
प्रयोगशाला सिंटरित (फ्रेटेड) छन्नी —
छिद्रिलता श्रेणी निर्धारण, श्रेणीविभाजन
एवं संकेत
(पहला पुनरीक्षण)

**Laboratory Sintered (Fritted)
Filters — Porosity Grading,
Classification and Designation**
(*First Revision*)

ICS 71.040.20

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002

www.bis.org.in www.standardsbis.in

NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with ISO 4793: 1980 'Laboratory sintered (fritted) filters – Porosity grading, classification and designation' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Glass, Glassware and Laboratoryware Sectional Committee and approval of the Chemical Division Council.

The system for porosity grading and designating laboratory sintered (fritted) filters was of classification in grades from G-00 to G-5. The Technical Committee responsible for preparing this standard decided to formulate this standard aligning it with ISO 4793: 1980 to assist the purchaser and user of the laboratory sintered (fritted) filters. This standard was originally published in 1988. The comparison between the then old and new designation were shown graphically in that standard.

Considering the importance of following uniform practices globally, the committee felt the need of revising this standard and also felt that it would be more convenient to prepare this standard by adoption of ISO 4793 on dual number basis.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards where the standard atmospheric conditions to be observed are stipulated which are not applicable to tropical/subtropical countries. The applicable standard atmospheric conditions for Indian conditions are $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity and shall be observed while using this standard.

This standard also makes a reference to the Packing, additional marking on the product, BIS Certification Marking clause of the product and sampling, details of which are given in National Annex 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 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

LABORATORY SINTERED (FRITTED) FILTERS —
POROSITY GRADING, CLASSIFICATION AND
DESIGNATION
(*First Revision*)

1 Scope and field of application

This International Standard specifies a system of porosity grading, classifying and designating laboratory sintered (fritted) filters by the determination of pore size index.

It is applicable to laboratory filters made of glass, vitreous silica, ceramics, metals and plastic materials.

Test methods are included in annexes B and C for the determination of air permeability and uniformity of pore size, but these characteristics do not form part of the requirements of this International Standard.

2 Definitions

2.1 sintered (fritted) filter : A filter produced from porous material formed by the thermal bonding of particles.

2.2 pore size index : A characteristic of a filter related to pore diameter.

2.3 permeability : A characteristic of a filter related to the rate of flow through it under specified conditions.

3 Quality

Filters shall not shed particles under conditions of normal use and shall withstand a working pressure differential of 1,013 bar applied in the normal direction of use.

When tested for pore size index by the method specified in annex A, there shall be no evidence of faults in the filter material, or the sealing into the holder.

4 Grading of filters

Filters shall be graded according to their pore size index in one of the eight grades specified in table 1.

The designation allotted to each grade consists of the upper limit of its pore size index range, expressed in micrometres preceded by the letter "P".

Filters may be provided in certain materials or for special purposes with pore size indexes falling within narrower ranges than those given in table 1; if so, this should be indicated by stating both the minimum and maximum limits of the range.

Table 1 – Grading of filters

Designation of grade	Pore size index, μm	
	>	\leq
P 1,6	—	1,6
P 4	1,6	4
P 10	4	10
P 16	10	16
P 40	16	40
P 100	40	100
P 160	100	160
P 250	160	250

5 Limits for pore size index

When the filter is tested in accordance with the method specified in annex A, the pore size index shall be within the limits specified in table 1 for its grade.

NOTE — It is recommended that filters be manufactured with pore size indexes near the centre of the range of the appropriate grade.

6 Uniformity test

If it is required to assess the uniformity of the filter over its working area, the method of test described in annex B should be used.

7 Permeability

If it is required to measure the permeability of the filter, it should be tested in accordance with the method described in annex C, and should not have a permeability less than the value specified in table 2 for its grade.

Table 2 — Permeability of filters

NOTE — The figures given relate to filter discs up to 6 mm thick.

Designation of grade	Minimum permeability (airflow at 1 mbar)	
	m ³ /m ² .ks	cm ³ /cm ² .min
P 1,6	0,12	0,72
P 4	0,33	1,98
P 10	0,83	4,98
P 16	1,7	10,2
P 40	5,0	30
P 100	33	198
P 160	67	402
P 250	83	498

Annex A

Method for determination of pore size index

A.0 This method of test measures the pressure at which the first air bubble breaks away from the filter under specified conditions. This pressure is then used to calculate the equivalent capillary diameter. Thus, the test does not constitute a measurement of pore size but provides an indication of pore diameter, which is related to the maximum size of particle that the filter will pass.

The retentivity of a filter is also affected by other factors.

A.1 Ensure that the filter is thoroughly clean, especially that it is free from detergents, and wettable by the test liquid.

Table 3 lists some of the test liquids that have been found suitable for various filter materials, and that have the desirable properties of low or zero flammability and low toxicity.

In the case of filters made of materials such as glass, vitreous silica, ceramics, platinum, bronze or stainless steel, the choice of the test liquid is wide, in relation to both wettability and non-

reactivity with the filter material. In the case of plastic materials, reactivity is an important consideration, and certain liquids may cause partial dissolution or swelling.

In order to give an adequate reading on a mercury manometer, it is generally preferable to use water as the test liquid on the coarse filters. There may, however, be important reasons for using one of the liquids of low surface tension on some filters, and in such cases it is more appropriate to employ a water manometer and make the necessary correction. Examples are

- 1) polytetrafluoroethylene filters, which are not wetted by water;
- 2) domed filters, for which excessive pressure on the concave side could cause fracture;
- 3) fine grade filters, because the pressure necessary when using water may be greater than that the filter can withstand.

Table 3 – Suitable test liquids

Test liquid	Nominal surface tension at 20 ° C		Filter material
	N/m	dyn/cm	
Ethanol, 95 % (V/V)	0,022	22	All
Propan-2-ol (<i>iso</i> -propanol)	0,022	22	All
1,1,1-trichloroethane	0,025	25	All except plastic materials
Water	0,073	73	See A.1

NOTE – The surface tension values quoted are sufficiently accurate for the purposes of the test, but they are liable to be affected by contamination of the test liquid (for example by the air supply) and this should be avoided.

A.2 Assemble the filters in a suitable apparatus, for example that illustrated in figure 1.

NOTE – If the filters comprise a fine grade material supported on a coarser grade, the filter characteristics stated should be those of the finer grade and the filter should be tested in such a way that the bubbles appear at the surface of the finer grade material.

Connect an adequate source of clean, dry air, that is supplied at an accurately and finely controlled pressure, for example using a needle valve (the equations in A.5 are based on the assumption of static conditions in the system). Situate the manometer so as to indicate the actual pressure at the filter.

A.3 Cover the filter with a layer of the test liquid, as shallow as is convenient, and ensure that all the pores are impregnated.

Assuming the usual flat form of filter is used, there should be no excessive variation of hydrostatic head over its working area. If this hydrostatic head is significant, convert its value to the appropriate pressure units, and deduct this pressure from the manometer reading to give the effective pressure.

When a domed filter is being tested, bubbles tend to appear first at the uppermost region of the dome, owing to the varying hydrostatic head. It may be desirable in this case to tilt the filter to bring different regions into the uppermost position, to ascertain

- a) the point of maximum pore size index;
- b) the general uniformity of the filter (see annex B).

Hollow filters (for example cylindrical) should be supported with the axis horizontal and suitably rotated.

A.4 Gradually increase the air pressure until the first air bubble breaks away from the surface of the filter. (For hollow filters it is necessary to allow sufficient time to ensure that all free liquid is driven out of the central cavity of the filter.) Read the pressure at the filter from the manometer.

Repeat the test, taking the precautions stated above, with the pressure being increased more slowly. If concordant results are obtained the test has been performed satisfactorily.

A.5 Calculate the pore size index, d , in micrometres (μm), using either of the following formulae

$$\text{a) } \frac{40 \gamma_1}{P_1}$$

where

γ_1 is the surface tension, in newtons per metre, of the test liquid;

P_1 is the effective pressure, in bars;

$$\text{b) } \frac{30 \gamma_2}{P_2}$$

where

γ_2 is the surface tension, in dynes per centimetre, of the test liquid;

P_2 is the effective pressure, in millimetres of mercury.

NOTES

1 1 bar = $10^5 \text{ N/m}^2 = 750,24 \text{ mm Hg}$

2 If a manometer liquid other than mercury is used, the actual reading of the manometer should be converted to bars or millimetres of mercury, as required.

3 The manometer may be calibrated or a graph constructed for a particular test liquid, so that the pore size index can be read directly.

A.6 When the pore size index has been determined, the filter may be left connected to the apparatus and its uniformity checked as described in annex B.

Annex B

Procedure for assessing uniformity of filters

B.1 Use the procedure specified in annex A for determination of pore size index.

B.2 Following the appearance of the first air bubble, as

described in A.4, increase the air pressure until bubbles emerge uniformly over the upper surface and note the new pressure readings. This should correspond to a pore size index not less than the minimum for the grade (see table 1).

Annex C

Method for determination of air permeability

C.0 This method measures the rate of flow of air through a filter under specified conditions. It is related (but not necessarily by simple proportionality) to the rate of liquid flow through the filter, and hence to the speed of filtration.

C.1 Ensure that the filter is thoroughly clean and dry.

Assemble the filter in a suitable apparatus, for example that illustrated in figure 2. Establish a suitable pressure difference P_3 (for example 1 mbar) across the filter and maintain this during the test. Measure the air flow rate Q by means of a suitable air flow meter, and convert the rate to cubic metres per kilosecond or cubic centimetres per minute, as required.

C.2 Determine the effective surface area A of the filter in square metres or square centimetres, as required, making

allowance for the part of the filter near the edge which is rendered ineffective by the fixing process.

C.3 Calculate the air permeability per millibar pressure difference, expressed in cubic metres per square metre kilosecond [$\text{m}^3/(\text{m}^2 \cdot \text{ks})$] or cubic centimetres per square centimetre minute [$\text{cm}^3/(\text{cm}^2 \cdot \text{min})$], as required, from the formula

$$\frac{Q}{A P_3}$$

NOTE — The test assumes viscous flow of air through the filter, and is adequate for the general requirements of laboratory sintered filters. For particular purposes, for example filters required for accurate work in fluid flow, more detailed tests may be required and should be agreed upon by the interested parties.

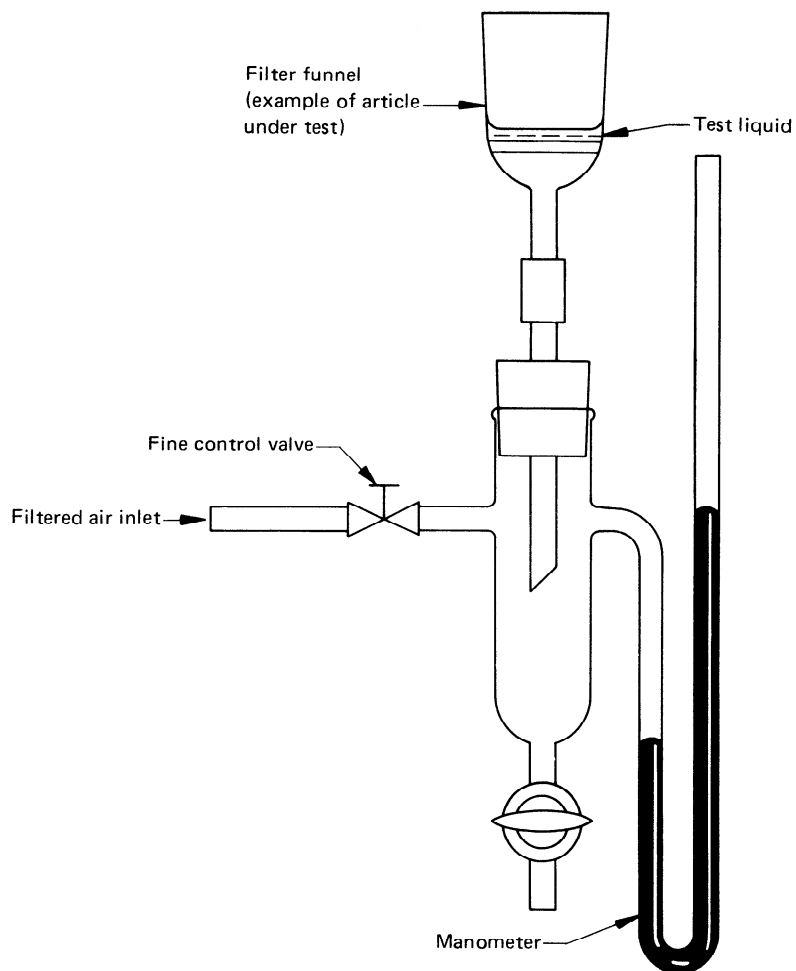


Figure 1 – Apparatus for determination of pore size index

WARNING – For safety reasons, this apparatus must be suitably shielded when in use.

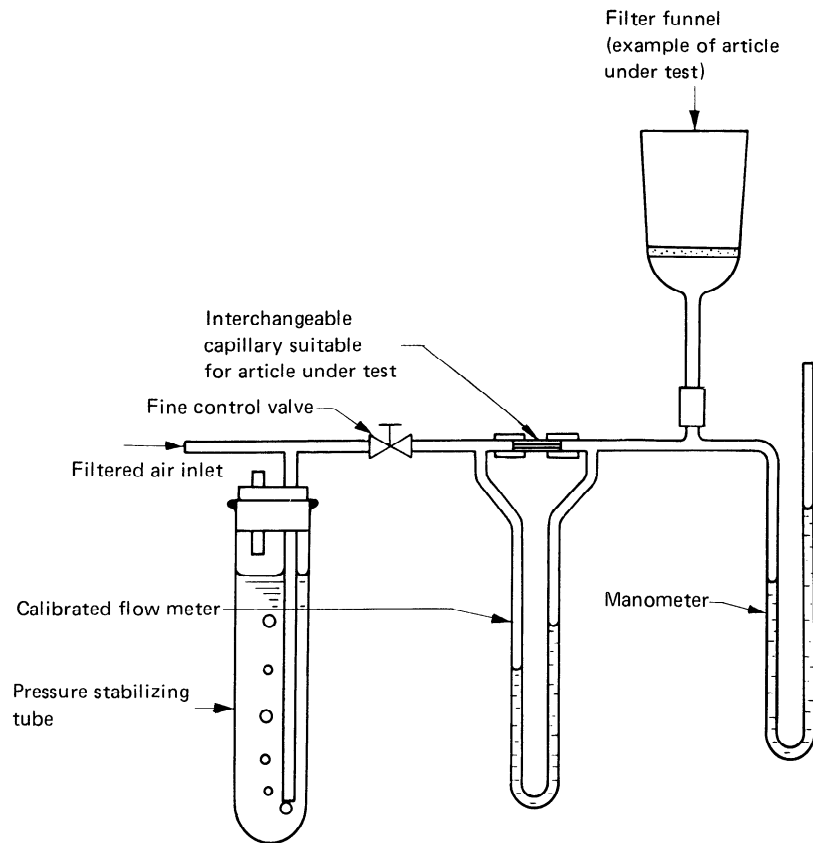


Figure 2 — Apparatus for determination of air permeability

NATIONAL ANNEX A

(National Foreword)

A-1 PACKING

Each sintered filter shall be suitably packed so as to avoid any shredding, disintegration and breakage during transit (see also IS 6945).

A-2 MARKING

A-2.1 Each package shall be marked permanently and legibly with the following:

- a) Name of the manufacturer or his recognized trade-mark;
- b) Designation of porosity grade (see 4);
- c) Diameter of the disc, if it is round; or largest surface area, if in any other shape;
- d) Lot No. for identification or manufacturing date;
- e) If they are supplied as pre-sterile then the sterility date shall be marked and with the word 'Sterile';
- f) If sintered filter is for single use only, then it should be marked as 'For Single Use'; and
Note — The use of term, 'Disposable' is not acceptable.
- g) Type of material used for the sintered filter shall also be marked. If glass is used, the quality of glass shall be marked according to IS 2303 (Part 1/Sec 1) : 2012/ISO 719: 1985 or IS 2303 (Part 1/Sec 2): 2012/ISO720.

A-2.2 BIS Certification Marking

The product may also be marked with the Standard Mark.

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 there under. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

A-3 SAMPLING, TESTING AND INSPECTION OF SINTERED (FRITTED) FILTERS

A-3.1 Sampling and testing

A-3.1.1 Lot — In any consignment, all the filters of

the same grade manufactured under similar conditions, shall be put together to constitute a lot.

Samples shall be tested for each lot separately for ascertaining the conformity of the lot to the requirements of this specification.

A-3.1.2 The number of filters to be chosen from the lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 1 below.

Table 1 Sampling Plan and Criteria for Conformity

Lot Size (1)	Sample Size (2)	Acceptance No. (3)
Up to 25	3	0
26 to 100	5	0
101 to 150	8	1
151 to 300	13	1
301 and above	20	2

A-3.1.3 The filters shall be selected from the lot at random and in order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

A-3.2 Number of Tests

All these samples of filter drawn in **A-3.1.2** shall be tested for all the requirements of this specification.

A-3.3 Criteria for Conformity

A-3.3.1 Any of the filters so selected shall be considered as defective if it fails to satisfy any of these requirements given in **A-3.2.1**. The lot shall be considered as conforming to the requirements of the standard if the number of defective filters found in the sample is less than or equal to the corresponding acceptance number in col 3 of Table 1.

A-3.3.2 The lot shall be declared as conforming to this standard, if it satisfies **A-3.3.1**.

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices:

	<i>Telephones</i>
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 260 3843 260 9285
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892

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