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IS 877 (1989): Methods of sampling and test for activated carbons, powdered and granular [CHD 1: Inorganic Chemicals]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
**ACTIVATED CARBONS, POWDERED
AND GRANULAR — METHODS OF
SAMPLING AND TEST
(*Second Revision*)**

भारतीय मानक

**सक्रियित कार्बन चूर्णित और दानेदार के नमूने लेने और
परीक्षण की पद्धतियां की विशिष्टि का मसौदा**

(दूसरा पुनरीक्षण)

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**BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002**

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards on 20 October 1989, after the draft finalized by the Inorganic Chemicals (Miscellaneous) Sectional Committee had been approved by the Chemical Division Council.

This standard was originally published in 1956 covering the methods of test for powdered activated carbons. This was revised in 1977 extending the scope of the standard to powdered as well as granular activated carbons used for water purification, solvent recovery, respirators and decolourizing pharmaceuticals in addition to vegetable oils and sugar solutions.

In this revision, new methods for determination of, retentivity index, chloride, sulphate and cyanogen compounds have been incorporated. Method for determination of adsorption capacity using benzene has been substituted by carbon tetrachloride method.

This standard does not deal with the material but prescribes the methods for determining whether they comply with the requirements of individual standards. Specification for powdered activated carbon for use in decolourizing pharmaceuticals, vegetable oils and sugar solution is covered in IS 8366 : 1989 'Activated carbons, powdered — Specification (*first revision*)', and granular activated carbon used in water purification, solvent recovery and for use in respirators has been covered in IS 2752 : 1989 'Activated carbons, granular — Specification (*second revision*)'.

In reporting the result of the test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

AMENDMENT NO. 1 JANUARY 1998
TO
IS 877 : 1989 ACTIVATED CARBONS, POWDERED
AND GRANULAR — METHODS OF SAMPLING
AND TEST

(*Second Revision*)

(Page 4, clause 13.1, line1) — Substitute '12.7 mm' for 12.5-mm'.

Indian Standard

ACTIVATED CARBONS, POWDERED AND GRANULAR — METHODS OF SAMPLING AND TEST (*Second Revision*)

1 SCOPE

1.1 This standard prescribes the methods of sampling and test for activated carbons, powdered and granular.

2 REFERENCES

2.1 The Indian Standards listed below are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
IS 264 : 1976	Specification for nitric acid (<i>second revision</i>)
IS 265 : 1987	Specification for hydrochloric acid (<i>third revision</i>)
IS 460 : 1985	Specification for test sieves: Part 1 Wire cloth test sieves (<i>third revision</i>)
IS 460 : 1985	Part 2 Perforated plate test sieves (<i>third revision</i>)
IS 1070 : 1977	Specification for water for general laboratory use (<i>second revision</i>)
IS 1745 : 1978	Specification for petroleum hydrocarbon solvents (<i>second revision</i>)
IS 4905 : 1968	Methods for random sampling.

3 QUALITY OF REAGENTS

3.1 Unless specified otherwise, pure chemicals and distilled water (*see* 1070 : 1977) shall be employed in tests.

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

4 MOISTURE

4.1 Procedure

Weigh accurately about 10 g of the material in a flat-bottomed petri dish. Place the dish in an electric oven maintained at $110 \pm 5^\circ\text{C}$ for about 4 hours. Cover the dish, cool in a desiccator and weigh. Repeat the procedure of heating, cooling and weighing at half-hour intervals until the difference between two consecutive weighings is less than 5 mg.

4.2 Calculation

$$\text{Moisture content, percent by mass} = \frac{100 (M - M_1)}{M}$$

where

M = mass in g of the material taken for test, and

M_1 = mass in g of the material after drying.

5 ASH

5.1 Procedure

Weigh accurately about 2 g of the material (of known moisture content) into a tared porcelain crucible (42 mm top diameter and 35 mm deep). Place the crucible and its contents in an electric oven maintained at 110 to 120°C for about 4 hours. Remove the crucible from the oven, place it on a nichrome triangle and ignite the contents of the crucible with a flame from a Meker burner for 5 hours. Cool the crucible in a desiccator and weigh. Repeat the above procedure of igniting, cooling and weighing at half-hour intervals until the difference between two consecutive weighings is less than 1 mg. Preserve the ash for test in 10.3.

5.1.1 The preliminary drying of the material in the oven is desirable because if the moist sample is ignited, the liberation of moisture throws a part of the material out of the crucible.

5.1.2 An electric muffle furnace, if available may be used with advantage in place of a Meker burner. Place the crucible in the furnace and heat at 1000°C for about 3 hours.

5.2 Calculation

$$\text{Ash (on dry basis), percent by mass} = \frac{10000 M_1}{M(100 - X)}$$

where

M_1 = mass in g of the ash,

M = mass in g of the material taken for the test, and

X = percentage of moisture content present in the material taken for the test.

6 PARTICLE SIZE

6.1 Apparatus

6.1.1 Test Sieves — 500-micron, 230-micron, 125-micron, 63-micron and 53-micron IS Sieve (see IS 460 : 1985).

6.1.2 Mechanical Shaker

6.1.3 Camel Hair Brush

6.2 Procedure

Clean and thoroughly dry the sieves before use. Nest the sieves in order, with 500-micron sieve on top. Weigh accurately 100 g of the well mixed material and transfer it into the top sieve. Put the sieves on the mechanical shaker and run the shaker for 10 minutes. Remove the sieves. Transfer the material from each sieve in separate petri dishes with the help of camel hair brush. Weigh the material collected from each sieve and remove the top sieve and shake this sieve separately.

6.3 Calculation

Material retained on any given sieve, per cent by mass = Mass in g of the material retained on the given sieve

6.3.1 The sum of percentage of the material retained on each sieve plus the percentage passing through 53-micron IS Sieve shall be 100.

7 MATTER SOLUBLE IN WATER

7.1 Procedure

Weigh accurately about 10 g of the material of known moisture content and transfer it into one-litre beaker. Add 300 ml of water and heat to boiling with continuous stirring. Continue to stir the contents for about 5 minutes after the flame is removed. Allow the material to settle and decant the supernatant liquid through a tared Gooch crucible fitted with an asbestos mat. Repeat the above procedure three times, adding 300 ml of water to the residue in the beaker each time. After the fourth digestion, concentrate the volume to less than 100 ml. Make up the volume to 100-ml mark in a volumetric flask.

7.1.1 Transfer 50 ml of the concentrate to a tared shallow dish. Evaporate as far as possible on a water-bath and finally dry in an electric oven maintained at $160 \pm 2^\circ\text{C}$. Cover the dish, cool in a desiccator and weigh. Repeat the above procedure of drying, cooling and weighing at half-hour intervals until the difference between the two consecutive weighings is less than 5 mg.

7.2 Calculation

Matter soluble in water (on dry basis), percent by mass = $\frac{20\,000\,M}{M_1(100 - X)}$

where

M = mass in g of the dried residue,

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

X = percent of moisture present in the material taken for the test.

8 MATTER SOLUBLE IN ACID

8.1 Reagent

8.1.1 Standard Hydrochloric Acid, 0.25 N.

8.2 Procedure

Weigh accurately about 10 g of the material of known moisture content and transfer to a 1-litre beaker. Add 300 ml of 0.25 N hydrochloric acid and heat to boiling with continuous stirring. Continue to stir the contents for about 5 minutes after the flame is removed. Allow the material to settle and decant the supernatant liquid through a tared Gooch crucible fitted with an asbestos mat into a 2-litre beaker. Repeat the above procedure three times, adding 300 ml of acid to the residue in the beaker each time. After the fourth digestion and decantation, concentrate the filtrate to less than 100 ml. Make up the volume to 100-ml mark in a volumetric flask.

8.2.1 Transfer exactly 50 ml of the concentrate to a tared shallow dish. Evaporate to dryness on a water-bath and finally dry in an electric oven maintained at $160 \pm 2^\circ\text{C}$. Cover the dish, cool in a desiccator and weigh. Repeat the above procedure of drying, cooling and weighing at half-hour intervals until the difference between two consecutive weighings is less than 5 mg.

8.2.2 Carry out a blank using the same quantity of water and standard hydrochloric acid.

8.3 Calculation

Acid soluble matter (on dry basis), percent by mass = $\frac{20\,000\,(A - B)}{M(100 - X)}$

where

A = mass in g of the dried residue,

B = mass in g of the dried residue in the blank,

M = mass in g of the material taken for the test, and

X = percentage of moisture present in the material taken for the test.

9 pH

9.1 Apparatus

9.1.1 *pH Meter*, with glass electrode.

9.2 Procedure

Weigh about 10 g of the dried material and transfer it to a 1 000-ml beaker. Add 300 ml freshly boiled and cooled water (adjusted to pH 7) and heat to boiling. Digest for 10 minutes and filter while hot, rejecting the first 20 ml of the filtrate. Cool the filtrate to room temperature and determine its pH using glass electrode.

10 IRON

10.1 Apparatus

10.1.1 *Nessler Cylinders*, 50-ml capacity.

10.2 Reagents

10.2.1 *Dilute Hydrochloric Acid*, 5 N approximately.

10.2.2 *Concentrated Nitric Acid*, See IS 264 : 1976.

10.2.3 *Dilute Sulphuric Acid*, 4 N approximately.

10.2.4 *Ammonium Thiocyanate Solution*, 4 N.

10.2.5 *Iso-amyl-Alcohol or Ether*

10.2.6 *Standard Iron Solution*

Dissolve 0.702 g of ferrous ammonium sulphate hexahydrate [$\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$] in about 100 ml of water containing 10 ml of dilute sulphuric acid (10 percent v/v) and dilute to 1 000 ml with water in a measuring flask. One millilitre of this solution contains 0.1 mg of iron (as Fe).

10.3 Procedure

Transfer the ash as obtained in 5.1 to a 150-ml conical flask using 50 ml of dilute hydrochloric acid. Heat to boiling, add 1 ml of concentrated nitric acid and again boil for about 1 minute. Cool and transfer to a 250-ml volumetric flask. Add 20 ml of dilute sulphuric acid and make up to the mark with water. To 5 ml of this solution add 5 ml of ammonium thiocyanate solution and 20 ml of iso-amyl alcohol or ether in a Nessler cylinder and shake well.

10.3.1 Carry out a control test in another Nessler cylinder by taking 2 ml of water, 5 ml of ammonium thiocyanate, 20 ml of iso-amyl alcohol or ether, 0.5 ml of dilute sulphuric acid, 2.5 ml of dilute hydrochloric acid and 2 drops of concentrated nitric acid. Add standard iron solution drop by drop with the help of a microburette with constant stirring till the intensity of the colour is same in both the cylinders.

10.4 Calculation

$$\text{Iron (as Fe), percent by mass} = \frac{0.4 \times V}{M}$$

where

V = volume in ml of standard iron solution required for matching the colour, and

M = mass in g of the material taken for the test in 5.1.

11 DETERMINATION OF DECOLOURIZING POWER

11.1 Reagent

11.1.1 *Methylene Blue Solution*

Dissolve 0.15 g of methylene blue in 100 ml of water.

11.2 Procedure

Weigh accurately about 0.1 g of the material, as received, and transfer to a 50-ml glass stoppered flask. Add from a burette 10 ml of methylene blue solution and shake for 5 minutes. After the first 10 ml are decolourized continue to add methylene blue solution (1 ml at a time) till the blue colour does not disappear for 5 minutes. Decolourizing power of carbon (is expressed in terms of milligrams of methylene blue adsorbed by 1 g of activated carbon).

11.2.1 Activated carbons, granular for the purpose of this test shall be reduced to 75 micron IS Sieve.

11.3 Calculation

$$\text{Decolourizing power} = \frac{15 \times V}{10 \times M}$$

where

V = volume in ml of methylene blue solution consumed, and

M = mass in g of the material taken for the test.

12 FILTRABILITY AND OIL RETENTION

12.1 Outline of the Methods

12.1.1 Filtrability is determined by noting the time taken by oil in filtering through a bed of the material, prepared under specified conditions.

12.1.2 Oil Retention

The oil retained by the cake of the material formed during filtration, is extracted with solvent under specified conditions and oil retention is determined.

12.2 Apparatus

12.2.1 Bucliner Funnel, 9 cm inside diameter immersed in hot water-bath.

12.2.2 Filter Flask, 1-litre capacity.

12.2.3 Filter Pump or Vacuum Pump

12.2.4 Soxhlet Extraction Apparatus

12.2.5 Stop-Watch

12.3 Material and Reagents

12.3.1 Refined Groundnut Oil

12.3.2 Petroleum Ether Solvent, conforming to solvent grade 60/80 of IS 1745 : 1978.

12.4 Procedure for Determination of Filtrability

Weigh 200 ± 0.1 g of the refined groundnut oil in a 500-ml beaker. Weigh accurately 10 g of the material and add to the oil. Heat the oil to 90°C mixing thoroughly with a glass rod. Wet the filter paper (Whatman No. 1 is suitable) placed inside the Buchner funnel with a little groundnut oil, taking care to avoid channeling effect. Heat the water-bath and maintain its temperature at 90°C . Start the vacuum pump. Mix the contents of the beaker thoroughly and immediately pour the entire mixture in the Buchner funnel. Adjust vacuum to absolute pressure of 100 ± 10 mm of Hg. In another beaker keep ready 200 g of groundnut oil (without the material) heated up to 90°C (Oil A). As soon as the film of oil on the cake in the Buchner funnel disappears, pour into the Buchner funnel over the bed of the previous material second batch of groundnut oil heated to 90°C (Oil B). Start the stop-watch as soon as the filtered oil starts flowing from the funnel. Maintain the vacuum at the absolute pressure of 100 ± 10 mm of Hg. Note the time when the oil film of the cake in the Buchner funnel disappears. At this point the vacuum will also drop.

12.4.1 Calculation

Filtrability = Time in minutes taken by the second batch of oil (Oil B) to filter through the cake of the material.

NOTE — Continue filtration till the rate of filtration falls to a drop per 15 seconds. Stop the pump and remove the cake from the Buchner funnel for the determination of oil retention as described in 12.5.

12.5 Procedure for Determination of Oil Retention

Weigh accurately by difference about 5 g of the cake obtained in 12.4 on a filter paper (Whatman No. 42 is suitable), roll and enclose it in a second filter paper folded in such a manner so as to prevent the cake from escaping (the second filter

paper is left open at the top to serve as a thimble). Place a piece of absorbent cotton at the top of the thimble to distribute the solvent evenly over the material. Place the wrapped material in the Soxhlet extraction apparatus. Put approximately 75 ml of the solvent into the tared extraction flask before attaching to the tube. Heat on a water-bath or electric hot-plate at such a rate that the solvent drops from the condenser on the centre of the thimble at the rate of at least 150 drops per minute. Keep the volume of the solvent fairly constant by adding more solvent to make up the loss due to evaporation. Continue extraction for 3 hours. Cool and disconnect the extraction flask. Evaporate the solvent on a steam or water-bath until no odour of it remains. A gentle flow of clean and dry air may be used to facilitate removal of the solvent. Cool to room temperature, carefully remove any moisture or dirt from the outside of the flask and weigh. Repeat heating, cooling and weighing until the difference between two successive weighings does not exceed 1 mg. Find the mass of the oil retained in the extraction flask.

12.5.1 Calculation

Oil retained by the material,
percent by mass $= \frac{100 \cdot M}{M_1}$

where

M = mass in g of the oil retained in the extraction flask, and

M_1 = mass in g of the filter cake taken for the determination of oil retention.

NOTE — The determination of oil retention should be done soon after the determination of filtrability.

13 HARDNESS

13.1 Procedure

Weigh about 50 g of the material and transfer to a sieve bottom (pan) with fifteen 12.5-mm diameter and fifteen 9.5-mm diameter smooth steel balls. Rest the pan with cover and shake on a vibrating machine for 30 minutes. Brush out all the material on to a 600-micron IS Sieve and shake separately on the vibrating machine for 3 minutes. Weigh the material remaining on the sieve.

13.2 Calculation

Hardness number $= \frac{M \times 100}{M_1}$

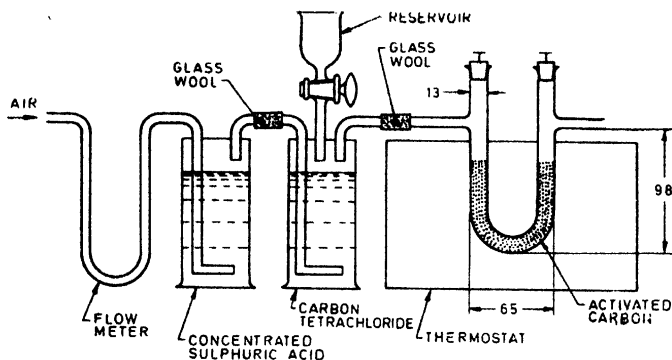
where

M = mass in g of the material remaining on the sieve, and

M_1 = mass in g of the material taken for the test.

14 ADSORPTION CAPACITY FOR CARBON TETRACHLORIDE

14.1 Apparatus — as shown in Fig. 1.



All dimensions in millimetres.

FIG 1 APPARATUS FOR DETERMINATION OF ADSORPTION CAPACITY BY BENZENE ADSORPTION

14.2 Procedure

Dry the material at 140° to 150°C for 4 hours and cool in a desiccator. Transfer to the adsorption tube a volume of the dried material (about 25 ml) sufficient to give a tapered column length of 15.0 cm in the adsorption tube. Weigh the tube and the contents to 1 mg. Place the adsorption tube in position in the thermostat which is controlled at about 30°C. Allow sufficient time (about 30 minutes) for the material to reach temperature equilibrium with thermostat. Maintain an air-flow rate of 150 ml per minute through carbon tetrachloride. Continue passing of carbon tetrachloride-air mixture with weighing of the adsorption tube every half an hour until no further gain in mass is evident. The gain in mass of carbon tetrachloride in 100 g for the material is recorded as adsorption capacity.

14.3 Calculation

$$\text{Adsorption capacity, percent by mass} = \frac{100 \times M_1}{M}$$

where

M_1 = increase in mass in g of the material, and

M = mass in g of the material taken for the test.

15 RETENTIVITY INDEX

15.1 Procedure

Pass dry air at 30°C through the material, after the measurement of carbon tetrachloride adsorption capacity as in 14.2 and weigh to constant mass.

15.2 Calculation

$$\text{Retentivity index, percent by mass} = \frac{M_1 - M_2}{M_1}$$

where

M_1 — mass in g of the material before passing dry air, and

M_2 = mass in g of the material after passing dry air.

16 CHLORIDE

16.1 Reagents

16.1.1 Silver Nitrate Solution 0.5 N, Dissolve 8.5 g of silver nitrate in 1 000 ml of water.

16.1.2 Ammonium Thiocyanate Solution 0.05 N, Dissolve 4.5 g of ammonium thiocyanate in 1 000 ml of water.

16.1.3 Concentrated Nitric Acid (See IS 264 : 1976).

16.1.4 Nitrobenzene

16.2 Procedure

Take 10 g of the sample of activated carbon of particle size less than 212 microns and mix it with 5.0 g of the mixture A (containing 1 part by mass of sodium carbonate and 2 parts by mass of light calcined magnesium carbonate) in a porcelain dish. Cover this mixture with another 10 g of the mixture A. Keep the porcelain dish containing the mixture in a muffle furnace and heat slowly to 400°C and then rapidly to 800°C. Maintain the temperature at 800°C for 1 h. Cool the fused mass and treat it with concentrated nitric acid to dissolve the fused mass and filter. Add 100 ml of silver nitrate solution to the filtrate. Titrate the excess silver nitrate with standard ammonium thiocyanate solution using ferric alum solution as indicator. Prior to titration add a few drops of nitrobenzene for masking the precipitate of silver chloride. The end point is indicated by the appearance of a wine red colour.

16.3 Calculation

$$\text{Chloride, percent by mass} = 0.1773 (100 - V N)$$

where

V = volume in ml of ammonium thiocyanate solution used in the titration, and

N = concentration of ammonium thiocyanate solution.

17 SULPHATE

17.1 Reagents

17.1.1 Concentrated Hydrochloric Acid — (See IS 265 : 1987).

17.1.2 Barium Chloride Solution — 10 percent.

17.1.3 Silver Nitrate Solution — 1 percent.

17.1.4 Concentrated Ammonium Hydroxide

17.2 Procedure

Take 1.0 g of activated carbon in a porcelain dish and thoroughly mix with the mixture *A* (containing 1 part by mass of sodium carbonate and 2 parts by mass of light calcined magnesium carbonate). Cover this mixture with 1.0 g of mixture *A* and place in a muffle furnace. Heat slowly to 400°C and then rapidly to 800°C. Maintain the temperature at 800°C for 1 h. Cool and transfer to a 500-ml beaker. Add slowly 180 ml of water and then slowly 20 ml of concentrated hydrochloric acid. Digest the mass on a hot plate for about 30 minutes. Filter with Whatman filter paper (No. 42) and reject the residue. Neutralize the filtrate with the addition of concentrated ammonium hydroxide solution followed by 10 ml of barium chloride solution. Keep overnight and then filter. Wash the residue with hot water till it is chlorine free. Take the residue along with the filter paper in porcelain crucible. Ignite at 850°C for 1 h. Cool and weigh the residue.

17.3 Calculation

$$\text{Sulphate, percent by mass} = \frac{41.12 M_1}{M}$$

where

M_1 = mass in g of the residue, and

M = mass in g of the sample taken for the test.

18 CYANOGEN COMPOUNDS

18.1 Reagents

18.1.1 Sodium Hydroxide — 1 N.

18.1.2 Ferrous Sulphate Solution

18.1.3 Tartaric Acid

18.2 Procedure

Add 5.0 g of activated carbon to a solution of 2 g of tartaric acid in 50 ml of water contained in a distillation flask. Attach the flask to an efficient condenser with the outlet tube dipping below the surface of 10 ml of 1 N sodium hydroxide, and distil about 25 ml. To the liquid in the receiver add 2 ml of ferrous sulphate solution and acidify to litmus paper with hydrochloric

acid. The sample shall be considered as having passed the test for cyanogen compounds if no blue colour is produced.

19 SAMPLING

19.1 General Precautions

In drawing, preparing, storing and handling samples, the following precautions shall be observed.

19.1.1 Samples shall not be taken to a place exposed to the atmosphere.

19.1.2 The sampling instruments shall be clean and dry.

19.1.3 Precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the containers for samples from adventitious contamination.

19.1.4 The samples shall be placed in suitable clean, dry and airtight glass or other suitable containers on which the material has no action.

19.1.5 The sample containers shall be of such a size that they are almost, but not completely, filled with the sample.

19.1.6 Each sample container shall be sealed airtight after filling and marked with full details of sampling, the date of sampling, the year of manufacture and other important particulars of the consignment.

19.1.7 Samples shall be stored in such a manner that the temperature of the material does not vary unduly from the normal temperature.

19.2 Scale of Sampling

19.2.1 Lot

All the containers in a single consignment of the material of same type (powdered or granular) and belonging to the same batch of manufacture shall constitute a lot.

19.2.2 For ascertaining the conformity of the lot to the requirements of the specification samples shall be tested from each lot separately.

19.2.3 The number of containers to be sampled from each lot shall depend on the size of the lot and shall be in accordance with Table 1.

Table 1 Scale of Sampling

Lot Size	No. of Containers to be Selected
Up to 25	3
26 „ 50	4
51 „ 100	5
101 „ 300	6
301 „ 500	7
501 „ 800	8
801 „ 1 000	9
1 001 and above	10

19.2.3.1 The sample containers shall be selected at random. In order to ensure the randomness of selection, procedure given in IS 4905 : 1968 may be followed.

19.3 Test Samples and Referee Samples

19.3.1 Draw with a suitable sampling instrument approximately equal quantity of material from different parts of the container till about 1 kg of material is drawn; divide into three equal parts. Each part so obtained shall constitute an individual sample representing the container and shall be transferred immediately to thoroughly dried bottles which are sealed airtight with glass stoppers. These shall be labelled with full particulars of sampling given in **19.1.6**. One set of test samples shall be sent to the purchaser, another to the supplier and the third kept for the referee.

19.3.2 From the material remaining in each of the containers selected, after individual sample has been taken, small but approximately equal

quantities of material shall be taken and mixed together to form a composite sample of the quantity sufficient to make triplicate determination for each of the characteristics tested on the composite sample. The composite sample shall be divided into three equal parts and transferred to thoroughly dried bottles which are sealed airtight with glass stoppers. One of these composite samples shall be marked for the purchaser, another for the supplier and the third for the referee.

19.3.3 The referee samples consisting of a set of individual samples and a composite marked for this purpose shall bear the seals of the purchaser and the supplier. These shall be kept at a place as agreed between the two and used in case of any dispute.

19.4 Number of Tests and Criteria for Conformity — These shall be as given in the individual material specification.

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The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard 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 BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference:

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