

# JIS

## JAPANESE INDUSTRIAL STANDARD

Iron and steel slag  
for road construction

JIS A 5015—1992

Translated and Published

by

Japanese Standards Association

Printed in Japan

In the event of any doubt arising,  
the original Standard in Japanese is to be final authority.

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Iron and steel slag for road construction

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1. Scope This Japanese Industrial Standard specifies iron and steel slag (hereafter referred to as "slag") to be used for road bed and for heated asphalt mixture.

Remarks 1. Concerning the slag, there are two types, the blast-furnace slag which is generated in the pig iron manufacturing process, and the steel manufacturing slag which is generated in the manufacturing process of steel.

The blast-furnace slag is classified by the difference of cooling process, into the blast-furnace slowly cooled slag and the blast-furnace water granulated slag.

The steel manufacturing slag is classified by the difference of manufacturing methods of steel into the converter slag and the electric-furnace slag.

2. In the slag to be used for road construction, there is the one which is manufactured for road bed material, as single or combination of the blast-furnace slag and the steel manufacturing slag as materials, and the one which is manufactured for the aggregates to be used for heated asphalt mixture and pitch stabilizing process (heating mixture) using the steel manufacturing slag as material.

3. The following Standards are cited in this Standard.

JIS A 1102 Method of test for sieve analysis of aggregates

JIS A 1103 Method of test for amount of material passing standard sieve 75  $\mu\text{m}$  in aggregates

JIS A 1104 Method of test for unit weight of aggregate and solid content in aggregate

JIS A 1110 Method of test for specific gravity and absorption of coarse aggregates

JIS A 1121 Method of test for resistance to abrasion of coarse aggregates by use of the Los Angeles machine

JIS A 1203 Test method for water content of soils

JIS A 1210 Test method for soil compaction using a rammer

JIS A 1211 Test method for the California Bearing Ratio (CBR) of soils in laboratory

JIS K 0101 Testing methods for industrial water

JIS K 8005 Standard substances for volumetric analysis

JIS P 3801 Filter paper (for chemical analysis)

JIS R 3503 Glass apparatus for chemical analysis

JIS R 5210 Portland cement

JIS R 5211 Portland blast-furnace slag cement

JIS R 5212 Portland pozzolan cement

JIS R 5213 Portland fly-ash cement

JIS Z 8401 Rules for rounding off of numerical values

JIS Z 8801 Test sieves

JIS Z 9001 General rules for sampling inspection procedures

4. The numerical values and units given in { } in this Standard are based on the International System of Units (SI) and are appended for informative reference.

The traditional units and numerical values in this Standard shall be converted to the SI units and numerical values on April 1, 1995.

2. Definitions For the main terms used in this Standard, the definitions shall be as follows:

- (1) Aging The operation to react with air and water, after crushing of the cooled and solidified blast-furnace slowly cooled slag and the steel manufacturing slag, for the prevention of generation of the yellow muddy water in the blast-furnace slowly cooled slag, and stabilizing the expansion of the steel manufacturing slag. In the methods of the aging, there are two types, the normal aging by air and water, and the accelerated aging by warm water or vapour.
- (2) Hydraulicity The nature of hardening of the slag by the reaction with water.

3. Classification and designation The classification and designation shall be as shown in Table 1.

Table 1. Classification and designation

| Classification                          | Designation | Use (for informative reference)              |
|-----------------------------------------|-------------|----------------------------------------------|
| Hydraulic graded slag                   | HMS-25      | Upper layer road bed material                |
| Graded slag                             | MS-25       | Upper layer road bed material                |
| Crusher-run slag                        | CS-40       | Lower layer road bed material                |
|                                         | CS-30       |                                              |
|                                         | CS-20       |                                              |
| Single grading steel manufacturing slag | SS-20       | For heated asphalt mixture                   |
|                                         | SS-13       |                                              |
|                                         | SS-5        |                                              |
| Crusher-run steel manufacturing slag    | CSS-30      | For pitch stabilizing process (heat mixture) |
|                                         | CSS-20      |                                              |

#### 4. Quality

4.1 Appearance The slag shall not contain detrimental amount of slender component, thin component, dust, mud or organic matters, etc.

4.2 Hydraulic graded slag, graded slag and Crusher-run slag The quality of the hydraulic graded slag, graded slag and Crusher-run slag shall be as follows:

- (1) Judgement of coloration The judgement of coloration shall be made by test in accordance with 6.2, and there shall be no coloration. However, this specification shall be applied to the slags using the blast-furnace slowly cooled slag.
- (2) Immersion expansion ratio The immersion expansion ratio shall be tested in accordance with 6.3, and shall be not more than 1.5 %. However, this specification shall be applied to the slags using the steel manufacturing slag.
- (3) Grading The grading shall be tested in accordance with 6.4, and shall conform to Table 2.

Table 2. Grading

| Designation | Range of grading mm | Mass percentage of grading passing through sieve %        |           |           |           |           |          |          |          |             |            |
|-------------|---------------------|-----------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|-------------|------------|
|             |                     | Nominal size of aperture of sieve specified in JIS Z 8801 |           |           |           |           |          |          |          |             |            |
|             |                     | 53 mm                                                     | 37.5 mm   | 31.5 mm   | 26.5 mm   | 19 mm     | 13.2 mm  | 4.75 mm  | 2.36 mm  | 425 $\mu$ m | 75 $\mu$ m |
| HMS-25      | 25 to 0             | —                                                         | —         | 100       | 95 to 100 | —         | 60 to 80 | 35 to 60 | 25 to 45 | 10 to 25    | 3 to 10    |
| MS-25       | 25 to 0             | —                                                         | —         | 100       | 95 to 100 | —         | 55 to 85 | 30 to 65 | 20 to 50 | 10 to 30    | 2 to 10    |
| CS-40       | 40 to 0             | 100                                                       | 95 to 100 | —         | —         | 50 to 80  | —        | 15 to 40 | 5 to 25  | —           | —          |
| CS-30       | 30 to 0             | —                                                         | 100       | 95 to 100 | —         | 55 to 85  | —        | 15 to 45 | 5 to 30  | —           | —          |
| CS-20       | 20 to 0             | —                                                         | —         | —         | 100       | 95 to 100 | 60 to 90 | 20 to 50 | 10 to 35 | —           | —          |

- (4) Unit weight The unit weight of the hydraulic graded slag and the graded slag shall be tested in accordance with 6.5, and shall be not less than 1.50 kg/l.
- (5) Uniaxial compression strength The uniaxial compression strength of the hydraulic graded slag shall be tested in accordance with 6.6, and shall be not less than 12 kgf/cm<sup>2</sup> (1.2 N/mm<sup>2</sup>).
- (6) Modified CBR The modified CBR shall be predetermined by the agreement between the parties concerned with delivery.

4.3 Single grading steel manufacturing slag The quality of the single grading steel manufacturing slag shall be as follows:

- (1) Immersion expansion ratio The immersion expansion ratio shall be tested in accordance with 6.3, and shall be not more than 2.0 %.
- (2) Grading The grading shall be tested in accordance with 6.4, and shall conform to Table 3.

Table 3. Grading

| Designation | Range of grading<br>mm | Mass percentage of grading passing through sieve %        |           |           |           |         |         |
|-------------|------------------------|-----------------------------------------------------------|-----------|-----------|-----------|---------|---------|
|             |                        | Nominal size of aperture of sieve specified in JIS Z 8801 |           |           |           |         |         |
|             |                        | 26.5 mm                                                   | 19 mm     | 13.2 mm   | 4.75 mm   | 2.36 mm | 1.18 mm |
| SS-20       | 20 to 13               | 100                                                       | 85 to 100 | 0 to 15   | —         | —       | —       |
| SS-13       | 13 to 5                | —                                                         | 100       | 85 to 100 | 0 to 15   | —       | —       |
| SS-5        | 5 to 2.5               | —                                                         | —         | 100       | 85 to 100 | 0 to 25 | 0 to 5  |

- (3) Specific gravity in saturated surface-dry condition The specific gravity in saturated surface-dry condition shall be tested in accordance with 6.7, and shall be not less than 2.45.
- (4) Percentage of water absorption The water absorption shall be tested in accordance with 6.7, and shall be not more than 3.0 %.
- (5) Abrasion The abrasion shall be tested in accordance with 6.8, and shall be not more than 30 %.

4.4 Crusher-run slag The quality of the Crusher-run slag shall be as follows:

- (1) Immersion expansion ratio The immersion expansion ratio shall be tested in accordance with 6.3, and shall be not more than 2.0 %.
- (2) Grading The grading shall be tested in accordance with 6.4, and shall conform to Table 4.

Table 4. Grading

| Designation | Range of grading<br>mm | Mass percentage of grading passing through sieve %        |           |         |           |          |          |          |
|-------------|------------------------|-----------------------------------------------------------|-----------|---------|-----------|----------|----------|----------|
|             |                        | Nominal size of aperture of sieve specified in JIS Z 8801 |           |         |           |          |          |          |
|             |                        | 37.5 mm                                                   | 31.5 mm   | 26.5 mm | 19 mm     | 13.2 mm  | 4.75 mm  | 2.36 mm  |
| CSS-30      | 30 to 0                | 100                                                       | 95 to 100 | —       | 55 to 85  | —        | 15 to 45 | 5 to 30  |
| CSS-20      | 20 to 0                | —                                                         | —         | 100     | 95 to 100 | 60 to 90 | 20 to 50 | 10 to 35 |

- (3) Abrasion The abrasion shall be tested in accordance with 6.8, and shall be not more than 50 %.

## 5. Aging

5.1 Steel manufacturing slag used for hydraulic graded slag, graded slag and Crusher-run slag The steel manufacturing slag used for hydraulic graded slag, graded slag and Crusher-run slag shall be those to which the normal aging has been applied for not less than 6 months. However, when the normal aging is applied to the electric furnace slag for more than 3 months and the immersion expansion ratio is not more than 0.6 %, and when the accelerated aging is applied to the steel manufacturing slag, the aging period can be shortened with the full confirmation of the stabilization of the expansion referring to the execution results of works.

5.2 Steel manufacturing slag used for the single grading steel manufacturing slag and the Crusher-run steel manufacturing slag The steel manufacturing slag used for the single grading steel manufacturing slag and the Crusher-run steel manufacturing slag shall be those to which the normal aging has been applied for not less than 3 months.

## 6. Test methods

6.1 Sampling method The sample shall be taken carefully as it represents the whole.

6.2 Test of judgement of coloration The test shall conform to Annex 1.

6.3 Immersion expansion test The test shall conform to Annex 2. However, when aging is applied according to the respective grading for the heated asphalt mixture, obtain the immersion expansion ratio at the used grading, convert it into the immersion expansion ratio at the grading of Annex 2 Table 1, by the correlation with the immersion expansion ratio previously obtained according to the grading of Annex 2 Table 1.

6.4 Grading test The test shall be in accordance with JIS A 1102<sup>(1)</sup>. However, the test on the amount of hydraulic graded slag and graded slag passing through 75  $\mu\text{m}$  sieve shall be in accordance with JIS A 1103.

Note (1) For hydraulic graded slag and graded slag, the sample shall be the residue remaining on the sieve after the washing test, and the 425  $\mu\text{m}$  standard sieve specified in JIS Z 8801 shall be added to the sieve used.

6.5 Unit weight test The test shall be in accordance with JIS A 1104.

6.6 Uniaxial compression strength test The test shall be in accordance with Annex 3.

6.7 Specific gravity in saturated surface-dry condition and water absorption test The test shall be in accordance with JIS A 1110. However, the sample shall pass through 13.2 mm sieve and shall not pass through 4.75 mm sieve, and its total mass shall be approx. 2 kg.

6.8 Abrasion test The test shall be in accordance with JIS A 1121. However, the sample shall pass through 13.2 mm sieve and shall not pass through 4.75 mm sieve, and its total mass shall be  $5000 \pm 10$  g. The number of the steel balls used for the test shall be eight, and their total mass shall be  $3330 \pm 20$  g.

The rotation speed of the test machine shall be 30 rpm to 33 rpm, and the number of revolutions shall be 500.

7. Inspection The slag shall be inspected according to the items marked with circles in Table 5. The sample shall be assumed to be acceptable, if the results comply with all individual requirements. The size of inspection lot shall be determined in accordance with JIS Z 9001 or the agreement between the parties concerned with delivery.