SINGLE PASS SAND FILTER COMPONENT MANUAL
FOR
PRIVATE ONSITE WASTEWATER TREATMENT SYSTEMS

(see addendum A)

State of Wisconsin

Department of Commerce
Division of Safety and Buildings

SBD-10595-P (R.6/99)

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I. INTRODUCTION AND SPECIFICATIONS

This Private Onsite Wastewater Treatment System (POWTS) component manual provides design, construction, inspection, operation, and maintenance specifications for an single pass sand filter component. However, these items must accompany a properly prepared and reviewed plan acceptable to the governing unit to help provide a system that can be installed and function properly. Violations of this manual constitute a violation of chs. Comm 83 and 84, Wis. Adm. Code. The single pass sand filter component must receive influent flows and loads less than or equal to those specified in Table 1. When designed, installed and maintained in accordance with this manual, the single pass sand filter component provides treatment of domestic wastewater. The effluent from a single pass sand filter typically has monthly average values of ≤ 10 mg/L for BOD_5, ≤ 10 mg/L for TSS, and ≤ 10^4 cfu/100 ml for fecal coliform when inputs are within the range specified in Tables 1 to 3.

Note: Detailed plans and specifications must be developed for review and submitted for review and approval by the governing unit having authority over the plan for the installation. Also a Sanitary Permit must be obtained from the department or governmental unit having jurisdiction. See Section X for more details.

Table 1
INFLUENT FLOWS AND LOADS

Design wastewater flow (DWF)	≤ 2250 gal/day
Monthly average value of Fats, Oil and Grease (FOG)	≤ 30 mg/L
Monthly average value of five day Biochemical Oxygen Demand (BOD_5)	≤ 220 mg/L
Monthly average value of Total Suspended Solids (TSS)	≤ 150 mg/L
Number of design daily influent doses	Equally spaced throughout 24 hr. period
Discharge from an orifice during a single dose	≤ 0.25 gal
Design Loading Rate (DLR)	≤ 1.25gpd/ft^2

Table 1 **INFLUENT FLOWS AND LOADS** (continued)	
Design wastewater flow (DWF) from one- and two-family dwellings	≥ 150 gal/day/bedroom
Design wastewater flow (DWF) from public facilities	≥ 150% of estimated wastewater flow in accordance with Table 4 of this manual or s. Comm 83.43 (6), Wis. Adm. Code
Wastewater particle size	≤ 1/8 inch
Distribution cell area per orifice	≤ 6 ft^2

Table 2□SIZE	
Total distribution cell area	≥ DWF ÷ DLR
Depth of sand	≥ 24 inches
Depth of pea gravel under sand	≥ 6 inches
Depth of stone aggregate above sand	≥ 6 inches
Depth of cover over sand filter fabric and liner	≤ 6 inches of sandy loam or coarser or decorative stone
Depth of cover over sand filter fabric and liner	≥ 2 inches
Surge capacity in tank or chamber for pump used to does single pass sand filter	≥ 2/3 DWF above pump on level and 1/3 DWF above high level alarm
Liner	≥ 30 mil. PVC or ≥ 45 mil. EPDM
Piping material	Meets requirements of s. Comm 84.30 (2), Wis. Adm. Code for its intended use

Table 2 **SIZE** (continued)	
Fabric cover	Geotextile fabric meeting s. Comm 84.30 (6) (g), Wis. Adm. Code
Size of underdrain	≥ 4 inches
Depth of pea gravel above underdrain	≥ 3 inches

Table 3 OTHER SPECIFICATIONS	
Amount of stone aggregate around underdrain	≥ 2 inches
Depth of sand bedding	≥ 2 inches under liner
Effluent application	By use of pressure distribution network conforming to sizing requirements contained in this manual and methods delineated in either Small Scale Waste Management Project publication 9.6 or Dept. of Commerce publication SBD-10573-P
Difference in flow between any two orifices in a single lateral	≤ 10%
Difference in flow between any two orifices in the effluent distribution network	15%
Number of observation pipes	≥ Two 4 inch pipes extending from the sand aggregate interface to finished grade
Location of observation pipes	~~Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width~~
Head pressure on orifice	≥ 5 feet

<table>
<tr><th colspan="3">Table 3□OTHER SPECIFICATIONS (continued)</th></tr>
<tr><td>Effective size of sand media</td><td colspan="2">D10 > 0.30 mm</td></tr>
<tr><td>Uniformity Coefficient of sand media</td><td colspan="2">CU < 4.0</td></tr>
<tr><td rowspan="9">Sand media sieve specifications</td><td colspan="2">Sand Maximum/Minimum Gradation</td></tr>
<tr><td>Sieve Size</td><td>Percent Passing</td></tr>
<tr><td>3/8</td><td>100</td></tr>
<tr><td>4</td><td>95 – 100</td></tr>
<tr><td>8</td><td>80-100</td></tr>
<tr><td>16</td><td>45 – 85</td></tr>
<tr><td>30</td><td>15 – 60</td></tr>
<tr><td>50</td><td>3 – 15</td></tr>
<tr><td>100</td><td>0 – 4</td></tr>
<tr><td>Stone aggregate sieve specifications</td><td colspan="2">Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)</td></tr>
<tr><td rowspan="6"></td><td>Sieve Size</td><td>% Passing</td></tr>
<tr><td>2”</td><td>100</td></tr>
<tr><td>1-1/2”</td><td>90-100</td></tr>
<tr><td>1”</td><td>20-55</td></tr>
<tr><td>¾”</td><td>0-15</td></tr>
<tr><td>3/8”</td><td>0 – 5</td></tr>
<tr><td>Stone aggregate hardness specification</td><td colspan="2">> value of 3 on Moh’s Scale of Hardness</td></tr>
</table>

Table 3 **OTHER SPECIFICATIONS** **(continued)**	
Pea gravel sieve specifications	Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 7, coarse aggregate)
	Sieve Size / % Passing 3/4” / 100 ½” / 90-100 3/8” / 40-70 #4 / 0-15 #8 / 0 – 5
Pea gravel hardness specification	> value of 3 on Moh’s Scale of Hardness
Installation inspection	In accordance with ch. Comm 83 Wis. Adm. Code
Management	In accordance with ch. Comm 83 Wis. Adm. Code

Sieve Size	% Passing
3/4”	100
½”	90-100
3/8”	40-70
#4	0-15
#8	0 – 5

II. DEFINITIONS

Definitions unique to this manual are included in this section. Other definitions that may apply to this manual are located in ch. Comm 81 of the Wis. Adm. Code or the terms use the standard dictionary definition.

A. “Dispersal cell” means a layer of gravel that receives effluent from a distribution network and distributes that effluent onto the sand.

B. “Single Pass Sand Filter” means an onsite wastewater treatment component that contains an underdrain, sand, a distribution network, a container and a cap. The cap offers protection for the distribution cell of the sand filter.

C. “Surge capacity” means a volume in a tank above the normal working level, which stores above average discharge of wastewater from the facility.

III. DESCRIPTION AND PRINCIPLE OF OPERATION

POWTS single pass sand filter component operation consists of a fixed film aeration unit process in which wastewater passes through a porous media. The bacteria attach themselves to the media and extract food and nutrients as the wastewater flows through the porous media. Oxygen diffuses into the thin film of water as air passes through the media by convection due to temperature differences. Air is also drawn in as the wastewater moves through the media. The component is designed to encourage passive air movement through the unit.

As the effluent passes through the filter, various physical, chemical and biological reactions take place. Suspended solids are filtered out. Bacteria convert organic matter to carbon dioxide and water.

Physical entrapment, increased retention time, and conversion of pollutants in the wastewater are important treatment objectives accomplished under unsaturated conditions. Pathogens contained in the wastewater are eventually deactivated through filtering, retention, and adsorption by the sand.

Below are two cross section views of single pass sand filters. Figure 1 is a single pass sand filter that discharges effluent from the filter by gravity. Figure 2 is a single pass sand filter that discharges effluent from the filter by the use of a pump.

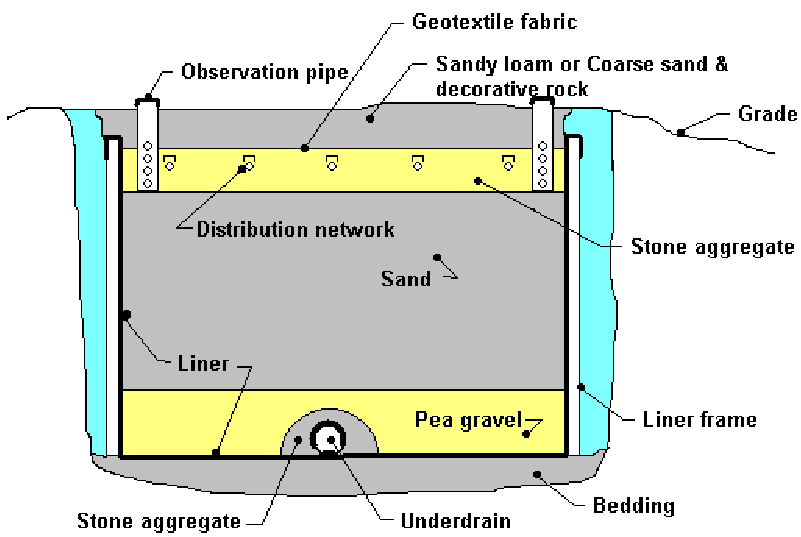

Figure 1 – Cross Section of an Single Pass Sand Filter with Gravity Discharge.

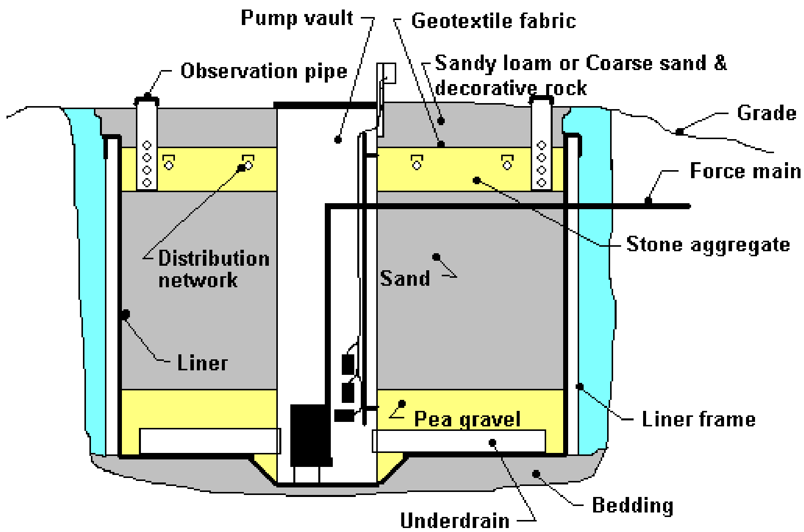

Figure 2 – Cross Section of an Single Pass Sand Filter with Pumped Discharge.

IV DESIGN

A. Size- Sizing of the single pass sand filter must be in accordance with this manual. The means of pressurizing the distribution network must provide equal distribution of influent over the distribution cell. A pressurized distribution network sized using the charts and graphs contained in this manual and methods delineated in either Small Scale Waste Management Project publication 9.6, entitled "Design of Pressure Distribution Networks for Septic Tank – Soil Absorption System" or Dept. of Commerce publication SBD-10573-P, entitled "Pressure Distribution Component Manual for Private Onsite Wastewater Treatment Systems" is acceptable.

B. Single Pass Sand Filter Component Design – Detailed plans and specifications must be developed, reviewed and approved by the governing unit having authority over the plan for the installation. A Sanitary Permit must also be obtained from the department or governmental unit having jurisdiction.

   Design of the single pass sand filter component is based on the design wastewater load. It must be sized such that it can accept the daily wastewater load at a rate that will provide treatment.

   Design of the single pass sand filter includes four steps, which are: (A) calculating the design wastewater load, (B) design of single pass sand filter component, (C) calculating the dose volume, number of doses per day, surge capacity of the tank or chamber that houses the pump dosing the component, and (D) design of distribution network. Steps A, B and C are discussed in this manual. Step D is not discussed in this manual. A design example is included in section IX of this manual.

Step A. Design Wastewater Flow

One- and two-family dwellings. The distribution cell size for one and two-family dwelling application is determined by calculating the design wastewater flow (DWF). To calculate DWF use formula 1.

Formula 1

DWF = 150 gallons/day/bedroom

Public. Distribution cell size for public facility application is determined by calculating the DWF using formula 2. Public facility estimated daily wastewater flows are listed in Table 4. Facilities that are not listed in Table 4 are not included in this manual. Many commercial facilities have high BOD_5, TSS and FOG (fats, oil and grease), which must be pretreated in order to bring their values down to an acceptable range before entering into the single pass sand filter component described in this manual.

Formula 2

DWF = Sum of each wastewater flow per source per day (from Table 4) x 1.5

Table 4
Public Facility Wastewater Flows

Source	Unit	Estimated Wastewater Flow (gpd)
Apartment or Condominium	Bedroom	100
Assembly hall (no kitchen)	Person (10 sq. ft./person)	1.3
Bar or cocktail lounge (no meals served)	Patron (10 sq. ft./patron)	4
Bar or cocktail lounge* (w/meals - all paper service)	Patron (10 sq. ft./patron)	8
Beauty salon	Station	90
Bowling alley	Bowling lane	80
Bowling alley (with bar)	Bowling lane	150
Camp, day and night	Person	25
Camp, day use only (no meals served)	Person	10
Campground or Camping Resort	Space, with sewer connection and/or service building	30
Campground sanitary dump station	Camping unit or RV served	25
Catch basin	Basin	65
Church (no kitchen)	Person	2
Church* (with kitchen)	Person	5
Dance hall	Person (10 sq. ft./person)	2
Day care facility (no meals prepared)	Child	12
Day care facility* (with meal preparation)	Child	16
Dining hall* (kitchen waste only without dishwasher and/or food waste grinder)	Meal served	2
Dining hall* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Meal served	5
Dining hall* (toilet and kitchen waste with dishwasher and/or food waste grinder)	Meal served	7
Drive-in restaurant* (all paper service with inside seating)	Patron seating space	10
Drive-in restaurant* (all paper service without inside seating)	Vehicle space	10
Drive-in theater	Vehicle space	3
Employees (total all shifts)	Employee	13
Floor drain (not discharging to catch basin)	Drain	25
Gas station / convenience store	Patron (minimum 500 patrons)	3
Gas station (with service bay) Patron Service bay	 Patron Service bay	 3 50
Hospital*	Bed space	135
Hotel, motel or tourist rooming house	Room	65
Medical office building Doctors, nurses, medical staff Office personnel Patients	 Person Person Person	 50 13 6.5
Migrant labor camp (central bathhouse)	Employee	20
Mobile Home (Manufactured home) (served by its own POWTS)	Bedroom	100
Mobile home park	Mobile home site	200

* = May be high strength waste

Table 4
Public Facility Wastewater Flows
(continued)

Source	Unit	Estimated Wastewater Flow (gpd)
Nursing, Rest Home, Community Based Residential Facility	Bed space	65
Outdoor sport facilities (toilet waste only)	Patron	3.5
Parks (toilets waste only)	Patron (75 patrons/acre)	3.5
Parks (toilets and showers)	Patron (75 patrons/acre)	6.5
Public shower facility	Shower taken	10
Restaurant*, 24-hr. (dishwasher and/or food waste grinder only)	Patron seating space	4
Restaurant*, 24-hr. (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	12
Restaurant, 24-hr. (toilet waste)	Patron seating space	28
Restaurant*, 24-hr. (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	40
Restaurant*, 24-hr. (toilet and kitchen waste with dishwasher and/or food waste grinder)	Patron seating space	44
Restaurant* (dishwasher and/or food waste grinder only)	Patron seating space	2
Restaurant* (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	6
Restaurant (toilet waste)	Patron seating space	14
Restaurant* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	20
Restaurant* (toilet and kitchen waste with dishwasher and/or food waste grinder)	Patron seating space	22
Retail store	Patron (70% of total retail area ÷ 30 sq. ft. per patron)	1
School* (with meals and showers)	Classroom (25 students/classroom)	500
School* (with meals or showers)	Classroom (25 students/classroom)	400
School (without meals or showers)	Classroom (25 students/classroom)	300
Self-service laundry (toilet waste only)	Clothes washer	33
Self-service laundry (with only residential clothes washers)	Clothes washer	200
Swimming pool bathhouse	Patron	6.5

* = May be high strength waste

Step B. Design of the Single Pass Sand Filter Component - This section determines the required size of the distribution cell area as well as the dimensions for the complete single pass sand filter component.

1. Determine the distribution cell area.

   The distribution cell area is calculated by dividing the design wastewater flow by a design loading rate of ≤ 1.25 gal/ft^2

   Distribution cell area = DWF ÷ DLR

2. Determine the width and length of the distribution cell.

   The width and length are determined by dividing the distribution cell area by a chosen dimension for either the width or length.

   Length of distribution cell = distribution cell area ÷ chosen cell width

   or

   Width of distribution cell = distribution cell area ÷ chosen cell length

3. Location of observation pipes. (See Addendum A)

   ~~The sand filter must include two observation pipes. The observation pipes are located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width.~~

Step C. Dose volume, number of doses, and surge capacity - Calculation of the dose volume, number of doses per day, and surge capacity of the tank or chamber that houses the pump dosing the component. These volumes and frequency of dosing are important so that the filter can provide its intended treatment.

1. Volume of a single dose.

   The volume of a single dose is determined by multiplying the distribution cell area by a volume of a single dose that is ≤ 0.08 gal/ft^2/dose.

   Volume of single dose = distribution cell area x ≤ 0.08 gal/ft^2/dose

2. Number of doses per day.

   The number of doses per day is determined by dividing DWF by the volume of a single dose.

   Number of doses per day = DWF ÷ gal/dose

3. Surge capacity of the tank or chamber that houses the pump dosing the component.

The surge capacity of the tank or chamber that contains the pump which doses the filter consists of two zones of the tank or chamber. Surge zone 1 is between the “pump on” elevation and “alarm on” level. This zone must be a volume that equals at least 2/3 of the DWF. Surge zone 2 is between the “alarm on” level and the inlet of the tank or chamber. This zone must be a volume, which equals at least 1/3 of the DWF.

Surge zone 1 = DWF ÷ 3 x 2

Surge zone 2 = DWF ÷ 3

Step D. Distribution Network and Dosing System A pressurized distribution network sized using the tables and graph contained in this manual and methods delineated in either Small Scale Waste Management Project publication 9.6, entitled “Design o f Pressure Distribution Networks for Septic Tank – Soil Absorption Systems” or Dept. of Commerce publication SBD-10573-P, entitled “Pressure Distribution Component Manual for Private Onsite Wastewater Treatment Systems” is acceptable.

C. Other specification for materials and design

1. Container and excavation

A watertight container, such as a durable 30 mil. PVC or 45 mil. EPDM liner is required. The liner must be protected from punctures that can be caused by sharp rocks and construction tools. The filter can be placed at various elevations in the landscape from placement on the ground surface with soil mounded over it to buried with the top 2” to 6” below ground surface. It is imperative that surface and ground water not be allowed to enter the filter.

The excavation is made 6” to 12” larger than the filter. Untreated plywood, waferboard or other suitable material is formed into a box to support the liner and allow the liner to be draped over the top. Only sand is placed between the frame and soil to protect the liner after the plywood has decomposed. Approximately 2” of sand is placed in the bottom of the excavation prior to placement of the liner. The top of the liner must be above the seasonal high water table so ground water does not flow into the sand filter.

When the excavation around the frame is backfilled, it is done with sand that is placed in one foot increments and compacted by use of water or tamping prior to additional sand being placed.

2. Effluent collection

A 4” underdrain pipe with slots or holes is placed on the liner to collect the sand filter effluent. The collection pipe connects to an internal pump vault or extends outside the tank to an external pump chamber or drains by gravity to a dispersal area. A boot is glued to the liner and attached to the pipe to eliminate the intrusion of groundwater through the opening or to prevent ponded effluent from exiting. For an internal pump vault, an excavation is made in the center of the filter and lined with sand prior to placement of the liner. The size and shape of the excavation must be adequate for the pump, pump controls and other necessary equipment.

3. Aggregate

A layer of stone aggregate is placed around and mounded over the collection pipe. A six to eight inch layer of washed pea gravel is placed on the liner with a two inch layer of washed pea gravel placed on top of the aggregate to keep the sand from infiltrating into the larger aggregate.

4. Sand media

A two-foot layer of sand, placed in 8” lifts and wetted to minimize settling, is placed on top of the pea gravel. The top of the sand is leveled. Media size, septic tank effluent quality and loading rates are interrelated. Table 3 gives the requirements for the sand media.

5. Distribution network

The distribution network spreads the septic tank effluent as uniformly as possible over the sand filter surface. The network consists of a manifold and laterals. Typical design consists of:

a. Orifices - orifices are located upward with orifice shields.

b. Laterals – laterals are spaced 2’ apart. Each lateral terminates with an upturned long sweep elbow and valve that can be used for cleaning. Lateral lengths can not exceed those given in Table 5 for various diameters. Laterals are sloped back in order to provide drainage of lateral between doses.

c. Manifold – manifolds slope back to the force main to provide drainage for the manifold between doses. The manifold is sized using Table 6.

d. Force main – Force main slopes back to provide drainage of the force main between doses. The force main is sized using Table 7.

e. Valve Boxes - Valve boxes are required to provide access to the valves on the laterals. The covers must provide a water tight cap.

f. Pump - Sized to meet flow rate and lateral pressure of a minimum of 5’ at distal end.

Two inches of stone aggregate is placed on the leveled sand surface. The distribution network is placed in the stone aggregate with laterals and manifold sloping back to force main. Additional aggregate is placed on top of the network with a minimum cover of one inch. The force main is placed through the plywood wall and liner. A boot is glued to the liner and attached to the pipe to eliminate the intrusion of groundwater through the opening or to prevent ponded effluent from exiting.

Table 5 Maximum length of distribution laterals for Schedule 40 PVC pipe having 1/8 inch orifices spaced 2 ft apart with 5 ft of head at distal end				
Lateral Diameter in inches	Maximum length in feet	Number of Orifices	Total Flow in gpm	Input Head in feet
¾	16	13	5.9	6.2
1	44	22	9.7	6.1
1-1/4	66	33	14.4	6.1
1-1/2	90	45	19.5	6.0
2	146	73	31.2	6.0

Table 6 **Maximum Manifold Length Based on Individual Lateral Flow Rates and** **2 Foot Lateral Spacing**					
Individual Lateral Discharge Rate					
End Manifold	Center Manifold	1-1/4" Diameter Manifold	1-1/2" Diameter Manifold	2" Diameter Manifold	3" Diameter Manifold
10	5	6 ft	8 ft	12 ft	18 ft
20	10	4 ft	6 ft	8 ft	14 ft
30	15	2 ft	4 ft	6 ft	12 ft
40	20	2 ft	2 ft	6 ft	10 ft
50	25	NP[a]	2 ft	4 ft	8 ft
60	30	NP	2 ft	4 ft	8 ft
70	35	NP	NP	2 ft	6 ft
80	40	NP	NP	2 ft	6 ft
90	45	NP	NP	2 ft	6 ft
100	50	NP	NP	2 ft	4 ft

Note a: NP means Not Permitted

Table 7 **Friction Loss (foot/100 feet) in Plastic Pipe**[a]					
Flow in	Nominal Pipe Size				
GPM	1-1/4”	1-1/2”	2”	3”	4”
10	2.50				
11	2.99				
12	3.51				
13	4.07				
14	4.66	1.92		Velocities in this area	
15	5.30	2.18		are below 2 feet per second	
16	5.97	2.46			
17	6.68	2.75			
18	7.42	3.06			
19	8.21	3.38			
20	9.02	3.72			
25	13.63	5.62	1.39		
30	19.10	7.87	1.94		
35	25.41	10.46	2.58		
40	32.53	13.40	3.30		
45	40.45	16.66	4.11		
50	49.15	20.24	4.99		
60		28.36	7.00	0.97	
70		37.72	9.31	1.29	
80	Velocities in this area exceed 10 ft		11.91	1.66	
90	per second, which are not acceptable		14.81	2.06	
100	velocity for this pipe diameter		18.00	2.50	0.62

Note a: Table is based on Hazen – Williams formula: $h = 0.002082L \times (100/C)^{1.85} \times (gpm^{1.85} \div d^{4.8655})$

Where: h = Feet of head L = Length in feet

C = Friction factor from Hazen – Williams (145 for plastic pipe)

gpm = gallons per minute d = Nominal pipe size

6. Observation pipes

At least two 4” observation pipes are placed to the sand/aggregate interface to monitor for ponding and/or formation of a clogging mat. The tubes must be secured and have perforations in the bottom 4 inches. See Figure 3.

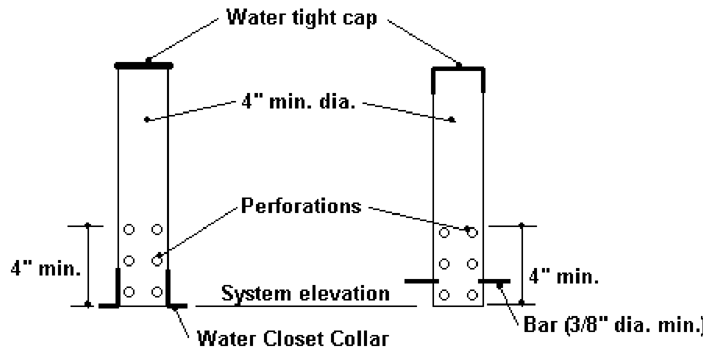

Figure 3 – Observation pipes

7. Sand filter pump vault and force main to distribution area.

The force main exiting the pump vault must be sloped to either drain back to the pump vault or to the distribution area. It may exit the sand filter above the liner, if not, a boot is installed similar to the boot installed for the force main from the septic tank pump chamber. Electrical wires from the control panel to the pump vault should be placed in conduit that is located on top of the aggregate. The pump can be a centrifugal effluent pump. It may also be a turbine pump, which will provide higher heads and lower flows. High and low level floats control the liquid level in the sand filter. The high water alarm, when activated, must shut off the septic tank effluent pump so as not to flood the sand filter. The two pumps must be interconnected so if the sand filter pump fails to pump, the septic tank pump will not pump effluent to the sand filter.

8. Fabric and cover

Geotextile fabric meeting the requirements of ch. Comm 84, Wis. Admin. Code, is placed on top of the aggregate, which covers the distribution network. The filter can be either covered with sandy loam and sodded or seeded and mulched or decorative rock can be placed on the geotextile fabric.

Lawn: Up to six inches of sandy loam or coarser soil is placed on the fabric, seeded and mulched. All surface waters must be diverted away from the single pass sand filter. The pump vault and valve box covers must be placed at ground surface for easy access but below the reach of a lawn mower.

Decorative rock: To eliminate the potential for “septic type” odor emitting from the filter when it is dosed, up to 2” of coarse sand is placed on the filter fabric. Decorative rock or other aggregate is placed on top of the sand to final grade. All surface waters must be diverted away from the sand filter.

9. Control panel

The sand filter is dosed by timed doses. The septic tank/pump chamber must provide for surge loading and surge (reserve) volumes.

10. Air tube

An optional air tube can be placed on top of the aggregate below the sand with a vertical pipe connected to one end and extended to the top of the filter. This allows air to be supplied via a pump to the filter if needed at a later date. The tube can be drip irrigation tubing placed in concentric circles on the aggregate surface or 3/4" diameter PVC pipe with 1/8" holes spaced 2 ft apart with 2 ft. lateral spacing, connected to a 1" PVC manifold. Air is pumped into the filter to provide additional oxygen to break up a clogging mat that may develop on the sand surface. It is used only when effluent becomes ponded at the aggregate/sand interface. Air is not pumped into the sand filter when air temperatures are below freezing as it may freeze the filter.

V. CONSTRUCTION

Procedures used in the construction of the single pass sand filter are just as critical as the design of the component. A good design with poor construction results in component failure.

A. Lay out the location and size of the single pass sand filter.

B. Determine where the pipe from the dosing pump will connect to the effluent distribution system of the single pass sand filter.

C. Excavate for the single pass sand filter to the correct elevation.

D. Place at least 2 inches of sand for bedding material in the bottom of the excavation to protect the liner.

E. Construct a form to hold the sides of the liner in place. Make sure there are no sharp edges or protrusions that may result in puncturing the liner material. The top or the liner terminates at a distance within 6 inches but greater than 2 inches below finish grade.

F. Install the liner.

G. Install the pump chamber if the single pass sand filter contains an internal pump chamber as part of its design. If the underdrain discharges by gravity from the single pass sand filter, install the boot that will seal the underdrain exit opening through the liner.

H. Install the under drain with the slots in the up position or holes in the up or side position making sure to seal the opening for the underdrain into the pump chamber or through the liner.

I. Cover the sides and top of the under drain with stone aggregate until the depth of the aggregate over the pipe is at least two inches.

J. Place six inches of pea gravel in the bottom of the single pass sand filter making sure there is at least two inches of pea gravel over the stone aggregate.

K. Backfill the excavation around the perimeter as you place the material inside of the single pass sand filter. The depth of backfill is kept near the same depth as the depth of fill inside of the liner.

L. Place and wet down 8 inches of sand media meeting the specifications listed in Table 3 over the pea gravel. Repeat this step until a depth of at least 24 inches is reached.

M. Install the required observation pipes with the bottom 4 inches of the observation pipe perforated. Installations of all observation pipes include a suitable means of anchoring. See Figure 3.

N. Place 2 inches of stone aggregate over the sand media.

O. Install the valve boxes, cleanouts and pressure distribution network with laterals sloped at least 1 inch toward the manifold.

P. Test the system to adjust the head pressure to at least 5 feet at the distal orifice.

Q. Install the orifice shields.

R. Place at least 2 inches of stone aggregate over the distribution laterals.

S. Cover the stone aggregate with a geotextile fabric that meets the specifications of ch. 84 of the Wis. Adm. Code.

T. Cover the geotextile fabric with 6 inches of sandy loam or coarser material(s), such as decorative rock.

VI. OPERATION, MAINTENANCE and PERFORMANCE MONITORING

A. The component owner is responsible for the operation and maintenance of the system. The county, department or POWTS service contractor may make periodic inspections of the components, and effluent levels, etc.

The owner or owner's agent is required to submit appropriate records routinely to the county or other appropriate jurisdiction and/or the department.

B. Design approval and site inspections before, during, and after the construction are accomplished by the county or other appropriate jurisdictions in accordance to Ch. Comm 83 of the Wis. Adm. Code.

C. Other routine and preventative maintenance aspects are:

1. Treatment and dispersal tanks are to be inspected routinely and maintained when necessary in accordance with their approvals.
2. Inspections of single pass sand filter component performance is required at least every six months for the first two years. Then once a year for the next two years. Then once every three years, thereafter. These inspections include checking the liquid levels in the observation pipes and examination for any seepage around the filter.

3. Winter traffic on the filter is not permitted to avoid frost penetration and to minimize compaction.
4. A good water conservation plan within the house or establishment will help assure that the filter system will not be overloaded.

D. User's Manual: A user's manual is to accompany the single pass filter component. The manual is to contain the following as a minimum:

1. Diagrams of all system components and their location.
2. Specifications for electrical and mechanical components.
3. Names and phone numbers of local health authority, component manufacturer or management entity to be contacted in the event of a failure.
4. Information on the periodic maintenance of the single pass filter component, including electrical and mechanical components.
5. Notice that the dose chamber may fill due to flow continuing during pump malfunction or power outages. One large dose when the power comes on or when the pump is repaired may cause the dispersal system to have problems. In this situation, the pump chamber should be pumped by a licensed pumper before pump cycling begins or other measures shall be used to dose the component with only the proper amount of influent. This may include manual operation of the pump controls until such time the pump chamber has reached its normal level.

E. Performance monitoring must be performed on single pass filter components installed under this manual.

1. The frequency of monitoring must be:
    a. At least every six months for the first two years after installation. Then once a year for the next two years. Then once every three years, thereafter, and
    b. At times of problem, complaint, or failure.

F. The minimum criteria addressed in performance monitoring of single pass filter components are:

1. Type of use.
2. Age of system.
3. Type of container installed.
4. Nuisance factors, such as odors or user complaints.
5. Mechanical malfunction within the component including problems with valves or other mechanical or plumbing components.
6. Material fatigue or failure, including durability or corrosion as related to construction or structural design.

7. Neglect or improper use, such as overloading the design rate, poor maintenance of vegetative cover, inappropriate cover over the single pass filter component, or inappropriate activity over the single pass filter component.
8. Installation problems such as improper materials or location.
9. Pretreatment component maintenance, including dosing frequency, structural integrity, groundwater intrusion or improper sizing.
10. Pump chamber maintenance, including improper maintenance, infiltration, structural problems, or improper sizing.
11. Ponding in the single pass filter component, prior to the pump cycle, is evidence of development of a clogging mat or reduced infiltration rates.
12. Pump malfunction including dosing volume problems, pressurization problems, breakdown, burnout, or cycling problems.
13. Overflow or seepage problems, as shown by evident or confirmed sewage effluent, including backup if due to clogging.

G. Reports are to be submitted in accordance to Ch. Comm. 83, Wis. Admin. Code.

VII. REFERENCES

W.A. Cagle and L.A. Johnson 1994. “On-Site Intermittent Sand Filter Systems, A Regulatory/Scientific Approach to their Study in Placer County, California” ASAE Proceedings of the Seventh International Symposium on Individual and Small Community Sewage Systems.

EPA Design Manual 1980. “Intermittent Sand Filters” Onsite Wastewater Treatment and Disposal Systems, chapter 6.3

VIII. WORKSHEET

SINGLE PASS SAND FILTER WORKSHEET

A. Design wastewater flow (DWF)

One or Two-family Dwelling.

DWF = 150 gal/bedroom x # of bedrooms

= 150 gal/bedroom x ______# of bedrooms

= ____________ gal/day

Public Facilities.

DWF = Sum of each wastewater flow per source per day x 1.5

= __________ gal/day x 1.5

= __________ gal/day

B. Distribution cell area

Calculate the distribution cell area by dividing the design wastewater flow (DWF) by design loading rate (DLR)of 1.25 gpd/ft^2

Distribution cell area = DWF ÷ 1.25 gpd/ft^2

= _______ gpd ÷ 1.25 gpd/ft^2

= _______ ft^2

C. Width and length of the distribution cell.

The width and length are determined by dividing the distribution cell area by a chosen dimension for either the width or length.

Width of distribution cell = distribution cell area ÷ chosen cell length

= ________ ft^2 ÷ _____ ft.

= _______ ft.

or

Length of distribution cell = distribution cell area ÷ chosen cell width

= ________ ft^2 ÷ _____ ft.

= _______ ft.

D. Location of observation pipes.

~~Distance from end of distribution cell to observation pipe = Length of distribution cell ÷ 6~~

~~= _______ ft. ÷ 6~~

~~= ______ ft.~~

E. Volume of a single dose.

Volume of a single dose ≤ number of orifices x 0.25 gal/dose

= ________ x 0.25 gal/dose

= ________ gal/dose

D. Number of doses per day.

Number of doses per day = DWF ÷ volume of single dose

= ________ gpd ÷ ____ gal/dose

= ________ doses/day

G. Time interval between pump start times

Time interval (hours) = 24 hrs/day ÷ Number of doses per day

= 24 hrs/day ÷ _____ doses/day

= _______ hours

Time interval (minutes) = 1440 minutes/day ÷ Number of doses per day

= 1440 minutes/day ÷ _______ doses/day

= ________ minutes

H. Surge capacity of the tank or chamber that houses the pump dosing the component

Surge capacity of zone 1 (between the "pump on" elevation and "alarm on" level).

Zone 1 = DWF ÷ 3 x 2

= _______ gal ÷ 3 x 2

= _______ gal

Surge capacity of zone 2 (between the “alarm on” level and the inlet of the tank or chamber).

Zone 2 = DWF ÷ 3

= _______ gal ÷ 3

= _______ gal

IX. EXAMPLE WORKSHEET

SINGLE PASS SAND FILTER WORKSHEET

A. Design wastewater flow (DWF)

One or Two-family Dwelling.

DWF = 150 gal/bedroom x # of bedrooms

= 150 gal/bedroom x __3__# of bedrooms

= __450__ gal/day

Public Facilities.

DWF = Sum of each wastewater flow per source per day x 1.5

= __________ gal/day x 1.5

= __________ gal/day

B. Distribution cell area

Calculate the distribution cell area by dividing the design wastewater flow (DWF) by design loading rate (DLR)of 1.25 gpd/ft^2

Distribution cell area = DWF ÷ 1.25 gpd/ft^2

= __450__ gpd ÷ 1.25 gpd/ft^2

= __360__ ft^2

C. Width and length of the distribution cell.

The width and length are determined by dividing the distribution cell area by a chosen dimension for either the width or length.

Width of distribution cell = Distribution cell area ÷ chosen cell length

= __360__ ft^2 ÷ __36__ ft.

= __10__ ft.

or

Length of distribution cell = Distribution cell area ÷ chosen cell width

= ________ ft^2 ÷ _____ ft.

= _______ ft.

D. Location of observation pipes.

~~Distance from end of distribution cell to observation pipe = Length of distribution cell ÷ 6~~

~~= _36_ ft. ÷ 6~~

~~= _6_ ft.~~

E. Volume of a single dose.

Volume of a single dose = distribution cell area x 0.08 gal/ft^2/dose

= _115_ x 0.25 gal/dose

= _28.75 or 29_ gal/dose

E. Number of doses per day.

Number of doses per day = DWF ÷ volume of single dose

= _450_ gpd ÷ _29_ gal

= _15.5_ doses/day

G. Time interval between pump start times

Time interval (hours) = 24 hrs/day ÷ Number of doses per day

= 24 hrs/day ÷ _____ doses/day

= _______ hours

Time interval (minutes) = 1440 minutes/day ÷ Number of doses per day

= 1440 minutes/day ÷ _15.5_ doses/day

= _92.9 or 90_ minutes

H. Surge capacity of the tank or chamber that houses the pump dosing the component

Surge capacity of zone 1 (between the "pump on" elevation and "alarm on" level).

Zone 1 = DWF ÷ 3 x 2

= _450_ gal ÷ 3 x 2

= _300_ gal

Surge capacity of zone 2 (between the “alarm on” level and the inlet of the tank or chamber).

Zone 2 = DWF ÷ 3

= 450 gal ÷ 3

= 150 gal

X. PLAN SUMBITTAL and INSTALLATION INSPECTION

A. Plan Submittal

In order to install a component correctly, it is important to develop plans that will be used to install the component correctly the first time. The following checklist may be used when preparing plans for review. The checklist is intended to be a general guide. Conformance to the list is not a guarantee of plan approval. Additional information may be needed or requested to address unusual or unique characteristics of a particular project. Contact the reviewing agent for specific plan submittal requirements, which the agency may require that are different than the list included in this manual.

General Submittal Information

- Submittal of additional information requested during plan review or and questions concerning a specific plan must be referenced to the Plan Identification indicator assigned to that plan by the reviewing agency.
- Plans or documents must be permanent copies or originals.

Forms and Fees

- Application form for submittal, provided by reviewing agency along with proper fees set by reviewing agent.
- Onsite verification report signed by the county or appropriate state official.

Documentation

- Architects, engineers or designers must sign, seal and date each page of the submittal or provide an index page, which is signed, sealed and dated.
- Master Plumbers must sign, date and include their license number on each page of the submittal or provide an index page, which is signed, sealed and dated.
- Three completed sets of plans and specifications (clear, permanent and legible); submittals must be on paper measuring at least 8-1/2 by 11 inches.

PLOT PLAN

- Dimensioned plans or plans drawn to scale (scale indicated on plans) with parcel size or all property boundaries clearly marked.
- Slope directions and percent in component area.
- Benchmark and north arrow.
- Setbacks indicated as per appropriate code.
- Location information; legal description of parcel must be noted.
- Location of any nearby existing component or well.

PLAN VIEW

- Dimensions for single pass sand filter distribution cell(s).
- Location of observation pipes.
- Pipe lateral layout, which must include the number of laterals, pipe material, diameter and length; and number, location and size of orifices.
- Manifold/force main locations, with materials, length and diameter of each.

CROSS SECTION OF COMPONENT

- Lateral elevation, position of observation pipes, dimensions and depths of aggregates and sand, and type of cover material such as geotextile fabric, and depth, if applicable.

COMPONENT SIZING

- For one- and two-family dwellings, the number of bedrooms must be included.
- For public facilities, the sizing calculations must be included.

TANK AND PUMP INFORMATION

- All construction details for site-constructed tanks.
- Size and manufacturer information for prefabricated tanks.
- Notation of pump or siphon model, pump performance curve, friction loss for force main and calculation for total dynamic head.
- Cross section of tank / chamber to include storage volumes; connections for piping, vents, and electricity; pump “off” setting; dosing cycle and volume; and location of vent and manhole.
- Cross section of two compartments tanks or tanks installed in a series must include information listed above.

OTHER

- For design flows greater than 1000 gpd, include the manufacturer, model, and location of a metering device, which accurately meters the amount of effluent entering the component.

B. Inspections.

Inspection shall be made in accordance with ch. 145.20,. Wis. Stats and s. Comm 83.26, Wis. Adm. Code. The inspection form on the following two pages may be used. The inspection of the component installation and/or plans is to verify that the component at least conforms to specifications listed in Tables 1-3 of this manual.

GENERAL INFORMATION		ISF INFORMATION
Permit Holders Name:	County:	ISF outside dimensions:
VRP Elevation:	Sanitary Permit Number:	Orifice position:
VRP Description:	Plan ID Number:	Sand source:
Inspector Name & License #:	Parcel Tax Number:	Forcemain length:
Dates Inspected:		Forcemain diameter:

CONTRACTOR INFORMATION	
Plumber Name:	Phone #:
Electrician Name:	Phone #:
Excavator Name:	Phone #:

ELEVATION DATA				
STATION	**BS**	**HI**	**FS**	**ELEV**
VRP:				
STFM:				
STFM End:				
SFPB FM:				
SFPB FM End:				
Base of STPB: Base of SFPB:				
STFM pitch:				

TANK INFORMATION	
Manufacturer: Tank Capacity:	Gallons/inch
Capacity of First Compartment:	
Capacity of Second Compartment:	

SEPTIC TANK VAULT	
Inside height:	Inches
*Alarm/timer override:	Inches
*Timer off:	Inches
*Red. Off/low level alarm:	Inches
Forcemain Diameter:	Inches
Forcemain Length:	Feet

* Measured from bottom of tank cover.

PUMP INFORMATION		
	DTPB	**SFPB**
Manufacturer: Model Number:		
Lift:		
Friction Loss:		
System Head:		
As-Built TDH:		
System Demand:		

OPERATIONAL REVIEW		
STPB floats tested	Yes	No
SFPB floats tested	Yes	No
Distribution pipes flushed	Yes	No
As-built TDH below pump curve	Yes	No
Septic tank tested for water tightness	Yes	No
Owner issued operational manual	Yes	No
Residual head at start up		
Programmable timer settings	On	Off

ADMINISTRATIVE REVIEW		
Revision to plans required	Yes	No
Construction directive issued	Yes	No
Construction order issued	Yes	No
Date of directive		
Directive deadline		
Enforcement order date		
Enforcement order deadline		
Date compliance issued		

DTPB – Dose Tank Pump Basin
SFPB – Sand Filter Pump Basin
SFPB FM - Sand Filter Pump Basin, Force Main
STFM – Septic Tank Force Main
STPB – Septic Tank Pump Basin
VRP- Vertical Reference Point

DEVIATIONS FROM APPROVED PLANS:

Date Installation Approved _____________ **Inspector Signature** ____________________________________