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Draft ***Indian Standard***

ULTRAFILTRATION MEMBRANE - BASED POINT-OF-USE DRINKING WATER TREATMENT SYSTEM — SPECIFICATION

ICS 130.060.01

Water Purification System	Last Date of Comments
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FOREWORD

(*Formal adoption clause would be added later*)

Access to safe drinking water is a critical concern for public health in India. While significant progress has been made in recent years in providing access to drinking water, ensuring water safety at the point of use remains an ongoing priority.

Point-of-use (PoU) water treatment systems offer an effective solution to this problem, incorporating water treatment technologies to remove various contaminants from tap water at the point of use, in individual homes, schools, or hospitals, ensuring that the water is safe for consumption.

Among the different types of water filtration systems, ultrafiltration (UF) is widely recognized as one of the most efficient and reliable methods for removing particulate contaminants from drinking water, including bacteria, viruses and protozoans. Since filtration requires low pressures, UF-based systems typically have low energy consumption or may be gravity-driven. Additionally, UF systems generate relatively lower volume of waste water, most of which is generated during backwashing and cleaning of components.

This Indian Standard specifies requirements for the materials, design, performance, maintenance and testing of UF membrane-based PoU drinking water treatment systems. The UF-based water filters are prescribed for removal of particulate contaminants, in particular microbiological contaminants from water, and may not be used for treatment of water containing any dissolved contaminant in excess of the acceptable limit as specified in IS 10500. Ultrafiltration may not be suitable as an effective purification technology where the feed water contains dissolved contaminants including inorganic ions, pesticides and other micro-pollutants.

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

ULTRAFILTRATION MEMBRANE - BASED POINT-OF-USE DRINKING WATER TREATMENT SYSTEM — SPECIFICATION

1 SCOPE

1.1 This standard covers ultrafiltration (UF) membrane-based point-of-use (PoU) water treatment systems designed to reduce turbidity and particulate impurities, including microbiological contaminants, in water to make it suitable for human consumption. The standard prescribes minimum requirements for materials, design, construction, and performance of these systems.

1.2 The standard covers plumbed-in and countertop (gravity) systems, designed for use with municipal tap water supply (TDS ≤ 500 mg/L) as feed water, for microbiological water safety at the point of use.

1.3 The standard does not cover requirements for consumables, such as filters and treatment media, or filters with ceramic candles for drinking water filtration. For ceramic water purifier filter candles, *see* IS 7402.

2 REFERENCES

The standards listed 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 standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
IS 302 (Part 1): 2008	Safety of household and similar electrical appliances: Part 1 General requirement (*sixth revision*)
IS 3025	Method of sampling and test (physical and chemical) for water and wastewater
(Part 10) : 2023	Turbidity (*second revision*)
IS 4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
IS 7402 : 2011	Ceramic water purifier filter candles — Specification (*second revision*)
IS 9845 : 1998	Determination of overall migration of constituents of plastics materials and articles intended to come in contact with foodstuffs — Method of analysis (*second revision*)
IS 10500 : 2012	Drinking water — Specification (*second revision*)
IS 15185: 2016 / ISO 9308-1 : 2014	Water quality — Detection and enumeration of *Escherichia coli* and *Coliform* bacteria — Membrane filtration method for water with low bacterial background flora (*first revision*)
IS 16240: 2023	Reverse osmosis based point-of-use water treatment system for drinking purposes — Specification (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply:

3.1 Contaminant — An undesirable physical, chemical, or microbiological substance or parameter in water that may have adverse effects on health or aesthetics, or both.

3.2 Drinking Water — Water from any source which is intended for human consumption, for both drinking and cooking (*see* IS 10500).

3.3 Feed Water — Water entering the system, which is to be treated by the system.

3.4 Influent Challenge Water — The standard test water with specified contaminants entering a system for evaluation.

3.5 Point-of-Use (PoU) Drinking Water Treatment System — A plumbed-in, faucet-mounted, or countertop (gravity) filter system used to treat the feed water for direct consumption or use, hereinafter referred to as 'system'.

NOTE — Water from PoU systems are not intended for distribution.

3.6 Production Rate — The volume of water produced by a system in litres per hour (lph).

3.7 Product Water — Water that has been treated by the system.

3.8 Ultrafiltration (UF) — Ultrafiltration is a membrane filtration process, that uses hydrostatic pressure to force water through a semi-permeable membrane, having a nominal pore size in the range of 0.01 – 0.1 µm. It separates macromolecules, colloids and particulates down to the 0.02-0.05 µm range, including microbiological contaminants such as bacteria, viruses, cysts and protozoans. Commonly used ultrafiltration materials include polymeric membranes, viz. polyvinylidene fluoride, polysulphones and polyethersulphones, cellulose acetate, polyacrylonitrile, polylactic acid etc., and ceramic candles (*see* IS 7402).

4 CONSTRUCTION

4.1 Method of Mounting — The system shall facilitate wall-mounting, under-the-sink installation, or countertop placement.

4.2 Inlet Port — For plumbed-in systems, the system's inlet port shall be so designed that it can be suitably connected to the feed water source.

4.3 Main Components

The PoU system shall have the following components:

a) *Sediment filter* — A filter required to remove physical impurities in the form of suspended solids like dust, dirt, silt and other fine particles from the feed water.
b) *Activated carbon media* — Required for the removal of chlorine and organic matter from water.
c) *UF membrane element*
d) *Cleaning and back-flushing arrangement*

5 MATERIALS

5.1 Materials in contact with water shall comply with the overall migration limits of 60 mg/L, *max* for various plastic materials when tested by the method prescribed in IS 9845.

5.2 Materials of Construction

Those surfaces of the components of the system, which are expected to get wet by the flow of water through the system, shall be made of corrosion-resistant materials or shall have corrosion resistant treatment or coating of food-grade quality. The manufacturer shall provide evidence of the same.

5.3 Membrane preservatives

5.3.1 The chemical preservatives used in the membrane shall be of food-grade quality and shall be declared by the manufacturer in the user guide for consumers.

5.3.2 The manufacturer shall also declare the flushing requirement at the time of installation, in the user guide.

6 PERFORMANCE REQUIREMENTS

6.1 General

6.1.1 The system shall be so designed and constructed that its intended purpose is accomplished when installed and operated in accordance with the manufacturer's instructions and this standard.

6.1.2 The replacement components, including filters, shall be easily removable.

6.2 Hourly Production Rate

6.2.1 The minimum initial product water flow rate for plumbed-in systems shall not be less than 30 litre in an hour. Countertop (gravity) filters with manual filling of feed water in the top chamber shall be exempt from this requirement.

6.2.2 The method of testing hourly production rate is given in Annex A.

6.3 Evaluation of Contaminant Reduction Performance

6.3.1 *Turbidity Reduction*

6.3.1.1 The UF system shall reduce the turbidity level of feed water to less than or equal to 1 NTU as per the acceptable limit specified in IS 10500, when the challenge water has a turbidity of 10±2 NTU, or the maximum operable turbidity level as declared by the manufacturer, whichever is higher.

6.3.1.2 The method for testing Turbidity reduction is given in Annex B.

6.3.2 *Microbiological Reduction*

6.3.2.1 The manufacturer shall meet the requirements of Table 1 to deliver microbiologically safe drinking water. The method of testing bacteriological and virological reduction is given in Annex C.

6.3.2.2 *Optional requirements for microbiological reduction*

The requirements given in Table 2 shall be optional requirements which shall be tested for the system as per Annex D.

Table 1 Microbiological Reduction (Bacteria and Viruses)

(*Clause* 6.3.2.1)

Sl. No.	Contaminant	Influent Challenge Level	Maximum Allowable Product Water Level	Method of Testing
(1)	(2)	(3)	(4)	(5)
i.	*E. coli*	1.0×10^7 cfu/100 mL to 1.0×10^8 cfu/100 mL	99.9999 percent reduction (LRV 6)	IS 15185
ii.	MS-2 *Coliphage* (Virus)	1.0×10^6 pfu/100 mL to 1.0×10^7 pfu/100 mL	99.99 percent reduction (LRV 4)	USEPA method in Manual of Methods for Virology, Chapter 16, June 2001

NOTES

1 Method for testing microbiological reduction (for *E. coli* and MS-2 *Coliphage*) shall be the same as given in Annex C, wherein the preparation of influent challenge water is also prescribed for the test. The testing protocol given in Annex C is to be followed along with methods of test indicated in Column (5) of Table 1 for specific contaminants.

2 LRV- Log reduction value.

Table 2 Microbiological Reduction (Protozoan Cysts)

(*Clause* 6.3.2.2)

Sl. No.	Contaminant	Influent Challenge Level	Maximum Allowable Product Water Level	Method of Testing
(1)	(2)	(3)	(4)	(5)
i.	*Inactivated Cysts (Protozoan) or microspheres*	> 5×10^3 /100 ml	99.9 percent (LRV 3)	Annex D

NOTES

1. Claims for above microbiological reduction shall be made for the specific contaminants shown in this table. To qualify for a specific contaminant reduction claim, the system shall reduce the level of the contaminant from the influent challenge to the specified limits.
2. LRV- Log reduction value.
3. Annex D prescribes two alternative methods for evaluating the reduction of specified protozoans. The method given in D-**1** shall be the reference method in case of dispute, and either of the methods D-**1** or D-**2** shall be the routine method of testing

6.4 Electrical Safety

If the system requires electrical power for operation, it shall be tested for the following requirements to ensure electrical safety:

6.4.1 The system shall not have excessive leakage current when tested in accordance with **13** of IS 302 (Part 1).

6.4.2 The system shall be able to withstand high voltage test when tested in accordance with **13** of IS 302 (Part 1).

6.4.3 The system shall have provision for earthing in accordance with Clause **27.5** of IS 302 (Part 1). All parts of metallic construction shall be permanently and reliably connected to an earthing termination within the UF system and shall be free of rough or sharp edges or other hazards that may cause injury to persons adjusting, servicing, or using the system.

NOTE — Class II appliances and Class III appliances shall have no provision of earthing.

6.5 Power supply

If the system requires electrical power for operation, it shall work on electrical supply up to and including 250 V, 50 Hz for single phase.

6.6 Hydrostatic Pressure Test

6.6.1 For plumbed-in systems, all components of the system through which the water passes shall maintain structural integrity when checked by hydrostatic test at a pressure of 0.3 MPa (45 psi) or 1.5 times the maximum operating pressure specified by the manufacturer, whichever is higher.

6.6.2 Water-tightness of the unit is to be tested by closing the outlet of the UF system. The hydrostatic pressure shall be slowly increased so that the required pressure is reached in 15 min. There shall not be any leakage from any of the joints, filter housing, connectors, etc., when the unit is held at that pressure for 15 min.

6.6.3 Systems not designed for direct connection to a pressurized supply line (gravity filters) shall be exempt from the hydrostatic pressure test but shall be watertight in normal use.

6.7 The manufacturer shall declare:

a) Maximum operable feed water turbidity;
b) Production rate in litres per hour; and
c) Operating pressure range, in MPa. The upper limit shall not be lower than 0.3 MPa (45 psi).

7 ROUTINE PRESSURE TEST (PNEUMATIC TEST)

7.1 Full Device Leakage Testing : Compressed air [at a pressure 0.2 MPa (30 psi)] is fed through the inlet point of the device keeping all the outlets shut. After the pressure reaches the maximum, the airline is isolated by a manual valve and checked for a drop in pressure over 3 minutes. If the pressure is sustained, then this indicates the system is free from any leak.

7.2 Systems not designed for direct connection to a pressurized supply line (gravity filters) shall be exempt from the pneumatic test.

8 SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Take samples (test systems) as per the sampling plan given in Annex E.

8.2 Test as per the sequence given in Annex E.

8.3 All tested systems shall pass in all the requirements. In case of any failure discontinue further testing.

9 MAINTENANCE OF THE PRODUCT

9.1 The manufacturer shall give clear and detailed instructions in the user manual and also on the product itself, for cleaning and back-flushing of the UF membrane, cleaning of the sediment filter, activated carbon filter and the storage tank. The recommended frequency shall also be mentioned in the user manual.

9.2 The manufacturer shall provide with the system, any equipment or accessories required for back flushing and cleaning of the filter components**.**

9.2 For all filtration components like sediment filter, activated carbon filter and UF membrane, the manufacturer shall declare the maximum life in terms of litres of water, which can be processed through each filter. Factors affecting the performance of the filters shall be mentioned. All this information shall be provided in the user manual.

10 PACKING

The PoU system shall be suitably packed in order to avoid damage during transit and storage.

11 MARKING

11.1 The system shall be affixed with a conformance label meeting the following requirements, namely:

a) The label shall be durable and all the markings shall be legible and indelible.

b) The label shall be affixed on a part necessary for normal operation of the product and not normally requiring replacement during the life of the product.

11.2 The label shall be marked with the following details:

a) Name and address of the manufacturer or assembler of product, as the case may be;
b) Model name or code;
c) Production serial number;
d) Date of manufacture of product of the product;
e) Product water flow rate in litre/h;
f) Maximum operable turbidity level;
g) If applicable: Supply voltage, frequency, and wattage.

11.3 A user manual for the proper method of operation and use of the PoU system shall be supplied along with the system. It shall also include the specifications and life/replacement frequency of all the filters/consumables, and factors affecting the life of the filters.

11.4 The manufacturer shall provide a suitable warranty for the PoU system.

12 BIS CERTIFICATION MARKING

12.1 The product may be marked with the BIS Standard Mark.

12.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations made thereunder. 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.

ANNEX A

(*Clause* 6.2.2)

EVALUATION OF HOURLY PRODUCTION RATE

A-1 GENERAL TEST WATER

Municipal tap water supply with the following characteristics shall be used as general test water for determination of hourly production rate, and for preparing influent challenge water for turbidity reduction and microbial reduction testing:

a) *p*H – 6.5 to 8.5
b) Turbidity – 0.1-5 NTU
c) Total dissolved solids (TDS) – <500 mg/L
d) Total organic carbon (TOC) – 0.1 to 5 mg/L
e) Temperature – 25 ±5 °C

The test water shall be free of chlorine or any other disinfectant residual.

A-2 HOURLY PRODUCTION RATE

A-2.1 Two fresh systems shall be used for determining the hourly production rate.

A-2.2 Install and condition the UF systems as per the manufacturer's instructions. Connect the plumbed-in UF system to the general test water feed (*per* **A-1**) at the maximum recommended inlet pressure, and allow the system to operate until the flow of product water has stabilized. (If a storage tank is present, operate with the storage tank's dispensing tap open.) After the stabilization of flow, allow the system to operate for a minimum of 20 continuous minutes and record the volume of product water collected. Hourly production rate is calculated as follows:

A-2.3 Hourly production rate (litre/hour) = (Volume of water collected in litre/ no. of minutes of operation) x 60

ANNEX B

(*Clause* 6.3.1.2)

EVALUATION OF TURBIDITY REDUCTION

B-1 PREPARATION OF TURBIDITY INFLUENT CHALLENGE WATER

B-1.1 To prepare the turbidity influent challenge water, test dust shall be added to the general test water specified in **A-1** to achieve a minimum turbidity of 10±2 NTU, or the maximum operable level declared by the manufacturer, whichever is higher. The test dust shall have a nominal size classification of 0-5 μm and shall have 96% (by volume) of its particles within this range, with 20-40% (by volume) of particles greater than 2.5 μm.

B-2 METHOD OF TESTING

B-2.1 Plumbed-in Systems

B-2.1.1 Two systems previously used for determining hourly production rate shall be used for turbidity reduction testing.

B-2.1.2 For testing two systems at the same time, there shall be one common influent (feed) water tank for the devices.

Install and condition the UF systems as per the manufacturer's instructions. After flushing with general test water (**A-1**), connect the system to the turbidity influent challenge water feed at the maximum recommended inlet pressure and allow at least 1 L of product water to filter and drain away with the product water storage tank tap open. Then close the storage tank tap and allow the tank to fill until automatic cut-off. Collect 500 mL of water samples, in duplicate, from the influent challenge water tank and the product water storage tank, and analyse for turbidity as per IS 3025 (Part 10).

In case of direct flow models (where no storage tank is provided), allow 1 L of product water to flow before collecting samples.

B-2.2 Gravity Filters

Install and condition the new UF systems as per the manufacturer's instructions. Prior to the addition of the influent challenge water, ensure that the entire assembly, i.e., the top and bottom chambers, is empty of water.

Add the influent challenge water to the capacity of the top chamber. Allow the bottom (product) water chamber to fill. Collect 500 mL, in duplicate, of influent and product water samples from the respective chambers and analyse for turbidity as per IS 3025 (Part 10).

ANNEX C

(*Clause* 6.3.2.1 & *Table* 1)

EVALUATION OF MICROBIOLOGICAL REDUCTION - BACTERIAL AND VIRAL REDUCTION TESTING

C-0 The procedures described in this Section and the next should be carried out by suitably qualified personnel, who are well-versed in normal laboratory practice.

C-1 Two fresh systems shall be used for microbiological reduction testing. Bacterial reduction testing shall be done followed by viral reduction testing in the same UF system as per the sampling plan given in Annex E.

C-2 EQUIPMENT AND ACCESSORIES

As listed in **C-3** in IS 16240.

C-3 REAGENTS AND MEDIA

As listed in **C-4** in IS 16240.

C-4 CHALLENGE ORGANISMS

Bacterial Challenge - *Escherichia coli* (ATCC #10536, MTCC 68 or equivalent strain)

Viral Challenge - MS-2 Coliphage (ATCC #15597-Bl), *Escherichia coli* (ATCC #15597) host strain for MS-2 Coliphage

The methods of stock culture preparation and of enumeration shall be the same as described in **C-5** and **C-6** in IS 16240.

C-5 PREPARATION OF MICROBIOLOGICAL INFLUENT CHALLENGE WATER

C-5.1 Bacterial Influent Challenge Water

Prepare challenge water, by adding appropriate quantities of the bacterial stock suspension in the general test water described in **A-1**, for a final bacterial count between 10^7-10^8 /100 ml. The actual cell numbers are verified by the counts of colony forming units (cfu).

C-5.2 Viral Influent Challenge Water

Prepare challenge water, by adding appropriate quantities of the viral stock suspension in the general test water described in **A-1**, for a final viral count between 10^6-10^7 /100 mL, verified by the counts of plaque forming units (pfu) in a colony counter.

C-6 METHOD OF CHALLENGING THE UF TEST SYSTEM

C-6.1 Plumbed-in Systems

For testing two systems at the same time there shall be one common influent (feed) water tank for the devices.

The method of challenging the plumbed-in systems shall be same as described under **B-2.1.2**, using microbiological influent challenge water.

C-6.2 Gravity Filters

The method of challenging the gravity filter shall be same as described under **B-2.2**, using microbiological influent challenge water.

C-7 ANALYSIS OF WATER SAMPLES FOR MICROBIOLOGICAL REDUCTION TESING

C-7.1 Water samples should be stored at 5(±3) °C, and analysis should commence on the same day as sample collection, or within 18 hours.

C-7.2 Enumeration of E. coli in Water Samples

Prepare serial dilutions of influent and product water samples (10^0-10^{-5}) using sterile PBS. Enumeration of *E. coli* shall be done using the method listed in Column (5) of Table 1. The *E. coli* suspension titer shall be calculated by multiplying the number of cfu obtained by inverse of the dilution factor. Results shall be expressed as cfu/100 mL

C-7.3 Enumeration of MS-2 Coliphage Plaques

Prepare serial dilutions of influent and product water samples (10^0-10^{-5}) using sterile PBS. The dilute samples may be analysed for MS-2 coliphages using either the method described in Annex C of IS 16240 or the USEPA method in Manual of Methods for Virology, Chapter 16, June 2001. The coliphage suspension titre shall be calculated by multiplying the number of pfu obtained by inverse of the dilution factor. Results shall be expressed as pfu/100 mL

C-7.4 Challenge Verification

After the appropriate incubation period for *E. coli* and MS-2 Coliphage from the influent challenge water samples, the colonies shall be counted on all of the density determination plates. The mean number of microorganisms per mL for plates with 25 to 250 colonies/plaques shall be calculated. This shall verify that the challenge organism was present in the challenge test water at the optimum concentration before conducting the challenge reduction test.

C-8 DETERMINATION OF LOG_{10} REDUCTION

C-8.1 The bacterial or viral log reduction is calculated as follows-

a) Influent Challenge Level = ____cfu or pfu/100 ml
b) Log_{10} (Influent) = ____
c) Product Water Level (mean)= ____cfu or pfu/100 ml
d) Log_{10} (Product)= ____
e) Log_{10} Reduction= Log_{10} (Influent) – Log_{10} (Product)

C-8.2 The percentage log reduction is calculated as follows:

$$Percentage\ Reduction = \frac{(Input\ load - Output\ load)}{(Input\ load)} \times\ 100$$

C-9 SAFETY PRECAUTIONS AND HAZARDS

a) Steam sterilized samples and equipment shall be handled with protective gloves when being removed from the autoclave.
b) Cryogenic culture vials shall be handled with cryoprotective gloves.
c) All microbiological samples and contaminated test supplies shall be steam-sterilized to 120 °C at 15 psi for a minimum of 20 min prior to being discarded.

ANNEX D

(*Clause* 6.3.2.2 *& Table* 2)

EVALUATION OF MICROBIOLOGICAL REDUCTION - PROTOZOAN CYSTS USING INACTIVATED CYSTS AND MICROSPHERES

D-0 GENERAL

The method given at **D-1** shall be the reference method in case of dispute and either of the methods given at **D-1 or D-2** may be used as the routine method of test.

D-1 EVALUATION OF REDUCTION USING INACTIVATED CYSTS

D-1.1 Requirements

As listed in **D-1.1** IS 16240.

D-1.2 Influent Challenge Water

D-1.2.1 *Preparation*

Prepare influent challenge water, containing 50,000 inactivated oocysts/Litre (5×10^3/ 100 mL). *See* **D-1.2** of IS 16240 for detailed description of the challenge water preparation, with adaptation for the volume required.

D-1.2.2 *Analysis of Challenge Water Samples*

See **D-1.2.1** of IS 16240.

D-1.3 Challenging the UF Test System

D-1.3.1 *Plumbed-in Systems*

For testing two systems, there shall be one common influent (feed) water tank.

Install and condition the new UF systems as per the manufacturer's instructions. After flushing with general test water (**A-1**), connect the system to the influent challenge water feed at the maximum recommended inlet pressure and allow at least 1 L of product water to filter and drain away with the product water storage tank tap open. Then close the storage tank tap and allow the tank to fill until automatic cut-off. Collect three 1 L water samples from the product water outlet, in sample collection bottles containing 1 mL of 1% polysorbate-20.

In case of direct flow models (where no storage tank is provided), allow 1 L of product water to flow before collecting samples from the product water outlet. The samples are to be collected at the start, mid-point and end of the filtration cycle.

D-1.3.2 *Gravity Filters*

Install and condition the new UF system as per the manufacturer's instructions. Prior to the addition of the influent challenge water, ensure that the entire assembly, i.e., the top and bottom chambers, is empty of water.

Add the influent challenge water to the capacity of the top chamber. Allow the bottom (product) water chamber to fill. Collect 1 L water samples, in triplicate, from the product water storage tank in sample collection bottles containing 1 mL of 1% polysorbate-20.

D-1.4 Product Water Sample Analysis

See **D-1.2.3** of IS 16240.

D-1.5 Calculation

D-1.5.1 *Oocysts per Litre of Samples*

Record the oocysts on the slides of challenge and product water samples and calculate their numbers per liter of samples as follows:

a) Oocysts/L of challenge water sample = No. of oocysts in 10 mL of sample × 100

b) Oocysts/L of product water sample = No. of oocysts in 200 mL (average of 3 counts) of sample × 5

D-1.5.2 *Expression as Log_{10} Reduction Value (LRV)*

$$\text{Oocytes } \log 10 \text{ reduction value (LVR)} = \log 10 \text{ (Oocytes/litre of challenge water sample)} - \log 10 \text{ (Oocytes/litre of product water sample)}$$

The UF system should demonstrate a minimum of 3 Log_{10} reduction which corresponds to 99.9 percent reduction.

D-2 EVALUATION OF REDUCTION USING MICROSPHERES

Since ultrafiltration is a physical filtration process, microspheres are an acceptable surrogate to demonstrate the ability to remove *Cryptosporidium/Giardia* cysts. The polystyrene microspheres shall have 95% of particles in the range of 3.00 ± 0.15 μm with a surface charge of less than 2 μEq/g.

D-2.1 Requirements

As listed in **D-2.2** of IS 16240.

D-2.2 Influent Challenge Water

D-2.2.1 *Preparation*

Prepare influent challenge water, containing 50,000 microspheres/Litre (5×10^3/ 100 mL). *See* **D 2.2.1** of IS 16240 for the detailed description of the challenge water preparation, with adaptation for the volume required.

D-2.2.2 *Analysis of Challenge Water Samples*

See **D-2.2.2** of IS 16240.

D-2.3 Challenging the UF Test System

The method of challenging the UF test system shall be the same as described under **D-1.3**.

D-2.4 Product Water Sample Analysis

See **D-2.2.4** of IS 16240.

D-2.5 Calculation

D-2.5.1 *Microspheres per Litre of Samples*

Record the microspheres on the slides of challenge and product water samples and calculate their numbers per liter of samples as follows:

c) Microspheres/L of challenge water sample = No. of microspheres in 10 mL of sample × 100

d) Microspheres/L of product water sample = No. of microsphere in 200 mL (average of 3 counts) of sample × 5

D-2.5.2 *Expression as Log_{10} Reduction Value (LRV)*

$$\text{Microsphere } \log 10 \text{ reduction value (LVR)} = \log 10 \text{ (Microsphere / (litre of challenge water sample)} - \log 10 \text{ (Microsphere / (litre of product water sample)}$$

The UF system should demonstrate a minimum of 3 Log_{10} reduction which corresponds to 99.9 percent reduction.

ANNEX E

(*Clause* 8 & C-1)

SAMPLING PLAN FOR POU UF SYSTEM

E-1 Randomly select 4 sample units of UF-based Point-of-Use (PoU) water treatment system from the same batch. All UF systems of the same capacity produced under similar condition of manufacturing in a week shall constitute a batch. To ensure the randomness of selection, methods given in IS 4905 may be followed.

E-2 Use two units for hourly production rate evaluation and turbidity reduction testing, and two for microbiological reduction testing.

E-3 Conduct the testing for hourly production rate and turbidity reduction, and microbiological contaminants reduction, as per methods described in Annexes **A-D**.

E-4 Collect influent and product water samples for analysis as per the sequence and frequency below:

Sl. No.	**Parameters**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**No. of units tested**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
i)	a) Hourly production rate	✓	✓	✓	✓	✓	2 (new)
ii)	b) Turbidity reduction	✓	✓	✓	✓	✓	2
iii)	c) Microbiological parameters						
	i) *E. coli*	✓	✓	✓	✓	✓	2 (new)
	ii) MS2 coliphage	✓	✓	✓	✓	✓	
	iii) *Protozoan Cysts*	✓	✓	✓	✓	✓	

E-5 Allow at least 10 litre of product water after every sequence to wash out the previous set of contaminants.