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BUREAU OF INDIAN STNADARD

DRAFT FOR COMMENTS ONLY

भारतीय मानक मसौदा

फाउंड्री में कच्चे माल के परीक्षण के लिए मानक सिलिका रेत - विशिष्टता

(आई एस 3018 का *पहला पुनरीक्षण*)

Draft *Indian Standard*
STANDARD SILICA SAND FOR RAW MATERIAL TESTING IN FOUNDARY - SPECIFICATION

(*First Revision of* IS 3018)

ICS No. 77.140.80

Foundry and Steel Castings Sectional Committee, MTD 14	**Last date for receipt of comment is 24 September 2023**

FOREWORD

This Indian Standard (First Revision) subject to its finalization is to be adopted by the Bureau of Indian Standards on recommendation of Foundry and steel castings Sectional Committee and approval of Metallurgical Engineering Division Council.

This standard was first published in 1977. This revision (First Revision) has been brought out to bring the standard in the latest style and format of the Indian Standards. In addition, the following changes have been made:

a) Reference clause has been added;
b) In clause 5, Editorial change has been made;
c) Marking clause has been modified

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 equality 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 IS1987, available from different sources in the country.

For determining the fineness of standard silica sand, the aperture sixes are based on IS 460 (Part 3): 2020. 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.

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 : 2022 ‘Rules for rounding off numerical values (Second Revision)’. A 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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Indian Standard

STANDARD SILICA SAND FOR RAW MATERIAL TESTING IN FOUNDARY - SPECIFICATION

(*First Revision*)

1 SCOPE

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

2 REFERENCE

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 1387 : 1993	General requirements for the supply of metallurgical materials (Second Revision)
IS 1811 : 1984	Methods of sampling foundry sand (First Revision)
IS 1918 : 1966	Methods of physical tests for foundry sands
IS 1987 : 2002	High silica sand for use in foundries - Specification (Second Revision)

3 SUPPLY OF MATERIAL

General requirements relating to supply of standard sand to this specification shall be as laid down in IS 1387.

4 MANUFACTURE

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.

5 CHEMICAL COMPOSITIONS

The chemical composition of standard sand shall conform to Grade A high silica sand as specified in IS 1987.

6 MOISTURE CONTENT

Moisture content of standard sand shall not exceed 0.1 percent (*see* Appendix B).

7 CLAY CONTENT

The clay content of standard sand, when tested in accordance with the procedure specified in IS 1918 shall be 0.2 percent (*max*)

8 SINTERING TEMPERATURE

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

9 CHEMICAL BEHAVIOUR

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.

10 GRAIN SHAPE

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

10.1.1 The degree of angularity, when determined in accordance with the procedure given in Appendix B, shall be 1.4 to 1.5.

11 GRAIN FINENESS

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

IS SIEVE MICRONS	PERCENT RETAINED
(1)	(2)
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*

11.2 Grain Fineness Parameters

The parameters theoretical specific surface O'_K, theoretical specific grain number n'_K, representative diameterd_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 mm^2/g

n'_K = 3.5 × 10^{6}to 7 × 10^6 mm^2/g

d_n = 0.20 *to* 0.27 mm

A_G = 5 *to* 15 %

Fineness number shall be between 48 to 52.

12 SAMPLING

Representative samples shall be drawn according to the scheme of sampling given in IS 1811.

13 PACKING

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

14 MARKING

14.1 The material shall be marked with the following:

a) Indication of the source of manufacture;
b) Quantity;
c) Batch No;
d) Date of manufacture; and
e) Shelf life, if required.

14.2 BIS Certification Marking

The products(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provision of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed there under, and the product may be marked with the Standard Mark.

APPENDIX A

(*Foreword*)

COMPARATIVE SIEVE DESIGNATIONS OF IS, BS AND ASTM TEST SIEVES

IS Sieve (micron)	BS Test Sieve	ASTM Test Sieve
(1)	(2)	(3)
600	25	30
425	36	40
300	52	50
212	72	70
150	100	100
106	150	140
75	200	200

APPENDIX B

(*Clauses* 6, 8, 9, 10.1.1 *and* 11.2)

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 desiccators and then weighed. 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 1400°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. of a fire-clay plug. The furnace tube is then sealed by means 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 *d*m 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_s for the theoretical grain number.

The factors are as follows:

$$M_1 = \frac{6.d_{m^2}}{d_{m^3}.\delta} = \frac{22.641.5}{d_m} \text{ (mm}^2\text{/g)}$$

where δ is relative density of silica sand and is equal to 0.002 65 g/mm^3.

$$M_2 = \frac{6}{d_{m^3}.\pi.\delta} = \frac{72.108\,45}{d_{m^3}} \times 10^4 \text{ (particles per g)}$$

Where, $d_m$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 $O'_K = \frac{\sum g_1.M_{1i}}{\sum g_i}$ (mm^2/g) and the theoretical specific grain number $n'_K = \frac{\sum g_1.M_{2i}}{\sum g_i}$(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 diameterd_n as that of the test sample

$O'_{KG} = \frac{22\,641.5}{d_n}$ (mm^2/g)

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

Fineness number = $O'_K . 0.0057$

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.

Sl. No.	IS SEIVE Microns	RETENTION ON THE SIEVE	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)	(9)
i)	600	1.0	850 to 600	0.725	31.2×10^2	0.19×10^4	31.2×10^2	0.19×10^4
ii)	425	10.0	600 to 425	0.512	44.2×10^2	0.54×10^4	$442. \times 10^20$	5.40×10^4
iii)	300	25.0	425 to 300	0.362	62.5×10^2	1.52×10^4	$1\,562.5 \times 10^2$	38.0×10^4
iv)	212	38.9	300 to 212	0.256	88.4×10^2	4.30×10^4	$3\,435.8 \times 10^2$	167.20×10^4
v)	150	22.0	212 to 1 450	0.181	$125 \times 10^2.0$	12.16×10^4	$2\,750.0 \times 10^2$	267.52×10^4
vi)	106	2.0	150 to 105	0.128	176.8×10^2	34.38×10^4	353.6×10^2	68.76×10^4
vii)	75	1.0	106 to 75	0.90	251.5×10^2	98.91×10^4	251.5×10^2	98.91×10^4
viii)	Pan	0.1	75 to 52	0.064	353.7×10^2	275.07×10^4	35.37×10^2	27.51×10^4

100.0	Total	$8\ 864 \times 10^2$	673.39×10^4

$O'_K = \frac{8\ 864.97 \times 10^2}{100} = 88.65 \times 10^2$ mm^2/g

$O'_{KG} = \frac{22\ 641.5}{0.205} \times 11\ 044.6$ mm^2/g

$n'_K = \frac{673.39 \times 10^4}{100} = 6.73 \times 10^4$ particles per g

$A_G = \frac{11\ 044.6 - 8\ 864.97}{11\ 044.6} \times 100 = 19.73$ %

$d_n = \sqrt{\frac{88.65 \times 10^2}{6.73 \times 10^4}} = 0.205$ Fineness No. = 8

864.97 x 0.005 7 = 50.53