Apéndices:
Normas Industriales Japonesas en los agregados para Concreto

(A 1)

UDC 666.972.12:691.332:
620.16:621.928.2

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Sieve Analysis of Aggregates

A 1102-1989

1. Scope

This Japanese Industrial Standard specifies the test method for sieve analysis of aggregates ([1]) to be used for concrete.

Note ([1]) The aggregates here include lightweight aggregates for structure.

2. Testing Apparatus

2.1 The balance shall be sensitive to within 0.1 % of the mass of the sample.

2.2 The sieves to serve shall be 0.15, 0.3, 0.6, 1.2, 2.5, 5, 10, 15, 20, 25, 30, 40, 50, 60, 80 and 100 mm wire sieves (2).

Note ([2]) These sieves are the standard wire sieves of 150, 300, 600 μm and 1.18, 2.36, 4.75, 9.5, 16, 19, 26.5, 31.5, 37.5, 53, 63, 75 and 106 mm specified in JIS Z 8801.

Applicable Standards:

JIS Z 8401-Rules for Rounding off of Numerical Values

JIS Z 8801-Test Sieves

3. Samples

3.1 Representative samples of aggregates shall be taken and reduced nearly to the specified quantities by the quartering method or with a sample splitter. The quantities in mass after drying shall, as a rule, be as specified below. In the case of lightweight aggregates for structural use, half the value of the mass specified below shall be sampled as a rule.

Fine aggregates, not less than 95 % (by mass) passing 1.2 mm sieve	100 g
Fine aggregates, not less than 5 % (by mass) retained on 1.2 mm sieve	500 g
Coarse aggregates, max. size approx. 10 mm	1 kg
Coarse aggregates, max. size approx. 15 mm	2.5 kg
Coarse aggregates, max. size approx. 20 mm	5 kg
Coarse aggregates, max. size approx. 25 mm	10 kg
Coarse aggregates, max. size approx. 40 mm	15 kg
Coarse aggregates, max. size approx. 50 mm	20 kg
Coarse aggregates, max. size approx. 60 mm	25 kg
Coarse aggregates, max. size approx. 80 mm	30 kg
Coarse aggregates, max. size approx. 100 mm	35 kg

3.2 The samples specified in 3.1 shall be dried to a constant mass at temperatures of 100 to 110°C.

4. Test Method

4.1 The samples shall be sifted into a series of sizes using such sieves specified in 2.2 as are suitable for the purpose of test for sieve analysis of aggregates.

4.2 The sieving operation shall be conducted by applying to the sieve a vertical and lateral motion, accompanied by a jarring action so as to keep the sample moving continuously all over the surface of the sieve. Sieving shall be continued until not less than 1 % of the remaining sample can not pass the sieve in one minute.

When mechanical sieving is used ([3]), it shall be consummated by the final manual sieving to ensure that the amount of material passing the sieve in one minute is less than the value given above.

Note ([3]) The aggregates likely to be pulverized in the sieving operation shall not be consigned to mechanical sieving.

4.3 The grain of the sample caught in the meshes of the sieve shall be pushed back carefully so as not to crumble and shall be regarded as having remained on the sieve.

4.4 After completion of the sieving operation, the mass of the sample remaining on each sieve shall be weighed with a balance.

5. Calculation of Test Results

The results of the sieving analysis shall be expressed in terms of percentage of total mass of the sample, and the values shall be calculated to the first decimal place and rounded off to a whole number by the method specified in JIS Z 8401.

6. Report

The following items deemed necessary shall be included in the report.

(1) Class, size, appearance and place of production of aggregates, and in the case of artificial lightweight aggregates, name (4).

(2) Sampled position and date

(3) Test results expressed in any of the following:

(a) Percentage passing each sieve

(b) Percentage retained on each sieve

(c) Percentage retained among consecutive sieves

Note (4) Trade name may be used.

UDC 666.972.12:691.322:
620.168.3:621.928.4

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Amount of Material Passing Standard Sieve 75 μm in Aggregates

A 1103-1989

1. Scope

This Japanese Industrial Standard specifies the test method for determining the total quantity of those particles contained in aggregates (1) which pass through the 0.075 mm sieve (2).

Notes (1) These include lightweight aggregates for structural concrete.

(2) This means the 75 μm standard sieve specified in JIS Z 8801.

2. Test Apparatus

2.1 The balance used shall have a precision within 0.1 % of the mass of the sample.

2.2 The sieves to serve shall be 0.075 mm and 1.2 mm (3) wire sieves.

Note (3) This latter sieve means the 1.18 mm standard sieve specified in JIS Z 8801.

2.3 The container used shall be sufficiently large to prevent the sample from flying out when it is vigorously washed.

3. Sample

3.1 The sample shall be taken so that it represents the original aggregates (4) and reduced to approximately the quantity required for the test by the quartering method or with a sample splitter. The quantity of the sample after drying shall be the following as the standard.

Fine aggregate	1000 g
Coarse aggregate about 10 mm in maximum size	2 kg
Coarse aggregate about 20 mm in maximum size	5 kg
Coarse aggregate about 40 mm or larger in maximum size	10 kg

Note (4) The aggregate sufficient to hold them together are required to have a moisture during the sampling operation.

Applicable Standards:

JIS Z 8401-Rules for Rounding off of Numerical Values

JIS Z 8801-Test Sieves

3.2 The sample of 3.1 shall be dried at 100 to 110°C until a constant weight is obtained.

3.3 The sample of 3.2 shall be further divided into two equal parts with a sample splitter and each part shall be used as the sample for each test.

4. Test Method

4.1 The mass (m_{D1}) of the sample of 3.3 shall be accurately measured to the nearest 0.1 %.

4.2 Add water to the sample of 4.1 placed in a container until it is totally immersed in water. By violently stirring the sample in water, separate fine particles from coarse particles and allow to be suspended in the washing water. Taking care to prevent coarse particles from flowing out, immediately pour the washing water onto two overlapping sieves, a 1.2 mm wire sieve laid on top of a 0.075 mm wire sieve.

4.3 Again add water to the sample left in the container, stir and pour the washing water onto the two overlapping sieves ([5]). Repeat this operation until the washing water becomes clear.

Note ([5]) In this case, the particles remaining on the 0.075 mm sieve may still contain particles which can pass this sieve, so that it is necessary to additionally pour water or shake the sieve with its lower part dipped in the water or perform a similar operation.

4.4 Return the particles remaining on the two overlapping sieves to the sample which has been washed. Dry the sample thus obtained at 100 to 110°C until a constant mass reached, when its mass (m_{D2}) shall be measured accurately to the nearest 0.1 %.

5. Calculation of Result

5.1 The test result shall be calculated from the following formula and rounded to 2 significant figures in accordance with JIS Z 8401.

$$A = \frac{m_{D1} - m_{D2}}{m_{D1}} \times 100$$

where A: weight percentage of particles passing 0.075 mm sieve (%)

m_{D1} : dry mass of sample before washing (g)

m_{D2} : dry mass of sample after washing (g)

5.2 The test shall be conducted two times on the samples taken at the same time and the measured values shall be averaged.

6. Precision

The disparity from the mean value shall be within 0.5 for fine aggregate and within 0.3 for coarse aggregate.

7. Report

Information items selected from the following as necessary shall be carried in the report:

(1) Kind, size, appearance, and locality of production. However, in the case of artificial lightweight aggregates, the product name ([6]).

(2) Sampling position and date and time

(3) Weight percentage of particles passing the 0.075 mm sieve

Note (6) The product name may be a trade name.

(A 3) UDC 666.972.12:691.322:531.755.24

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Unit Weight of Aggregate and Solid Content in Aggregate

A 1104-1976
(Reaffirmed: 1986)

1. Scope

This Japanese Industrial Standard specifies the method of test for unit weight ([2]) and solid content in aggregates ([1]) used for concrete.

Notes ([1]) These include lightweight aggregates for structural concrete.

([2]) The weight referred to in this standard means the mass.

2. Test Appliances

2.1 The balance used shall have a precision of within 0.2 % of the total quantity of the sample.

2.2 The container used shall be a metal cylinder with its inner surface finished by machining and be watertight and sufficiently rigid. The container shall be provided with handles to facilitate handling.

The container shall be selected from those shown in the following table according to the maximum size of the aggregate:

Maximum size of aggregate mm	Container		Approximate volume ℓ
	Inner diameter cm	Internal height cm	
10 or smaller	14	13	2
Over 10 to 40 incl.	24	22	10
Over 40	35	31	30

The volume of the container shall be calculated by accurately measuring the weight of water required to fill the container.

2.3 The tamping rod used shall be a round steel rod of 16 mm in diameter and 50 cm in length with a hemispherical end.

3. Sample

3.1 The sample shall be taken so as to represent the aggregate to be tested and be reduced to about the required quantity by the method of quartering or by use of a sample splitter. The reduced quantity shall be not smaller than 2 times the volume of the container. The sample shall be in the air-dried condition or absolute dry condition.

Applicable Standards: See page 4.

3.2 The sample of 3.1 shall be divided into two equal parts and each part shall be used as the sample for one test.

4. Test Methods

4.1 Measurement of Weight per Unit Volume

(1) Method of Packing Sample

(a) In the Case of Rodding Test
The aggregates of 40 mm or smaller in maximum size shall be subjected to the rodding test. The method of packing the sample in this case shall be as follows: Introduce the sample up to 1/3 of the capacity of the container, level the upper surface with fingers, and pick uniformly with a tamping rod 25 times. Then introduce the sample up to 2/3 of the volume of the container and pick 25 times in the same manner. Lastly, introduce the sample until it overflows from the container and pick 25 times in the same manner as before.

(b) In the Case of Jigging Test
Where the maximum size of the aggregate exceeds 40 mm or where the aggregate is a lightweight aggregate, the jigging test shall be carried out. The method of packing the sample in this case shall be as follows:
Place the container on a rigid and horizontal floor such as a concrete floor and pack the sample in the container in three layers of almost equal quantities. For each layer of sample, raise one side of the container by about 5 cm and let it fall so as to hit the floor. Then raise the opposite side of the container by about 5 cm and let it fall. In this manner, let each side of the container fall 25 times alternately, 50 times in total, thereby shaking and compacting the sample.

(2) Method of Levelling Aggregate Surface
In the case of fine aggregate, the excess amount of sample shall be scraped off by using a tamping rod as a measuring rule and the surface of the aggregate shall be levelled to make it flush with the upper edge of the container.
In the case of coarse aggregate, the surface of the aggregate shall be levelled with fingers or a measuring rule so as to make the height of the projections of the coarse aggregate particles above the upper edge of the container almost equal to the depth of the indentations.

(3) The weight of the sample in the container shall be measured.

4.2 Measurement of Specific Gravity, Percentage of Water Absorption and Water Content [3]

(1) The sample for measuring the specific gravity, percentage of water absorption, and water content shall be taken by the method of quartering or by use of a sample splitter from the sample which has been subjected to the measurement of weight.

(2) The specific gravity, percentage of water absorption, and water content shall be measured in accordance with JIS A 1109, JIS A 1110, JIS A 1134, JIS A 1135 and JIS A 1125.

Note ([3]) The measurement of water content may be omitted where a sample in absolute dry condition is used or where the estimated water content of the sample is 1.0 % or less.

5. Calculation of Results

5.1 The weight per unit volume (T) of the aggregate shall be calculated from the following formula and rounded off to 3 significant figures in accordance with JIS Z 8401.

$$T = \frac{W_1}{V} \times \frac{W_D}{W_2}\ ([4])$$

where T: weight per unit volume of aggregate (kg/ℓ)

V: volume of container (ℓ)

W_1: weight of sample in container (kg)

W_2: weight of sample for water content measurement before drying (g)

W_D: weight of sample for water content measurement after drying (g)

Note ([4]) The following formula shall be used where a sample in absolute dry condition is used or where the measurement of water content is not performed:

$$T = \frac{W_1}{V}$$

5.2 The solid content (G) of the aggregate shall be calculated from the following formula and rounded off to 3 significant figures in accordance with JIS Z 8401.

$$G = T \times \frac{100 + Q}{D_s}$$

where G: solid content of aggregate (%)

Q: percentage of water absorption of aggregate (%)

D_s: specific gravity in saturated surface dry condition of aggregate

5.3 The test shall be conducted two times with the samples taken at the same time and the measured values shall be averaged.

6. Precision

The deviations (percentage) from the mean values of the weight per unit volume and solid content shall be not more than 0.5 %.

7. Report

Those information items required among the following shall be written in the report:

(1) Kind, size, appearance, and locality of occurrence, but in the case of an artificial lightweight aggregate, product name ([5])

(2) Sampling position and date and time

(3) Condition of sample, air dried or absolute dry

(4) In the case of air dried condition, whether or not water content is measured, and the measured value of water content where it is measured.

(5) Specific gravity and percentage of water absorption

(6) Weight per unit volume

(7) Solid content and particle size of sample

Note ([5]) The product name may be the trade name.

Applicable Standards:

JIS A 1109-Method of Test for Specific Gravity and Absorption of Fine Aggregate

JIS A 1110-Method of Test for Specific Gravity and Absorption of Coarse Aggregate

JIS A 1125-Method of Test for Total Moisture Content and Surface Moisture of Aggregate by Drying

JIS A 1134-Method of Test for Bulk Specific Gravity and Absorption of Light Weight Fine Aggregate for Structural Concrete

JIS A 1135-Method of Test for Bulk Specific Gravity and Absorption of Light Weight Coarse Aggregate for Structural concrete

JIS Z 8401-Rules for Rounding off of Numerical Values

(A 4)

UDC 666.972.124:543.74

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Organic Impurities in Fine Aggregate

A 1105-1976
(Reaffirmed: 1986)

1. Scope

This Japanese Industrial Standard specifies method of test for an approximate determination of the presence of injurious organic impurities in fine aggregate which are to be used in cement mortar or concrete.

2. Testing Apparatus

2.1 A balance shall be of capacity not less than 1 kg.

2.2 Two glass bottles shall be prepared. These bottles shall be transparent, 400 ml capacity with stopper, and both approximately same diameter and thickness. And at least one bottle shall be graduated at 125 ml and 200 ml.

Applicable Standards:

JIS K 8101-Ethyl Alcohol (99.5 v/v %) (Reagent)

JIS K 8576-Sodium Hydroxide (Reagent)

3. Sample

A representative sample shall be sampled and reduced to approx. 500 g ([1]) by the quartering method or by the use of a split sampler.

Note ([1]) In the case of light weight aggregate, sample shall be taken about 300 g.

4. Method of Testing

4.1 A standard colour solution shall be prepared by adding 2.5 ml of a 2 % solution of tannic acid in 10 % alcohol ([2]) to 97.5 ml of a 3 % sodium hydroxide ([3]) solution. This shall be placed in a glass bottle, stoppered, and shaken vigorously.

Notes ([2]) Special Grade specified in JIS K 8101 shall be used.

([3]) Special Grade specified in JIS K 8576 shall be used.

4.2 A graduated glass bottle shall be filled with the sample to the 125 ml mark, and a 3 % solution of sodium hydroxide shall be added until the total volume of the fine aggregate and liquid is 200 ml. And immediately, the bottle shall be stoppered, and shaken vigorously.

4.3 The glass bottle filled with the sample added with solution of sodium hydroxide and glass bottle filled with the standard colour solution shall be exposed for 24 h. And then the supernatant liquid above the fine aggregate shall be compared with the standard colour solution for their shades of colour, visually.

Reference: Test solution darker in colour than the reference standard colour solution indicates the necessity of conducting other tests for aggregate before use of the fine aggregate.

5. Report

The necessary items of the following shall be included in the report.

(1) Class, appearance and place of production of fine aggregate, in the case of artificial light weight aggregate, however, name ([4])

(2) Sampled position and date

(3) Test result for organic impurities in fine aggregate (dark or light in colour compared with standard colour solution)

Note ([4]) Trade name may be used.

(A 5) UDC 666.972.124:531.754.2+543.717

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Specific Gravity and Absorption of Fine Aggregate

A 1109-1976
(Reaffirmed: 1986)

1. Scope

This Japanese Industrial Standard specifies the method of test for the specific gravity and percentage of water absorption of fine aggregates ([1]).

Note ([1]) In the case of artificial lightweight aggregates, the test shall be performed in accordance with JIS A 1134.

2. Test Appliances

2.1 The balance used shall be one having a weighing capacity of 1 kg or larger and a reciprocal sensibility of within 0.1 g.

2.2 The flask used shall have a capacity of 500 ml and be verified to 0.15 ml at 20°C.

2.3 The metal flow cone used for testing the saturated surface-dry condition of fine aggregates shall be 38 mm in upper surface inner diameter, 89 mm in bottom surface inner diameter, 74 mm in height, and 4 mm or larger in thickness.

2.4 The tamping rod used shall have a weight of 340±15 g and one of its ends shall have a circular cross-section of 25±3 mm in diameter.

3. Sample

3.1 The sample taken shall be able to represent the original fine aggregate, and be reduced to almost the required quantity by the method of quartering or by use of a sample splitter and then made absorb water for 24 h. The required quantity shall be about 1000 g.

3.2 The sample of 3.1 shall be spread in a thin, flat layer on a flat surface and stirred at times, with a warm wind gently applied to dry it uniformly.

Applicable Standards:

JIS A 1134-Method of Test for Bulk Specific Gravity and Absorption of Light Weight Fine Aggregate for Structural Concrete

JIS Z 8401-Rules for Rounding off of Numerical Values

3.3 When the fine aggregate still appears to have some surface water, it shall be packed loosely in the flow cone, and after the upper surface is levelled, picked lightly with a tamping rod 25 times, and then the flow cone shall be quietly raised vertically. The above procedure shall be repeated while drying the sample little by little, and the condition reached when the cone of the fine aggregate has slumped at the first time when the flow cone is raised shall be taken as the saturated surface-dry condition ([2]).

Note ([2]) If the cone of the fine aggregate slumps when the flow cone is removed at the first time, it means that the saturated surface-dry condition has already been passed, so that in such a case, the above operation shall be performed after adding a small amount of water to the fine aggregate, mixing it well, and then leaving it standing with a covering for 30 min.

3.4 The sample of 3.3 shall be divided into two equal parts and each part shall be used as the sample for one test.

4. Test Methods

4.1 Test for Specific Gravity

(1) After measuring the weight ([3])(W_{s1}) of the sample of 3.4 to the nearest 0.1 g, the sample shall be placed in a flask and added with water up to the scale mark of about 500 ml ([4]).

Notes ([3]) The weight referred to in this standard means the mass.

([4]) The danger of breakage of the flask can be avoided by placing a small amount of water in the flask before introducing the sample into the flask.

(2) After expelling air bubbles by rolling the flask on a flat plate, the flask shall be soaked in a water bath at a constant temperature of 20±2°C.

(3) After the flask is soaked in the water bath for about 1 h, water shall further be added up to the scale mark of 500 ml.

(4) The total weight (W_1) of water added to the flask in (1) and (3) shall be measured to the nearest 0.1 g.

(5) The sample shall be dried by the method shown in 4.2 and its weight (W_{p1}) shall be measured.

4.2 Test for Percentage of Water Absorption After measuring the weight (W_{s1}) of the sample remaining in test of 4.1 to the nearest 0.1 g, the sample shall be dried at 100 to 110°C until a constant weight is obtained and cooled to room temperature in a desiccator, and its weight (W_{p1}) shall be measured to the nearest 0.1 g.

5. Calculation of Results

5.1 The specific gravity (D_s ([5]) and D_D ([6])) and percentage of water absorption (Q) of the fine aggregate shall be calculated from the following formulae and expressed in 3 significant figures by rounding off the 4th significant figure according to JIS Z 8401.

$$D_s = \frac{W_{s_1}}{500 - W_1}$$

where D_s: specific gravity in saturated surface-dry condition

W_{s_1}: weight of sample (g)

W_1: total amount of water added to flask (ml)

$$D_D = \frac{W_{D_1}}{500 - W_1}$$

where D_D: specific gravity in absolute dry condition

W_{D_1}: weight of sample after drying (g)

$$Q = \frac{W_{s_2} - W_{D_2}}{W_{D_2}} \times 100$$

where Q: percentage of water absorption (%)

W_{s_2}: weight of sample (g)

W_{D_2}: weight of sample after drying (g)

Notes ([5]) This specific gravity is the specific gravity in saturated surface-dry condition.

([6]) This specific gravity is the specific gravity in absolute dry condition.

5.2 The test shall be conducted two times with the samples taken at the same time and the measured values shall be averaged.

6. Precision

The deviation from the mean value shall be not larger than 0.01 in the specific gravity test, and not larger than 0.03 % in the percentage of water absorption test.

7. Report

Those required information items among the following shall be written in the report:

(1) Kind, size, appearance and locality of occurrence of aggregate

(2) Sampling position and date and time

(3) Specific gravity

(4) Percentage of water absorption

(A 6)

UDC 666.972.12: 620.16:
531.754:620.16:543.71

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Specific Gravity and Absorption of Coarse Aggregates

A 1110-1989

1. Scope

This Japanese Industrial Standard specifies the method of test for the specific gravity and the percentage of water absorption of coarse aggregates ([1]).

Note ([1]) Artificial lightweight aggregates shall be tested in accordance with JIS A 1135.

2. Test Apparatus

2.1 The balance used shall have a weighing capacity of 5 kg or larger and a reciprocal sensibility of within 0.5 g.

2.2 The balance shall be so constructed that a cage can be suspended from the center of its weighing pan by means of a metallic wire 3 mm or smaller in diameter and be immersed in water.

2.3 The cage for holding the coarse aggregate shall be made of wire netting not larger than 3 mm in aperture size and have a diameter of about 20 cm and a height of about 20 cm.

3. Sample

3.1 The sample taken shall be representative of the original coarse aggregate and be prepared as its part of the aggregate remaining on a 10 mm wire sieve ([2]) is reduced to about the specified quantity by the method of quartering. The weight of the sample shall be about 2 kg for coarse aggregates of the maximum size of 25 mm or under, and about 5 kg for aggregates of the maximum size exceeding 25 mm. Where the stone quality of the coarse aggregate is almost uniform, those particles remaining on a 25 mm wire sieve ([2]) shall be taken as the sample.

Note ([2]) These wire sieves shall conform to the 9.5 mm and the 26.5 mm standard sieves specified in JIS Z 8801.

Applicable Standards:

JIS A 1135-Method of Test for Bulk Specific Gravity and Absorption of Light Weight Coarse Aggregate for Structural Concrete

JIS Z 8401-Rules for Rounding off of Numerical Values

JIS Z 8801-Test Sieves

3.2 Thoroughly wash the sample of 3.1 with water, remove dust and other foreign matters from the particle surfaces and then allow to absorb water as it is immersed in water kept at 20 ± 2°C for 24 h.

3.3 Take the sample out of the water, swish off the water and allow to roll about on a water absorbing cloth ([3]) to be removed of visible water films. Where the particles are large, wipe each particle ([4]).

Notes ([3]) Because there is a possibility of overdrying when dry cloth is used, adequate care shall be exercised in performing this operation.

([4]) The surfaces of the particles still give a wet appearance in the saturated surface-dry condition. Where each particle is wiped, care shall be taken against excessive local drying that might occur.

3.4 The sample of 3.3 shall be divided into two equal parts and each part shall be used as the sample for one test run.

4. Test Method

4.1 The mass (m_s) of the sample of 3.4 shall be measured to the nearest 0.5 g.

4.2 The sample placed in the cage shall be immersed in clean water kept at 20 ± 2°C, removed of air bubbles adhering to the particle surfaces and between particles, and the mass in water (m_w) of the sample shall be measured.

4.3 The sample withdrawn from the water shall be dried at 100 to 110°C until a constant weight is reached and cooled to room temperature, and then its mass (m_D) shall be measured to the nearest 0.5 g.

5. Calculation of Result

5.1 The specific gravity values (D_S and D_D) and the percentage of water absorption (Q) of the coarse aggregates shall be calculated from the following formulas and expressed in 3 significant figures by rounding off the 4th significant figure in accordance with JIS Z 8401:

$$D_S = \frac{m_S}{m_S - m_W}$$

where D_S: specific gravity in saturated surface-dry condition ([5])

m_S: mass of sample (g)

m_W: virtual mass of sample in water (g)

$$D_D = \frac{m_D}{m_S - m_W}$$

where D_D: specific gravity in absolute-dry condition ([6])

m_D: mass of sample after drying (g)

$$Q = \frac{m_S - m_D}{m_D} \times 100$$

where Q: percentage of water absorption (%)

Notes ([5]) This specific gravity means the specific gravity in the saturated surface-dry condition.

([6]) This specific gravity means the specific gravity in the absolute dry condition.

5.2 The test shall be conducted each once on two samples taken at the same time and the measured values shall be averaged.

6. Precision

The deviation from the mean value shall be not larger than 0.01 in the specific gravity test, and not larger than 0.03 % in the percentage of water absorption test.

7. Report

Information items chosen from the following as required shall be carried in the report:

(1) Kind, size, appearance, and place of production or name

(2) Specific gravity

(3) Percentage of water absorption

(A 7) UDC 666.972.11.017:620.168.3

JAPANESE INDUSTRIAL STANDARD JIS

Method of Test for Surface Moisture in Fine Aggregate

A 1111-1976
(Reaffirmed: 1986)

1. Scope

This Japanese Industrial Standard specifies method of test for surface moisture in fine aggregate (1).

Note (1) Including light weight fine aggregate for structural concrete.

2. Testing Apparatus

2.1 Balance with a weighing capacity of 2 kg or more and discrimination of 0.5 g or better.

2.2 For container, either one of the followings shall be used.

(1) Glass container with a mark showing a given capacity

(2) Graduated volumetric glass container

(3) Pycnometer

(4) Container made of glass or non-corrosive metal, finished upper face by fitting, whose capacity is 2 to 3 times the loose volume of the sample. In the case the container is graduated or marked the scale shall be approved to 0.5 ml or less at 20°C.

3. Sample

3.1 As to the sample the representative one shall be sampled. And its weight (2) shall be 400 g (3) or more.

Notes (2) In this standard, weight shall mean mass.

(3) The larger the amount of the sample, the more accurate will be the result obtained.

3.2 In the case of handling the sample, the variation of the moisture content shall be kept as small as possible.

Applicable Standards:

JIS A 1109-Methods of Test for Specific Gravity and Absorption of Fine Aggregate

JIS A 1134-Method of Test for Bulk Specific Gravity and Absorption of Light Weight Fine Aggregate for Structural Concrete

JIS Z 8401-Rules for Rounding off of Numerical Values

3.3 The sample of 3.1 shall be divided into 2 parts, and be made the sample for one test each (4).

Note (4) For the sample to be used for the second test, care should be taken so that the moisture content will not vary until the commencement of the test.

4. Method of Testing

The test may be conducted by either the gravimetric method or volume method. During the test, the temperature of the container and its contents shall be kept constant as far as possible, within the range of 15 to 25°C.

4.1 Gravimetric Method In the case of gravimetric method, the container may be used any one of the containers shown in 2.2.

(1) The weight of the sample (W_1) of 3.3 shall be weighed.

(2) The container shall be filled with water to the mark or suitable graduation in the case of using glass container with a mark or graduated volumetric glass container. And the container shall be filled with water by the use of cap or flat glass in the case of using the pycnometer or the container finished upper face by fitting (5). The weight (W_2) of the container filled with water in this way, shall be measured.

Note (5) In the case of using pycnometer or container finished upper face by fitting, it shall be weighed with cap or flat glass intact.

(3) The container shall be emptied, and an amount of water sufficient to cover the sample shall be poured in it. The sample shall next be placed in the container, and the sample and water shaken or stirred in order to thoroughly eliminate entrapped air. Further, water shall be added to the mark or the same graduation, or the container to be filled by the use of cap or flat glass similarly to (2), and the total weight (W_3) of container, sample and water shall be weighed.

(4) The amount of water (W) displaced by the sample shall be calculated by the following formula:

$$W = W_1 + W_2 - W_3$$

where, W : amount of water displaced by sample (g)
W_1 : amount of sample (g)
W_2 : amount of container and water (g)
W_3 : amount of container, sample and water (g)

4.2 Volume Method In the case of volume method, among the containers of 2.2, a glass container with a mark showing a given capacity or graduated volumetric glass container shall be used.

(1) The weight of the sample (W_1) shall be weighed.

(2) An amount of water (V_1) sufficient to cover the sample shall be poured in the container after measuring the amount.

(3) The sample shall be placed in the container and the sample and water shaken or stirred in order to thoroughly eliminate entrapped air.

(4) The combined volume of the sample and the water shall be determined by direct reading of scale in the case of using the graduated volumetric glass container. When a glass container with a mark is used, the combined volume (V_2) of the sample and the water shall be obtained by filling with water of already-known volume to the mark and deducting this volume from that of the container.

(5) The amount of water (V) displaced by the sample shall be calculated from the following formula:

$$V = V_2 - V_1$$

where, V : amount of water displaced by the sample (ml)

V_1 : combined volume of the sample and water (ml)

V_1' : amount of water poured to cover the sample (ml)

5. Result of Calculation

5.1 The percentage of surface moisture (H) of the fine aggregate shall be obtained to two places of decimals from the following formula and shall be rounded off to one place of decimal by JIS Z 8401.

$$H = \frac{W - W_s}{W_s - W'} \times 100$$

provided that, $W_s = \frac{W'}{D_s}$ (g)

where, H : percentage of surface moisture of the fine aggregate to saturated surface-dry condition (%)

W : amount of water displaced by sample (g), in the case of conforming to volume method, taking the density of the water as 1 g/ml approximately

$$W = 1 \times V \quad (g)$$

is used.

D_s : Surface-dry specific gravity of fine aggregate obtained by JIS A 1109 or JIS A 1134.
In the case of light weight fine aggregate, however, it shall be the value measured at the condition that the moisture absorbing condition is as similar as possible to that of the sample.

5.2 The test shall be conducted twice on the sample sampled at the same time, and the mean value shall be taken.

6. Accuracy

The deviation from the mean value shall be not more than 0.3 %.

7. Report

For the report, among the following items, necessary ones shall be mentioned.

(1) Class, appearance and place of production of aggregate, in the case of artificial light weight aggregate, however, the nomenclature (6)

(2) Sampled position and date of the sampling

(3) Surface moisture

Note (6) The nomenclature may be the trade name.

UDC 666.972.123:620.178.167

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Abrasion of Coarse Aggregate by Use of the Deval Machine

A 1120-1976
(Reaffirmed: 1986)

1. Scope

This Japanese Industrial Standard specifies the method of test for the abrasion of coarse aggregate ([1]) by use of the Deval machine.

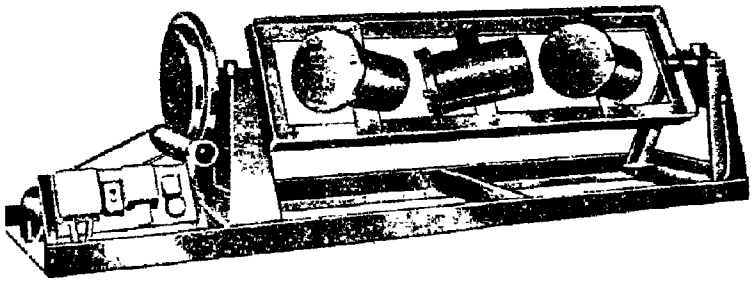
Note ([1]) Lightweight aggregates for structural concrete are excluded.

Remark: The units and numerical values given in { } in this standard are in accordance with the International System of Units (SI), and are appended for reference.

2. Test Apparatus and Appliances

2.1 The Deval machine shall be 20 cm in inner diameter and 34 cm in depth and consist of bottomed cast iron cylinders attached to horizontal rotating axes at an angle of 30 degrees, as shown in Figure. The cylinders shall respectively be attached with an iron cover which can be tightly fastened so as to leave no space.

Figure



(The number of cylinders may be suitably decided.)

Applicable Standards:

JIS B 1501-Steel Balls for Ball Bearings

JIS Z 8801-Test Sieves

2.2 The balls used shall be steel balls each having an average diameter ([2]) of about 4.68 cm and a weight ([3]) of 390 to 445 g. The total weight of 6 balls used for the testing machine shall be 2500±15 g.

Notes ([2]) The balls shall consist of balls of 4.6 cm, 4.68 cm and 4.76 cm in diameter, respectively, so as to make the total weight 2500±15 g. These balls shall respectively conform to the 1 13/16, 1 27/32 and 1 7/8 balls specified in JIS B 1501.

([3]) The weight referred to in this standard means the mass.

2.3 The balance used shall have a precision of within 0.1 % of the total weight of the sample.

2.4 The sieves used shall be wire sieves of 1.7 mm, 5 mm, 10 mm, 20 mm, 25 mm, 40 mm and 50 mm in size ([4]).

Note ([4]) These wire sieves shall respectively conform to the standard sieves 1680 μm, 4760 μm, 9.52 mm, 19.1 mm, 25.4 mm, 38.1 mm and 50.8 mm in size specified in JIS Z 8801.

3. Sample

3.1 The coarse aggregate shall be screened with 5 mm, 10 mm, 20 mm, 25 mm, 40 mm, and 50 mm wire sieves.

3.2 The sample shall be taken from the screened coarse aggregate made so that its grading agrees with either of the four gradings shown in Table 1. The grading selected shall be that closest to the grading of the coarse aggregate to be tested.

Table 1

Grading division	Ranges of particle diameters divided by nominal size of sieve mm	Weight percentage %
A	10 to 20 20 to 25 25 to 40 40 to 50	25 25 25 25
B	10 to 20 20 to 25 25 to 40	25 25 50
C	10 to 20 20 to 25	50 50
D	5 to 10 10 to 20	50 50

3.3 The total weight of the sample after drying shall have the value shown in Table 2 according to the specific gravity of the coarse aggregate as standard.

Table 2

Specific gravity of coarse aggregate	Total weight of sample g
Under 2.2	4000
2.2 to 2.4 excl.	4500
2.4 to 2.8 incl.	5000
Over 2.8	5500

3.4 Where the coarse aggregate to be tested contains particles smaller than 10 mm by 25 % or more but from the viewpoint of the grading either of the gradings A, B and C in Table 1 is considered suitable as the sample, the test shall be conducted by using either of the gradings A, B and C. In the case, where the hardness value of the particles smaller than 10 mm and that of the particles 10 mm or larger are judged to be different, a test shall additionally be conducted by using a sample of the grading D.

3.5 The sample shall be washed with water and then dried at 100 to 110°C until a constant weight is reached.

4. Test Method

4.1 The dried sample shall be weighed to the nearest 1 g.

4.2 The sample and 6 balls shall be placed in the cylinders, and the cylinders shall be rotated with cover on at a rate of 30 to 33 rpm {30 to 33 min^{-1}} for 10000 turns.

4.3 The sample shall be taken out of the cylinders and screened with a 1.7 mm wire sieve.

4.4 The part of the sample remaining on the sieve shall be washed with water, dried at 100 to 110°C until a constant weight is reached, and then weighed to the nearest 1 g.

5. Calculation of Result

The test result shall be calculated from the following formula:

$$R = \frac{W_1 - W_2}{W_1} \times 100$$

where R: abrasion loss (%)

W_1: weight of sample before test (g)

W_2: weight of sample remaining on 1.7 mm sieve after test (g)

6. Report

Those information item required among the following shall be written in the report:

(1) Kind, appearance and locality of occurrence of aggregate

(2) Grading division and weight of sample before test

(3) Abrasion loss (%)

(4) Weights of gravel and crushed stone ([5]) in sample before test

(5) Other information required

Note ([5]) In this standard, crushed gravel shall be regarded as crushed stone.

Reference

In the specification (the Standard Specification by the Japan Society of Civil Engineers) of aggregate, the permissible abrasion loss of coarse aggregate is specified respectively for gravel and crushed stone, and the permissible abrasion loss in the case of testing an aggregate consisting of a mixture of both shall be obtained from the following formula:

$$W = \frac{AL + (100 - A)L'}{100}$$

where W: permissible abrasion loss (%)

A: weight percentage of gravel in coarse aggregate (%)

$100 - A$: weight percentage of crushed stone in coarse aggregate (%)

L: permissible abrasion loss of gravel (%)

L': permissible abrasion loss of crushed stone (%)

UDC 666.972.12:620.178.16

JAPANESE INDUSTRIAL STANDARD J I S

Method of Test for Abrasion of Coarse Aggregates by Use of the Los Angeles Machine

A 1121-1989

1. Scope

This Japanese Industrial Standard specifies the method of test for the abrasion of coarse aggregates ([1]) by use of the Los Angeles machine.

Note ([1]) These do not include the lightweight aggregates for structural use.

Remarks 1. This Standard is also applicable to aggregates of particle sizes ranging from 2.5 mm to 5 mm (refer to 3.3).

2. The units and numerical values given in { } in this Standard are based on the International System of Units (SI) (and units which may be used in combination with the system) and are appended for informative reference.

2. Test Apparatus and Appliances

2.1 The los Angeles machine shall have such a construction that the axis of a steel cylinder 710 ± 5 mm in bore and 510 ± 5 mm in internal length which is closed at both ends is attached to a horizontal rotating axis (not extending to the inside of the cylinder), as shown in Figure. The cylinder shall be provided with a material-introducing opening on one side and with a steel cover which can be fastened tightly to leave no space. The attaching of the cover shall be so adjusted that its inner surface and the inner surface of the cylinder may form the same curved surface.

The cylinder shall have in its inside a detachable shelf having the same length as the cylinder and to be installed as protruding by 89 ± 2 mm in the radial direction of the cylinder. The shelf shall be apart from the material-introducing opening by not less than 1270 mm along the outer periphery of the cylinder in the rotating direction.

Applicable Standards:

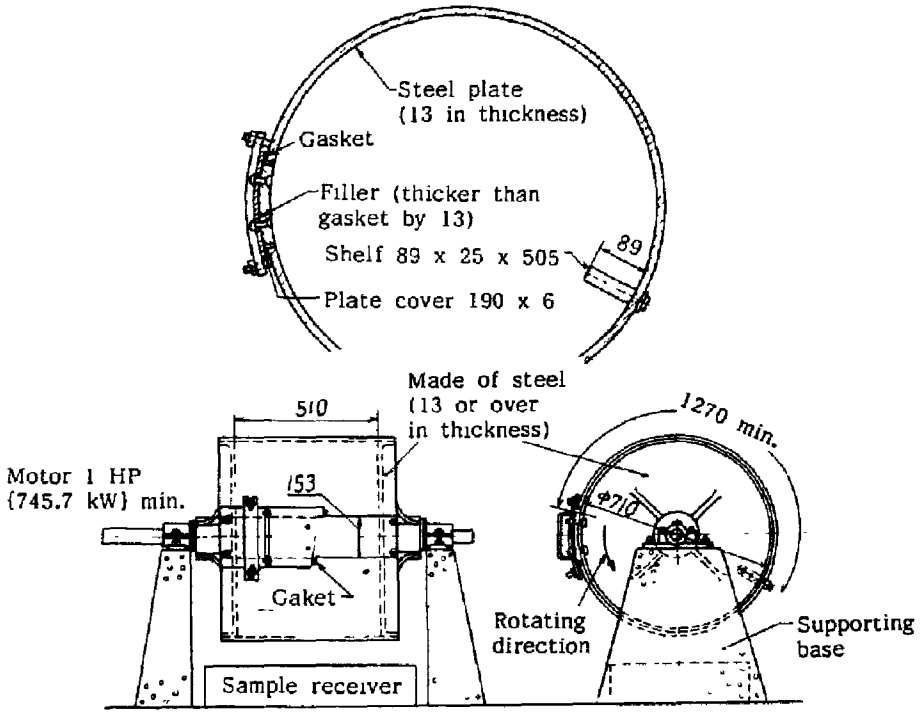
JIS B 1501-Steel Balls for Ball Bearings

JIS Z 8401-Rules for Rounding off of Numerical Values

JIS Z 8801-Test Sieves

Figure. Los Angeles Machine

Unit: mm



2.2 The balls shall be steel balls and their number and total mass shall be as specified in Table 1 classified according to the grading division shown in Table 2. The average diameter ([2]) of the balls shall be about 4.68 cm and the mass of each ball shall be 390 to 445 g.

Table 1

Grading division	Number of balls	Total mass of balls g
A	12	5000 ± 25
B	11	4580 ± 25
C	8	3330 ± 20
D	6	2500 ± 15
E	12	5000 ± 25
F	12	5000 ± 25
G	12	5000 ± 25

Note ([2]) The balls 4.6 cm, 4.68 cm and 4.76 cm in diameter shall be combined into a set so that the total mass given in Table 1 is obtained. These balls shall be the $1\frac{13}{16}$, $1\frac{27}{32}$ and $1\frac{7}{8}$ steel balls specified in JIS B 1501.

2.3 The balance shall have a precision of within 0.1 % of the total mass of the sample.

2.4 The sieves to serve shall be the wire sieves 1.7, 2.5, 5, 10, 15, 20, 25, 40, 50, 60 and 80 mm in size ([3]).

Note ([3]) These wire sieves shall respectively the standard sieves 1.7, 2.36, 4.75, 9.5, 16, 19, 26.5, 37.5, 53, 63 and 75 mm.

3. Sample

3.1 The coarse aggregates shall be screened on 2.5, 5, 10, 15, 20, 25, 40, 50, 60 and 80 mm wire sieves.

3.2 The aggregates of the grading division closest to that of the aggregates to be tested shall be selected from among the grading divisions shown in Table 2.

3.3 The aggregates to be tested shall be washed with water, dried at 100 to 110°C until a constant mass is reached, and a sample matching the particle size desired shall be taken from the aggregates.

The mass of the sample taken shall have the value shown in Table 2 after drying.

Table 2

Division of particle size grade	Ranges of particle sizes classified by nominal size of sieve mm	Mass of sample g	Total mass of sample g
A	10 to 15	1250 ± 10	5000 ± 10
	15 to 20	1250 ± 10	
	20 to 25	1250 ± 25	
	25 to 40	1250 ± 25	
B	15 to 20	2500 ± 10	5000 ± 10
	20 to 25	2500 ± 10	
C	5 to 10	2500 ± 10	5000 ± 10
	10 to 15	2500 ± 10	
D	2.5 to 5	5000 ± 10	5000 ± 10
E	40 to 50	5000 ± 50	10000 ± 100
	50 to 60	2500 ± 50	
	60 to 80	2500 ± 50	
F	25 to 40	5000 ± 25	10000 ± 75
	40 to 50	5000 ± 50	
G	20 to 25	5000 ± 25	10000 ± 50
	25 to 40	5000 ± 25	

4. Test Method

4.1 Samples through with drying shall be weighed to determine the mass (m_1) as given in Table 2.

4.2 Select the number of balls from Table 1 according to the particle size division of the sample, place so many balls in the cylinder together with the sample, put on the lid, and rotate the cylinder at a rate of 30 to 33 rpm {30 to 33 min^{-1}} by 500 turns in the case of particle size grades A, B and C, and by 1000 turns in the case of E, F and G.

4.3 Take the sample out of the testing machine and screen on a 1.7 mm wire sieve.

4.4 Wash the sample remaining on the sieve with water, dry at 100 to 110°C until a constant mass is obtained and measure its mass (m_2).

5. Calculation of Result

The test result shall be calculated from the following formula and rounded to the first decimal place in accordance with JIS Z 8401.

$$R = \frac{m_1 - m_2}{m_1} \times 100$$

where R : abrasion loss (%)

m_1 : mass of sample before test (g)

m_2 : mass of sample remaining on 1.7 mm wire sieve after test (g)

6. Report

Information items in the following shall be recorded in the report.

(1) Kind, appearance and locality of the occurrence of the aggregates

(2) Particle size grade of sample before test

(3) Abrasion loss (%)

(4) Other information required

For reference The abrasion loss obtained by this method of testing a rock manually crushed into approximately cubic particles is about 85 % of the abrasion loss obtained from mechanically crushed stone taken from the same rock.