BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY
(*Not to be reproduced without the permission of BIS or used as an Indian Standard*)

भारतीय मानक *मसौदा*

सिंचाई उपस्कर – चन्ना प्रकार फिल्टर – विशिष्ट

(आईएस 12785 *का दूसरा पुनरीक्षण*)

Draft ***Indian Standard***

IRRIGATION EQUIPMENT — STRAINER-TYPE FILTERS — SPECIFICATION

(*Second Revision of* IS 12785*)*

ICS 65.060.35

Farm Irrigation and Drainage Systems Sectional Committee, FAD 17

Last date for Comments: **6 February 2025**

FOREWORD

(*Formal clause will be added later*)

In drip irrigation system, the drippers/emitters have a small narrow orifice due to which there is always a hazard of blocking or clogging of drippers by suspended impurities present in the irrigation water. To ensure the efficient and uninterrupted operation of these components, use of filters is important. These filters play a crucial role in preventing blockages and maintaining the drip irrigation system's performance.

The standard covering the requirements of strainer-type and disc filters intended for operation with drip irrigation systems was first published in 1989 under the title 'Irrigation equipment — Strainer-type filters — Specification'. The standard was amended in 1992 based on comments received from manufacturers and testing authorities. Subsequently, the standard was revised in 1994 making modifications in terminology, sampling and acceptance criteria and test methods in line with ISO/DIS 9912-2 : 1992 'Agricultural irrigation equipment — Filters Part 2: Strainer-type filters'.

The second revision of the standard has been brought out to incorporate following modifications:

1) Amendments issued to the first version of the standard have been incorporated.
2) A new clause classifying different types of strainer-type filters has been added.
3) Requirements of plastic flanged connections have been added.
4) Cyclic pressure test has been added to test the durability of the filter.
5) Necessary editorial changes have been made including updating of referred Indian Standards and schematic diagrams given in the standard.

In revision of the standard, considerable assistance has been derived from ISO 9912-2 : 2013 'Agricultural irrigation equipment — Filters for micro irrigation Part 2: Strainer-type filters and disc filters'. In the Indian Standard, following modifications have been made with respect to the ISO standard:

1) Strainer-type filters are classified into two types – screen filters and disc filters.
2) The sampling and acceptance criteria for the filters have been provided.
3) Test for resistance of filters to internal hydrostatic pressure at high temperatures has been provided.

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*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft **Indian Standard**

IRRIGATION EQUIPMENT — STRAINER-TYPE FILTERS — SPECIFICATION

(*Second Revision of* IS 12785*)*

1 SCOPE

1.1 This standard specifies the general construction requirements and test methods for strainer type filters (hereinafter called filters) intended for operation in agricultural irrigation systems.

1.1.1 This standard does not cover filtration ability, efficiency and capacity (quality of filtered water, time of operation before filter becomes completely clogged, etc.), nor does it deal with filters that have integral automatic flushing devices.

2 REFERENCES

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

IS No.	***Title***
IS 554 : 1985	Dimension for pipe threads where pressure-tight joints, are required on the threads (*third revision*)
IS 2500 (Part 1) : 2000/ISO 2859-1 : 1999	Sampling procedures for inspection by attributes: Part 1 sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot Lot inspection (*third revision*)
IS 2643 : 1975	Dimensions for pipe threads for fastening purposes (*first revision*)
IS 4736 : 1986	Hot dip zinc coatings on mild steel tubes (*first revision*)
IS 4984 : 2016	Polyethylene Pipes for Water Supply — Specification (*fifth revision*)
IS 4985 : 2021	Unplasticized PVC pipes for water supplies — Specification (*fourth revision*)
IS 6418 : 1971	Cast iron and malleable cast iron flanges for general engineering purposes
IS 15801 : 2008	Polypropylene - Random copolymer pipes for hot and cold-water supplies — Specification
IS 17425 : 2020	Irrigation equipment — Quick coupled polyethylene pipes and fittings for sprinkler irrigation system — Specification

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Strainer-Type Filter

A device containing one or more filtering elements, used for separating suspended solids/impurities from the water passing through the device and collecting them on the filter element.

3.2 Screen Filter Element

The filter component, consisting of a perforated plate, screen, mesh, or a combination of these, intended to retain solid contaminants larger than a given size from the water flowing through the component.

3.3 Disc Filter Element

The component of a filter composed of plastic discs with grooved or textured faces arranged adjacent to the other to form a stack.

3.3 Clogged Filter Element

The filter element which has collected a quantity of solid contaminants/impurities, such that it cannot maintain the prescribed highest flow rate recommended by the manufacturer without exceeding the safe maximum pressure drop.

3.4 Filter Housing

The part of the filter that contains all the filtering components, except for the control equipment.

3.5 Filter Housing Cover

A removable cover permitting assembling, dismantling, and cleaning of the filter elements.

3.6 Drain or Flush Valve

A valve, normally installed at the bottom of the filter, intended for draining or flushing the entrapped contaminants from the filter housing.

3.7 Maximum Operating Pressure

The maximum static water pressure immediately upstream of the filter inlet, at which the filter is intended to operate.

3.8 Critical Pressure Drop Before Failure

The maximum allowable pressure difference across each filtering element of the filter, which will not cause failure of the filter element.

3.9 Safe Maximum Pressure Drop

The maximum allowable difference between inlet and outlet pressures across the filter when the filter element has become clogged/blocked to the extent of requiring cleaning or replacement.

3.10 Clean Pressure Drop

The pressure drops in a clean filter, measured with a flow of clean water under normal condition.

3.11 Range of Recommended Flow Rates

The range of flow rates declared by the manufacturer for proper operation of the filter.

3.12 Nominal Size

A conventional numerical designation, expressed in *mm*, used to indicate the size of the filter. This designation equals the nominal size of the pipe to which the filter can be connected without intermediate fittings.

3.13 Aperture Size

The dimension, expressed in microns, of the aperture in the filter element such as the diameter of a round opening or the side of a square opening.

3.14 Closing Force or Moment

The turning effect of force is known as closing force or moment of force. It is the product of the force multiplied by the perpendicular distance from the line of action of the force to the pivot or point where the object will turn. The S.I unit is Newton Meter (Nm).

4 TYPES

The strainer-type filters are generally of following types:

a) Screen Filter
b) Disc Filter

5 TECHNLCAL REQUIREMENTS

5.1 General

5.1.1 The filter parts that are in contact with the water shall be of non-toxic materials and shall be resistant to or protected against degradation caused by existing working conditions and types of water used in agricultural irrigation. The filter housing shall also be resistant to environmental conditions. Components belonging to filter of same size, type and model, and produced by the same manufacturer, shall be interchangeable.

The filter element shall be either made of stainless steel or plastics or combination of both and should be detachable for cleaning. Housing made of mild steel shall be powder coated or hot dip galvanized. The hot dip galvanizing shall be done in accordance with IS 4736 with a minimum zinc coating of 500 g/m^2 . When measured in accordance with the method given below the thickness of powder coating shall not be less than 70 μm.

5.1.1.1 The powder coating shall be measured at three places preferably on flat portion and avoiding corners with the help of cone gauge having an accuracy not less than one micron. The resulting measurement shall be expressed to the nearest one micron.

5.1.2 Plastics parts of the filter that are exposed to ultraviolet (UV) radiation in normal working conditions in which the filter operates shall include additives to improve their resistance to UV radiation. Plastics parts that enclose waterways shall be opaque or shall be provided with an opaque cover design to block all light from reaching clear waterway enclosures.

5.1.3 The construction of the filter shall be such as to facilitate its proper installation in its intended location and position.

5.1.4 The filter shall be so designed that after assembly of the filter element in the filter housing, all the water flowing through the filter flows through the filter element.

5.2 Filter Housing

5.2.1 In filter where the size offers thread connected filter housing or its configuration does not allow for easy handling of the housing while connecting or disconnecting pipe work, the filter housing shall be provided with a boss or with some other means to facilitate connection or disconnection of the filter housing to and from the pipe network.

5.2.2 The filter shall be so designed that contaminants accumulated on the filter element or in the filter housing, do not enter the supply line when cleaning or replacing the filter element. The construction of the filter element should allow disassembly, cleaning and reassembly of the without removal of the filter from the supply line.

5.2.3 The filter housing cover shall be attached to the filter housing by means of threads or bolts or in any other manner that ensures full and uniform tightness around the cover periphery. Means shall be provided to ensure the tightness of the filter element ends.

5.3 Connections

5.3.1 In filter with threaded ends for direct connection to the supply line, the threads shall comply with IS 2643 or IS 554.

5.3.2 Flanged connections made of mild steel and HDPE/PP/PVC/PA shall comply with dimensions/specifications given in the Table 6 and Table 7 of IS 17425 respectively.

5.3.3 A suitable connection shall be provided on the drain outlet to facilitate connection of drainage means from the filter.

5.3.4 A gate or ball valve made of suitable metal or suitable plastic like PVC/PP with minimum opening of 12 mm shall be provided for flushing out the filter more frequently.

6 SAMPLING AND ACCEPTANCE CRITERIA

6.1 Type Tests

If the filters are produced as a regular product series, the test specimens shall be taken at random by the test laboratory representative from a quantity of at least 20 filters. The number of test specimens required for each test shall be as specified in Table 1.

If the filters are not produced as a regular production series and the number of filters produced is less than 20, no requirement is stipulated as to the sampling procedure.

If the number of defective specimens in the sample does not exceed the acceptance number specified in Table 1, the sample shall be considered as complying with the requirements of this Indian Standard. If the number of defective specimens in the sample is greater than the acceptance number, the sample shall be considered as not complying with the requirement of this Indian Standard.

6.2 Acceptance Test

The tests specified in **7.2** and **7.6** are only performed as part of the type tests at the time of inclusion and then at every one-year frequency.

For acceptance of manufacturing lot of strainer filters, the sampling shall be conducted according to IS 2500 (Part 1) based on the AQL 2.5 and inspection level IV.

For the tests specified in **7.1 (**excluding **7.1.6.2)**, **7.3**, **7.4** and **7.5,** the test specimens shall be selected at random in accordance with the number specified in Table 1. The manufacturing lot is considered to comply with this standard if the number of defective specimen found in the other tests does not exceed the acceptance number specified in Table 1.

Table 1 Required Number of Test Specimens and Acceptance Number
(*Clauses* 5.1 and 5.2)

Clause No.	Name of Test	No. of Test Specimen	Acceptance Number
7.1	Resistance of strainer filter to internal hydrostatic pressure	3	1
7.2	Resistance to internal hydrostatic pressure at high temperature	3	1
7.3	Resistance of strainer filter element to buckling or tearing	2	0
7.4	Tightness of strainer filter element	3	0
7.5	Clean pressure drop	1	0
7.6	Cyclic pressure test	1	0

NOTES
1. For metal filter housings, see **7.1.5**; for plastic filter housings, see **7.1.6.**
2. Clause **7.1** and **7.2** referring only to leakage at joints; if there is leakage through the filter housing or damage to the filter element occurs, then the lot shall be rejected.

7 MECHANICAL TESTS

All tests shall be performed with water at a temperature of 20 °C to 30 °C, except for test **7.2** where the water temperature shall be (60 ± 2) °C. The instruments used for measuring the various parameters shall permit measurement to an accuracy of within 2 percent of the actual values.

7.1 Resistance of Strainer Filter to Internal Hydrostatic Pressure

7.1.1 This test shall be performed on the filter with all its parts assembled for normal operation.

7.1.2 Before conducting the test on filters equipped with a drain valve, open and close the valve 100 times while applying a water pressure equal to the maximum operating pressure multiplied 0.75 at the valve inlet.

7.1.3 Close the cover of the filter housing in accordance with the manufacturers catalogue.

7.1.4 Close the outlet of the filter by suitable means. Apply a hydraulic pressure at the inlet of the filter, and check that no air remains trapped in the system and that the water reaches all places that may be under pressure during the operation of the filter.

7.1.5 *Metal Filter Housing*

Raise the pressure gradually to the declared maximum operating pressure multiplied by 1.5 and maintain this pressure for five minutes.

7.1.5.1 The filter shall withstand the test pressure without suffering damage or deformation.

7.1.5.2 If the gasket of the housing cover swells or is dislodged, apply the pressure for an additional I5 minutes and recheck for leakages.

7.1.5.3 No signs or leakage shall appear through the filter housing, the filter housing cover seal or the drain valve.

7.1.6 *Plastic Filter Housing*

7.1.6.1 Filters with plastic filter housing shall be tested either as per the test method given below or alternatively as per the procedure given in **7.1.6.2**.

7.1.6.1.1 Raise the pressure gradually to the declared maximum operating pressure multiplied by 2 and maintain this pressure for five minutes.

7.1.6.1.2 The filter shall withstand the test pressure without suffering damage or deformation.

7.1.6.1.3 If the gasket of the housing cover swells or is dislodged, apply the pressure for an additional I5 minutes and recheck for leakages.

7.1.6.1.4 No signs or leakage shall appear through the filter housing, the filter housing cover seal or the drain valve.

7.1.6.2 The pressure test shall be performed on an injection-moulded tube specimen made of the same material as the plastic moulded body. The dimensions of the specimen shall be as shown in Fig. 1. The wall thickness of the test sample shall not be less than that fitting a PN6 pipe and not greater than for a PN12.5 pipe for the same diameter as per IS 4984, 4985 and 15801. The specimen shall be tested in accordance with Annex A and shall meet the strength requirements specified in Table 2. The specimen tested shall not suffer fracture or other damage.'

NOTES

1 This test shall be carried out either once in a year or whenever a change is made in the polymer, composition or colour or master batch or new size in order to establish the suitability and the performance capability of the filter.

2 Manufacturer shall declare the raw material used for manufacturing plastic filter housing and material test report should also be available with the manufacturer as a declaration for conformity of the raw material.'

3 This test may be omitted if the filter manufacturer supplies the test laboratory with a satisfactory test report on the strength requirements in accordance with Table 2.

Table 2 Test Conditions and Requirements

(*Clause* 7.1.6.2)

Sl. No.	Material	Temperature °C	Circumferential Stress N/mm^2	Minimum Duration h	Reference Indian Standards

(1)	(2)	(3)	(4)	(5)	(6)
i)	PVC-U	60	10	1 000	IS 4985
ii)	PE 63	80	3.5 (3.2)	165 (1 000)	IS 4984
iii)	PE 80	80	4.5 (4.0)	165 (1 000)	IS 4984
iv)	PE 100	80	5.4 (5.0)	165 (1 000)	IS 4984
v)	PP (Glass Reinforced)	95	3.5	1 000	IS 15801
vi)	POM	60	10	1 000	–
vii)	ABS	70	4	1 000	–
viii	PA6 (GF reinforced)	70	4	1 000	–

7.2 Resistance to Internal Hydrostatic Pressure at High Temperature

This test shall be performed only for strainer filters with nominal sizes of up to and including 150 mm.

7.2.1 Proceed as described in **7.1.1** to **7.1.5** but fill the filter with hot water at (60 ± 2) ºC. and raise the internal pressure to the maximum operating pressure. Maintain the pressure and temperature for 15 minutes. The filter shall withstand the test without showing any signs of leakage.

7.2.2 After completing the test, disassemble the filter and check the parts for damage. The parts of the filter shall show no signs of damage or deformation.

7.3 Resistance of Filter Element to Buckling or Tearing

This test is only performed on strainer filters with nominal sizes of up to and including 150 mm.

7.3.1 Use a thin film of impermeable plastics, for example polyethylene or PVC to seal the filter elements against the passage of water through it.

7.3.1.1 In filter where the unfiltered water passes normally from the outside to the inside of the filter element, wrap the film around the outside of the filter element. In filter where the unfiltered water flows normally from the inside to the outside of the filter element, line its inside with the plastics film.

7.3.1.2 The filter element may be sealed in any other manner, provided that the sealing does not increase or decrease the resistance of the filter element to buckling or tearing. Assemble the sealed filter element in the filter housing and close the filter housing cover as described in **7.1**.

7.3.1.3 Keeping the outlet, open, apply a hydraulic pressure at the inlet of the filter and raise the pressure gradually to the maximum operating pressure. Maintain this pressure for 5 minutes.

7.3.1.4 The leakage allowed at the filter outlet shall not exceed 1 percent of the maximum recommended flow rate. This leakage shall remain steady or shall lessen during the test.

7.3.2 Open the cover of the filter housing in accordance with the manufacturer's instructions.

7.3.2.1 The force or moment required to open 'the cover shall not exceed the closing force or moment multiplied by 1.5.

NOTE — Closing force or moment is required mostly only for metal filter where lid is locked using T handle and not applicable to plastic filters.

7.3.3 Examine the filter element visually.

7.3.3.1 The filter element shall show no signs of permanent deformation, cracks or tears.

NOTE — In filter containing several filter elements in series, the test shall be performed on each filter element separately.

7.3.4 Test those filter which, according to the manufacturer's declaration, can be cleaned during operation by means of "full-flow reverse flushing" again as described in **7.3.1** to **7.3.3**, but with the following modifications:

a) In filter where the normal water flow is from the outside to the inside of the filter element, line the inside of the filter element with plastics film.
b) In filter where the normal water flow is from the inside to the outside of the filter element, wrap the plastics film around the outside of the filter element.
c) Keeping the inlet open, apply the hydraulic test pressure at the outlet of the filter, and raise it to the maximum operating pressure multiplied by 0.5.

7.4 Tightness of Filter Element

This test is only performed on strainer filters with nominal sizes of up to and including 150 mm.

7.4.1 Instead of the regular filter element, install in the filter a solid impermeable clement identical in size to the regular filter element. Close the cover of the housing as described in **7.1**. Repeat the test described in **7.3.1**.

7.4.1.1 No signs of leakage shall appear at the outlet of the filter.

NOTES
1. In filter containing several filter elements, the test is performed on each filter element separately.
2. The test specified in this clause is not performed on filter in which no leakage has been observed in the test performed according to **7.3.1**. Also, this test is not performed on strainer filters whose filter elements or whose construction does not enable the filter element to be replaced as required in this clause, or where the water tightness of the filter elements consisting of plastics screen could affect the test results.

7.5 Clean Pressure Drop

7.5.1 Measure the pressure drop of the clean filter in the range of flow rates declared by the manufacturer plus 20 percent beyond each end of the range. Prescreen the water used for the testing pressure loss in clean filter element by passing the water through a filter element with an aperture size of at least 50 percent smaller than the filter elements being tested.

7.5.1.1 The measured pressure drop shall not be more than 10 percent greater than the pressure drop declared by the manufacturer.

7.6 Cyclic Pressure Test

7.6.1 Position the filter in a test bench as shown in Fig. 1. Fill the test system with water and raise its pressure up to 1.00 kg/cm^2.

7.6.2 Apply a cyclic pressure at both the inlet and the outlet of the filter, increasing gradually from 1 kg/cm^2 to the maximum operating pressure (p_{mo}), holding up this pressure, then decreasing gradually to 1 kg/cm^2, as shown in Fig. 2.

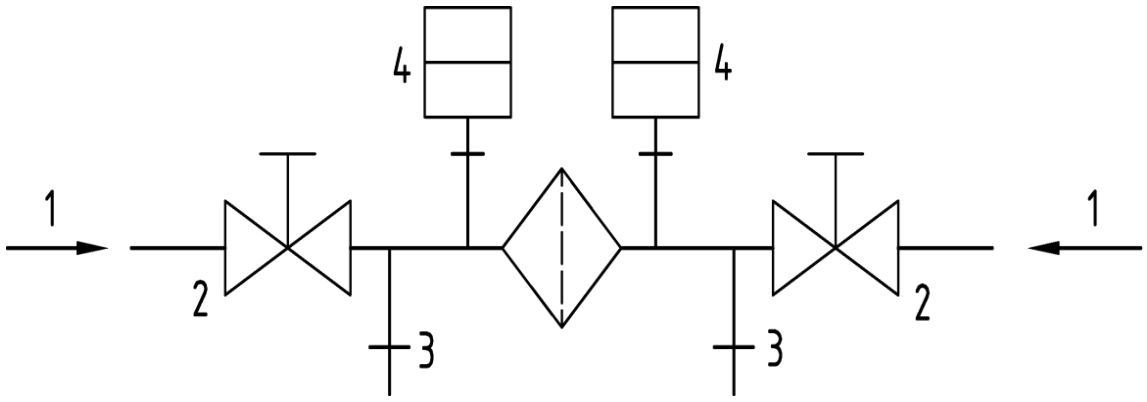
7.6.3 Continue applying the same cyclic pressure pattern for 20 000 cycles.

7.6.4 Then, continue applying a similar cyclic pressure pattern for 2 000 cycles, with pressure cycling between 1 bar and 1.5 × p_{mo}.

7.6.5 Increase the pressure to 1.5 × p_{mo} for filters with a metallic housing, or to 2 × p_{mo} for filters with a plastic (in whole or in part) housing, and maintain it for an additional period of 30 min.

7.6.6 The duration of pressure increase, pressure decrease, and pressure hold periods shall be according to Table 3.

7.6.7 The filter complies with the test requirements if there is no evidence of leakage from the filter shell and no fracture or other failure occurs during the test. Packing leakage shall not be a cause for rejection.



Key
1 Pressurizing device
2 Stop valve/solenoid valve
3 Drain valves
4 Pressure gauge
5 Filter under test

FIG. 1 CYCLIC PRESSURE TEST RIG

Table 3 Duration of Cyclic Pressure Steps
(*Clause* 7.6.6)

S.No.	Filter's volume, l	Duration of pressure increase/decrease, s	Duration of pressure hold, s
(1)	(2)	(3)	(4)
i)	0 to 60	4 ± 1	4 ± 1
ii)	61 to 200	8 ± 2	8 ± 2
iii)	201 to 600	15 ± 3	15 ± 3
iv)	above 600	25 ± 5	25 ± 5

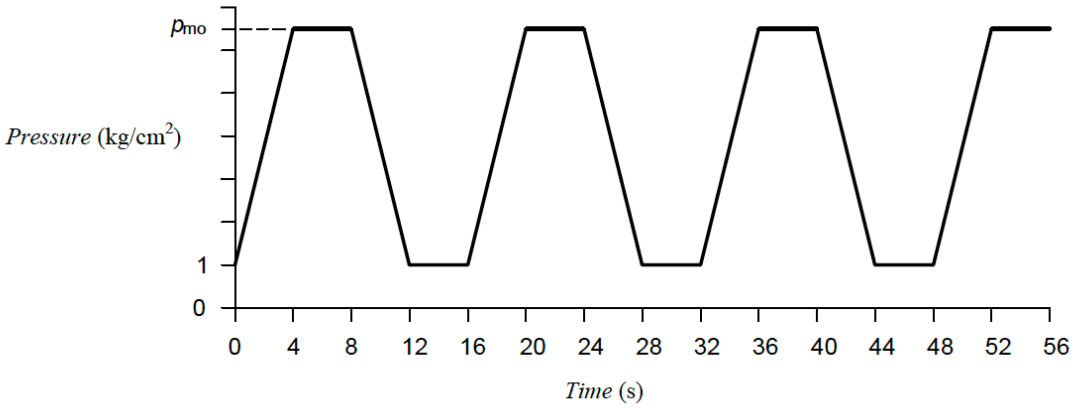


FIG. 2 CYCLIC PRESSURE SEQUENCE

8 MARKING

Each filter shall bear a readily visible, durable marking incorporating the following particulars:

8.1 Filter Housing

a) Name of manufacturer and/or his registered trade-mark

b) Model identification
c) Nominal size
d) Maximum operating pressure (p_{mo})
e) Arrow indicating the direction of water flow; and
f) Size of aperture (if the filter is supplied with the filter element already assembled). The size of the aperture may be marked on a gummed label attached to the filter housing in a prominent location. (OPTIONAL MARKING)
g) Maximum flow capacity at declared clean pressure drop.

8.2 Filter Element

a) Name of manufacturer and/or his registered trade-mark
b) Size of aperture - The size of the aperture may be identified by a marking such as a colour that is defined in the manufacturer's catalogue.

8.3 BIS Certification Marking

Each filter may also be marked with the Standard Mark.

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

9 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

The manufacturer shall supply the following information about the filters:

a) Name and address of manufacturer or supplier;
b) Model and catalogue number of filter;
c) Filter data:
    i. Nominal size,
    ii. Maximum operating pressure,
    iii. Critical pressure drop before failure, for each type of filter element
    iv. Range of recommended flow rates,
    v. Dimensions of Filter,
    vi. Type of connections to piping network,
    vii. Length for assembly, and
    viii. Size of apertures;
d) Closing instructions;
e) Instructions for assembly, operation, cleaning, maintenance, including limitations and prohibitions;
f) List of spare parts;
g) Resistance to chemicals commonly used in irrigation.

h) Curve of clean pressure drop in range of recommended flow rates beyond each end of the range; and
j) Safe maximum pressure drops.

ANNEX A
(*Clause* 7.1.6.2)

RESISTANCE OF FILTER TO INTERNAL HYDROSTATIC PRESSURE: TEST FOR PLASTIC MOULDED MATERIAL FOR FILTER HOUSING

Prepare the test specimen as per **7.1.6.2**

A-1 PRINCIPLE

After conditioning, test pieces are subjected to a specified constant internal hydrostatic pressure for a specified period or until a test piece or pieces fail.

Throughout the test, the test pieces are kept in an environment at a specified constant temperature. The environment is either water ("water-in-water" test), another liquid ("water-in-liquid" test) or air ("water-in-air test).

The following test parameters shall be specified:

a) the type of end cap to be used;
b) the test temperature;
c) for evaluation purposes, the SDR or S-series or size of pipe or fitting to be used;
d) the number of test pieces;

e) the test pressure*, p,* or the circumferential (hoop) stress, a, to be induced by the test pressure;
f) the type of test, i.e. "water-in-water", "water-in-liquid" or "water-in-air";
g) the duration of the test under pressure and the criteria for a failure.
h) the requirements, or patterns of requirements, if any which determine the initiation of additional testing.

A-2 APPARATUS

A-2.1 End Caps — These are fixed to the ends of the test piece. By means of an appropriate system or procedure, end caps shall allow sealing and connection to the pressurizing equipment and shall allow purging of the air before testing.

The end caps shall be one of the following types:

Type A: fittings rigidly connected to the test piece but not to each other, and hence transmitting the hydrostatic end thrust to the test piece, e.g. as shown Fig. 2, or equivalent. They may comprise flanged plates on the ends of a large diameter pipes, optionally fused when flanges, caps, plugs or plates are of a compatible material to the test pieces.

Type B: sockets, made of metal, fitted with joints ensuring sealing onto the external surface of the test piece and connected to one another, and hence not transmitting the hydrostatic end thrust to the test piece. They may comprise one or more metal rods, *see* Figure 2, allowing sufficient longitudinal movement at the ends of the test pieces, to avoid buckling due to thermal expansion. If external rods are used, contact of the outside surface of the test piece with one or several rods shall be avoided during the test. In this case, the test shall be disregarded.

Other than toothed gripe any sharp edges which would come into contact with the outside surface of the pipe shall be rounded off. The constituent material of the end caps might have an adverse effect on the test piece under test and such materials should therefore be avoided as far as possible.

NOTE — It is recognized that times to failure can be different depending upon the type of end caps used.

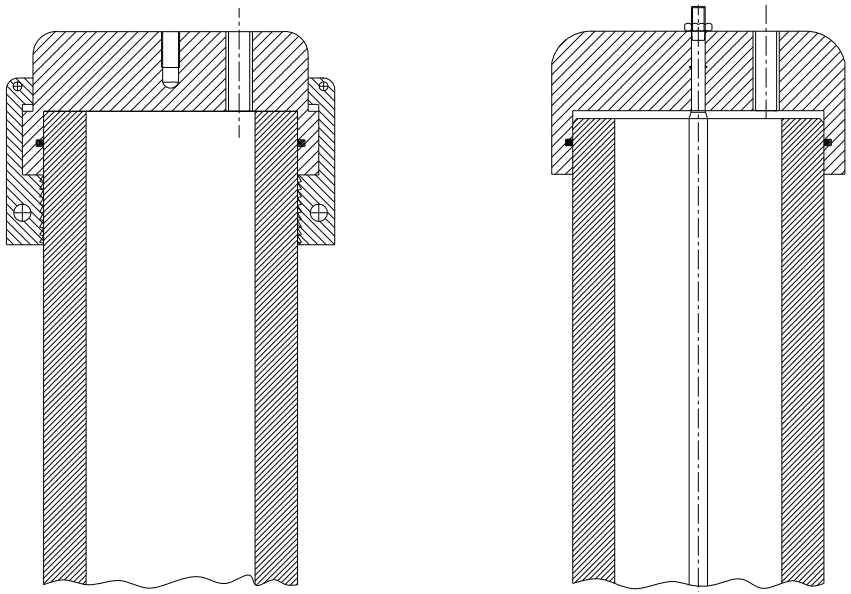


FIG. 3 EXAMPLES OF END CAPS FOR INTERNAL PRESSURE TESTING

A-2.2 Tank, filled with water or other liquid kept at a constant temperature as specified in the referring standard to within ± 1 °C, or oven, the temperature of which shall be kept at the specified value to within + 2 to - 1 °C. When an environment other than water is used, necessary precautions shall be taken, in particular those concerning safety and any interaction between liquid and the material(s) of the test piece. When environments other than water are used, tests which are intended to be comparative shall be carried out in the same environment. As the results are strongly influenced by temperature, the tolerance on temperature should be kept as small within the specified limits e.g. by using forced circulation of the fluid. When testing in all the pipe surface temperature should be checked in addition to the air. Potable water should be used, and it is necessary to avoid contamination of the water by any substance likely to affect the results, e.g. detergents lubricants.

A 2.3 Support or hangers, enabling test pieces to be pieces in the tank or oven such that contact between them of with the sidewalls of the tank/oven is avoided as far as possible so as not to influence the test results.

A 2.4 Pressurizing equipment: capable of applying the required pressure gradually and smoothly and then of keeping this indicated (or measured) pressure to within $^{+2}$-1 % for the duration of the test. As the results are strongly influenced by pressure, the tolerance on pressure should be kept as small as possible within the specified limits. The pressure should preferably be applied individually to each test piece. However, the use of equipment enabling the pressure to be applied simultaneously to several test pieces is also permitted if there, is no danger of interference when failure occurs (e.g. by the use of an isolation valve or a test based on the first failure in a batch).

To maintain the pressure within the specified tolerance, a system should be introduced which automatically controls the pressure within this specified tolerance (e.g. due to expansion of the test piece).

A-2.5 Pressure Measurement Devices — These devices are capable of checking conformity to the specified test pressure. The range of the gauge shall be such that the required pressure setting shall lie within the calibrated range of the device used (*see* **A-4**). The pressure measurement devices shall not contaminate the test fluid. In case of dispute, the reference level of the pressure device shall be equal to the water level in the tank. Master gauges for calibration of the apparatus should be used. It is recommended to use equipment which can stop the timer (**A-2.7**) in event of failure or leakage and closing the pressure circuit to the test piece concerned.

A-2.6 Temperature measuring equipment, capable of checking conformity to the specified test temperature (*see* **A-2.2**).

A-2.7 Timer, capable of recording the duration of the pressure applications up to the moment of failure or leakage, to within 0.5 percent of the expected testing time.

A-3 NUMBER OF TEST PIECES

Prepare a minimum of three test pieces unless otherwise specified in the referring standard or specification.

A-4 CALCULATION OF TEST PRESSURE

A-4.1 General

A-4.1.1 For material testing, the test pressure shall be calculated from a given circumferential hoop stress and based on the measured dimensions of the test piece, *see* **A-4.2**.

A-4.1.2 For pipe testing, the pressure shall be calculated from a given circumferential hoop stress and using one of the following options/given by the referring standard or specification:

a) Based on the measured dimensions of the test piece (*see* **A-4.2**);
b) Based on the nominal dimensions of the test piece (*see* **A-4.3**).

A-4.1.3 For testing of components, the test pressure shall be as given in the referring standard. For testing of assemblies, the test pressure shall be calculated from a given circumferential hoop stress and based on the SDR of the pipe(s) used for the test piece, *see* **A 4.4**, unless a test pressure is specified by the referring standard or specification.

A-4.2 Pressure calculations based on the measured dimensions of the test piece:

Calculate the test pressure, p, in kg/cm^2), to three significant figures, using the following equation:

$$p = 10.2\sigma\left(\frac{2e_{min}}{d_{em} - e_{min}}\right)$$

Where,

σ is the hoop stress to be induced by the applied pressure, in megapascals

d_{em} is the mean outside diameter of the test piece, in millimeters;

e_{min} is the minimum wall thickness of the free length of the test piece, millimeters.

NOTE — The factor 10.2 results from the ratio between megapascals (MPa) and kg/cm^2.

A-4.3 Pressure calculations based on the nominal dimensions of the test piece:

Calculate the test pressure, p, in kg/cm^2), to three significant figures, using the following equation:

$$p = 10.2\sigma\left(\frac{2e_n}{d_n - e_n}\right)$$

Where,

σ is the hoop stress to be induced by the applied pressure, in megapascals

d_n is the mean outside diameter of the test piece, in millimeters;

e_n is the minimum wall thickness of the free length of the test piece, millimeters.

NOTE — The factor 10.2 results from the ratio between megapascals (MPa) and kg/cm^2

A-4.4 Pressure calculations based on SDR of pipe(s) of the test piece:

Calculate the test pressure, p, in kg/cm^2), to three significant figures, using the following equation;

$$p = \frac{2(10.2\sigma)}{[SDR] - 1}$$

Where,

σ is the hoop stress to be induced by the applied pressure, in megapascals;

[SDR] is the standard dimension ratio of the pipe(s) of the test piece.

NOTE — The factor 10.2 results from the ratio between megapascals (MPa) and kg/cm^2.

A-5 CALIBRATION AND ACCURACY OF THE APPARATUS

The temperature and pressure control systems and the equipment for measuring temperature, pressure and time shall be capable of maintaining the values within the specified limits and shall be calibrated. The accuracy of the apparatus shall be considered such that the requirements for temperature, pressure and time are fulfilled.

A-6 CONDITIONING

Prepare the test pieces, removing any traces of dirt, oil, wax or other contamination, and fit them with the end caps (**A-2**) specified for the test. Measure and record the free length (l_o) of the pipes of the test piece, as appropriate. Fill the test pieces with water, which may be preheated to a temperature not more than the test temperature. After filling the test pieces, immerse them in a water bath or place them in an oven at the temperature specified by the referring standard and condition for a period in accordance with Table 4. When conditioning at temperatures in excess of 100 ºC sufficient pressure shall be applied to prevent boiling.

Table 4 Conditioning Periods

S.No.	Thickness (e_{min}), /mm	Minimum conditioning period, h
(1)	(1)	(3)
i)	$e_{min} < 3$	1
ii)	$3 \leq e_{min} < 8$	3
iii)	$8 \leq e_{min} < 16$	6
iv)	$16 \leq e_{min} < 32$	10
v)	$32 \leq e_{min}$	16

NOTE — It is recognized that extended conditioning periods beyond those specified in Table 4 could influence the test results.

The test pieces shall not be tested within the period of time after their manufacture specified in the referring standard. Otherwise, a minimum period of 24 h after production shall be observed.

A-7 TEST PROCEDURE

A-7.1 Select the type of test, i.e. “water-in-water”, “water-in-air”, or “water-in-liquid”, as specified by the referring standard or specification. Measure and record the time taken to pressurize the test piece as follows. Connect the test pieces to the pressurizing equipment (**A-2.4**) and bleed off the air. After conditioning, progressively and smoothly apply the test pressure as calculated in **A-4**, in the shortest time practicable between 30 s and 1 h depending upon the material, the size of the test piece and the capability of the pressurizing equipment.

When the test pressure is achieved, record the time or reset the timer as necessary to begin to measure the period for which the specified pressure is maintained in the test piece(s).

A-7.2 Keep the test piece suspended in the thermally controlled environment. Maintain a constant temperature as mentioned in **Table 2** and observe the temperature tolerances specified in **A-2.2** until testing ceases in accordance with **A-7.3** or **A-7.4** as applicable.

A.7.3 The test is terminated either when the specified duration as mentioned in Table 2 is reached, or when a failure or leak occurs in the test piece, in which case record the time to failure, unless the procedure given in **A-7.4** is applicable.

If a failure occurs, record the type, i.e. brittle, or ductile, or other.

> NOTE — Failure is "brittle" if no visible yield deformation has occurred in the failure zone. If the failure is accompanied by a yield deformation in the failure zone, visible without magnification, it is of the “ductile” type. For some materials, brittle failure could be indicated by weeping at the pipe surface.

In the event of equipment failure, tests which have been ongoing for a period of 500 h to 1 000 h may be continued providing the equipment is reinstated within one day. For tests which have been ongoing for a period of more than 1 000 h, the test may be continued, provided the equipment is reinstated within three days. The time during which the equipment is not able to function normally shall not be included in the test time. Test interruptions shall be recorded in the test report.

A-7.4 If a break occurs in the test piece at a distance of less than l0 mm from an end cap, disregard the result and repeat the test using another test piece.

When testing components, if there is a leakage outside of the component itself (failure of the seal or bursting of the pipe), or any failure associated with grooves machined and indicative of inappropriate groove design and/or machining conditions, repeat the test – if necessary, using other components – such that the assembly remains watertight for the minimum period required for the test.