

भारतीय मानक

रोगन के लिये सिलिका — विशिष्ट

(दूसरा पुनरीक्षण)

Indian Standard

SILICA FOR PAINTS — SPECIFICATION

(Second Revision)

ICS 71.100; 87.060

© BIS 1998

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Raw Materials for Paint Industry Sectional Committee had been approved by the Chemical Division Council.

This standard was first published in 1950. In the first revision in 1979 two types of the material were covered. Further for crystalline type of the material, two grades, based on the fineness of the material, were prescribed. Additional requirements for pH of aqueous solution and loss on ignition were prescribed and requirements for oil absorption value had been modified. In this revision crystalline and amorphous types have been combined as Natural type and a new type of precipitated silica has been added. Another type, fused silica, shall be taken up when commercial usage is available.

Composition of the Committee responsible for the formulation of this standard is given in Annex F.

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 'Rules for rounding off numerical values (*revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SILICA FOR PAINTS — SPECIFICATION

(*Second Revision*)

1 SCOPE

1.1 This standard prescribes requirements and methods of sampling and test for silica, intended for use as an extender in paint industry.

2 REFERENCES

2.1 The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this Indian 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:

IS No.	Title
33 : 1992	Methods of sampling and test for inorganic pigments and extenders for paints (<i>third revision</i>)
1070 : 1992	Reagent grade water (<i>third revision</i>)
1303 : 1983	Glossary of terms relating to paints (<i>second revision</i>)

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1303 and under 2 of IS 33 shall apply.

4 TYPES AND GRADES

4.1 Types

The material shall be of the following two types:

a) *Type 1* — Natural, and

b) *Type 2* — Precipitated.

4.2 Grades

The material of Type 1 shall be of two grades, namely, Grade 1 (240 mesh) and Grade 2 (micronized).

5 REQUIREMENTS

5.1 Composition

The material, dried as described under 8 of IS 33 shall contain not less than 98 percent silicon dioxide (SiO₂) in case of Type 1 and not less than 85 percent in case of Type 2 when determined as prescribed in Annex A.

5.2 Form and Condition

The material shall be supplied in the form of dry powder or in such a condition that it can be reduced to the powder form by crushing, without grinding action, under a palette knife.

5.3 When lead free silica is required, it shall contain not more than 0.03 percent of lead or compounds of lead (calculated as metallic lead), when tested by the method specified under 26 of IS 33.

5.4 The material shall also conform to the requirements given in Table 1.

Table 1 Requirements for Silica for Paints
(*Clauses 5.4 and 8.1*)

Sl No.	Characteristic	Requirement			Method of Test	
		Type 1		Type 2	Annex	Cl No. of IS 33
		Gr 1	Gr 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Volatile, matter, percent by mass, <i>Max</i>	0.5	0.5	0.5	—	8
ii)	Residue on sieve, percent by mass, <i>Max</i>					
	45 Micron	—	0.5	—		9
	63 Micron	0.5	—	0.5		
iii)	Oil absorption	← 18 to 20 →		90 to 110	—	10
iv)	Colour	Close match to the approved sample			—	11
v)	Matter soluble in water, percent by mass, <i>Max</i>	0.5		2.0	—	19
vi)	pH of aqueous extract	← 6 to 8 →		8 to 9.5	—	21
vii)	Loss on ignition, percent by mass, <i>Max</i>	← 0.5 →		10	B	—
viii)	Particle size and shape	Close match to the approved sample			C	—
ix)	BET surface area, m ² /g	—	—	160-200	D	—
x)	Matter insoluble in acid other than silica, percent by mass, <i>Max</i>	—	—	2.0	E	—

6 PACKING AND MARKING

6.1 Packing

The material shall be packed as agreed to between the purchaser and the supplier.

6.2 Marking

The material shall be marked with the following particulars:

- a) Name, type and grade of the material,
- b) Net mass,
- c) Indication of the source of manufacture,
- d) Batch No. or Lot No. in code or otherwise, and
- e) Month and year of manufacture.

6.2.1 BIS Certification Marking

The product may also be marked with Standard Mark.

6.2.1.1 The use of the Standard Mark is governed by the provision of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers

or producers may be obtained from the Bureau of Indian Standards.

7 SAMPLING

7.1 Preparation of Test Samples

Representative samples of the material shall be prepared as prescribed under 5 of IS 33.

7.2 Criteria for Conformity

The material shall be taken as conforming to this specification if the composite sample satisfies all the requirements prescribed in this specification.

8 TEST METHODS

8.1 Tests shall be conducted as prescribed in Annex A to D and IS 33 in accordance with the requirements of 5.1 and col 6 and 7 of Table 1.

8.2 Quality of Reagents

Unless otherwise specified, pure chemicals and distilled water (*see* IS 1070) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

ANNEX A

(Clauses 5.1, 8.1 and E-1.1)

ESTIMATION OF SILICA

A-1 REAGENTS

A-1.1 Sulphuric Acid — concentrated.

A-1.2 Hydrofluoric Acid — 40 percent (*m/m*).

A-2 APPARATUS

A-2.1 Steam Bath

A-2.2 Platinum Crucible

A-2.3 Muffle Furnace

A-3 PROCEDURE

A-3.1 Weigh accurately in a clean weighed platinum crucible about 1 g of the material, previously dried as described under 8 of IS 33. Moisten with water and add 5 drops of concentrated sulphuric acid and 15 ml of hydrofluoric acid. Evaporate to dryness on a steam

bath and heat gently until sulphuric acid has been expelled. Ignite at $1\ 000 \pm 25^\circ\text{C}$ in the muffle furnace for 15 minutes, cool and weigh.

A-4 CALCULATION

A-4.1 From the loss in mass, which represents silica, calculate the percentage of silica in the material as follows:

$$\text{Silica (as SiO}_2\text{), percent by mass} = \frac{100 (M_2 - M_3)}{(M_2 - M_1)} - \text{LOI}$$

where

M_1 = mass, in g, of the empty platinum crucible;
 M_2 = mass, in g, of the platinum crucible with sample;

M_3 = mass, in g, of the platinum crucible after ignition; and

LOI = loss on ignition (*see* Annex B).

ANNEX B

[Clauses 5.4, 8.1 and A-4.1; and Table 1, Item (vii)]

DETERMINATION OF LOSS ON IGNITION

B-1 APPARATUS

B-1.1 Porcelain or Platinum Dish — shallow.

B-1.2 Muffle Furnace

B-2 PROCEDURE

B-2.1 Weigh, to the nearest 0.001 g, about 2 g of the test sample, previously dried in accordance with 8 of IS 33, into the tared porcelain or platinum dish. Ignite in the muffle furnace at $1\ 000 \pm 25^\circ\text{C}$ to constant mass.

Cool in a desiccator containing phosphorus pentoxide and weigh.

B-3 CALCULATION

$$\text{Loss on ignition, percent by mass} = \frac{100 (M_1 - M_2)}{M_1}$$

where

M_1 = mass, in g, of the sample taken for the test;
and

M_2 = mass, in g, of the residue after ignition.

ANNEX C

[Clauses 5.4 and 8.1; and Table 1, Item (viii)]

DETERMINATION OF PARTICLE SIZE AND SHAPE

C-1 APPARATUS

C-1.1 Microscope — suitable for viewing at minimum of 400 magnification.

C-2 PROCEDURE

C-2.1 Mix a small quantity, about 0.1 g, of the material with petroleum hydrocarbon solvent and apply a thin film of the paste on a clean glass slide. The

film should be free from any aggregate particle as far as possible. Observe the size and shape of the material under the microscope using 400 magnification. Compare the size and shape of the material with a similarly prepared slide of the approved sample. The size and shape of the material shall not be different from that of the approved sample.

ANNEX D

[Clauses 5.4 and 8.1; and Table 1, Item (ix)]

DETERMINATION OF SPECIFIC SURFACE AREA —
METHOD USING IN AREAMETER APPARATUS

D-1 PRINCIPLE

Two flasks of equal volume — one containing the test portion and the other empty — are filled with nitrogen under atmospheric pressure at room temperature. Both flasks are then cooled by immersion in liquid nitrogen.

At this temperature, the test portion adsorbs nitrogen, whereby a pressure difference is created between the flask containing the test portion and the reference flask.

The pressure difference is measured by means of a differential pressure gauge. The specific surface area is calculated from the measured pressure difference, the feed pressure and the mass of the test portion.

D-2 MATERIALS

D-2.1 Nitrogen — in a cylinder or other source of pre-purified nitrogen of recognized analytical quality.

D-2.2 Liquid Nitrogen

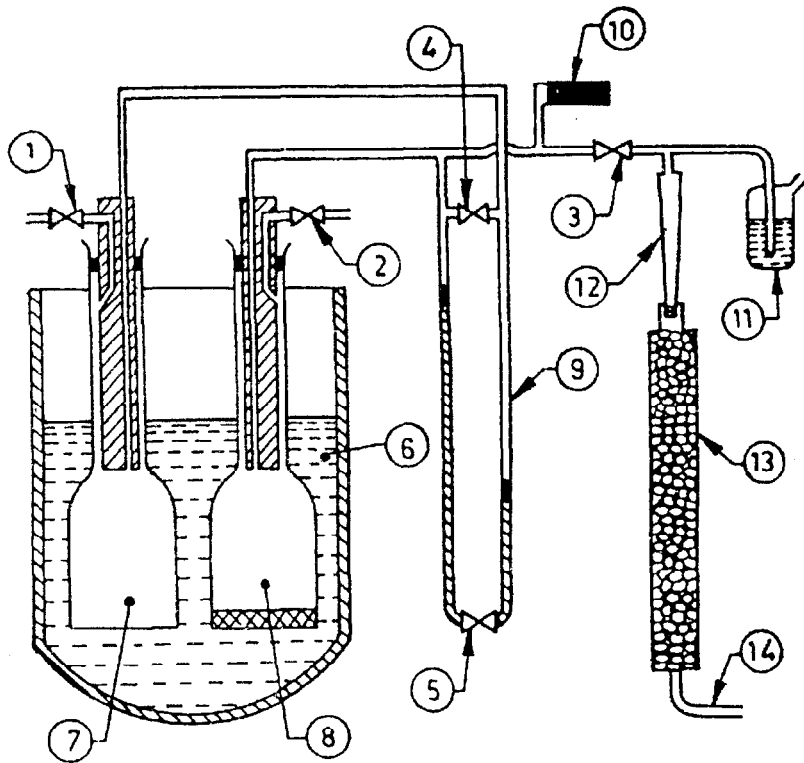
D-3 APPARATUS

D-3.1 Adsorption Apparatus (see Fig. 1)

Comprising a reference flask (7) and a sample flask (8) mounted with gas-tight connection.

These connections are provided with one valve each (1 and 2) by means of which the flasks may be connected with the atmosphere. The gas to be adsorbed is fed into each flask through the connection pieces.

D-3.1.1 The flasks are made of glass which is resistant to sudden changes of temperature and have a volume of approximately 100 ml. The volume difference between the two flask necks shall not exceed 0.1 percent.



1 to 5 Valves	10 Equalizing Volume
6 Cold Bath	11 Safety Valve
7 Reference Flask	12 Flow Meter
8 Sample Flask	13 Driving Tower
9 Differential Pressure Gauge	14 Nitrogen Inlet

FIG. 1 AREAMETER ADSORPTION APPARATUS

The flask necks are made of calibrated precision glass tubes with an inside diameter of 5 ± 0.02 mm. This ensures that several flasks may be used as sample of reference flasks without needing to adjust the equalizing volume for every combination.

D-3.1.2 A U-tube is mounted between the two flasks, and the legs of the pressure gauge are connected by capillary tubes to the two adsorption flasks. By means of valve 4, the two adsorption vessels can be either separated from one another or connected to one another *via* their capillary tubes. Using valve 5, both liquid legs of the differential pressure gauge can be separated or joined together. The measuring fluid is dibutylphthalate.

The legs of the differential pressure gauge are made of calibrated precision glass tubing with an inside diameter of 5 ± 0.02 mm. Therefore, any change in volume during the gas adsorption may be accurately calculated. The feed capillary to the sample flask, equalizing volume which is adjusted during the preparation of the owing to its short length, is considered as an equipment.

The gas is allowed into the equipment through valve 3. If valves 1, 2 and 4 are open, the gas flows through

both flasks. If valves 1 and 4 are closed, the reference flask is shut off and only the sample flask is rinsed with the gas.

During measurement, only part of the volume enclosed by valves 1, 2 and 3 is cooled to the measuring temperature by the liquid nitrogen. The remaining volume, at room temperature, may be only 10 percent of the total volume. The connections to the adsorption flasks are, therefore, capillaries which almost completely fill the necks of the flasks. In this manner, the volume of gas at room temperature is kept to a minimum.

NOTE—Procedures for commissioning new equipment and for control purposes are given in D-7.

D-3.2 Regulating Thermostat

Permitting maintenance of the adsorption flasks (with the test portion) at a constant temperature, and either rinsing with dry nitrogen or evacuation.

D-3.3 Analytical Balance

accurate to 0.1 mg.

D-3.4 Drying Oven

capable of being controlled at $105 \pm 2^\circ\text{C}$.

D-3.5 Cold Bath

containing the liquid nitrogen (*see* D-2.2).

D-4 PREPARATION OF THE SAMPLE

D-4.1 The maximum indication (400 mm) on the differential pressure gauge corresponds to a surface area of approximately 50 m². The mass of the test portion must, therefore, be adjusted so that on the differential pressure gauge is as great as possible and at least 50 mm. If approximate specific surface area is not known, preliminary tests with various masses of test portion shall be performed to establish the most suitable mass of test portion.

NOTE — As a guide, Table 2 gives masses of test portion according to specific surface area.

Table 2 Mass of Test Portion According to Specific Surface Area

Specific Surface Area m ² /g (1)	Mass of Test Portion g (2)
20	0.6 to 0.8
30	0.4 to 0.6
40	0.3 to 0.5
80	0.2 to 0.3
120	0.15 to 0.2
140	0.1 to 0.15
≥ 200	≤ 0.1

D-4.2 Dry the sample for 2 h in the drying oven controlled at 105 ± 2°C. Transfer a suitable amount of sample to the previously tared sample flask by means of a funnel, introducing the test portion into the flask in such a manner that no material adheres to the walls of the neck.

Determine the mass of sample by difference, carrying out both the weighings to the nearest 0.1 mg.

D-4.3 Before the determination, remove as much as possible of the matter that has already been adsorbed from the surface of the test portion. Carry out desorption by rinsing in a flow of nitrogen. This desorption shall be carried out in a thermoregulator at 150 to 160°C (preferably 155 to 160°C), the desorption time being 65 ± 5 minutes. The nitrogen flow in the sample flask shall be adjusted to 75 ml/minute.

D-4.4 After desorption, cool the test portion to room temperature under a flow of nitrogen, and stopper and store the flasks until required for the determination.

D-5 PROCEDURE

D-5.1 Connect the sample flask containing the prepared test portion to the nitrogen source and open valves 2 and 3.

D-5.2 Open valves 4, 1 and 5, and place the flasks in a water bath controlled at 27 ± 2°C.

D-5.3 After 10 to 15 minutes, determine the pressure difference in the flasks by closing valves 1, 2, 3 and 4.

If a pressure difference exists, reopen the valves in the order 4, 3, 2 and 1, and continue rinsing with nitrogen. Close valves flow by closing the valves.

D-5.4 When pressure equilibrium is attained, close valve 5 and stop the nitrogen flow by closing the valves.

D-5.5 Wipe off the water drops and immerse the flasks in the liquid nitrogen bath (*see* D-3.5) to the lower mark on the neck and, after 1 min, open valve 5 very slowly.

D-5.6 After the resulting pressure differential has stabilized, read the difference in liquid heights of the U-tube arms to the nearest 0.5 mm.

D-5.7 Close valve 5 and open valve 4. Replace the cold bath with a water bath controlled at approximately 40°C. After a few minutes, start the nitrogen flow and open valves 3, 2, 1 and 5 in that order.

D-5.8 As soon as the connections have reached room temperature, close valves 1, 4 and 5 and disconnect the sample flask.

D-6 EXPRESSION OF RESULTS

D-6.1 Method of Calculation — Calculate the specific surface area, S_m , in square metres per gram, from the formula:

$$S_m = 1.187 \times 10^{-7} \left[\frac{(1.044 \times 10^5) - P}{m} \right] \times \left[\{ 13.6458 + (6.65 \times 10^{-5} P) \} \Delta h + \frac{1}{P \cdot \rho} \left(\frac{P}{77.6} - \frac{P_B}{295} \right) \right]$$

where

P = equilibrium pressure, in pascals;

$P = \frac{105.55 P_B}{393.11 + (0.0049 \Delta h)} - 10.2 \Delta h$;

m = mass, in g, of the test portion;

Δh = difference in liquid heights, in millimetres, in the U-tube arms;

P_B = atmospheric pressure, in pascals; and

ρ = density, in g/ml of the test sample (assumed to be equal to 2.0 g/ml).

NOTE — For specific surface areas greater than 1 m²/g, the term $\frac{1}{P \cdot \rho} \left[\frac{P}{77.6} - \frac{P_B}{295} \right]$ may be ignored.

Express the result to the nearest 1 m²/g.

D-6.2 Calculation Using a Nomogram

The calculation may be simplified by the use of a nomogram (*see* Fig. 2).

Draw a straight line connecting the measured value of Δh on the vertical Δh scale with the measured value of P_B on the vertical P_B scale. Record the value at the point of intersection of the line and scale A.

Draw a straight line connecting the measured value of Δh on the vertical Δh scale with the measured value of

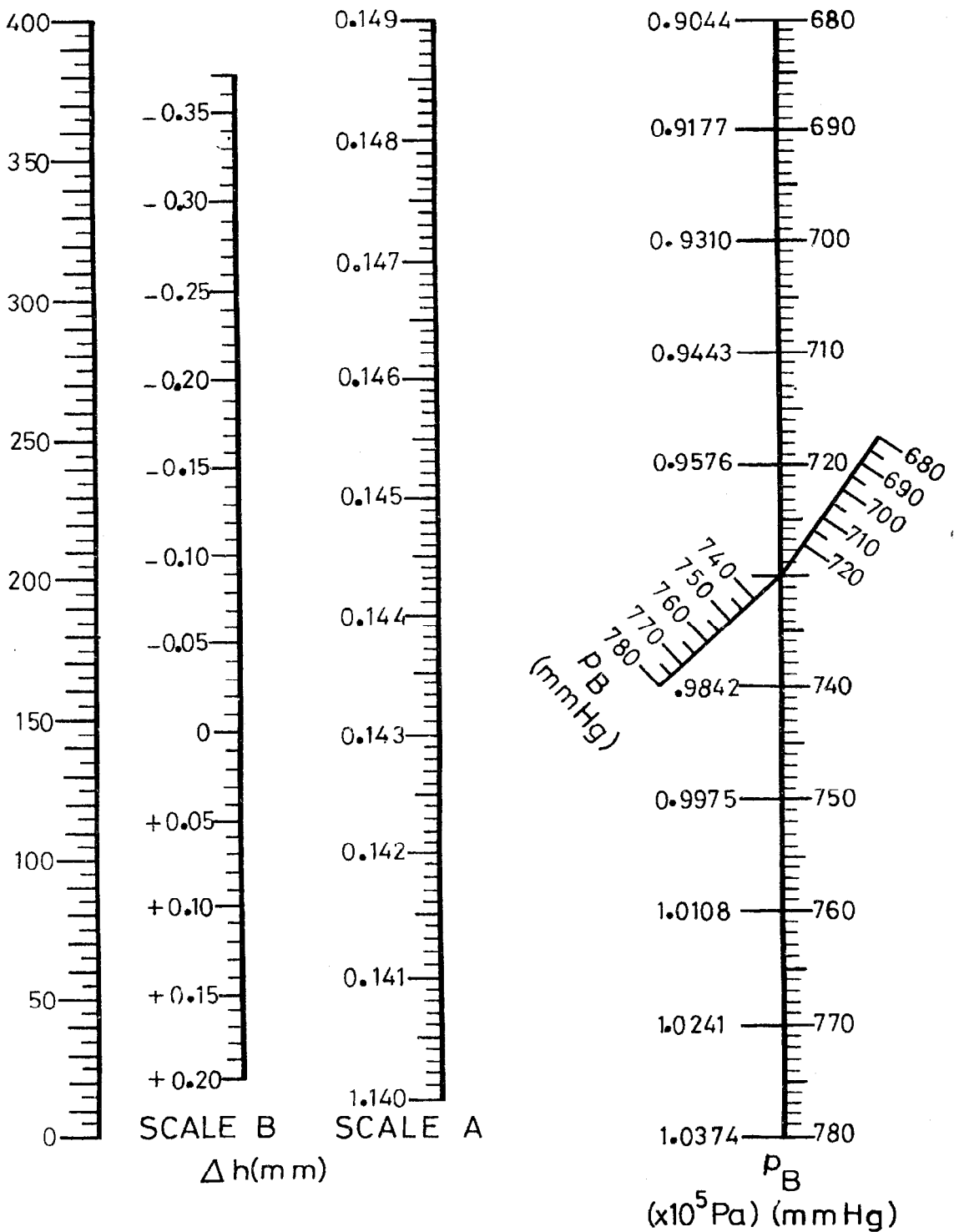


FIG. 2 NOMOGRAM

P_B on the inclined reduced P_B scale. Record the value where P_B intersects the inclined scale. Record the value at the point of intersection of the line and scale B .

The specific surface area, in square metres per gram, is given by the formula;

$$S_m = \frac{A \cdot \Delta h}{m} + \frac{B}{\rho \cdot P}$$

A and B are values derived from the nomogram as described above; and Δh , m , ρ and P have the same meanings as in D-6.1.

Express the result to the nearest $1 \text{ m}^2/\text{g}$.

D-7 NOTES ON PROCEDURE — PREPARATION OF THE AREAMETER

D-7.1 General

When commissioning new equipment or for control purposes, carry out tests to check whether the equalizing volume (*see* 10 in Fig. 1) is correctly adjusted and whether the apparatus is leakproof.

D-7.2 Test for Volume Equalization

The volume equalization balance pre-supposes the tightness of valve 4 (*see* D-7.3).

Connect the empty adsorption flasks to the apparatus, aligning the upper marks on the flask neck with the lower gasket. Then open all valves and rinse the apparatus with nitrogen. The flow rate should be 2.8 ± 0.15 ml/s.

While rinsing, immerse the flasks in a water bath at $27 \pm 2^\circ\text{C}$ to the lower mark on the flask neck so that both flasks may attain the same temperature. As soon as equality of temperature is expected (after at least 10 min), seal the apparatus from the atmosphere and separate the flasks from each other by closing valves 1, 2, 3 and 4 in that order. Closing valve 4 may cause a minor pressure differential. If this pressure differential changes within the next 2 min, complete temperature balance has not been achieved within the adsorption flasks. In this case, reopen valves 4, 3, 2 and 1 in that order and again rinse the apparatus with nitrogen. Repeat the test after a few minutes. When temperatures balance is achieved, again close valve 5. Removed the water bath, wipe off the adhering water drops and immerse the flasks to the lower marks on the flask in a cold bath of boiling nitrogen.

As soon as the flasks have assumed the temperature of the boiling nitrogen (for empty flasks, after approximately 1 min), open valve 5 very slowly. If the volumes of the sample flask and the reference flask are correctly balanced, no pressure difference will be present. In this case, again close valve 5 and reopen valve 4. Then remove the cold bath and replace by a water bath at approximately 40°C to thaw the flasks. Remove the warm water bath as soon as the flasks have reached approximately room temperature. After a few minutes reopen valves 3, 2 and 1 in that order and rinse the apparatus with nitrogen.

Cooling and heating of the flasks may result in greater pressure differentials for a short time. This could cause the dibutylphthalate in the U-tube to enter other parts of the apparatus; valve 5 must, therefore, be open during the indicated stages.

If a pressure differential should arise during the preparation of the apparatus, change the equalizing volume (*see* 10 in Fig. 1) at room temperature in such a way that the volumes on both sides of the differential pressure gauge are equal. For control of the volume balance, repeat the above test.

D-7.3 Leak Test

If balancing the volumes at the temperature of boiling nitrogen shows continuously increasing or very considerably pressure differentials (greater than 400 mm) after valve 5 has slowly been opened, this evidence of leaks from the apparatus of the atmosphere (that is, valves 1, 2 and 3).

The tightness of valve 4 cannot be checked by pressure differential and must be tested separately. To do this, immerse the flasks in the cold bath, close valves 2, 3 and 4 and open valves 1 and 5. By means of valve 1, produce a pressure differential giving a difference in liquid heights of 300 mm and again close valve 1.

The difference in height should not change by more than 1 mm within 10 minutes.

D-7.4 Operational Test

Check the correct operation of the apparatus initially, and periodically during use, by measurement of a silica of known specific surface area. The specific surface area of the reference material should have been measured using the same method.

D-7.5 Maintenance

Replace the dibutylphthalate in the U-tube, if it becomes polluted, or at least once a year. Also replace exhausted silica gel in the drying tower.

D-8 TEST REPORT

The test report shall include the following information:

- a) All details required for complete identification of the sample,
- b) Test conditions,
- c) Mass of test portion used, and
- d) Results obtained.

ANNEX E

[Table 1, Item (x)]

DETERMINATION OF MATTER INSOLUBLE IN ACID OTHER THAN SILICA

E-1 PROCEDURE

E-1.1 Determine silica content, percent by mass, as detailed in Annex A.

E-1.2 Determine matter soluble in water, as detailed in 19 of IS 33.

E-2 CALCULATION

Matter insoluble in acid
other than silica, percent by mass
= [(100 – silica content) – Matter soluble in water]

ANNEX F
(Foreword)
COMMITTEE COMPOSITION

Raw Materials for Paint Industry Sectional Committee, CHD 021

<i>Members</i>	<i>Chairman</i> SHRI R. MARPHATIA 14 Orion Oomar Park, Bhulla Bhai Desai Road, Mumbai-400026 <i>Representing</i>
SHRI K. R. SANTHANAM	Addisons Paints & Chemicals Ltd, Chennai
SHRI K. S. RAMCHANDRAN (<i>Alternate</i>)	Asian Paints (India) Ltd, Mumbai
DR R. B. TIRODKER	Berger Paints (India) Ltd, Calcutta
SHRI K. P. JAMBOTKAR (<i>Alternate</i>)	Central Building Research Institute, Roorkee
DR S. M. A. HAMZA	Coates of India Ltd, Calcutta
DR A. ROY (<i>Alternate</i>)	Colour-Chem Ltd, Mumbai
DR R. K. JAIN	Continental Coatings Pvt Ltd, Chennai
SHRI K. K. ASTHANA (<i>Alternate</i>)	Development Commissioner (SSI), New Delhi
SHRI B. B. SEN	Ministry of Industry, Department of Industrial Policy and Promotion, Government of India
SHRI R. G. GANGULY (<i>Alternate</i>)	Export Inspection Council of India, New Delhi
SHRI S. C. SRIVASTAVA	Deve Paints Ltd, Mumbai
SHRI M. B. SATYANARAYANA	Goodlass Nerolac Paints Ltd, Mumbai
INDUSTRIAL ADVISOR (CHEM)	ICI India Ltd, Calcutta
DIRECTOR CHEMICALS (<i>Alternate</i>)	Indian Paints Association, Mumbai
SHRI JASBIR SINGH	The Kerala Minerals & Metals Ltd, Quilon
SHRI N. R. NARAYANAN (<i>Alternate</i>)	Ministry of Defence (DGQA), Kanpur
SHRI P. P. SAXENA	Ministry of Defence (R&D), New Delhi
SHRI KARAM CHAND (<i>Alternate</i>)	RDSO, Lucknow
DR P. G. CHAUDHARI	National Organic Chemical Industries Ltd, Mumbai
SHRI S. S. ANKAIKAR	National Test House, Calcutta
SHRI S. N. BHANDARKAR (<i>Alternate</i>)	Oil Technologists Association of India, Kanpur
SHRI R. BEHL	The Punjab Paint Colour and Varnish Works, Kanpur
DR K. V. SESHADRI (<i>Alternate</i>)	Resin and Plastics Ltd, Mumbai
SHRI G. C. JADHAV	Shriram Institution for Industrial Research, New Delhi
SHRI D. K. ROY (<i>Alternate</i>)	Sudarshan Chemical Industries Ltd, Pune
SHRI K. V. SEBASTIAN	Travancore Titanium Products Ltd, Thiruvananthapuram
SHRI G. HARINDRAN (<i>Alternate</i>)	Director General, BIS (<i>Ex-officio Member</i>)
SHRI B. P. HAZELA	
SHRI K. L. BHATIA (<i>Alternate</i>)	
SHRI I. K. LOOMBA	
SHRI K. L. BHATIA (<i>Alternate</i>)	
CHEMIST & METALLURGIST	
SHRI A. A. RAMAKRISHNAN	
SHRI R. B. GANGULY (<i>Alternate</i>)	
SHRI P. B. PATEL	
DR S. K. SAHA (<i>Alternate</i>)	
SHRI A. S. KHANNA	
SHRI SURENDRA GARG (<i>Alternate</i>)	
SHRI G. N. TEWARI	
SHRI P. K. KHANNA (<i>Alternate</i>)	
SHRI M. C. CHOKSI	
DR A. R. ACHARAKAR (<i>Alternate</i>)	
DR V. K. VERMA	
SHRI A. P. SINGH (<i>Alternate</i>)	
SHRI H. K. KHESE	
SHRI SUDHIR HARSULA (<i>Alternate</i>)	
DR P. K. JOY	
SHRI K. G. NAIR (<i>Alternate</i>)	
DR R. S. RAJAGOPALAN, Director (Chem)	

Member-Secretary
SHRI S. MAZUMDER
Joint Director (Chem), BIS

(Continued on page 10)

(Continued from page 9)

Pigments and Extenders Subcommittee, CHD 021:01

Convener

DR P. R. PRADHAN

Members

SHRI K. R. SANTHANAM

SHRI P. D. RAMABADRAN (*Alternate*)

SHRI K. P. JAMBOTKAR

SHRI S. G. SHEVDE (*Alternate*)

DR S. M. A. HAMZA

SHRI A. ROY (*Alternate*)

SHRI V. B. KAPOOR

SHRI S. KAMAL KUMAR (*Alternate*)

SHRI M. B. SATYANARAYANA

DR P. G. CHAUDHARI

SHRI BHARAT CHOKSEY

SHRI HARISH SHAH (*Alternate*)

DR K. V. SESHADRI

DR A. R. BANDYOPADHYAY (*Alternate*)

SHRI K. V. SEBASTIAN

SHRI G. HARINDRAN (*Alternate*)

DR S. K. SAHA

SHRI B. K. BISWAS (*Alternate*)

SHRI R. H. PAREKH

DR S. P. BASU

SHRI L. N. DE (*Alternate*)

SHRI S. P. GOEL

SHRI V. K. VERMA

SHRI V. K. GUPTA (*Alternate*)

SHRI H. K. KHESE

SHRI SUDHIR HARSULE (*Alternate*)

SHRI J. B. GUPTA

SHRI S. H. KRISHNAN (*Alternate*)

DR P. K. JOY

SHRI S. D. POTTI (*Alternate*)

Representing

Goodlass Nerolac Paints Ltd, Mumbai

Addisons Paints & Chemicals Ltd, Chennai

Asian Paints (India) Ltd, Mumbai

Berger Paints (I) Limited, Calcutta

Colour-Chem Ltd, Mumbai

Continental Coatings, Pvt Ltd, Chennai

Deve Paints Ltd, Mumbai

Hindustan Mineral Products Co Pvt Ltd, Mumbai

ICI India Limited, Rishra

The Kerala Minerals & Metals Ltd, Quilon

National Test House, Calcutta

Pidilite Industries, Mumbai

Phillips Carbon Black Ltd, Calcutta

Rajdoot Paints Ltd, New Delhi

Shriram Institute for Industrial Research, Delhi

Sudarshan Chemical Industries Ltd, Pune

Tata Pigment Ltd, Jamshedpur

Travancore Titanium Products Ltd, Thiruvananthapuram