SSF 1.25 through SSF 10 series Slow Sand Filter

Installation and Maintenance Guide

Three SSF 10s shown above.

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How the slow sand filter works

1) Slow sand filtration is a biological process that cleans water much the way the sandy bed of a river does. A column of water passes through a three-foot layer of fine sand at the rate of 0.1 gallons per minute per square foot or less. On top of the sand, an intense layer of microbes naturally develops. This layer grows and thrives by consuming whatever is passing through in the water. In a slow sand filter, this layer, called the *schmutzdecke*, is responsible for removing up to 99.99% of all bacteria, viruses, Giardia, Cryptosporidium, and parasites through perdition. As the water passes through the deeper sand and gravel layers, other processes such as sedimentation, mechanical filtration, and electrical attraction remove still more. The result is that slow sand filters may be the best stand-alone water filters known.

2) Slow sand filters are recognized as a superior technology by the USEPA (United States Environmental Protection Agency), the World Health Organization, Oxfam and many U.S. state agencies, and they enjoy widespread use in the U.S., Europe, and developing countries.

System requirements

3) *Location:* The slow sand filter should be located on a concrete slab, prepared and compacted earth site, or a bed of pea gravel. The best location is between a spring source and a storage tank; however, many other arrangements are possible.

Storage

4) The slow sand filter has a normal peak design output, or loading rate, of 0.1 gpm/ft^2. The filter is designed to run continuously at this slow rate, and therefore requires storage of the filtered water to accommodate peak usage. Storage should be able to handle peak 24 hour demand periods.

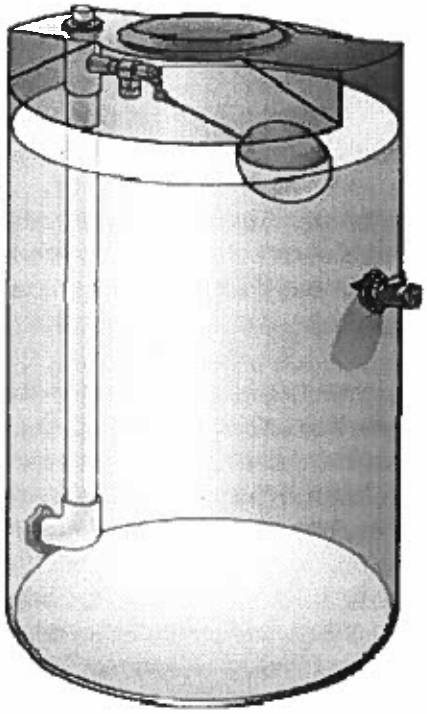
Raw Water Quality

5) Slow sand filters are very good at removing turbidity (cloudiness) and bacteria and other pathogens. However, too much turbidity may cause the filter to clog prematurely. We recommend a maximum turbidity of the raw water at no more than 20 NTU for continuous use. The filter can tolerate higher turbidity for short periods, however. If your raw water is very cloudy and has substantial suspended solids, you should install a sediment tank and/or a roughing filter ahead of the slow sand filter. If you have questions about raw water quality, call Blue Future Filters at (360) 756-0071 for recommendations.

Installation

6) *Site preparation:* Locate the slow sand filter on a well compacted, stable site such that the outlet from the filter is above the inlet to the storage tank. The filter may be placed on compacted soil, a concrete slab, or a bed of pea gravel. Do not place filter cells on a sand base. Sand can wash away during heavy rains and lead to uneven settling. Note for multiple filter systems: Filters are labeled "A" or "B" where multiple

filters are installed. Place an A with a B in such a way that the Piezometer tubes face as in illustration below.

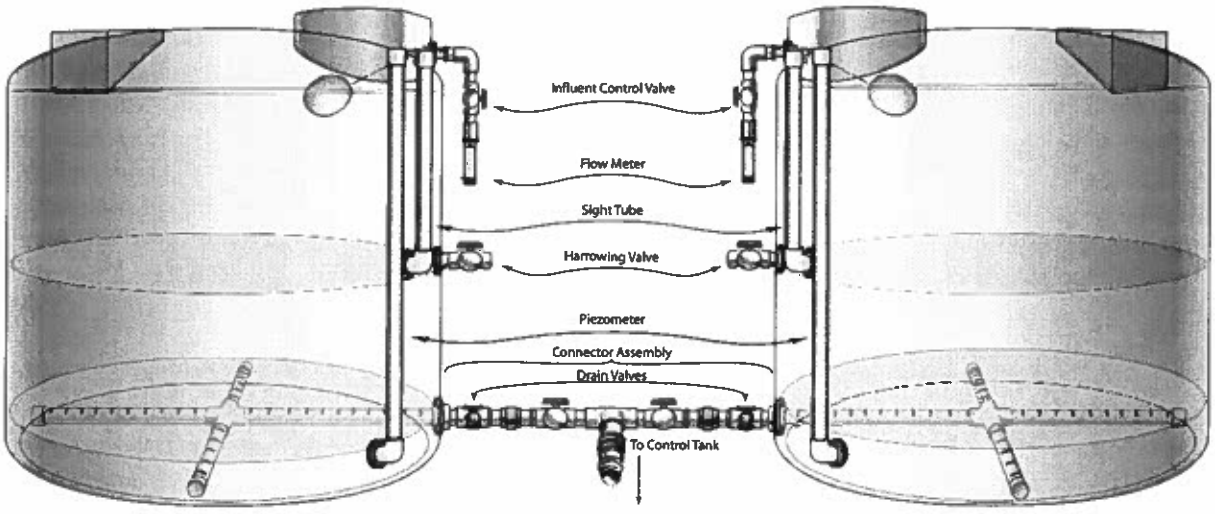


Plumbing connections
(For SSF-1.25 refer to drawing page 13)

7) Connect the raw water source to the two flow meters located on the upper side walls of the filter vessels near the two round small access ports. For SSF-1.25, connect directly to inlet fitting

8a) Position the tanks so that the outlets of the two tanks face each other. Install the male adapters, ball valves, and tee fitting as shown. Place the control tank so that the outlet of the tee faces the inlet of the control tank. Make this connection as shown. Install the threaded PVC nipples and threaded ball valves in the harrowing fittings as shown. Connect the 1 inch ball valve and flow gauge or fixed orifice device from the center control tank to the pipe going to storage.

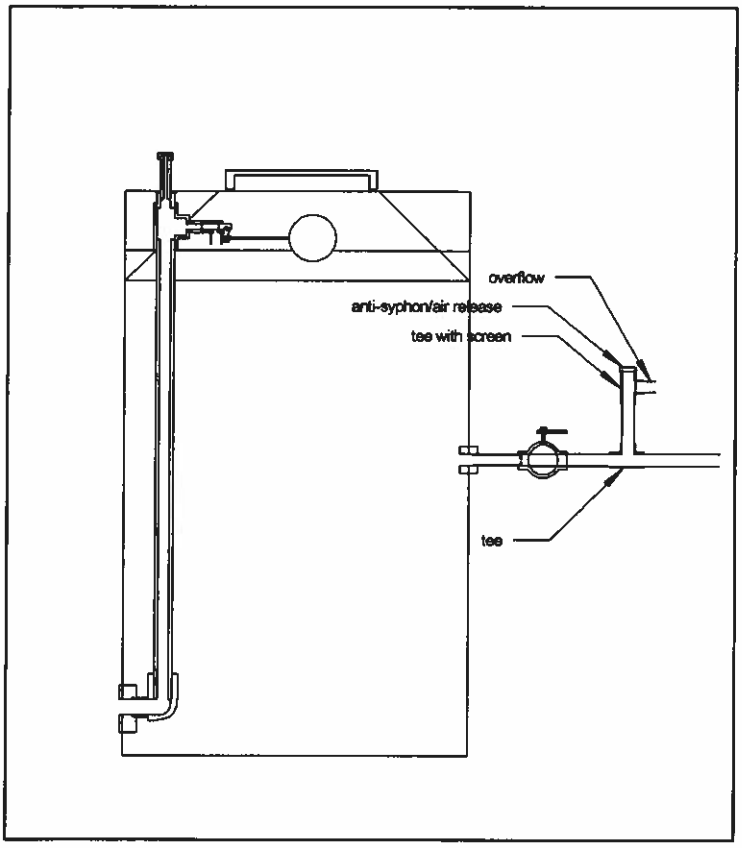
Slow sand filter control tank.



A slow sand filter with two tanks and tank-connector assembly.

Install an anti-syphon/air release/overflow device as shown if any of the following circumstances are present:

a) Air locks in pipeline going to storage tank.
b) Significant elevation or lateral distance to storage.
c) Storage tank has a shutoff float valve.



Make sure flow gauge, if used, is installed with arrow in direction of flow from slow sand filter system to your storage tank. Take care to make sure that cross-connections of wastewater to filtered water cannot occur.

8b) Install the piezometers and sight tubes in the 1 ¼" tank fittings. Secure them at the top of the tanks through the appropriate bolt holes with the supplied bolt and bracket assemblies.
SSF-1.25 peizometer attaches to the ½" threaded fitting on the top of the control tank.

9) Install and/or adjust floats for filter cells (1 each) and for center tank (beneath access lid).

Loading the filter

10) Now that the filter is connected on its site, media loading can be initiated. On SSF 1.25 through SSF 6, remove the screw down lid on top of filters. Start by adding gravel per specification to each filter cell. Make sure that the gravel is level and covers the pipes in the bottom of the filter by at least 2 inches. You may want to disinfect the gravel prior to loading sand. To do this, open the two hose bibs on the manifold between the filter cells and the control tank. Close the ball valves. Allow water to enter the filter. Once the gravel is covered by water, add

liquid chlorine. Water coming from hose bibs should run to waste until it is clear and excess chlorine is not evident.

Next comes the sand. Add sand until two inches below harrowing bulkhead fittings. The specs at the end of this document show how much sand each filter size uses. When the sand is loaded, rake the top surface level. This completes filter loading. Finally, place a 12 inch (approximate) square concrete or ceramic tile on sand beneath inlet float valve to act as a splash plate.

Startup

11) When the filter is operating, water will enter from above the sand through the float valves. But to eliminate air bubbles in the sand, it is best to fill the filter the first time through the hose bibs on the pipe between the filter cells and control tank.

a) **Important: First open the 1.5" ball valves so water fills the control tank and filter tanks simultaneously.** Attach a hose from your source water to the hose bib. Open the hose bib and slowly fill the filter vessel. Once the water level is above the sand in the filter vessel, you may discontinue filling from the bottom and allow source water to fill through the float valves above the sand from now on. Set inlet flow equal to or less than the maximum allowable flow for that filter cell. Example: if you have an SSF-10, each filter cell can handle a maximum of 5 gpm. Set the inlet flow equal to or less than 5 gpm.

Loading bagged sand into the two tanks of a slow sand filter.

b) Close the 1.5" ball valve. Let water from the filter flow out the hose bibs to waste until the water is clear* and dust from the gravel and sand is no longer flowing out.

c) When water coming from the hose bibs is clear*, open the ball valves that were closed to clean the gravel, close the hose bibs, and open the control valve coming from the control tank going to your storage tank. Adjust the flow equal to or less than the maximum flow as shown in the specifications for that model [note: most models come with built in fixed orifices set to the maximum flow of the filter]. The label on the control tank provides this information. Flow adjustment is carried out using a flow gauge (if provided), or you can measure this by timing how long it takes to fill a one-gallon bucket. A fixed orifice at the control valve is installed at the factory. This orifice is sized to the maximum capacity of your filter.

d) It is recommended that safety chlorination disinfection of the distribution lines and tanks be initiated prior to placing the system on line. Remove the dome lid of the center control tank. Chlorine bleach sufficient to leave a measurable residual in the entire distribution system should be added to the center control tank of the slow sand

filter once water is flowing through the system. Replace dome lid. The precise amount of bleach to add is dependent upon storage volume and organic materials contamination of tanks, pipes, and fittings. A residual-free chlorine level of 2-5 parts per million should be sufficient. If there may be a problem with personnel inadvertently changing the control valve, remove the handle of the valve and place the handle in a secure place.

* *or run to waste according to approved operations plan.*

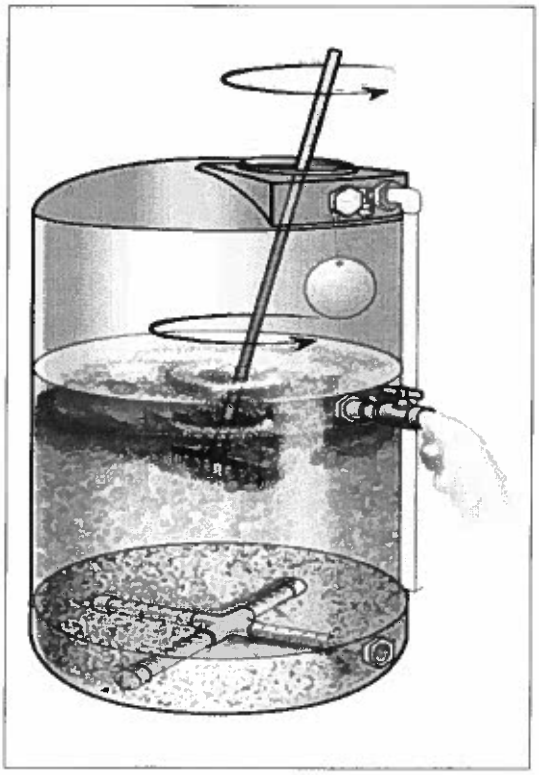
12) A ripening period is necessary for full performance of the biological layer of the filter to be achieved. This is variable depending on raw water quality, season, and temperature. Water testing for microbial quality of finished water is recommended prior to use for drinking water.

Maintenance

13) The clear sight-tubes emerging from filter tanks tell you the operational condition of the filter. The longer tube, called a piezometer, indicates the pressure loss in the filter. The shorter tube (sight tube) indicates water level in the filter tank. As the filter begins to clog from buildup of suspended solids, the water level in the piezometer tubes will drop even though the filter vessels are full. When the water level in the piezometer tubes drops to the level of the harrowing fitting, but the filter vessels are full as indicated by the shorter sight tubes, it is time to service the filter.

Wet harrowing

14) The filter is returned to proper operating condition by wet harrowing (raking the sand bed). The valves placed a little over halfway up the filter vessels are used for harrowing the filter. First, cutoff the water entering the filter through the float valve. Next, open the harrowing valve by rotating the handle one quarter turn. This will begin to drain the standing water above the sand. Open the lid of the filter vessel. With a rake, stir the top layer of the sand vigorously 2-3 inches deep.



Continue to rake the sand until the water has drained off from above the sand. You will notice large amounts of silt and other fine material are being drained away. You may now shut the lid on the filter, re-close the harrowing valve, and return the filter to normal operation. If the water needs continued cleaning, open the valve at the float valve allowing water to enter the filter tank while continuing to rake and drain off through the harrowing valves. It is important to not let the top layer of the sand be exposed to air for long. This can damage the biological layer and affect filter performance. If raw water quality is pretty good, you can alternate

harrowing the filters in a regular schedule of maintenance. If raw water quality is marginal, it is recommended that both filters be harrowed at the same time.
IMPORTANT NOTE! If you are going to take one cell off line, be sure to turn the total outflow from the filter to ½" of rated capacity. Example: If you have an SSF-10 filter and you are taking one cell off line, adjust the valve coming out of the control tank to 5 gpm or less. Failure to do this can result in overloading the filter cell.

Sand replacement.

15) The sand and gravel specified for these filters will probably never need to be replaced. If it is necessary to remove the sand and wash or replace it, however, you will need to drain the filter cells to do so. Draining a filter cell is accomplished by closing the 1.5 inch valve on the filter outlet. The filter drain faucet is then opened and the filter cell drained. Remove sand. If replacing the sand, it is best to do this on a cool morning, as the empty tanks will get hot inside if in direct sunlight. Once the sand and gravel is removed, the filter may be cleaned with fresh water, refilled with media as in installation above, and restarted.

Troubleshooting.

16) The slow sand filter is a remarkably simple machine to install and operate, and there are not a lot of things to go wrong. However, if you do have a problem arise, please refer to the following chart:

Problem	Cause	Solution
High turbidity at start up	Fine material usually on underdrain gravel	Run water to waste until water runs clear
Algae in sight tubes	Sunlight promoting algae growth	Clean with bottle brush and cover to block sunlight
Not enough flow	EITHER: 1) blocked ball valve, or 2) filter needs cleaning	1) Check ball valves for flow into tanks. Check ball valve setting coming out of control tank. 2) Check piezometer (sight tube). If water in piezometer has dropped to level with the sand, harrow the filter.
Turbidity or positive coliform after harrowing	Not thorough enough cleaning	Thoroughly re-harrow filter, making sure there are no unharrowed areas on the sand bed.
Smell in the water	Usually from anaerobic condition	Check to make sure filter is running continuously. If not, add aeration to supernatant water layer above sand.

Float valve sticks open or closed	Valve needs cleaning	Shut off incoming and outgoing water. Remove float, float arm and piston from float valve. Lubricate rings with silicon grease. If float won't shut off due to high pressure on inlet, replace float with a larger float.
Filtered water not reaching storage tank	Air lock in piping	Install tee in pipe at high point between filter and storage, open at top to allow air to escape

Specifications

SSF- 1.25

Flow-rate: 1.25 gpm at a 0.1 g/ft^2/minute maximum loading rate
Filter-vessel tanks: single NSF-rated linear polyethylene, 47 wide x 71 inch high (optional 90" high).
Control tank: NSF-rated linear polyethylene, 30 inch wide x 53 inch high
Sand: 32 ft^3 per tank, 0.35 mm effective size; uniformity-coefficient (uc) < 3
Under drain gravel: 6 ft^3 of 3/8 inch pea gravel

SSF- 3

Flow rate: 1.25 gpm per cell, 2.50 gpm total, 3,619 gpd two cells total, at a 0.1 g/ft$^{2/}$minute maximum loading rate.
Filter vessel tanks: minimum of 2 tanks; additional tanks can be manifolded: NSF-rated linear polyethylene, 47 inch diameter x 71 inch high each (optional 90" high); includes piezometers to indicate head-loss in system.
Control tank: NSF-rated linear polyethylene, 30 inch wide x 53 inch high; flow gauge (optional) and brass ball valve.
Sand: 32 ft^3 per cell 0.35 mm effective size; uc < 3
Under drain gravel: 16 ft^3 of 3/8" pea gravel per tank

SSF- 4

Flow-rate: 2.2 gpm per cell, 4.4 gpm total, 6,336 gpd two cells total, at a 0.1 g/ft^2/minute maximum loading-rate.
Filter vessel tanks: minimum 2 tanks, additional tanks can be manifolded: NSF-rated linear polyethylene 64 inch wide x 79 inch high.
Control tank: linear polyethylene, 29 inch wide x 49 inch high; external piezometer for measuring head loss.
Sand: 67 ft^3 per cell 0.35 mm effective size; uc < 3
Under-drain gravel: 8 ft^3 of 1.5" gravel, 8 ft^3 of 7/8" gravel, 8 ft^3 of 3/8" pea gravel per tank

SSF- 6

Flow-rate: 2.82 gpm per cell maximum flow, 5.65 gpm total, 8,136 gpd two cells total; at a 0.1 g/ft^2/minute maximum loading rate

Filter-vessel tanks: minimum of 2 tanks, additional tanks may be manifolded: UV stabilized, NSF-rated linear polyethylene, 71 inch wide x 79 inch high each; external piezometer for measuring head loss.
Control tank: NSF-rated linear polyethylene, 30 inch wide x 53 inch high: flow gauge, brass metering valve for setting flow rate; brass float valves for maintaining tank water levels.
Sand: 82 ft^3 per tank 0.35 mm effective size; uc < 3
Under-drain gravel: 9 ft^3 of 1.5" gravel, 9 ft^3 of 7/8" gravel, 9 ft^3 of 3/8" pea gravel per tank

SSF- 8
Flow-rate: 3.8 gpm per cell maximum flow, 7.69 gpm total, 11,083 gpd two cells total; at a 0.1 g/ft^2/minute maximum loading rate
Filter-vessel tanks: minimum of 2 tanks, additional tanks may be manifolded. **Nestable with removable lids:** UV stabilized, NSF-rated linear polyethylene, 84 inch wide x 84 inch high each; external piezometer for measuring head loss.
Control tank: NSF-rated linear polyethylene, 29 inch wide x 49 inch high: fixed orifice, brass metering valve for setting flow rate; brass float valves for maintaining tank water levels.
Sand: 92 ft^3 per tank 0.35 mm effective size; uc < 3
Under-drain gravel: 10 ft^3 of 1.5" gravel, 10 ft^3 of 7/8" gravel, 10 ft^3 of 3/8" pea gravel per tank

SSF- 10
Flow-rate: 5 gpm per tank, 7,200 gpd total, 14,400 gpd two tanks total; at a 0.1 g/ft^2/minute maximum loading rate.
Filter-vessel tank: minimum of 2 tanks, additional tanks may be manifolded. Tanks 91 inch wide x 92 inch high; external piezometer for measuring head loss.
Control tank: 30 inch wide x 53 inch high; brass float valves for maintaining tank water levels; flow gauge, brass metering valve for setting flow rate
Sand: 135 ft^3 per tank .35 mm effective size; uc < 3
Under drain gravel: 15 ft^3 of 1.5" gravel, 15 ft^3 of 7/8" gravel, 15 ft^3 of 3/8" pea gravel per tank

Media Specifications

Gravel layers
4 inches of 1.5" gravel
4 inches of 7/8" gravel
4 inches of 3/8" pea gravel

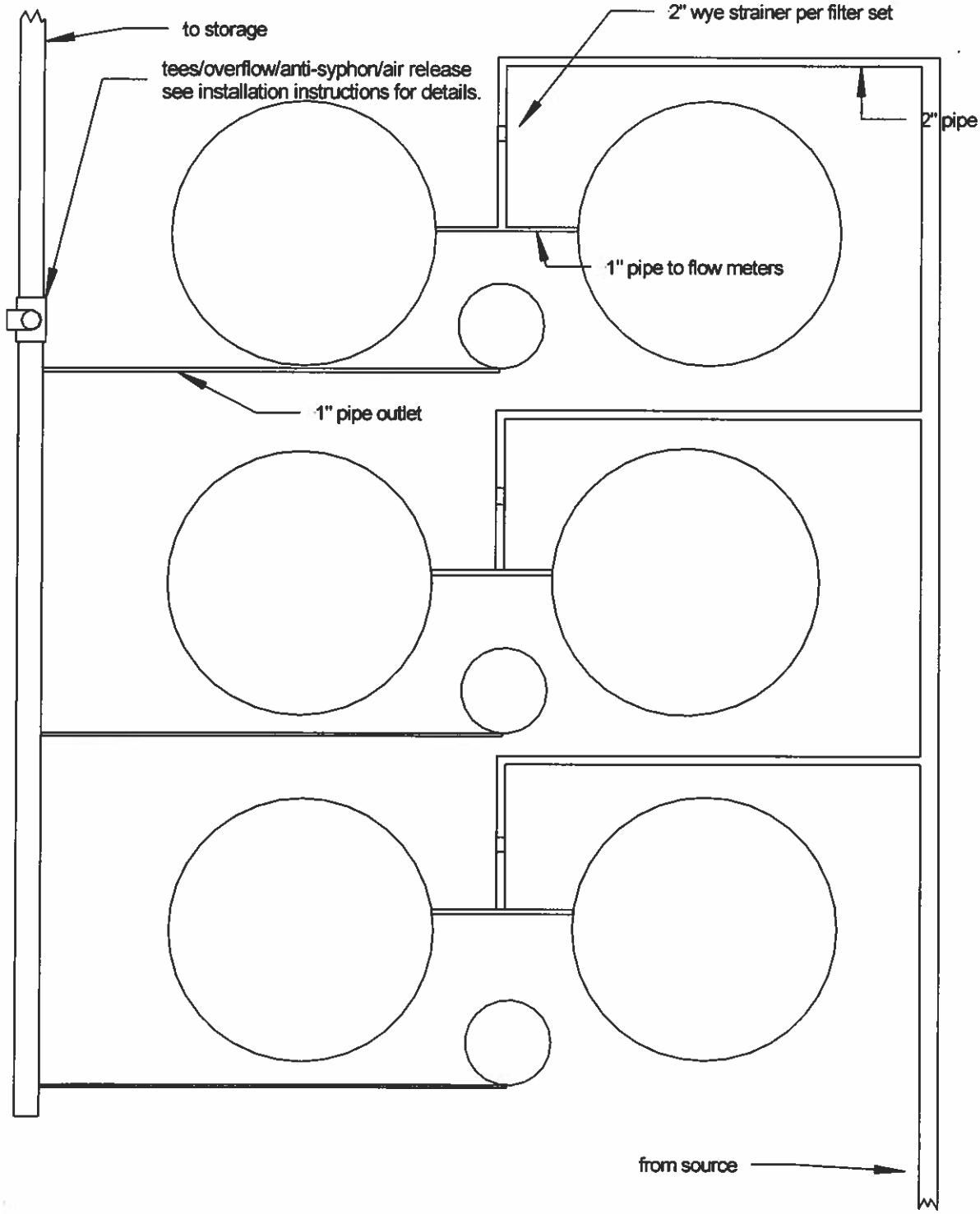
Sand
0.35 mm silica sand. U.C.(uniformity coefficient) = 1.5-2

Sieve Analysis

sieve	*mm*	*cum.*	*passing*
#16	1.18		
#20	0.85	100	+- 0
#30	0.6	92	+- 1
#40	0.43	34	+- 2
#50	0.3	7	+- 1
#70	0.21	1	+- 0
#100	0.15		

Technical assistance

Voice (360) 756-0071, Fax (360) 543-5606, email hb@bluefuturefilters.com

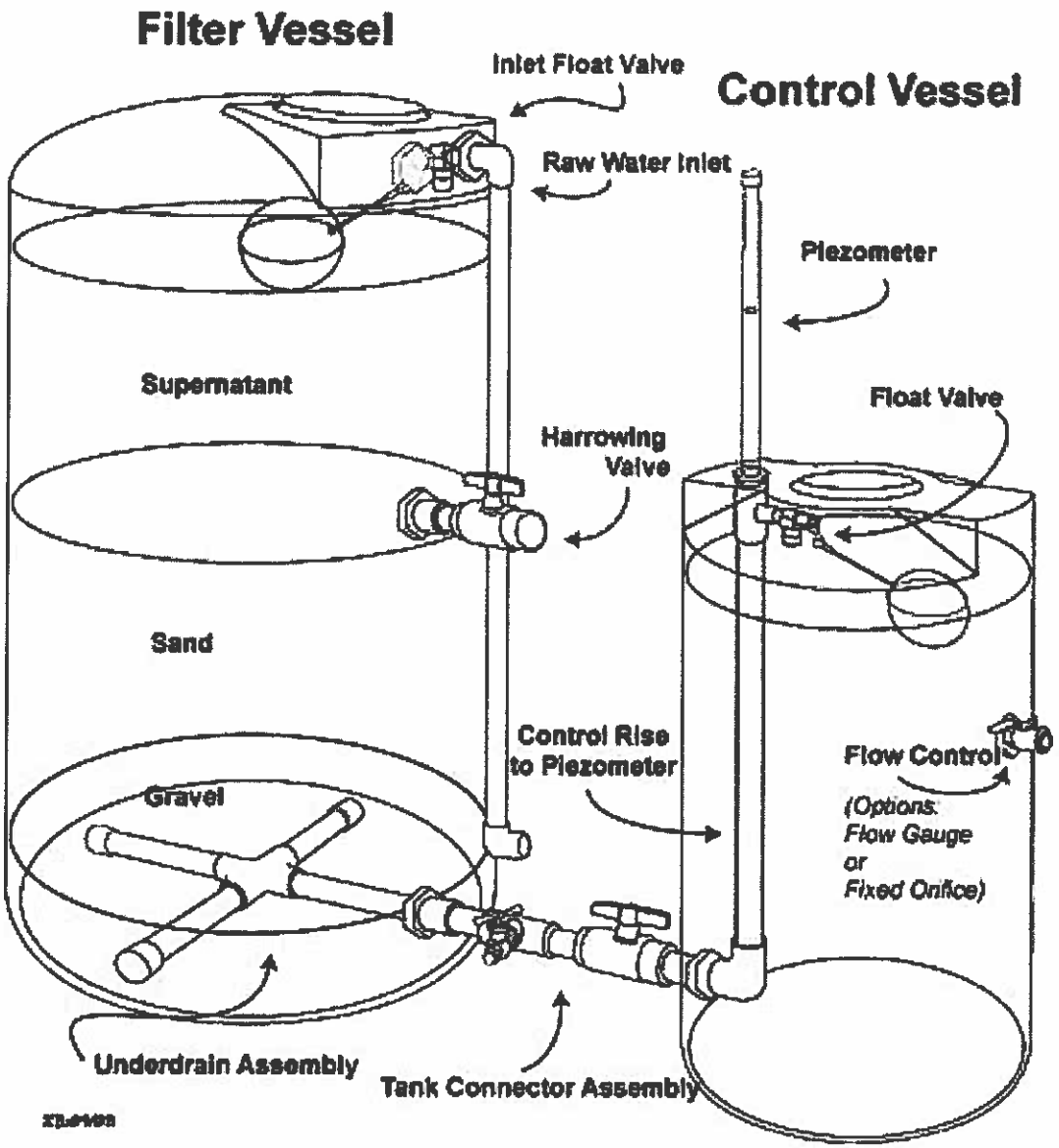


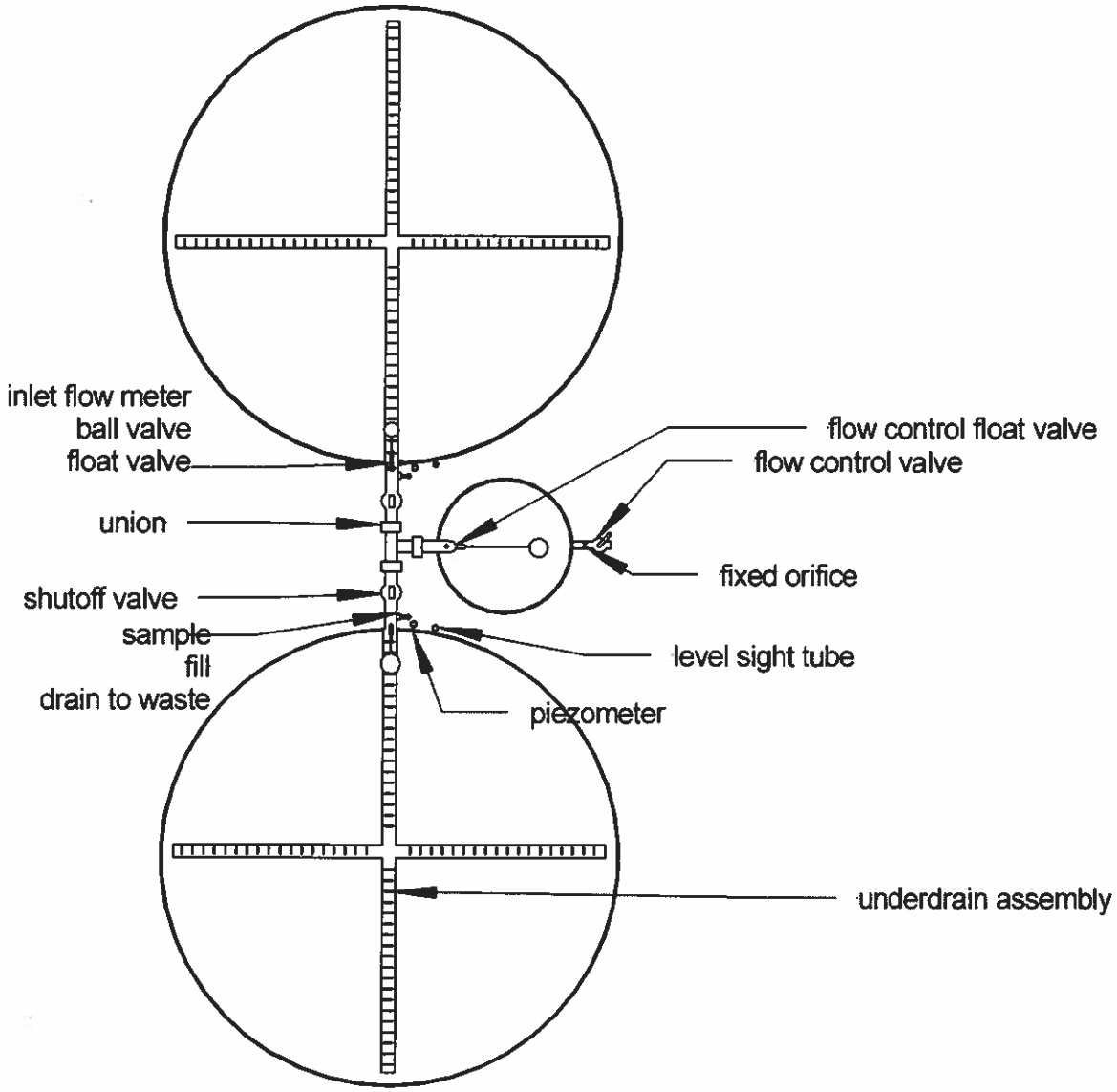
Configuration for three SSF 10 filters manifolded together for a maximum output of 30 gpm.

Blue Future Filters Inc.
Warranty Statement

Blue Future Filters, Incorporated (BFFI) provides warranty coverage to the purchaser that all products are reliable and free from known defects. BFFI will, without charge, repair or replace defective parts that fail due to manufacturing defect. BFFI will provide warranty coverage for filter tanks for a period of up to five (5) years from the purchase of the filter-system. BFFI will provide warranty coverage for all valves and fittings for a period of one (1) year from purchase of the filter-system. Although BFFI provides technical support before, during and after installation, BFFI will not be held responsible or extend a warranty for operational failure or interruption that may be due to incorrect installation or maintenance. Unless installation is performed by certified Blue Future Filters personnel, BFFI will not provide warranty for damage to system components caused during or after installation, or through failure to follow installation instructions. Given the variability in each filtration system and in source-water conditions, BFFI will not provide warranty for filtration performance based on water-quality parameters (including climatic changes, raw-water quality, turbidity, etc.). Any unauthorized alteration to the equipment as supplied or to BFFI filter designs as specified void the warranty.

SSF 1.25
Note: Not to scale





Blue Future Filters slow sand filter plan view