

Products used for treatment of water intended for human consumption — Inorganic supporting and filtering materials — Methods of test

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Additional information

Article 8 of the Council of the European Community Directive 80/778/EEC relating to the quality of water intended for human consumption requires Member States to ensure that substances used in the preparation of drinking water do not cause any contravention of the maximum admissible concentrations prescribed in annex 1 to the Directive.

This requirement is given effect in England and Wales by regulation 25 of the Water Supply (Water Quality) Regulations 1989 (similar provisions apply in Scotland and Northern Ireland). Regulation 25 makes provision for attaching conditions of use to chemicals and filter media which are authorized for use in public water supplies.

Details of conditions of use are contained in the Secretary of State's *List of Approved Products* published by the Drinking Water Inspectorate, Floor 2/A1, Ashdown House, 123 Victoria Street, London SW1E 6DE.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 43 and a back cover.

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Products used for treatment of water intended for human
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Produits utilisés pour le traitement de l'eau destinée à la
consommation humaine – Matériaux inorganiques de
filtration et de support – Méthodes d'essai

Produkte zur Aufbereitung von Wasser für den
menschlichen Gebrauch – Anorganische Filterhilfs und
Filtermaterialien - Prüfverfahren

This European Standard was approved by CEN on 16 July 1999.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

	Page
Foreword	2
1 Scope	2
2 Normative references	3
3 Terms and definitions	4
4 Sampling	4
5 Physical properties	4
5.1 Particle size distribution	4
5.2 Bulk density (loose and packed)	5
5.3 Permeability of powders	7
5.4 Cake density	10
6 Chemical properties	15
6.1 Acid-soluble material (acid loss)	15
6.2 Ash	16
6.3 Water-extractable toxic substances	17
6.4 Silica content	20
6.5 Water content (mass loss at 105 °C or 150 °C)	21
6.6 Content of carbon (C)	22
6.7 Content of volatile matter	22
6.8 Water-soluble material	22
6.9 Content of zinc	24
6.10 Iodine number	26
7 Determination of polynuclear aromatic hydrocarbons (PAH) in aqueous extracts	30
7.1 General	30
7.2 Principle	30
7.3 Interferences	30
7.4 Reagents	30
7.5 Apparatus	31
7.6 Sampling	34
7.7 Procedure	34
7.8 Calibration	36
7.9 Measurement of samples	38
7.10 Expression of results	38
Annex A (informative) Measurement of resistance to friability	39

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 164 "Water supply", the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2000, and conflicting national standards shall be withdrawn at the latest by February 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard describes methods of test to determine physical and chemical properties of Inorganic Supporting and Filtering Materials (ISFM).

NOTE The applicability of the methods is specified in the relevant product standard.

2 Normative references

This European Standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1483, *Water quality - Determination of mercury*.

EN 12901, *Products used for treatment of water intended for human consumption - Inorganic supporting and filtering materials – Definitions*.

EN 26595, *Water quality - Determination of total arsenic - Silver diethyldithiocarbamate spectrophotometric method (ISO 6595 : 1982)*.

EN ISO 3696, *Water for analytical laboratory use - Specification and test methods (ISO 3696:1987)*.

ISO 562, *Hard coal and coke - Determination of volatile matter*.

ISO 565, *Test sieves - Metal wire cloth, perforated metal plate and electroformed sheet - Nominal sizes of openings*.

ISO 609, *Solid mineral fuels - Determination of carbon and hydrogen - High temperature combustion method*.

ISO 2395, *Test sieves and test sieving – Vocabulary*.

ISO 2591-1, *Test sieving - Part 1 : Methods using test sieves of woven wire cloth and perforated metal plate*.

ISO 3165, *Sampling of chemical products for industrial use - Safety in sampling*.

ISO 6206, *Chemical products for industrial use - Sampling – Vocabulary*.

ISO 6703-1, *Water quality - Determination of cyanide - Part 1 : Determination of total cyanide*.

ISO 8213, *Chemical products for industrial use - Sampling techniques - Solid chemical products in the form of particles varying from powders to coarse lumps*.

ISO 8288, *Water quality - Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods*.

ISO 9174, *Water quality - Determination of chromium - Atomic absorption spectrometric methods*.

ISO 9276-1, *Representation of results of particle size analysis - Part 1 : Graphical representation*.

ISO 9965, *Water quality - Determination of selenium - Atomic absorption spectrometric method (hydride technique)*.

ISO 11885, *Water quality - Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy*.

ISO/DIS 13320-1, *Particle size analysis - Laser diffraction methods – Part 1 : General principles*.

3 Terms and definitions

For the purpose of this standard, the definitions given in EN 12901 apply.

4 Sampling

Observe the recommendations of ISO 3165 and see ISO 6206. Sample in accordance with ISO 8213 and obtain the laboratory sample from the bulk sample by using a divider.

5 Physical properties

5.1 Particle size distribution

5.1.1 General

The particle size distribution of granular materials shall be determined by sieving; this is applicable to distributions measured using sieves of nominal aperture size of 0,025 mm and above (see ISO 2591-1).

For powders, the particle size shall be determined according to the laser optical method (see 5.1.3).

NOTE Alternative methods for particle size determination include:

- - water sieving for powders,
- - size measurement with magnification: microscopic counting
- - particle fall in a fluid without acceleration: settling
- - particle fall in a fluid with acceleration: cycloning
- - electromagnetic wave diffraction: turbidity
- - dielectric properties: Coulter counter

5.1.2 Particle size distribution for granular material

The particle size distribution for granular material shall be determined in accordance with ISO 2591-1; see also ISO 2395 and ISO 565.

5.1.3 Particle size distribution for powders

5.1.3.1 General

The laser diffraction method described applies to powders in suspension in a liquid or gaseous fluid as well as to aerosols or emulsions. Measurable particle sizes are between 0,5 μm and an upper limit linked to the optical configuration of the laser equipment used which can range up to 3 600 μm . The principle of the method and guidance on measurement are given in ISO/DIS 13320-1.

5.1.3.2 Reagents

All reagents shall be of a recognized analytical grade and the water used shall conform to grade 3 in accordance with EN ISO 3696.

5.1.3.3 Apparatus

Usual laboratory equipment together with the following:

5.1.3.3.1 Laser diffraction instrument (see ISO/DIS 13320-1).

5.1.3.4 Measurement

Disperse the sample in a suitable fluid (e.g. water, see ISO/DIS 13320-1) and introduce it into the analyser in accordance with the manufacturer's recommendations. Adjust the measurement conditions by carrying out repetitive analyses to optimize reproducibility. Measure the scattering pattern and convert the results to particle size distribution following the recommendations in ISO/DIS 13320-1.

5.1.4 Expression of results

Results shall be presented as a cumulative particle size distribution curve in accordance with ISO 9276-1.

5.1.5 Processing of results

From the cumulative particle size distribution curve, determine the value of the following parameters:

- - effective size d_{10} ;
- - uniformity coefficient U ;
- - minimum size d_1 ;
- - oversize percentage;
- - undersize percentage.

5.2 Bulk density (loose and packed)

5.2.1 General

This method of measurement is not routinely used for materials with particle size greater than 4 mm.

5.2.2 Principle

The volume of dried ISFM, loose or packed, is determined in a measuring cylinder; dividing the mass of dried ISFM by its volume gives the bulk density.

5.2.3 Apparatus

Ordinary laboratory apparatus and glassware together with the following:

- 5.2.3.1 Balance with a capacity of 500 g or 2000 g depending on volume of sample (see table 1), with an accuracy of ± 1 g.
- 5.2.3.2 Desiccator.
- 5.2.3.3 Oven capable of being controlled at $(105 \pm 2) ^\circ\text{C}$.
- 5.2.3.4 Graduated measuring cylinder of (250 ± 2) ml or $(1\ 000 \pm 10)$ ml according to table 1.

5.2.4 Preparation of the sample

Dry a sufficient quantity of ISFM at $(105 \pm 2) ^\circ\text{C}$ to constant mass. Return to ambient temperature in the desiccator.

NOTE For porous material, it should be dried at $(150 \pm 2) ^\circ\text{C}$.

The volume of sample is determined according to the particle size of ISFM (table 1).

Table 1 - Minimum ISFM sample volume according to particle size

ISFM	Maximum particle size mm	Measuring cylinder volume ml	minimum sample volume ml
Powder	< 0,4	250 ± 2	100
Granular material	0,4 to 4	$1\,000 \pm 10$	500

5.2.5 Procedure

5.2.5.1 Loose material

Weigh the empty measuring cylinder and note its mass m_0 to the nearest 1 g. With the measuring cylinder positioned vertically, pour the sample of ISFM into the measuring cylinder. Measure the volume of the loose material V_1 to the nearest 10 ml. Weigh the measuring cylinder full and note its mass m_1 to the nearest 1 g.

5.2.5.2 Packed material

Weigh the empty measuring cylinder and note its mass m_0 to the nearest 1 g. With the measuring cylinder positioned vertically, pour the minimum volume of ISFM according to table 1 into the measuring cylinder. Tap the walls of the measuring cylinder with a glass rod covered with a rubber sleeve until the volume of ISFM remains constant. Measure the volume V_1 . Weigh the measuring cylinder full and note its mass m_1 to the nearest 1 g.

5.2.6 Expression of result

The bulk density (ρ) of the material expressed in kilograms per cubic metre is calculated from the following equation:

$$\rho = \frac{m_1 - m_0}{V_1}$$

where:

- m_0 is the mass of the measuring cylinder, in grams;
- m_1 is the mass of the sample of ISFM and the measuring cylinder, in grams;
- V_1 is the volume of the ISFM in the measuring cylinder, in millilitres.

5.3 Permeability of powders

5.3.1 General

The method is applicable to ISFM with median diameter (d_{50}) between 5 μm and 200 μm .

5.3.2 Principle

Measurement of the time needed for a constant volume of water to flow across a cake of ISFM of precise dimensions under specified conditions of temperature and pressure.

5.3.3 Reagent

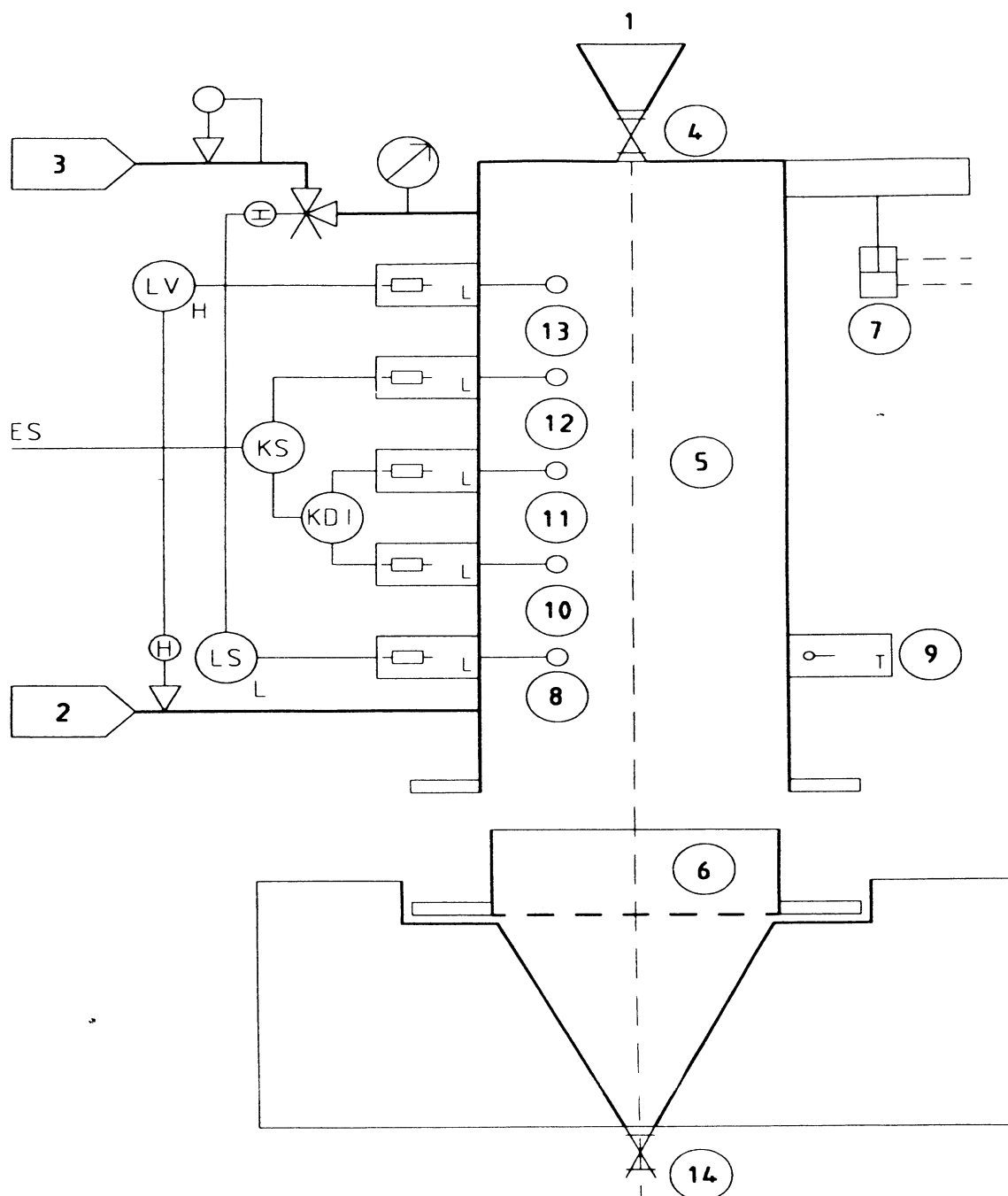
The fluid used for the test shall be water conforming to grade 3 in accordance with EN ISO 3696.

5.3.4 Apparatus

Ordinary laboratory apparatus and glassware together with the following:

5.3.4.1 Permeameter

Figure 1 gives an example of a permeameter.



- (1) funnel
- (2) test fluid
- (3) compressed air
- (4) valve
- (5) measurement chamber
- (6) cylindrical cake carrier
- (7) pneumatic jack
- (8) electric shut down
- (9) thermometer
- (10-13) electrodes
- (14) drain valve

Figure 1 - Example of permeameter

- 5.3.4.2** Beaker 600 ml.
- 5.3.4.3** Flat ruler.
- 5.3.4.4** Fluid reservoir.
- 5.3.4.5** Reducing valve with a manometer 0 kPa to 220 kPa, readable to ± 2 kPa.
- 5.3.4.6** Thermometer 15 °C to 30 °C readable to $\pm 0,1$ °C.
- 5.3.4.7** Compressed air under 500 kPa.
- 5.3.4.8** Analytical balance capable of weighing up to 500 g with an accuracy of $\pm 0,01$ g.
- 5.3.4.9** Desiccator.
- 5.3.4.10** Oven capable of being controlled at (105 ± 2) °C.

5.3.5 Preparation of sample

Dry a sufficient quantity of ISFM at 105 °C in the beaker (5.3.4.2) to constant mass, return to ambient temperature in the desiccator. The mass of test sample required depends on the dimensions of the filter cake holder (see 5.3.6) and is given by the following equation:

$$m = S \times h \times \rho_G \times 1,1$$

where:

- ρ_G is the cake density of the ISFM, in kilograms per cubic metre;
- S is the surface of the cake, in square centimetres ;
- h is the height of the cake, in centimetres ;
- 1,1 is a factor to ensure a sufficiently large test sample is taken.

5.3.6 Procedure

Select a filter cake holder suitable for the quality of the filter material to be tested on the basis of its assumed permeability, according to table 2:

Table 2 - Characteristics for the selection of the filter cake

Presumed permeability Darcy	Height of cake holder cm	Percolated volume ml	Driving pressure kPa
0,01 to 0,4	2,2	30	200
0,4 to 0,9	3,6	30	200
0,9 to 15	3,6	140	50
15 to 20	5,0	140	50

Select the appropriate programme, depending on the tested material and in accordance with the manufacturer's recommendations. Weigh the quantity of ISFM defined in 5.3.5. Add the sample to be tested to (200 ± 10) ml of water and thoroughly mix the suspension.

Pour the suspension into the funnel of the measurement chamber, stirring all the time to avoid any settlement. Initiate the formation of the cake and, by hand, level the filter cake using the ruler.

NOTE The accuracy of the method depends on the care taken when levelling the cake.

Initiate the measurement of permeability and record the pressure (kPa), temperature (°C) and filtration time (s).

5.3.7 Expression of result

The permeability B_0 (in Darcy) is calculated from the following equation:

$$B_0 = \Delta V / \Delta t \times 1/S \times \mu/P \times 1/h$$

where:

- ΔV is the volume of filtrate flowed during the time Δt (in seconds), in millilitres;
- μ is the dynamic viscosity at the temperature of test, in millipascal seconds (mPa·s);
- S is the filtering surface of the cake, in square centimetres;
- h is the cake thickness, in centimetres;
- P is the pressure, in pascals.

The table 3 gives the dynamic viscosity (μ) of water as a function of the temperature of the test.

Table 3 - Dynamic viscosity (μ) of water as a function of the temperature of the test

Temperature °C	Dynamic viscosity mPa·s
0	1,787
5	1,519
10	1,307
15	1,139
20	1,002
25	0,890
30	0,798
35	0,719
40	0,653
50	0,547

5.4 Cake density

5.4.1 General

The cake density is the ratio between the mass of ISFM which is filtered on a filter and the volume occupied by the cake. The method is applicable to ISFM with median diameter (d_{50}) between 5 μm and 200 μm .

5.4.2 Reagent

The fluid used for the test shall be water conforming to grade 3 in accordance with EN ISO 3696.

5.4.3 Apparatus

Ordinary laboratory apparatus and glassware together with the following:

5.4.3.1 Filtering cell as shown in figures 2 and 3.

The filtering cell comprises:

- - cylinder (A) with internal diameter of (40 ± 5) mm and a height of (170 ± 20) mm;
- - clamp (B);
- - base (C);
- - supporting plate (D);
- - stainless steel screen (E) with square mesh, opening (30 ± 10) μm .

Figure 2 shows separated drawings of pieces (A) to (D) and figure 3 shows the assembled apparatus without fixings and accessories.

5.4.3.2 Vacuum generator capable of supplying a constant vacuum of 65 kPa.

5.4.3.3 Balance capable of weighing up to 500 g with an accuracy of $\pm 0,01$ g.

5.4.3.4 Desiccator.

5.4.3.5 Oven capable of being controlled at (105 ± 2) °C.

5.4.3.6 Ruler 250 mm long, graduated in 0,5 mm.

5.4.3.7 Beaker, 600 ml.

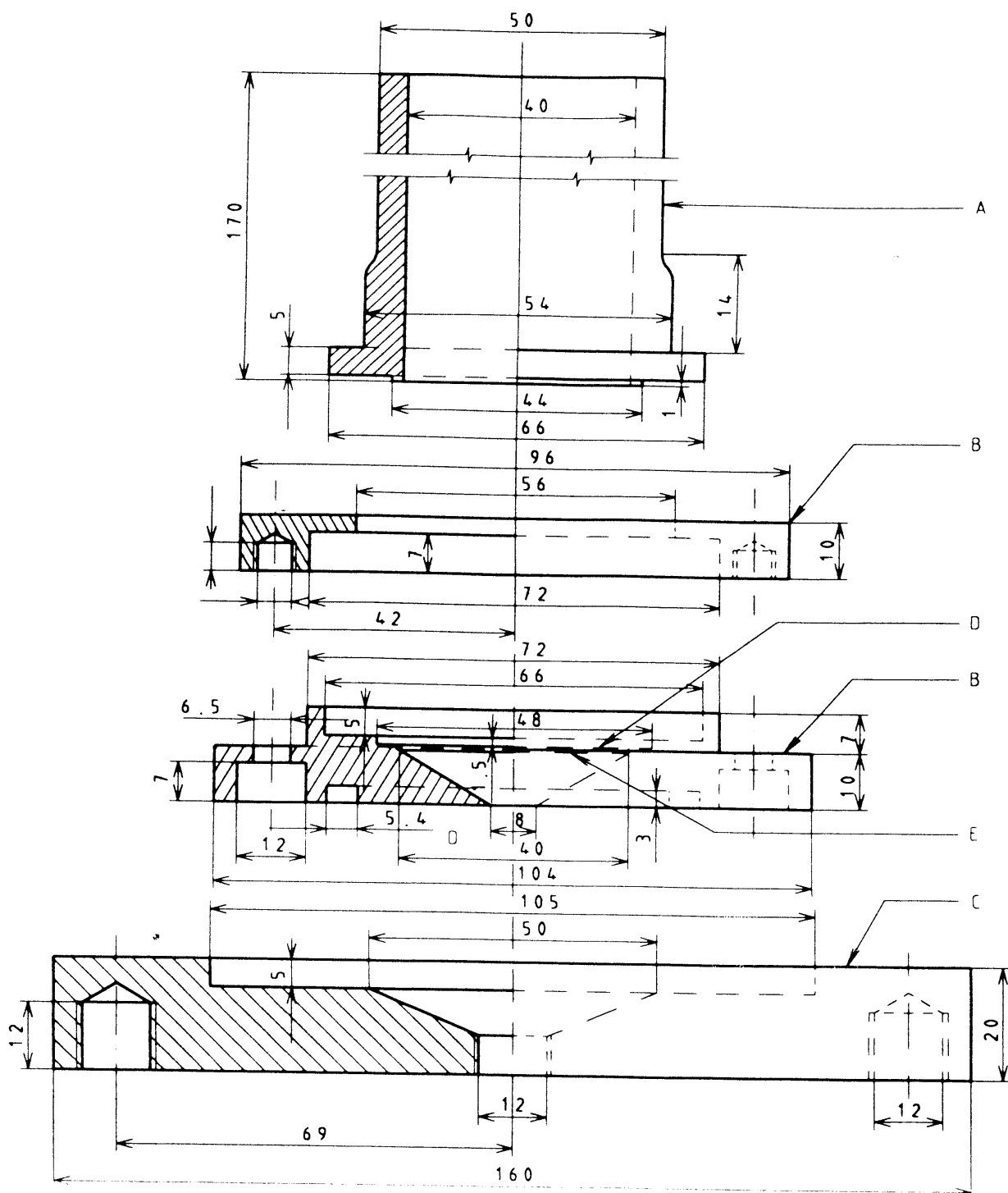


Figure 2 - Example of filtering cell