

IAPMO PS 80-2019

Clarifiers



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IAPMO Standard

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Clarifiers

1 Scope

1.1 General

1.1.1 This Standard covers clarifiers intended for separating liquids and or solids that have different specific gravities than water and specifies requirements for materials, physical characteristics, performance testing, and markings.

1.1.2 It is recommended that a sample box be located at the outlet end of all grease interceptors so that the administrative authority can periodically sample effluent quality.

1.2 Alternative Materials

The requirements of this standard are not intended to prevent the use of alternative materials provided such alternatives meet the intent and requirements of this standard.

1.3 Terminology

In this Standard,

- (a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
- (b) “should” is used to express a recommendation, but not a requirement;
- (c) “may” is used to express an option or something permissible within the scope of the Standard; and
- (d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.4 Units of Measurement

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

1.5 Amendments

Proposals for amendments to this Standard will be processed in accordance with the standards-writing procedures of IAPMO.

2 Reference Publications

This Standard refers to the following publications and, where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C1116/C1116M	Standard Specification for Fiber-Reinforced Concrete
ASTM C1399/C1399M	Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
ASTM C1227	Standard Specification for Precast Concrete Septic Tanks
ASTM D2240	Standard Test Method for Rubber Property-Durometer Hardness
ASTM D3822/D3822M	Standard Test Method for Tensile Properties of Single Textile Fibers
ACI 318	Building Code Requirements for Structural Concrete & Commentary
IAPMO PS 1	Tank Risers
IAPMO/ANSI Z1000	Prefabricated Septic Tanks
UL 58	Steel Underground Tanks for Flammable and Combustible Liquids
UL 1746	External Corrosion Protection Systems for Steel Underground Storage Tanks

3 Definitions and Abbreviations

This section is reserved for later use.

4 General Requirements

4.1 Materials

4.1.1 Concrete

4.1.1.1 Concrete shall have a minimum compressive strength of 28 MPa (4,000 psi) at 28 days of age. Concrete shall have a maximum water/cementing materials ratio of 22.7 L (6 gal)/sack of cement. Concrete shall be made with Type II or V, low/alkali portland cement conforming to ASTM C150, Specification for Portland Cement, and shall also include sulfate expansion option as specified in Table 4, Optional Physical Requirements of ASTM C150 for Type II or V.

Concrete shall contain 4% - 7% entrained air utilizing admixtures conforming to ASTM C260, Specification for Air Entraining Admixtures for Concrete. Concrete aggregates shall conform to ASTM C33, Specification for Concrete Aggregates. Ready mix concrete, if used, shall conform to ASTM C94, Specification for Ready Mix Concrete. Fly ash and raw or calcined natural pozzolan, if used as a mineral admixture in portland cement concrete, shall conform to ASTM C618, Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a mineral Admixture in Portland Cement Concrete.

4.1.1.2 Walls shall have a thickness of at least 76.2 mm (3in), except where engineering analysis and production methods can justify a lesser thickness.

4.1.1.3 The minimum area of steel reinforcement (in both directions) of the structural elements shall be in accordance with ACI 318. Specifications for steel reinforcement and placement location shall also comply with ACI 318. Clarifiers shall be of sufficient strength to resist stresses caused during handling and installation without structural cracking.

4.1.1.4 If repairs are necessary, they shall be carried out in accordance with the established practices of the manufacturer in a manner that insures that the repaired clarifier meets the requirements of this standard.

4.1.2 Fiberglass Reinforced Polyester

Fiberglass reinforced polyester clarifiers shall comply with the requirements for fiberglass reinforced polyester septic tanks in Section 5, Testing Requirements of IAPMO PS 1.

4.1.3 Polyethylene

Polyethylene clarifiers shall comply with the requirements for polyethylene septic tanks in IAPMO Z1000.

4.1.4 Synthetic Structural Fiber Reinforced Clarifiers

4.1.4.1 Tanks produced with synthetic structural fiber reinforcement shall demonstrate compliance with all requirements of its specific standard.

4.1.4.2 Fiber Properties

Synthetic fibers used shall meet the requirements in Section 4.1.3, Type III Synthetic Fiber-Reinforced Concrete of ASTM C1116, Part III.

- 4.1.4.2.1** Manufacturer of synthetic structural fibers shall provide certificate showing fibers meet the requirements in Section 4.1.3, Type III Synthetic Fiber-Reinforced Concrete of ASTM C1116, Part III.
- 4.1.4.2.2** Manufacturer of the fiber reinforced septic tank shall provide DSC (Dynamic Scanning Calorimetry) analysis of the synthetic structural fiber being used in the production of the tanks.
- 4.1.4.2.3** Synthetic fibers shall be monofilament, made of polypropylene or polypropylene/polyethylene blend.
- 4.1.4.2.4** Synthetic structural fibers shall have a minimum length of 38 mm (1.5 in).
- 4.1.4.2.5** Synthetic structural fibers shall have an aspect ratio (length divided by the equivalent diameter of the fiber) between 80 and 100.
- 4.1.4.2.6** Synthetic structural fibers shall have a minimum tensile strength of 0.5 Gpa (72.5 ksi) when tested in accordance with ASTM D3822.
- 4.1.4.2.7** Synthetic structural fibers shall have minimum modulus of elasticity of 8.48 Gpa (1230 ksi) when tested in accordance with ASTM D3822.
- 4.1.4.3** Structural design of clarifiers shall be by calculation or by performance. Design by calculation shall be completed using the Strength Design Method (ultimate strength theory) outlined in ACI 318. Design by performance requires the manufacturer to demonstrate that failure will not occur by physically applying loads to the product. The load applied shall be 1.5 times the anticipated actual loads.
- 4.1.4.4** When synthetic structural fibers are used to replace some or all steel reinforcement in clarifiers, equivalent performance shall be shown based on engineering calculations. The ultimate flexural strength of the fiber reinforced wall shall match that of the steel reinforced concrete wall. The ultimate flexural capacity, M_u in N·m (lb·in), of the steel reinforced concrete wall is given by:

$$M_u = A_s f_y (0.4h)$$

Where:

A_s = area of steel mm²/linear m (in² / linear ft)

f_y = yield stress of steel 414 MPa (60,000 psi)

h = thickness of wall mm (in)

The ultimate strength, M_u N·m (lb-in), of the fiber reinforced concrete wall is given by:

$$M_u = (f'_t) \left[\frac{bh^2}{6} \right]$$

Where:

b = unit length of wall section 305 mm (12 in)

h = thickness of wall mm (in)

f'_t = average residual strength MPa (psi) of the fiber reinforced concrete when tested according to ASTM C1399 and calculated as specified herein.

Equivalent performance between steel and fiber reinforcements is demonstrated if the minimum average residual strength of the fiber reinforced concrete, $f'_{t,min}$ satisfies the following equation:

$$f'_{t,min} \geq \left[\frac{2.4A_s f_y}{bh} \right]$$

Where:

A_s = area of steel mm²/linear m (in² / linear foot)

f_y = yield stress of steel 414 MPa (60,000 psi)

h = thickness of wall mm (in)

b = unit length of wall section 305 mm (12 in)

Based on the above engineering analysis, the required minimum residual strength of the fiber reinforced clarifiers is calculated for typical steel meshes and presented in Table 1.

4.1.4.5 The minimum average residual strength $f'_{t,min}$ of the concrete mix designs used to manufacture clarifiers with synthetic structural fibers shall not in any case be less than 150 psi when tested.

Note: The minimum residual strength of 1 MPa (150 psi) is equivalent in performance to a steel ratio, ρ , of 0.10% based on the engineering calculation mentioned in the above Section 4.1.4.4. This steel ratio is in accordance with the minimum steel ratio of 0.10% recommended by ACI 318, for precast nonprestressed walls.

The steel ratio ρ_s , is given by:

$$\rho_s = \left[\frac{A_s}{bh} \right] \times 100\%$$

Where:

A_s = area of steel mm²/linear m (in² / linear ft)

h = thickness of wall mm (in)

b = unit length of wall section 305 mm (12 in)

- 4.1.4.6** The residual strength of the concrete with synthetic fibers shall be determined from samples prepared from concrete mixture with a design compressive strength of 27.6 MPa (4,000 psi) (or at the design concrete strength for the grease interceptor and clarifier). The number of specimens tested to determine the residual strength, shall not be less than 8. The average residual strength factor (ARS) of each single test shall be reported. The average residual strength f'_t , is given by:

$$f'_t = f'_{t,mean} - \left[S_p \left(\frac{t_{10}}{n^{0.5}} \right) \right]$$

Where:

$f'_{t,mean}$ = mean value of the average residual strength factor for all test specimens

S_p = Standard Deviation of the ARS results for all tests

t_{10} = Student distribution at 10% fractile (see Table 2)

n = number of specimens tested

- 4.1.4.7** Mix designs showing compliance to ARS (Average Residual Strength) requirements will not need to be re-tested unless there is a change to the mix design properties or proportions and/or materials used from that of the pre-qualified mix.

4.1.2 Coated Steel

Steel shall be coated with a polyurethane material complying with the following specifications:

Property	Value
Hardness (ASTM D2240)	70 Shore D
Temperature Range	1°C – 49°C (35°F – 120°F)
Impact Strength	>40 in. lbs
Flexibility	15 MILS bent 180 over 3 mm (1/8 in) mandrel
Abrasion Resistance	110 mg (C17, 1 kg, 100 cycles)

The thickness of exterior layer shall be a minimum 75 MILS and the interior shall be a minimum 15 MILS and shall be Spark Tested per STI standard for uniformity. Finished coated tanks shall comply with the requirements of UL 58 and UL 1746 and manufactured per the requirements of the Steel Tank Institute (STI).

4.1.3 Alternate Materials

Clarifiers constructed of alternate materials may be approved by the Administrative Authority when complying with approved applicable standards. Wooden clarifiers are prohibited.

4.2 Dimensions

- 4.2.1** Drawings shall be complete and shall show all dimensions, capacities, reinforcing and structural design calculations.
- 4.2.2** Clarifiers shall have a minimum of three compartments. The outlet compartment shall have a minimum capacity of not less than one-third of the total required interceptor capacity. The liquid depth shall not be less than 0.8 m (2.5 ft) nor more than 1.8 m (6 ft).

- 4.2.3** All clarifiers shall have a minimum of 0.09 m² (1 ft²) of free surface area of liquid for every 170 L (45 gal) of liquid capacity.
- 4.2.4** Access to each clarifiers shall be provided by a manhole over the inlet and a manhole over the outlet. There shall also be an access manhole for each compartment. Each such access opening shall have a lid that cannot slide, rotate or flip, exposing the opening when properly installed and which does not require the use of mechanical fasteners. Manholes shall extend to grade, have a minimum size of 0.5 m (20 in) diameter or 0.5 m x 0.5 m (20 in x 20 in) square.
- 4.2.5** The inlet, outlet and baffles shall be provided with baffle tees, elbows or other approved fittings which will allow for the retention of the intercepted products and prevent siphonage.
- 4.2.6** Adequate partitions or baffles of sound durable material shall be constructed between compartments. Wooden baffles are prohibited.
- 4.2.7** The inlet, outlet and main baffles shall have a free vent area equal to the required cross-sectional area of the inlet pipe.
- 4.2.8** The airspace above the liquid level over the entire surface of the clarifiers shall have a minimum capacity equal to 12.5% of the clarifier's liquid volume.

4.3 Structural Requirements

- 4.3.1** Clarifiers shall be designed to withstand all anticipated loads.
- 4.3.2** Clarifiers and covers shall be designed for an earth load of not less than 24 kPa (500 psf) when the maximum coverage does not exceed 0.9 m (3 ft). Each clarifier and cover shall be structurally designed to withstand all anticipated earth or other loads and to be installed level and on a solid bed. Wood covers are prohibited. Clarifiers for installation in traffic areas shall be designed to withstand an AASHTO H20-44 wheel load, an additional 0.9 m (3 ft) earth load with an assumed soil weight of 4.8 kPa (100 psf), and 1.4 kPa (30 psf) fluid equivalent sidewall pressure.
- 4.3.3** Baffles for clarifiers shall be designed to withstand the maximum hydrostatic pressure of one compartment is at a maximum capacity to the point of overflow with the adjacent compartment(s) empty.
- 4.3.4** Independent laboratory tests and engineering calculations certifying the clarifier capacity and structural stability, shall be provided.

5 Testing Requirements

5.1 General

Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided.