भारतीय मानक

Indian Standard

IS 18666 : 2024

घूर्णी रूप से ढाला गया पॉलीथीन सेप्टिक टैंक — विशिष्टि

Rotationally Moulded Polyethylene Septic Tanks — Specification

ICS 13.060.30

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Public Health Engineering Sectional Committee, CED 24

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Public Health Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

Considering the strong dependence of the Indian population on On-site sanitation (OSS) systems in both urban and rural areas and the increasing adoption of rotationally moulded polyethylene septic tanks, the Committee deemed it imperative to bring out this Indian Standard to safeguard the quality and performance of such products.

This standard, by providing a comprehensive framework for assuring the product quality and performance, endeavours to enable consistently safe decentralized primary treatment of wastewater in the country towards the protection of public health and prevention of environmental pollution.

The composition of the Committee responsible for formulation of the standard is given in Annex K.

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.

Indian Standard

ROTATIONALLY MOULDED POLYETHYLENE SEPTIC TANKS — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements of design, materials, size, performance, and inspection and testing of rotationally moulded polyethylene (PE) septic tanks for underground installation. These tanks are suitable for installation at standard temperature and pressure conditions.

1.2 The standard does not cover mechanisms for the disposal of septic tank effluent which requires further remediation before discharge into the environment in accordance with IS 2470 (Part 2).

2 REFERENCES

The standards listed in Annex A 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 edition of these standards.

3 TERMINOLOGY

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

3.1 Biological Filter — It consists of a bed of gravel, broken stone, clinkers or such other material through which sewage flows. The organic matter present in the sewage gets partly removed and stabilized by the biological slime on the surface of the media.

3.2 Black Water — Waste water and excreta from water closets, excluding water from baths, showers, hand basins, kitchen and sinks.

3.3 Bulk Density — It is the measure of the bulk of the plastic powder and is defined as the mass per volume of the raw plastic powder including voids inherent in the material. It also measures how well the polymer particles pack together. Further, bulk density also affects the densification rate of molten polymer.

3.4 Density — The measure of weight for a given volume of moulded material. It not only serves as an important identity of the material but also is used to assess physical changes within samples and as an indicator of uniformity among samples.

3.5 Dispersion Trench — A trench in which open jointed pipes are laid and surrounded by coarse aggregate media and overlaid by fine aggregate. The effluent gets dispersed through the open joints and is absorbed in neighbouring soil.

3.6 Dry Flow Time — The measure of how a powder will tumble and flow during the rotational moulding process. It is the most effective method to determine powder quality.

3.7 Environmental Stress Cracking — The property of ethylene plastics to exhibit mechanical failure by cracking in the presence of environments such as soaps, wetting agents, oils or detergents when subjected to stress. It is one of the most common causes of unexpected brittle failure of plastics.

3.8 Extension Shaft — Component which, placed on the top of the septic tank, allows it to be fitted flush with the ground surface or slightly above ground surface, permits installations to be fitted below the frost line, allows accessibility and enables maintenance work to be carried out. Depending on the requirements, it may be vertical extension pieces of the installation housing, or components, which are fitted over maintenance access holes and manholes.

3.9 Filter Media — Materials, such as clinker, broken stone and gravel through which sewage flows and on the surface of which zoological films develop.

3.10 Flexural Modulus — The ratio of stress difference to the corresponding strain difference in a bending test. It is used as an indication of a material's stiffness during bending.

3.11 Grey Water — Domestic wastewater excluding toilet wastewater.

3.12 IGEPAL — It is an alkylphenol ethoxylate that is majorly used as an anionic surfactant. It belongs to the IGEPAL series of surfactants, which have hydrophobic chains. Its properties include low surface tension, low sensitivity, and biocompatibility. It is used in Environmental stress

crack resistance (ESCR) determination testing of polyolefin polymers.

3.13 Invert — The lowest point of the interior of a sewer or drain at any cross-section.

3.14 Melt Flow Index (MFI) — The measure of flowability of polymer resin once melted. The significance of this parameter is that it gives the relative ease with which the melt flows within the mould. It is an indicator (not measure) of viscosity of the material.

3.15 Nominal Capacity (NC) — Numerical designation of the volume of a septic tank, expressed as an integer in cubic metres.

3.16 Oxidative Induction Time (OIT) — The qualitative assessment of stability of material under oxidative environment. It is the time interval between melting and the onset of decomposition of material under isothermal conditions.

3.17 Population Equivalent (PE) — Indicates the wastewater loading produced during 24 h by transient populations in relation to the individual wastewater loading in household produced by one person in the same time.

3.18 Prefabricated Septic Tank — Single/multiple piece factory made unit, including inlet and outlet level openings which leaves the factory completed, controlled and ready for installation.

3.19 Rotational Moulding — A method for producing hollow plastic objects by placing finely divided plastic powder particles in a hollow mould that is rotated about two axes or given rock and roll type of motion, exposing it to heat and then to cold.

3.20 Scum — The greasy and other substances floating on the surface of sewage.

3.21 Seepage Pit (Soak Way, Soak Pit) — A pit through which effluent is allowed to seep or leach into surrounding soil.

3.22 Septic Tank — A watertight tank which imparts primary treatment to incoming wastewater through settling of suspended solids and anaerobic digestion of organic matter. The settled solids in the tank require periodic evacuation for continued treatment performance of the tank. The primary-treated tank effluent also requires further management for safe disposal or recycling.

3.23 Septic Tank Effluent — The partially-treated wastewater discharged from a septic tank.

3.24 Sewage — The liquid waste of a household or community including human excreta.

3.25 Sludge — It is the settled solid matter in semi-solid condition.

3.26 Subsoil Water — Water occurring naturally below the surface of the ground.

3.27 Supernatant Liquor — The layer of liquid overlying the settled solids which have separated from it.

3.28 Suspended Solids — The solids which are suspended in a sewage or effluent.

3.29 Surface Water — The run-off from precipitation and other water that flows over surface of the ground.

3.30 T.W. L — The top water level in the tank.

3.31 Ultraviolet (UV) Resistance — The ability of plastic materials to withstand the degradation caused by exposure to ultraviolet light. A low ultraviolet resistance can cause premature or unintended failure as a result of deterioration.

3.32 Wastewater (Sullage) — The discharge from basins, sink and similar appliances, which does not contain human excreta.

3.33 Yield Strength — It is the point on the stress-strain curve of a material at which an object ceases to be elastic and becomes plastic.

4 DESIGN SPECIFICATIONS

4.1 General

On-site sanitation systems, like septic tank systems, are alternatives to centralized sewerage systems in areas where the latter is unfeasible or unavailable in both urban and rural areas. The septic tank effluent should be given secondary treatment either in a biological filter, up-flow anaerobic filter, on the land or in a sub-surface disposal system.

4.2 Inlet and Outlet

4.2.1 The inlet and outlet of the septic tank shall be designed so as to:

a) introduce the incoming wastewater with the least possible disturbance of the settled sludge or the surface scum; and

b) keep particle entrainment and escape of scum from the tank at a minimum.

This may be achieved through provision of a T or bend-shaped inlet as in 4.2.1.1 or an inlet baffle as described in 4.2.1.2. Similarly, for outlet, this may be achieved through the provision of scum board as described in 4.2.1.3 or a T or bend-shaped outlet as in 4.2.1.1. Typical configurations of inlet and outlet are given in Annex B.

4.2.1.1 The inlet pipe shall be fixed with top limb rising above scum level and the bottom limb extending about 300 mm below the top water level. The final outlet for tanks shall be fixed with the top limb rising above scum level and the bottom limb extending to about one-third of the liquid depth below top water level.

4.2.1.2 The inlet baffle, if provided, shall be placed 150 mm horizontally from the inlet end of the tank, extending 150 mm below the invert of the inlet pipes and 150 mm above the top water level.

4.2.1.3 A scum board shall be placed 150 mm horizontally from the outlet of the tank, extending one-third of the liquid depth below the water level and 150 mm above the top water level.

4.2.1.4 Adequate ventilation of the inlet pipe work shall be provided to prevent the accumulation of fermentation gases.

4.2.1.5 Inlets and outlets shall have a minimum diameter of 110 mm for tanks lesser than 6 000 litres and 150 mm for tanks greater than 6 000 litres in effective volume.

4.2.1.6 The invert of the outlet pipe shall be a minimum of 25 mm below the invert of the inlet pipe to ensure that no surcharge or backflow in the inlet pipe occurs at the maximum flow rate.

4.3 Ventilation

Adequate ventilation of the septic tank shall be provided with an opening of at least 50 mm diameter for the ventilation pipe.

4.4 Effective Volume and Nominal Size

4.4.1 The septic tank shall be designed for a minimum hydraulic retention time of 24 h based on an average daily flow of wastewater (black water or both black water and grey water) for a given number of users and a minimum sludge storage period of 2 years.

4.4.2 The minimum effective volume of the septic tank shall be 1 000 litres. The recommended effective volume of the septic tank for a given number of users is provided in Annex C.

4.4.3 The actual volume of the tank shall be determined as per methods described in Annex C. When the nominal size declared by the manufacturer differs from the actual volume, the nominal size shall be set at the lower size.

4.5 Shape and Dimensions

4.5.1 Cylindrical shape of the septic tank shall be preferred to ensure the durability and longevity of the installed product.

4.5.2 For rectangular or horizontal cylindrical septic tanks, the length of the tank shall be at least twice the width or the diameter.

4.5.3 A minimum free board of 300 mm shall be provided for all septic tanks. For cylindrical and spherical tanks, the free board shall be measured as the distance between the top of the water level and the internal height of the septic tank at its maximum.

4.6 Compartmentation and Flow

4.6.1 All septic tanks greater than 2 000 litres in effective volume shall be divided into two or more chambers by means of fixed and durable partitions.

4.6.2 The partition shall be located so that the capacity of the first chamber is at least twice that of any subsequent chambers and such that their tops are at least 100 mm above the top of the water level for horizontal tanks only.

4.6.3 The partition shall not compromise the integrity of the tank. It shall be able to withstand pump-out during mechanized desludging of the septic tank.

4.6.4 Suitable opening(s) with a minimum width of 100 mm and maximum 150 mm shall be provided for the inter compartmental flow of wastewater. An up-flow transfer regime may be adopted to enhance hydraulic efficiency of the septic tank.

4.7 Water Tightness

The septic tank shall meet at least one of the requirements listed in 4.7.1 or 4.7.2, when tested in accordance with test methods described in Annex D.

4.7.1 *Water Test*

No leakage is observed.

4.7.2 *Pneumatic Pressure Test*

Either one of the conditions listed in 4.7.2.1 and 4.7.2.2 are met.

4.7.2.1 When tested in the conditions given in D-2.2.2.1, the pneumatic pressure chosen for the test does not decrease by more than 0.005 bar during the related test period.

4.7.2.2 Tested in the conditions given in D-2.2.2.2, the pneumatic pressure 0.3 bar is maintained during 180 s within limits of ± 10 percent.

4.8 Hydraulic Efficiency

The septic tank shall be designed to exhibit a minimum hydraulic efficiency of 99 percent as verified using the test methods in Annex E.

4.9 Access for Maintenance

4.9.1 Each compartment of a septic tank shall be provided with an access opening for maintenance and inspection measuring not less than 250 mm × 250 mm or a circular opening of 250 mm diameter. Septic tanks shall be securely covered to prevent unauthorized access and ensure operational safety.

4.9.2 Covers for each of the access openings shall provide for lifting and an airtight seal of the septic tank when shut, if required.

4.10 Extension Shafts

Extension shafts and access covers shall be fit as per requirement. Septic tanks less than 6 000 litres, they shall have a minimum dimension of 250 mm for square sections or a nominal diameter of 250 mm for circular sections. A minimum of 550 mm is required for septic tanks with a volume greater or equal than 6 000 litres.

4.11 Effluent Filter

The outlet of the septic tank may be fitted with an effluent filter to avoid particle entrainment and reduce the quantity of the remnant solid particles in the effluent at the point of discharge.

The effluent filter, where provided, shall be easily accessible and removable for maintenance purposes.

4.12 Tolerances

The septic tank shall conform to the aforementioned specifications of dimensions with an acceptable tolerance of ± 3 percent.

5 STRUCTURAL STRENGTH AND INTEGRITY

5.1 Primary Raw Material

The primary raw material shall conform to the values of the properties listed in Table 1. The manufacturer shall procure and maintain records of the certificate for the resin properties and raw material testing from the raw material supplier.

5.2 Additives

The material for tanks, lids, access cover openings, and the inspection openings should be manufactured by compounding the base resin with antioxidants, UV stabilizers and pigments, as required.

5.2.1 Carbon black or other colour pigments may be used, provided it does not compromise the UV stability requirements.

5.2.1.1 Additives containing carbon black to provide UV stability shall contain 2.5 percent ± 0.5 percent by mass of carbon black when determined in accordance with test methods prescribed in IS 2530 and IS 7328.

5.2.1.2 The average particle size of carbon black shall be less than 0.025 µ when determined in accordance with methods prescribed in IS 4984.

5.2.2 *Dispersion of Additives and Pigments*

5.2.2.1 Compounded powders for rotational moulding should exhibit a uniform colour distribution after the master-batch has been compounded into the polymer. It should also exhibit uniform distribution of all other additives including UV light stabilizers that have been compounded into the master-batch simultaneously with the pigments.

5.2.2.2 A sample for visual inspection of between 0.5 mm to 1 mm in thickness and a minimum of 40 mm diameter shall be rotationally moulded, compression moulded, or melted down from production powder to provide a sample sufficiently large to allow inspection under a light source. Colour shall be even through the specimen, without any evidence of agglomeration, blotching or other visual evidence of uneven dispersion.

5.3 Wall Thickness

The minimum wall thickness of the tank shall be designed considering a factor of safety (FOS) in the range of 3 to 5 for the yield strength (calculated as yield stress/FOS) of the base resin, however, in no case it shall be less than 8 mm.

5.3.1 Loads resulting from vertical and horizontal soil pressures, pore water pressure (water table), surcharge loading, thermal loads, backfilling, and handling and transport loads shall be considered during the designing of the septic tank.

Considering the limitation of rotational moulding process to achieve uniform thickness particularly in the intricate joints or corners of the part, the manufacturer may provide more liberal radii and avoid sharp corners in the product to eliminate the stress concentration.

Table 1 Properties of Primary Raw Material for Testing

(*Clause* 5.1)

Sl No.	Parameter	Unit	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)	(5)
a) Properties for the base resin : Granules				
i)	Melt flow index	g/10 min	3 to 5	IS 2530 and IS 7328
ii)	Density	g/cm^3	≥ 0.935[1]	IS 2530 and IS 7328
iii)	Oxidation-induction time (pellets[2])	min	≥ 20	IS 4984
b) Properties of the powder				
iv)	Environmental stress crack resistance (10 percent IGEPAL)	h	≥ 350	IS 13360 (Part 8/ Sec 9 and Sec 11)
v)	Dry flow time	s	18 to 25	Annex F
vi)	Bulk density	g/cm^3	≥ 0.38	Annex G
vii)	Particle size	microns	Typical particle size should lie within the range as below: 250 microns to 700 microns	IS 2386 (Part 1)

5.3.2 The thickness shall be measured at 10 different locations so as to include wall, floor, and roof of the septic tank. At the time of design approval, the thicknesses shall be measured by adopting an appropriate destructive technique. For routine testing, the wall thicknesses shall be measured using ultrasonic thickness gauge.

5.4 Secondary Materials

Fasteners or any other components used in the septic tank but not fabricated from the primary raw material (*see* **5.1**) shall be manufactured from materials which are durable and resistant to the environment and if inaccessible upon installation, effective for the serviceable life of the tank.

5.5 Fittings

Flanges and fittings integral to the tank shall make a leak proof seal with the tank. Where threads are to be tapped directly into the tank, an area of localized thickening shall be provided. Threaded sockets formed in the tank wall during the moulding process shall be acceptable. Brass fittings shall be dezincification resistant.

5.6 Finish

The finished tank surface shall be free from visual defects such as foreign inclusions, air bubbles, pinholes, crazing and cracking that will impair the serviceability of the vessel. The surfaces shall be smooth, have a homogeneous appearance, and be free of any loose powder particles. The internal surface shall be free from high gloss and discoloration.

5.7 Durability

Septic tanks shall be manufactured from materials with physical characteristics and corrosion resistant properties that make them suitable for use in the wastewater environment. Septic tanks shall be designed to have a serviceable life appropriate to their intended end use.

5.8 Load Bearing

Septic tanks shall be designed such that no structural failure, undue distortion or in surface cracking occurs due to external hydrostatic groundwater pressure and soil loading of 18 kPa per m depth acting on an empty tank. Accordingly, the pressure at which structural failure occurs, when tested as per methods in Annex H, shall exceed the desired cumulative top-load pressure.

5.9 Structural Strength

The final product, that is, rotationally moulded septic tank, shall conform to the requirements as specified in Table 2.

[1] The suggested value of density is the minimal requirement for the material to qualify for the application. However, for better structural integrity and long-term performance under soil loading, a higher density material of 0.938 g/cm3 or above is recommended.

[2] Pellets containing virgin pallets or compounded pelleted of pigment and anti-oxidant master batch.

5.9.1 *UV Resistance*

When tested in accordance with IS 14885, the natural (non-pigmented) compound shall retain 50 percent tensile elongation after 8 000 h of exposure in a xenon-arc weather-ometer.

6 SAMPLING AND TESTING

6.1 The conformity of the products with the requirements of this standard shall be demonstrated by the manufacturer through (a) type tests and (b) acceptance tests in accordance with Table 3. The scale of sampling and criteria for conformity of a lot for routine tests specified in Table 3 shall be as given in Annex J.

6.2 Type Test

Type tests are intended to prove the suitability and performance of septic tank of a new composition, a new technique, a new design, new shape or modified wall thickness. The manufacturer shall mandatorily undertake the type tests for the properties indicated in col (4) of Table 3 before undertaking mass production or whenever, a change is made in the raw material, raw material supplier, method of manufacture, or when a new design, size or shape of the septic tank is introduced. If no change is envisaged, at least one sample of any size shall be put through the prescribed type tests once in a year.

6.3 Factory Production Control

The manufacturer shall establish and document a factory production control system consisting of procedures for the internal control of production to ensure that the final products comply with the requirements of the present standard.

6.3.1 The manufacturer shall verify the specifications of incoming raw materials and components.

6.3.2 The relevant features of the septic tank and production process shall be defined by giving the frequency of the inspection checks and tests, together with the criteria required for the controlling and manufacturing processes in accordance with the requirements of this standard. The factory production control system shall specify the action to be taken when the control values or criteria specified are not met. Measuring equipment shall be verified and the procedure, frequency and criteria documented.

6.3.3 A sampling plan shall be prepared in accordance with Annex J for the routine quality testing of finished products. The results of tests shall be recorded and made available.

6.3.4 The finished shall not be exposed to direct sunlight when in storage. The stock control of finished products, together with procedures for dealing with non-conforming products, shall be documented.

7 INSTALLATION INSTRUCTIONS

The manufacturer shall supply installation instructions with each septic tank written in either one or both of Hindi, English, and applicable regional language(s). These instructions shall contain information on the following parameters:

a) The installation of the septic tank, including the installation of duplicating tanks where larger capacities are required by the user;

b) Pipe connections (Annex B may be referred for more information);

c) Commissioning and start-up procedures;

d) Properties of the backfill material to be used (Φ and ρ of soil);

e) Water table level designed for;

f) Maximum design service temperature;

g) Depth of the septic tank;

h) Top load limitation and maximum depth of cover; and

j) Hydraulic efficiency.

8 OPERATION AND MAINTENANCE INSTRUCTIONS

8.1 The manufacturer shall provide with each septic tank comprehensive operation and maintenance instructions, written in either one or both of Hindi, English and applicable regional language(s).

8.2 These instructions shall specify the recommended tank emptying or desludging frequency in accordance with Annex C.

9 MARKING

9.1 A durable and easily legible label with information listed as given below shall be provided on the outer wall of the septic tank such that it is accessible after installation:

a) Manufacturer’s name and recognized trademark, if any;

b) Model name or number of the septic tank;

c) Lot or batch number and year of manufacture; and

d) Nominal size in litres and population equivalent.

9.2 BIS Certification Marking

The products(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 product may be marked with the Standard Mark.

Table 2 Properties of Rotationally Moulded Septic Tank

(*Clause* 5.9)

Sl No.	Parameter	Unit	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)	(5)
i)	Flexural modulus	MPa	≥ 500	IS 13360 (Part 5/Sec 7)
ii)	Tensile strength at yield	MPa	≥ 18	IS 13360 (Part 5/Sec 1)
iii)	Elongation at break	Percent	≥ 150	IS 13360 (Part 5/Sec 1)
iv)	Dart impact test	Mean failure energy (in Joules)	≥ 80 J; and the sample shall show ductile fracture	IS 12701

Table 3 Schedule of Routine Tests and Type Tests

(*Clauses* 6.1 *and* 6.2)

Sl No.	Requirements	Acceptance Tests	Type Tests
(1)	(2)	(3)	(4)
i)	Inlets, outlets, and connections	Yes	Yes
ii)	Accessibility	Yes	Yes
iii)	Water tightness	Yes	Yes
iv)	Effective volume	Yes	Yes
v)	Hydraulic efficiency	No	Yes
vi)	Wall thickness	Yes	Yes
vii)	Structural strength of final product:		
	a) Environmental stress crack resistance (10 percent IGEPAL)	No	Yes
	b) Flexural modulus	Yes	Yes
	c) Tensile strength at yield	Yes	Yes
	d) Elongation at break	Yes	Yes
	e) UV resistance	No	Yes
	f) Low-temperature falling dart impact test	No	Yes
viii)	Load bearing	No	Yes

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 2386 (Part 1) : 1963	Method of test for aggregates for concrete: Part 1 Practice size and shape
IS 2470	Code of practice for installation of septic tanks:
(Part 1) : 1985	Design criteria and construction (*second revision*)
(Part 2) : 1985	Secondary treatment and disposal of septic tank effluent (*second revision*)
IS 2530 : 1963	Methods of test for polyethylene moulding materials and polyethylene compounds
IS 4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures
IS 4984 : 2016	Polyethylene pipes for water supply — Specification
IS 7328 : 2020	Specification for polyethylene material for moulding and extrusion
IS 12701 : 1996	Specification for rotational moulded polyethylene water storage tanks
IS 13360	Plastics — Methods of testing:
(Part 5)	Mechanical properties,
(Sec 1) : 2021/ ISO 527-1 : 2019	Determination of tensile properties — General requirements (*second revision*)
(Sec 7) : 2022/ ISO 178 : 2019	Determination of flexural properties (*second revision*)
(Part 8)	Permanence/chemical properties,
(Sec 9) : 2022/ ISO 22088-3 : 2006	Determination of resistance to environmental stress cracking (ESC) — Bent strip method (*first revision*)
(Sec 11) : 2018/ ISO 22088-2 : 2006	Determination of environmental stress cracking (ESC) — Constant-tensile load method (*first revision*)
IS 14885 : 2022	Polyethylene pipes for the supply of gaseous fuels — Specification (*first revision*)

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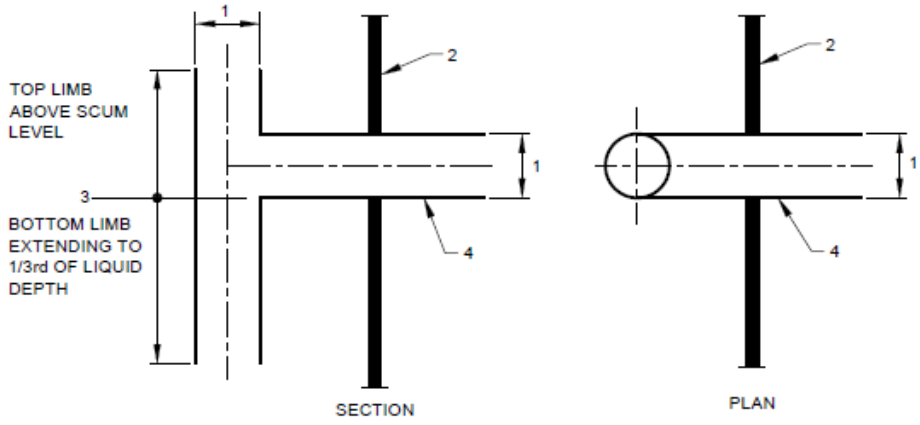
ANNEX B

(*Clauses* 4.2.1 *and* 7)

CONFIGURATIONS OF OUTLET DEVICES

B-1 PIPE TYPE

Typical configurations of pipe types are shown in Fig. 1.



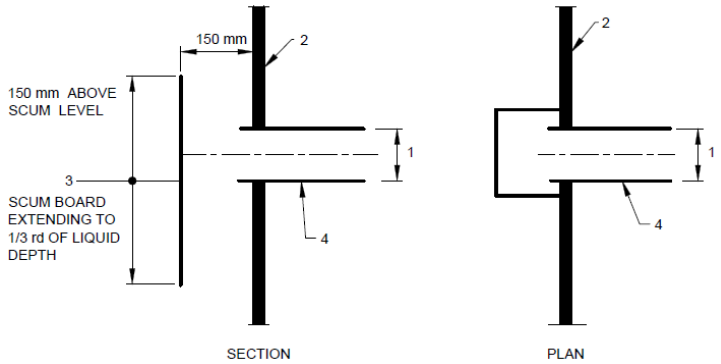
Key

1 Nominal diameter
2 Septic tank's wall
3 Scum level
4 Outlet

FIG. 1 OUTLET TEE CONFIGURATION

B-2 SCUM BOARD TYPE

Typical configurations of scum boards are shown in Fig. 2.



Key

1 Nominal Diameter
2 Septic tank's wall
3 Scum level
4 Outlet

FIG. 2 SCUM BOARD CONFIGURATION

ANNEX C

(*Clauses* 4.4.2, 4.4.3 *and* 8.2)

RECOMMENDED MINIMUM EFFECTIVE VOLUME

C-1 The septic tank, as a primary treatment unit, is designed for settling of solids in the wastewater and the storage, and partial digestion, of the settled sludge over time. Accordingly, the septic tank should have sufficient capacity to provide the desired hydraulic retention time, after accounting for the volume of the tank occupied by sludge and scum, at the end of the designed operative cycle.

C-2 The minimum effective volume for a given number of users based on a two-year operative, or desludging cycle, and the treatment of total quantum of wastewater generated is calculated as follows:

a) Population equivalent = n

b) Digested sludge per user per year in accordance with IS 2470 (Part 1), S = 76.65 litres per capita per day

c) Number of years, T = 2

d) Black water generated, B = 30 litres per capita per day

e) Wastewater generated, W = 108 litres per capita per day

f) Hydraulic retention time = 24 h = 1 day

g) Minimum effective volume for septic tank with both grey water and black water loading = (n × W × 1) + (n × S × 2) = n × (W + 2S)

h) Minimum effective volume for septic tank with only black water loading = (n × B × 1) + (n × S × 2) = n × (B + 2S)

NOTE — Wastewater generated is calculated as per national water supply benchmark set by Central public health and environmental engineering organization (CPHEEO) and in accordance with National building code of India 2016 = 80 percent × 135 litres per capita per day = 108 litres per capita per day.

C-3 Accordingly, Table 4 recommends the minimum effective volume, or the effective volume for a given Population Equivalent. For residential properties, one user equals one population equivalent. Population equivalents for other types of establishment may be calculated as per the relevant benchmark.

Table 4 Minimum Effective Volume by Type of Loading and Number of Users

(*Clause* C-3)

Sl No.	Population Equivalent	Black Water-Only Septic Tank	Total Wastewater Septic Tank
		litres	litres
(1)	(2)	(3)	(4)
i)	5	1 000	1 400
ii)	10	1 900	2 700
iii)	15	2 800	4 000
iv)	20	3 700	5 300
v)	25	4 600	6 600
vi)	30	5 500	7 900
vii)	50	9 200	13 100
viii)	60	11 000	15 700

ANNEX D

(*Clause* 4.7 *and* G-1)

WATERTIGHTNESS AND NOMINAL CAPACITY TESTS

D-1 CAPACITY TEST

The water tightness test and nominal capacity test shall be carried out on a complete septic tank.

D-1.1 Sample

The test shall be carried out on an empty septic tank.

D-1.2 Procedure

D-1.2.1 The septic tank shall be placed on an elevated grid (50 mm minimum mesh width) and secured in place to enable inspection of the base of the septic tank.

D-1.2.2 The septic tank shall be filled to the outlet level with clean water at ambient temperature. The volume of water required to fill the septic tank shall be recorded in litres with an accuracy of 1 percent.

D-1.3 Expression of Results

The value of the measurement shall be expressed in litres.

D-2 WATERTIGHTNESS TEST

D-2.1 Water Test

D-2.1.1 *Sample*

The test is carried out on the septic tank, once the capacity test is completed.

D-2.1.2 *Procedure*

The septic tank shall be filled to the top of the septic tank after sealing the connections. An interval of half an hour shall elapse.

D-2.1.3 *Expression of Results*

At the end of the test period, water level up to the top level shall be measured. These shall be no leakage.

D-2.2 Pneumatic Pressure Test

D-2.2.1 *Sample*

The test is carried out on an empty septic tank.

D-2.2.2 *Procedure*

The test shall be done according to one of the two methods listed in **D-2.2.2.1** and **D-2.2.2.2**.

D-2.2.2.1 The septic tank shall be placed on a level surface and laterally supported. One of the three pressures given in Table 5 shall be chosen for the test. The chosen vacuum pneumatic pressure shall be gradually imposed on the septic tank and held for 3 min to allow the septic tank to absorb the deformation. After this, the variation of the pressure in the septic tank shall be measured during the related test period specified in Table 5.

D-2.2.2.2 The septic tank shall be placed on a level surface and laterally supported. The septic tank shall be subjected to an initial pneumatic pressure of 0.3 bar for at least 3 min.

D-2.2.3 *Expression of Results*

The value of the variation of the pressure shall be expressed in bars.

Table 5 Test Period

(*Clause* D-2.2.2.1)

Sl No.	Test Pressure	Test Period
(1)	(2)	(3)
i)	0.1 bar ± 2 percent	60 s ± 1 s
ii)	0.2 bar ± 2 percent	30 s ± 1 s
iii)	0.3 bar ± 2 percent	15 s ± 1 s

NOTE — 1 bar = 0.1 MPa.

ANNEX E

(*Clause* 4.8)

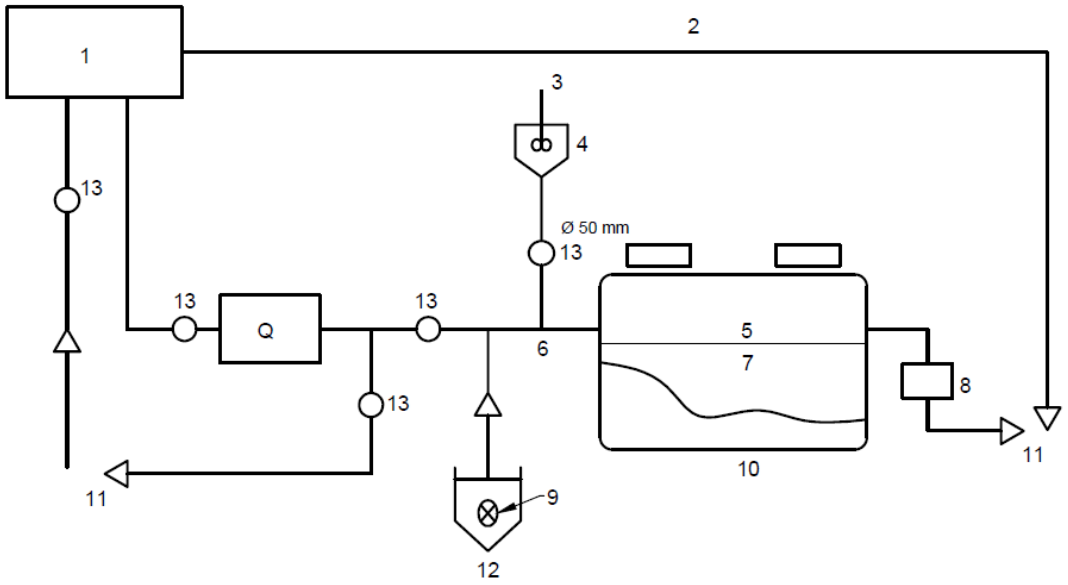
HYDRAULIC EFFICIENCY TEST

E-1 PRINCIPLE

This is used to characterize the hydraulic efficiency of septic tanks. Polystyrene spherical beads shall be used to simulate settling matter. The parameters to be selected for each capacity of septic tanks shall be as specified in Table 6.

E-2 EXPERIMENTAL SETUP

A constant level tank shall be used to supply the septic tank with clean water. A flow meter shall regulate the flow at the inlet of the septic tank. A mixing tank of a minimum size of 10 litres, used for settling sludge tests, shall be installed at 2 m from the inlet of the septic tank (*see* Fig. 3).



Key

1. Water supply
2. Control level
3. Mixing device
4. Mixing tank for suspended particles 10 liters
5. Water
6. Slope = 2 percent
7. Polystyrene beads 50 percent of wet volume + Polysobrate
8. Beads screen
9. Pump
10. Septic tank
11. Sewer
12. Mixing tank for beads + Polysorbate 80 + water (synthetic sludge supply)
13. Flow regulation

FIG. 3 EXPERIMENTAL SETUP FOR HYDRAULIC EFFICIENCY TEST

E-3 SYNTHETIC MATERIALS USED FOR TESTING

One type of particles shall be used for the hydraulic testing procedure. Polystyrene beads (P_A), containing 50 ppm to 2 000 ppm of anti-static agent shall be used. Beads shall not be externally lubricated.

E-3.1 Simulation of Settled Solids

Polystyrene beads (P_A), size 0.3 mm to 0.4 mm or 0.4 mm to 0.5 mm equally distributed by weight, density 1.04 g/cm^3 shall be used.

E-3.2 Simulation of Settled Sludge

Polystyrene beads (P_B), size 2 mm to 5 mm, density 1.04 g/cm^3 shall be used.

E-4 PREPARATION OF TEST

E-4.1 The septic tank shall be installed in the test apparatus in a horizontal way. The inlet pipe shall be similar to the type of pipes used for normal operating conditions. Before testing, the septic tank shall be rinsed with clean water and left full of water. The water temperature shall be 30 °C. The tests shall be carried out on a septic tank full of water with bottom sludge (P_B) of 50 percent of the septic tank volume.

E-4.2 For a septic tank with a wet volume of '*V*' litres, a solution of polystyrene beads (P_B) in the amount of 50 percent of the nominal capacity (about 1 000/3 × NC, in kg) and a complement of water up to the nominal capacity shall be prepared. This solution shall be pumped and injected with a total flow rate (water and beads) between q and 2q (*see* **E-5**) into the septic tank via the inlet pipe. The outlet water shall be filtered during the injection of the solution and the beads collected shall be re-injected into the septic tank.

E-4.3 If polystyrene beads (P_B) are floating on the water surface, polysorbate 80 (detergent) shall be added into the septic tank to reduce the surface tension. If some polystyrene beads (P_B) are still floating, they shall be removed from the septic tank.

E-4.4 After the beads (P_B) have been added, the water flow *q* shall be maintained for a further period of 30 min. A minimum period of 45 min shall be observed before the beginning of the tests.

As an example, for a 3 m^3 septic tank, a solution of 1 000 kg of beads (P_B) (≈ 1.5 m^3), few drops of detergent in order to reduce surface tension of the water, and a complement of water up to 3 m^3 shall be prepared.

E-5 TEST PARAMETERS

The flows in *l*/s for the different sizes of septic tanks shall be calculated by the following empirical formula:

$$q = (22 - NC) \times \frac{\text{NC}}{100} \text{ for NC = 2 to 10}$$

$$q = 1.5 + (NC - 10) \times 0.05 \text{ for NC > 10}$$

where

NC = nominal capacity, that is, volume in m^3; and

q = test flow rate, in l/s.

Table 6 Test Parameter for Preferred Sizes

(*Clause* E-1)

Sl No.	Volume (NC)	P_B Volume	*Q*
	m^3	m^3	l/s
(1)	(2)	(3)	(4)
i)	2	1.0	0.5
ii)	3	1.5	0.7
iii)	4	2.0	0.9
iv)	5	2.5	1.05
v)	6	3.0	1.2
vi)	7	3.5	1.3
vii)	8	4.0	1.4
viii)	9	4.5	1.45
ix)	10	5.0	1.50
x)	11	5.5	1.55
xi)	12	6.0	1.6

E-6 PROCEDURE

E-6.1 A concentrated test suspension consisting of 1 kg of polystyrene beads (P_A), water up to 10 litre and 20 g of polysobrate 80 shall be prepared. The septic tank shall be tested with a permanent water flow for a period of 10 min = (q × 10 × 60 litre of water supplied). As an example, for a 3 m^3 septic tank, 420 litre of water shall be supplied. The test suspension shall be injected into the water flow during the first 30 sec from the start. A steady flow shall be maintained during testing.

E-6.2 The outlet water shall be screened, and beads shall be collected during the test and 15 min after the end of the water supply. The beads shall be dried in an incubator at 60 °C and weighed until they attain a constant mass (accuracy of 0.01 g).

E-6.3 The procedure shall be carried out five times in one day. Between each test, a minimum rest period of 45 min shall be established.

E-7 CALCULATION OF TEST RESULTS

E-7.1 The results shall be expressed by the quantity of beads collected, expressed in grams.

E-7.2 The five test results shall be compared to the requirement and four results out of five shall meet the requirement. Tolerances on measures shall be 0.1 g.

ANNEX F

[*Table* 1, *Sl No.* (v)]

DETERMINATION OF DRY FLOW TIME

F-1 The test for dry flow time measures the amount of time taken by a known quality of powder to flow through a flow funnel with dimensions as shown in Fig. 4. The internal surface of the flow funnel shall have a finish of sulphuric anodized. Since the roughness of the internal surface of the funnel is critical to accurate flow measurements, it shall be ensured that the finish of the internal surface of the funnel is preserved throughout its lifetime.

F-2 The funnel shall be mounted vertically at a height of 38 mm above a measuring cup with its outlet level with the horizontal and centred over the measuring cup. The outlet of the funnel shall be temporarily closed by a flat strip of card or a spatula. To measure the dry flow time, 100 g ± 1 g of the sample powder, at a temperature of 20 °C to 25 °C, shall be poured into the funnel lightly to ensure that any compacting of the powder is avoided.

F-3 Once the funnel is filled with the specified amount of the powder, the flat strip or spatula sealing its outlet shall be removed and a stopwatch started at the same instant. The powder shall be allowed to run freely from the funnel into the measuring cup without the application of any external disturbances or vibrations.

F-4 The timer shall be stopped at the instant the last trace of the powder leaves the funnel. The time in seconds required for the powder to flow through the tunnel, to the nearest 0.1 seconds, shall be reported as the dry flow time.

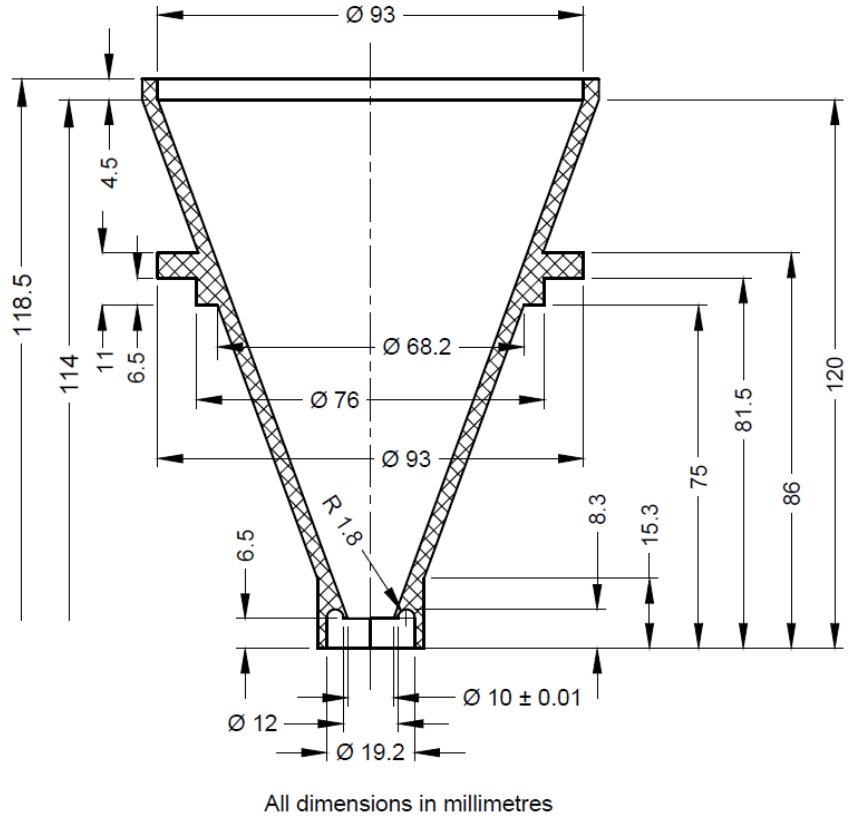


FIG. 4 FUNNEL SPECIFICATION FOR TEST FOR DRY FLOW TIME

ANNEX G

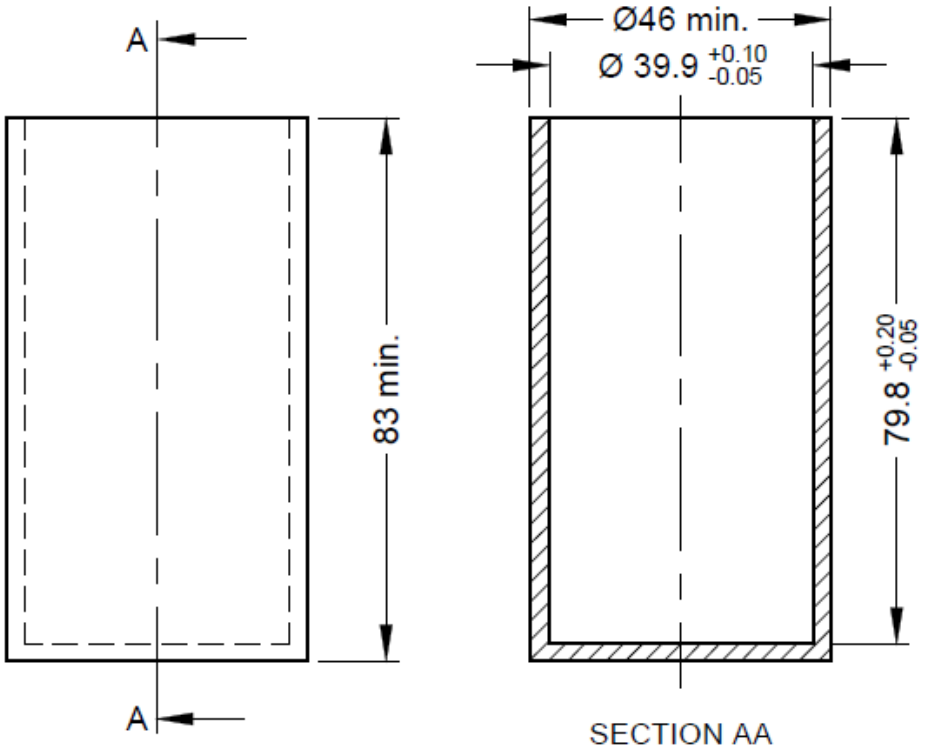
[*Table* 1, Sl No. (vi)]

DETERMINATION OF BULK DENSITY

G-1 Bulk density or apparent density is measured as the weight per unit volume of the material (including any voids inherent in the material). The test for bulk density utilizes an apparatus similar to that specified in the test for dry flow time (*see* Annex D) and therefore, may be performed in conjunction with it.

G-2 To determine the bulk density, the flow funnel shall be suspended above a measuring cup of known internal volume (100 cm^3 ± 0.5 cm^3) and with dimensions as shown in Fig. 5. Sample powder weighing 100 g ± 1 g, at a temperature of 20 °C to 25 °C shall be poured into the funnel and allowed to freely flow out of it into the measuring cup.

G-3 Once all the sample powder has flown out of the funnel, any excess powder at the top of the measuring cup shall be scraped off with a straight edge taking care to avoid disturbing the measuring cup. The weight of the powder in the cup shall be measured to the nearest 0.1 g and the bulk density is determined as measured weight by the internal volume of the cup. The result shall be expressed to the nearest 0.01 g/cm^3.



All dimensions in millimetres.

FIG. 5 MEASURING CUP SPECIFICATIONS FOR BULK DENSITY

ANNEX H

(*Clause* 5.8)

LOAD BEARING TEST

H-1 SELECTION OF TEST METHOD

To determinate the load bearing capacity of a septic tank, one or more method(s) as mentioned below shall be used:

Sl No.	*Test Conditions*	*Method of Test, Ref. to*
(1)	(2)	(3)
i)	Dry conditions	**H-3**
ii)	Wet conditions	**H-2**

H-2 VERTICAL LOAD TEST

H-2.1 General

This test method is applicable for use in wet conditions only.

H-2.2 Sample

The test shall be carried out on an empty septic tank equipped with its cover(s) without any extension and/or possible maintenance shafts. The test apparatus shall be set up schematically as shown in Fig. 6.

H-2.3 Procedure

H-2.3.1 Testing shall be carried out at the temperature of 25 °C ± 5 °C.

H-2.3.2 The septic tank shall be placed in its normal operating conditions on a sand bed of granulometry 0 mm to 5 mm, water content (7 ± 2) percent by mass. This sand bed shall be levelled to a thickness of 6 cm ± 1 cm before the installation of the tank.

H-2.3.3 A vertical stress shall be equally distributed on the upper part of the septic tank by means of a loading plate. This loading plate shall be adjusted to the centre of the upper part of the septic tank and shall be placed on a 1 cm thick plate. If the upper part of the septic tank in contact with the loading plate is not plane (for example, covers or raised points), level differences shall be compensated.

H-2.3.4 The load shall be applied gradually in order to obtain the applicable threshold load (as per the requirement of 18 kPa/min as specified in **5.8**) between 5 min and 15 min. The tolerance on the load shall be ± 3 percent.

H-2.3.5 The load on the tank shall be increased to the collapse. Variation of h_t shall be noted, step by step. The load, F at which the collapse occurs shall be noted and converted by dividing the load by the area of the loaded section.

where

h_t = distance between the bottom of the and the axis of the inlet pipe; and

F = maximum load

H-2.4 Expression of Results

The load per unit area corresponding to the collapse shall be noted and expressed in kPa. This load should have a minimum value corresponding to the applicable threshold load as per the requirement of 18 kPa/m specified in **5.8**.

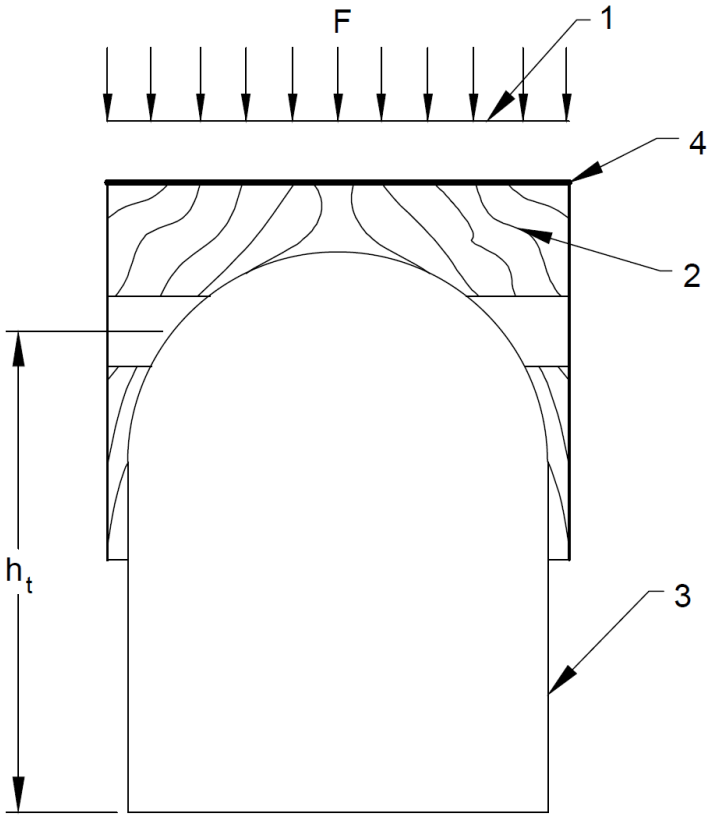
H-3 PIT TEST

H-3.1 Sample and Test Set-up

H-3.1.1 The test shall be carried out on an empty septic tank equipped with pipe connections (inlet, outlet and interconnection pipes), its cover(s) and any extension and/or maintenance shaft(s). The principle of this test is shown schematically in Fig. 7.

H-3.1.2 The septic tank shall be installed in a watertight test excavation. The size of the testing excavation shall be calculated to avoid side effects.

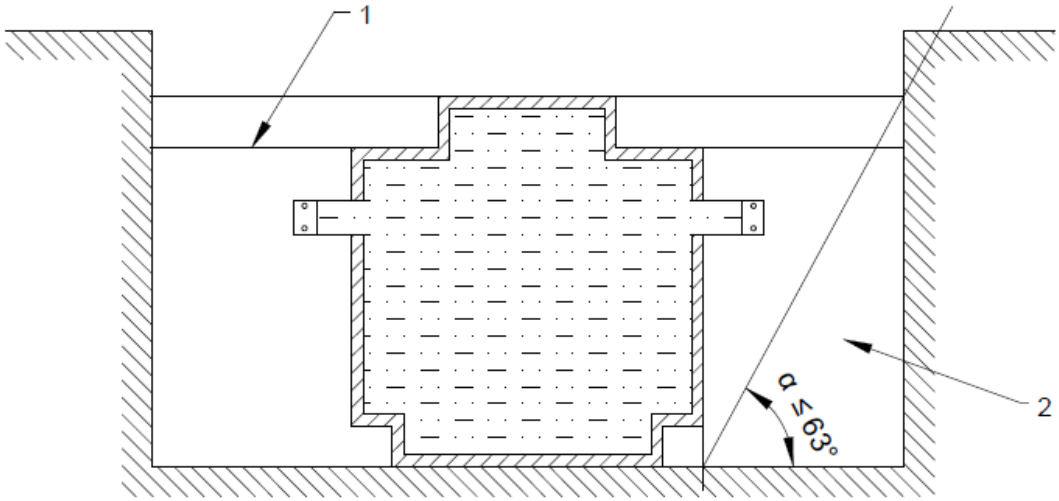
H-3.1.3 The septic tank shall be fixed on the base of the excavation, according to the manufacturer's installation instructions. The excavation shall be backfilled with preferably rounded gravel (3 mm to 8 mm). To simulate wet ground conditions, water shall be added to the top of the septic tank, as shown Fig. 7.



Key

1 Distributed load
2 Polyurethane foam
3 Septic tank
4 Plate

FIG. 6 SCHEME OF THE PRINCIPAL OF THE P_E PLANT TEST



Key

1 Water table level
2 Backfill

FIG. 7 SCHEME OF THE PRINCIPLE FOR PIT TEST

H-3.2 Procedure

H-3.2.1 The initial internal dimensions of the septic tank shall be measured.

H-3.2.2 The septic tank shall then be placed in the test excavation.

H-3.2.3 After sealing the inlet and outlet pipe works backfilling with gravel up to the level of pipe connections with simultaneously filling of the septic tank with water up to the top shall be done. For tanks made of polyethylene, the septic tank shall be discharged and the volume of water in the septic tank shall be measured after one day.

H-3.2.4 The position of the inlet and outlet pipe works shall be checked.

H-3.2.5 The backfilling shall be with gravel up to the maximum depth in accordance with the manufacturer's installation instructions, including consideration for the pedestrian load (2.5 kN/m^2), converted to a uniform backfill load. The inlet and outlet pipe works shall be sealed and, for a wet ground test, water shall be added in the excavation to the level of the top of the septic tank.

H-3.2.6 In wet condition; the inside of the septic tank shall be examined to check that the water tightness is maintained. The water shall be from the excavation. If the septic tank is watertight, water shall be refilled, and any change in the capacity of the septic tank shall be measured. In dry condition, the inside of the septic tank shall be examined. Volume of water required to fill the septic tank shall be added and any change in the capacity of the septic tank shall be measured.

H-3.3 Expression of Results

For septic tanks, no failure shall occur during the test. In addition, no lack of water tightness shall be recorded.

ANNEX J

(*Clauses* 6.1 *and* 6.3.3)

SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY FOR ACCEPTANCE TESTS

J-1 SCALE OF SAMPLING

J-1.1 Lot

In any consignment, all the septic tanks of same size, design and type made from same raw materials and manufactured under similar conditions shall be grouped together to constitute a lot.

J-1.2 For ascertaining the conformity of the tanks to the requirements of the standard, samples shall be tested from each lot separately.

J-1.3 The number of septic tanks to be selected from a lot shall depend on the size of the lot and shall be according to Table 7 for checking inlets, outlets, and connections, accessibility, water tightness, effective volume and wall thickness, and in accordance with Table 8 for checking flexural modulus, tensile strength at yield, elongation at break and load bearing.

J-1.4 The tanks shall be selected at random from the lot. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

J-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

J-2.1 Inlets, Outlets, Connections, Accessibility, Water Tightness, Nominal Capacity and Wall Thickness

Each of the tanks selected for testing in accordance with col (2) and col (3) of Table 7 shall be tested for inlets, outlets, connections, accessibility, water tightness, nominal capacity and wall thickness. A septic tank failing to satisfy one or more of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements if the number of defective septic tanks found in the sample is less than or equal to the corresponding acceptance number given in col (4) of Table 7.

J-2.2 Tests for Flexural Modulus, Tensile Strength at Yield, Elongation at Break and Load Bearing Test

The lot having been found satisfactory according to **J-2.1** shall be further tested for flexural modulus, tensile strength at yield, elongation at break and load bearing test. The number of test samples to be selected from the lot for subjecting to these tests shall be in accordance with Table 8. The lot shall be declared to have satisfied the requirements of these tests, if none of the sample tested fails.

Table 7 Scale of Sampling for Acceptance Tests for Inlets, Outlets, and Connections, Accessibility, Water Tightness, Nominal Capacity and Wall Thickness

(*Clause* J-2.1)

Sl No.	Lot Size	Sample Size	Acceptance Number
(1)	(2)	(3)	(4)
i)	Up to 50	5	0
ii)	51 to 150	20	1
iii)	151 to 280	32	2
iv)	281 to 500	50	3
v)	501 and above	80	5

Table 8 Scale of Sampling for Acceptance Tests for Flexural Modulus, Tensile Strength at Yield, Elongation at Break and Load Bearing Test

(*Clause* J-2.2)

Sl No.	Lot Size	Sample Size
(1)	(2)	(3)
i)	Up to 500	2
ii)	501 and above	3

ANNEX K

(*Foreword*)

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