*, and on a heat-resistant plastic net of about 1 mm thickness which has been autoclave-sterilized, in the case of *Formitopsis palustris*, with one end surface facing down and the other up. Leave them in a test site at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of not less than 70 % for 12 weeks.

Upon completion of this antibacterial operation, take out the specimen, remove the adhered matter on the surface such as mycelium sufficiently, and after drying it in air for approximately 24 h, then further drying it for 48 h in a circulating type dryer maintained at a temperature of $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, leave it in a desiccator for approximately 30 min, and weigh the mass to the nearest 0.01 g.

- c) **Corrective operation** Place 3 pieces each of correction specimens, which have been previously sterilized with ethylene oxide gas at room temperature for 5 h or longer, on the culture fungus per one cultural bottle, directly, in the case of *Trametes versicolor*, and on a heat-resistant plastic net of about 1 mm thickness having been autoclave-sterilized, in the case of *Formitopsis palustris*, with the direction of the fibre of the wood piece vertical. Place them in a test place at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of not less than 70 % for 12 weeks.

- d) **Specimen on which antibacterial operation has been performed** Upon completion of this antibacterial operation, take out the specimen, and after drying it in air for approximately 24 h, then further drying it for 48 h in a circulating type dryer maintained at a temperature of $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, leave it in a desiccator for approximately 30 min, and weigh the mass to the nearest 0.01 g.

5.2.1.1.4 Calculation

The calculation shall be as follows.

- a) **Absorbed amount of chemicals** Calculate the absorbed amount of chemicals according to formula (2) and obtain the result to three significant figures.

$$R_1 = \frac{(m_2 - m_1)}{V_1} \times C_1 \times 10 \dots\dots\dots (2)$$

where, R_1 : absorbed amount of chemical (kg/m^3)
 m_1 : dry mass of wood piece before injection treatment (g)
 m_2 : mass of wood piece just after injection treatment (g)
 C_1 : concentration of sample (mass fraction %)
 V_1 : volume of a wood piece (cm^3)

- b) **Mass decrease rate** Calculate the mass decrease rate of each specimen according to formula (3), and obtain the average value and standard deviation.

The calculation of the average ($\bar{x}$) and standard deviation (s) of mass decrease rate shall be in accordance with **JIS Z 9041-1**, and the results shall be rounded to an integer.

$$L_1 = \frac{m_3 - m_4}{m_3} \times 100 \dots\dots\dots (3)$$

where, L_1 : mass decrease rate (%)

m_3 : dry mass of specimen before antibacterial operation (g)

m_4 : dry mass of specimen after antibacterial operation (g)

The mass decrease rate of treated specimen (%) shall be obtained by subtracting the average mass decrease rate of correction specimen (%) from the mass decrease rate of specimen on which the antibacterial operation has been completed.

5.2.1.1.5 Effectiveness of test

When the average mass decrease rate of non-treated specimen tested at the same time as the treated specimen is under 30 % for *fomitopsis palustris* or under 15 % for *trametes versicolor*, a retest shall be carried out.

5.2.1.2 Surface treatment use

5.2.1.2.1 Material

- a) **Wood piece** The wood piece shall be as follows:

- 1) The wood piece to be used for test shall be a normal and sound *cryptomeria* sapwood.
- 2) The wood piece shall have straight grain in two ways, and be finished smoothly by planning.
- 3) The number of annual rings of the wood piece shall be 3 to 5 per 10 mm and the density, when dried, shall be within the range between 0.25 g/cm³ and 0.32 g/cm³.
- 4) The shape of the wood piece shall be such that it is 5 mm × 20 mm at the end surface and 40 mm in height and the surface of 20 mm × 40 mm is the grain face. The dimensional tolerance on the end surface and height shall be ±0.5 mm.
- 5) The end surface of the wood piece shall be coated entirely with epoxy resin coating, and after it is cured and sufficiently dried in an indoor environment, the mass shall be weighed to the nearest 0.01 g. Epoxy resin coating used shall have such a performance that the adhesion is not peeled from the end surface even when weathering operation is performed on the specimen.

- b) **Test fungus** The test fungus shall be in accordance with 5.2.1.1.1 b).

- c) **Culture bottle** The culture bottle shall be in accordance with 5.2.1.1.1 c).

d) **Culture medium** The culture medium shall be in accordance with **5.2.1.1.1 d)**.

e) **Culture fungus** The culture fungus shall be in accordance with **5.2.1.1.1 e)**.

5.2.1.2.2 Specimen

Two types of specimen, namely, treated specimen and non-treated specimen, shall be prepared according to the following respective methods.

a) **Treated specimen** The treated specimen shall be prepared as follows:

- 1) The wood piece shall be coated by, sprayed with or immersed in the sample, and the mass shall be weighed to the nearest 0.01 g. In the case of immersion treatment, the mass shall be weighed immediately after the wood piece after immersion is lightly wiped.
- 2) The sample treatment amount of wood piece shall be calculated according to formula (4), and the result shall be rounded to an integer.

$$B_1 = \frac{m_6 - m_5}{T_1} \times 10\,000 \dots\dots\dots (4)$$

where, B_1 : sample treatment amount (g/m²)

m_5 : mass of wood piece before surface treatment under air-drying condition (g)

m_6 : mass of wood piece just after surface treatment (g)

T_1 : surface area of wood piece (cm²)

- 3) The treated specimen shall be 110 g/m² ± 10 g/m² in sample treatment amount of wood piece, and shall have been left at the room temperature for at least 7 days.

b) **Non-treated specimen** The non-treated specimen shall be the wood piece specified in **5.2.1.2.1 a)** and shall be used for the judgment of activity of culture fungus in antibacterial operation.

c) **Number of specimens** The number of specimens shall be 9 in repetition number per one sample and shall be in accordance with table 3.

Table 3 Number of specimens in antiseptic performance test of wood preservatives for surface treatment

Class of specimen	Class of fungus	Repetition number	Total
Treated specimen	2	9	18
Non-treated specimen	2	9	18
Number required	—	—	36

5.2.1.2.3 Test

After carrying out the weathering operation on each specimen, perform the antibacterial operation.

- a) **Weathering operation** Take 9 pieces of each specimen as one set, put them in separate 500 ml beakers, add an amount, which is 10 times the volume of the specimen, of the deionized water of A2 specified in **JIS K 0557** to immerse the specimen in static water at $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. After leaving to stand for 5 h to eluviate, immediately remove the water on the surface of the specimen lightly. Then, leave to stand for 19 h in a circulating type dryer maintained at a temperature of $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, and volatilize the volatile content. Repeat the above procedures alternately 10 times.

For untreated specimens, this weathering operation may be omitted.

Dry the weathered specimen for 48 h in a circulating type dryer maintained at a temperature of $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, then leave it in a desiccator for approximately 30 min, and weigh the mass to the nearest 0.01 g.

- b) **Antibacterial operation** For the antibacterial operation of treated specimen and non-treated specimen, place a sterilized heat resistant plastic net of approximately 1 mm thickness on the culture fungus, frame three pieces per one culture bottle with a polytetrafluoroethylene frame plate of approximately 1 mm thickness as shown in figure 1, sterilize it with ethylene oxide gas at room temperature for 5 h or longer and then, place it with the surface of $40\text{ mm} \times 5\text{ mm}$ downward, and leave it at a test place at a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of 70 % or over for 12 weeks.

Upon completion of this antibacterial operation, take out the specimen, remove sufficiently the adhered matter on the surface such as mycelium, and after drying it in air for approximately 24 h, then further drying it for 48 h by a circulating type dryer maintained at a temperature of $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, leave it in a desiccator for approximately 30 min, and weigh the mass to the nearest 0.01 g.

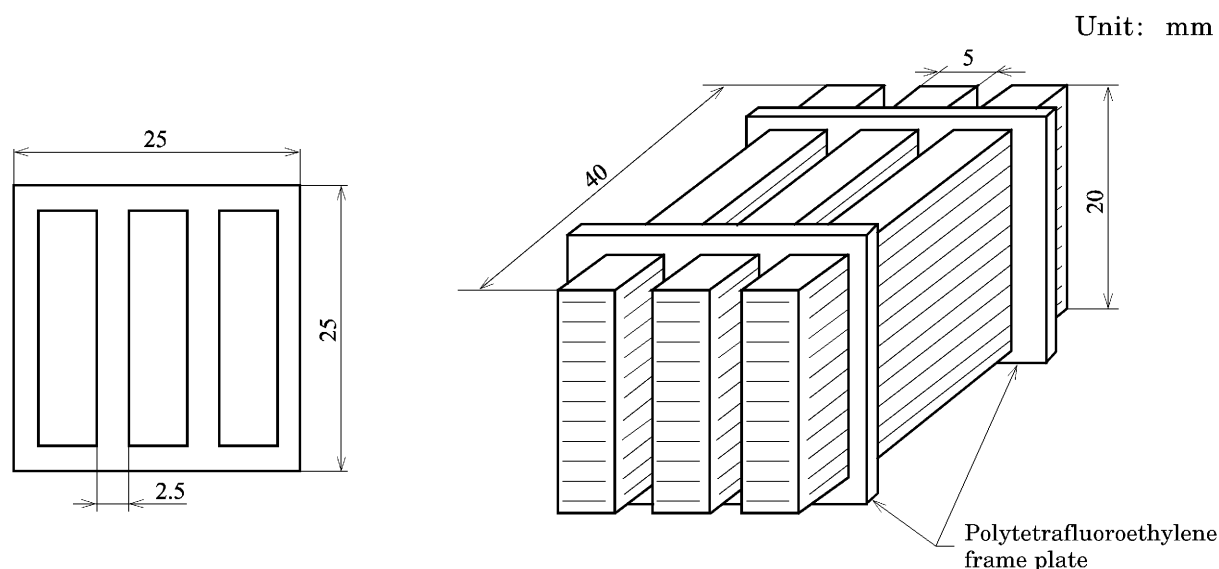


Figure 1 Specimen framed in frame plate of polytetrafluoroethylene

5.2.1.2.4 Calculation

Calculate the mass decrease rate of each specimen according to formula (5) and obtain the average value and standard deviation.

The calculation of the average ($\bar{x}$) and standard deviation (s) of mass decrease rate shall be in accordance with **JIS Z 9041-1** and the results shall be rounded to an integer.

$$L_2 = \frac{m_7 - m_8}{m_7} \times 100 \dots\dots\dots (5)$$

where, L_2 : mass decrease rate (%)

m_7 : dry mass of specimen before antibacterial operation
(g)

m_8 : dry mass of specimen after antibacterial operation
(g)

5.2.1.2.5 Effectiveness of test

When the average mass decrease rate of the non-treated specimen tested at the same time as the treated specimen is under 30 % for *fomitopsis palustris* or under 15 % for *trametes versicolor*, a retest shall be carried out.

5.2.2 Fungus cellar test

5.2.2.1 Culture bottle test

5.2.2.1.1 Material

a) **Wood piece** The wood piece shall be in accordance with **5.2.1.1.1 a)**.

b) **Soil** The soil shall be as follows:

- 1) The soil to be used for test shall be the stratum A of forest soil or clay loam. The soil taken, in its natural field-moist condition, shall be passed through a sieve of 4 mm opening to remove vegetation roots, stones and others.
- 2) The pH (H₂O) of the soil shall be within the range between 5.0 and 8.0.
- 3) The water content of soil shall be adjusted so as to correspond to the maximum water retention amount. The maximum water retention amount of soil shall be as follows:

Place a Class 2 filter paper of 55 mm diameter specified in **JIS P 3801** on a Buchner funnel of a size suitable for the filter. Put soil on the filter paper, and after tapping this Buchner funnel lightly on a table three times, scrape off the excess soil evenly with a microspatula. Set up the Buchner funnel filled with soil in a 300 ml beaker, pour the deionized water of A2 specified in **JIS K 0557** into this beaker so that the water level is higher than the position of the filter paper, and leave it at a room temperature for 12 h. Take out the Buchner funnel from the beaker, cover the surface of the soil with a piece of moistened cloth, and perform suction by using an aspirator for 15 min to remove excess moisture from the soil. Immediately take about 15 g of the soil in a 100 ml beaker, and weigh the mass to the nearest 0.01 g. Dry it for 24 h in a dryer maintained at a temperature of 105 °C±3 °C, leave it in a desiccator for approximately 30 min and then weigh the mass to the nearest 0.01 g. Calculate the maximum water retention amount of the soil according to formula (6), and round the result to an integer.