IS 3018 (1977): Standard Silica Sand for Raw Material Testing in Foundries [MTD 14: Foundry]

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Indian Standard

SPECIFICATION FOR STANDARD SILICA SAND FOR RAW MATERIAL TESTING IN FOUNDRIES

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Indian Standard

SPECIFICATION FOR STANDARD SILICA SAND FOR RAW MATERIAL TESTING IN FOUNDRIES

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Indian Standard

SPECIFICATION FOR STANDARD SILICA SAND FOR RAW MATERIAL TESTING IN FOUNDRIES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 December 1977, after the draft finalized by the Foundry Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 A majority of raw materials used in foundries as sand binders, for example, bentonite, dextrines, core oils, shell resins, hot box resins, air hardening oils, etc, are tested by preparing a standard sand mix and testing its physical properties. These properties, apart from depending upon the quality of the raw materials under test, are affected by the quality of sand used for the purpose of testing. It has, therefore, been decided to formulate an Indian Standard on standard sand with a well defined sieve analysis to check the quality of binders. This sand is very conveniently prepared from the raw silica sand conforming to IS : 1987-1974*, available from different sources in the country.

0.3 For determining the fineness of standard silica sand, the aperture sizes are based on IS : 460-1962†. Where IS Sieves are not available, other equivalent standard sieves may be used. For the purpose of comparison, the corresponding BS and ASTM test sieve numbers are given in Appendix A.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960‡. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers the quality requirements of standard sand to be used for testing of foundry raw materials.

*Specification for high silica sand for use in foundries (*first revision*).
†Specification for test sieves (*revised*).
‡Rules for rounding off numerical values (*revised*).

2. SUPPLY OF MATERIAL

2.1 General requirements relating to supply of standard sand shall conform to IS : 1387-1967*.

3. MANUFACTURE

3.1 The sand shall be obtained by manual or mechanized washing and grading of high silica sand conforming to Grade A 300/150 of IS : 1987-1974†.

4. CHEMICAL COMPOSITION

4.1 The chemical composition of standard sand shall conform to Grade A high silica sand as specified in IS : 1987-1974†.

5. MOISTURE CONTENT

5.1 Moisture content of standard sand shall not exceed 0·1 percent (*see* Appendix B).

6. CLAY CONTENT

6.1 The clay content of standard sand, when tested in accordance with the procedure specified in IS : 1918-1966‡ shall be 0·2 percent maximum.

7. SINTERING TEMPERATURE

7.1 Sintering temperature A, when measured with the platinum ribbon method as specified in **18.2** of IS : 1918-1966‡ shall be 1 685°C minimum. Alternatively the refractoriness may be measured by the method given in Appendix B. The material shall pass the test.

8. CHEMICAL BEHAVIOUR

8.1 The sand shall be almost neutral. The hydrochloric acid demand value, when tested in accordance with the procedure given in Appendix B, shall not exceed 8 mg/100 g of sand.

9. GRAIN SHAPE

9.1 Sand grains shall be round as far as possible having no compounded grains and fissures (cracks).

9.1.1 The degree of angularity, when determined in accordance with the procedure given in Appendix B, shall be 1·4 to 1·5.

*General requirements for the supply of metallurgical materials (*first revision*).
†Specification for high silica sand for use in foundries.
‡Methods of physical tests for foundry sands.

10. GRAIN FINENESS

10.1 The sieve grading shall be as given in Table 1.

TABLE 1 GRAIN FINENESS GRADING OF STANDARD SILICA SAND FOR TESTING RAW MATERIAL

IS Sieve Microns	Percent Retained
600	1 *Max*
425	9 to 14
300	20 to 30
212	30 to 40
150	15 to 25
106	2·0 *Max*
75	1·0 *Max*
Pan	0·1 *Max*

10.2 Grain Fineness Parameters — The parameters theoretical specific surface O'_K, theoretical specific grain number n'_K, representative diameter d_n, variation from hypothetical uniform sphere model A_G, calculated as specified in Appendix B shall have the following values:

O'_K = 8 000 to 9 000 mm²/g.

n'_K = 3·5 × 10⁶ to 7 × 10⁶ mm²/g.

d_n = 0·20 to 0·27 mm.

A_G = 5 to 15 percent.

Fineness number shall be between 48 to 52.

11. SAMPLING

11.1 Representative samples shall be drawn according to the scheme of sampling given in IS : 1811-1961*.

12. PACKING

12.1 The material shall be packed in polythene-lined gunny bags of 50 kg capacity.

13. MARKING

13.1 The bags shall be clearly marked with the manufacturer's name or trade-mark.

*Methods of sampling foundry sands.

13.1.1 The material may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

APPENDIX A

(*Clause* 0.3)

COMPARATIVE SIEVE DESIGNATIONS OF IS, BS AND ASTM TEST SIEVES

IS Sieve	*BS Test Sieve*	*ASTM Test Sieve*
600-micron	25	30
425-micron	36	40
300-micron	52	50
212-micron	72	70
150-micron	100	100
106-micron	150	140
75-micron	200	200

APPENDIX B

(*Clauses* 5.1, 7.1, 8.1, 9.1.1 *and* 10.2)

TEST METHODS OF STANDARD SILICA SAND

B-1. MOISTURE CONTENT

B-1.1 Fifty grams of silica sand is weighed in the state supplied, to an accuracy of 0·001 g. The sample is then transferred, without loss, into a flat basin, and oven-dried at 105°C until a constant weight is reached. Following this, the sample is cooled in a desiccator and thenweighed. Loss in mass between the initial and the final masses is converted into a percentage value. The water content thus found is indicated at an accuracy of 0·01 percent.

B-2. REFRACTORINESS

B-2.1 A muffle furnace is required for testing the refractoriness of a sample. The heating chamber is formed by a silicon-carbide tube. The furnace temperature should be controllable to 1 400°C so that the temperature does not deviate by more than ± 10°C.

B-2.1.1 The silica sand sample is placed in bulk into a porcelain boat (74 to 85 mm long and 10 to 13 mm wide) and pushed into the furnace tube pre-heated to 1 400°C. The furnace tube is then sealed by means of a fire-clay plug. As soon as the testing temperature has again been reached, the sample is left to soak for 5 minutes. The boat is then taken out and placed on a refractory base for cooling. Using a needle, the silica sand is examined under a microscope to see what extent glazing and sintering has taken place. The silica sand, however, should not show any thermal degradation of this nature.

B-3. CHEMICAL BEHAVIOUR

B-3.1 To assess chemical reactivity, 50 g of dried silica sand is weighed to an accuracy of 0·1 g. The sample is stirred in a beaker by means of a magnet stirrer for 5 minutes at ambient temperature, together with 50 ml of distilled water and 50 ml of N/10 HCl. After allowing the sample to soak for an hour, back-titration is effected with N/10 NaOH until the end point is reached. Consumption of N/10 HCl by the sand sample, converted into mg/100 g of sand shall be reported.

B-3.1.1 It is necessary to control that 50 ml of N/10 HCl in 50 ml of distilled water will neutralize exactly 50 ml of N/10 NaOH. Otherwise, a corresponding factor should be taken into account.

B-4. GRAIN FINENESS PARAMETERS

B-4.1 The parameters specified in **10.2** shall be calculated from the screen analysis as given in **B-4.1.1** to **B-4.1.3.**

B-4.1.1 Average diameters of the individual screen factions dm are calculated by taking the arithmetic mean, based on the mesh sizes of two consecutive test screens. The mass retained g_1 on the respective sieves are multiplied by the factors M_1 for the theoretical surface and M_2 for the theoretical grain number.

The factors are as follows:

$$M_1 = \frac{6.d_m^2}{d_m^3.\delta} = \frac{22\,641{\cdot}5}{d_m} \text{ (mm}^2\text{/g)}$$

where δ is relative density of silica sand and is equal to 0·002 65 g/mm^3.

$$M_2 = \frac{6}{d_m^3.\pi.\delta} = \frac{72{\cdot}108\,45}{d_m^3}.\ 10^4 \text{ (particles per g)}$$

where dm is in mm.

B-4.1.2 The resulting theoretical surface, and theoretical grain numbers, respectively, of all volume portions are added together. The division of the sums by the total grain mass results in the theoretical specific surface $O'_K = \frac{\Sigma g_1 . M_{11}}{\Sigma g_1}$ (mm^2/g) and the theoretical specific grain number $n'_K = \frac{\Sigma g_1 . M_{21}}{\Sigma g_1}$ (particles per g)

B-4.1.3 The two other properties of the granular constituents are then calculated as follows:

Representative diameter $d_n = \sqrt{\frac{O'_K}{n'_K}}$ (mm)

Variation from a hypothetical uniform-sphere sample $A_G = \frac{O'_{KG} - O'_K}{O'_{KG}} .100$ (percent)

O'_{KG} = specific surface of a uniform-sphere sample with the same representative diameter d_n as that of the test sample

$$O'_{KG} = \frac{22\ 641{\cdot}5}{d_n} \text{ (mm}^2\text{/g)}$$

In addition, the fineness number can be calculated as follows:

Fineness number = $O'_K . 0{\cdot}C05\ 7$

B-4.1.4 Table 2 gives a sample calculation of the parameters for a typical screen analysis.

B-5. DEGREE OF ANGULARITY

B-5.1 The degree of angularity is defined as the ratio of real specific surface to the theoretical specific surface. The theoretical specific surface shall be calculated as given in **B-4.** The real specific surface area of the sand is determined by a method based on rate of air filtration through a column of sand under test.

B-5.1.1 Any of the standard apparatus available for the purpose may be used. The measurement shall be carried out as per instructions of the apparatus manufacturers.

TABLE 2 SPECIMEN CALCULATION FOR VARIOUS SAND FINENESS PARAMETERS

(*Clause* B-4.1.4)

IS Sieve Microns	Retention on the Sieve g_i	Grain Size Class	Mean Dia	Multiplier M_{1i}	Multiplier M_{2i}	$g_i \times M_{1i}$	$g_i \times M_{2i}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	g	mm	mm	mm^2/g	Particles/g	mm^2	Particles
600	1·0	850 to 600	0·725	$31·2 \times 10^2$	$0·19 \times 10^4$	$31·2 \times 10^2$	$0·19 \times 10^4$
425	10·0	600 to 425	0·512	$44·2 \times 10^2$	$0·54 \times 10^4$	$442·0 \times 10^2$	$5·40 \times 10^4$
300	25·0	425 to 300	0·362	$62·5 \times 10^2$	$1·52 \times 10^4$	$1\,562·5 \times 10^2$	$38·00 \times 10^4$
212	38·9	300 to 212	0·256	$88·4 \times 10^2$	$4·30 \times 10^4$	$3\,438·8 \times 10^2$	$167·20 \times 10^4$
150	22·0	212 to 150	0·181	$125·0 \times 10^2$	$12·16 \times 10^4$	$2\,750·0 \times 10^2$	$267·52 \times 10^4$
106	2·0	150 to 106	0·128	$176·8 \times 10^2$	$34·38 \times 10^4$	$353·6 \times 10^2$	$68·76 \times 10^4$
75	1·0	106 to 75	0·090	$251·5 \times 10^2$	$98·91 \times 10^4$	$251·5 \times 10^2$	$98·91 \times 10^4$
Pan	0·1	75 to 52	0·064	$353·7 \times 10^2$	$275·07 \times 10^4$	$35·37 \times 10^2$	$27·51 \times 10^4$
	100·0				Total:	$8\,864·97 \times 10^2$	$673·39 \times 10^4$

$$O'_K = \frac{8\,864·97 \times 10^2}{100} = 88·65 \times 10^2 \text{ mm}^2/\text{g}$$

$$O'_{KG} = \frac{2\,264·15}{0·205} = 11\,044·6 \text{ mm}^2/\text{g}$$

$$n'_K = \frac{673·39 \times 10^4}{100} = 6·73 \times 10^4 \text{ Particles/g}$$

$$A_G = \frac{11\,044·6 - 8\,864·97}{11\,044·6} \times 100 = 19·73 \text{ percent}$$

$$d_n = \sqrt{\frac{88·65 \times 10^2}{6·73 \times 10^4}} = 0·205 \text{ mm}$$

Fineness No. $= 8\,864·97 \times 0·005\,7 = 50·53$

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