



BEAD FILTER MODEL PG-3



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BEAD FILTER

PolyGeyser Bead Filter is the newest addition to Aquaculture Systems Technologies' line of bead filters. Patented (U.S. Patent # 9,227,863; Patent pending European Patent #0977713B Canadian Patent #2,287,191) under development for numerous years, the technology exploits the biofilm protection provided by our Enhanced Nitrification (EN) Bead Media. Designed as "bioclarifiers" capable of performing both biological and mechanical filtration, *PolyGeyser* Bead Filters are capable of handling biological loads 50% to 100% higher than our Bubble-Washed or Propeller-Washed Bead Filters equipped with standard bead media. Additionally, the *PolyGeyser* Bead Filters offer a very high degree of reliability and are virtually immune to clogging and caking, since they backwash automatically without moving parts or electronics.

OPERATION

The *PolyGeyser* Bead Filter stands apart from AST's other Bead Filter technologies primarily through its automatic pneumatic backwash mechanism. Recirculated water is introduced below the bed of packed EN bead media and travels upward through the filtration chamber where mechanical and biological filtration takes place. Simultaneously, air is introduced into the air charge chamber at a constant, predetermined rate to achieve the desired backwash frequency. Once the charge chamber has reached capacity, the pneumatic trigger fires, releasing the entrained air from the charge chamber below the media bed. The sudden release of air from the charge chamber causes the beads to mix, roll and "drop" as the air agitates the beads.

The circulation pump/airlift operates continually, which ensures that the filter chamber begins refilling immediately after each backwash event. This causes the beads to float upward and reform as a bed. During the recharge cycle, suspended solids in the trapped backwash waters settle into the sludge storage chamber for later disposal via the sludge drain valve (usually every 2-3 days). At the same time, the supernatant is passed slowly through the bead bed again as the air charge chamber is recharged with air.

The elimination of water loss associated with backwashing is a key element in this new technology. In most applications, dozens of backwash sequences can be automatically executed before sludge removal is required. There is no water loss associated with the backwash process and the water loss associated with sludge drainage is negligible. This strategy is particularly advantageous for marine systems, where the loss of saltwater and need for large backwash water treatment units are minimized.

The pneumatic strategy breaks the linkage between backwash frequency and water loss and allows the nitrification capacity of the unit to be fully utilized. Frequent backwash sequences have proven advantageous for optimizing the nitrification capacity of the unit. Numerous gentle scrubbing cycles promote high rates of nitrification by maintaining a healthy thin biofilm on the bead surfaces. Typical backwash cycles occur once every three to six hours. In recirculating bioclarifier applications, where the *PolyGeyser* Bead Filter operates concurrently as a clarifier and biofilter, total ammonia nitrogen (TAN) levels below 0.3, 0.5 and 1.0 mg-N/l can be expected at feed loading rates of 0.5, 1.0 and 1.5 pounds feed per cubic foot of EN bead media (8, 16 and 24 kg-feed m⁻³ day⁻¹), respectively.

Bead Filters are Bioclarifiers

The term “Bioclarification” was coined some years ago by Dr. Ronald F. Malone, the inventor and patent holder of Bead Filter Technologies, to describe the ability of bead filters to perform both mechanical and biological filtration in the same unit. The ability of bead filters to perform these tasks is described in detail below.

Clarification

Bead filters perform well in the control of suspended solids across a broad spectrum of conditions. Bead filters capture solids through four identifiable mechanisms (Table 1). With the exception of adsorption, the solids capture mechanisms are physical in nature and are common to all types of granular media filters. As a general observation, the filters seem to control fine colloidal particles best with some biofilm development. This suggests that the biofilm absorption process is an important mechanism in the control of fine suspended solids and thus water clarity. Studies have shown that bead filters capture 100% of particles > 50 microns and 48% of particles in the 5-10 micron range per pass (Figure 1).

Table 1. Mechanisms Contributing to the Capture of Solids in a Bead Filter

Mechanisms	Comment
Straining	Direct capture of larger particles as they pass into small openings between the beads.
Settling	Sinking of suspended solids onto the surface of the beads.
Interception	Impact of particles directly onto the surface of a bed.
Adsorption	Small particles are captured and absorbed into the sticky biofilm.

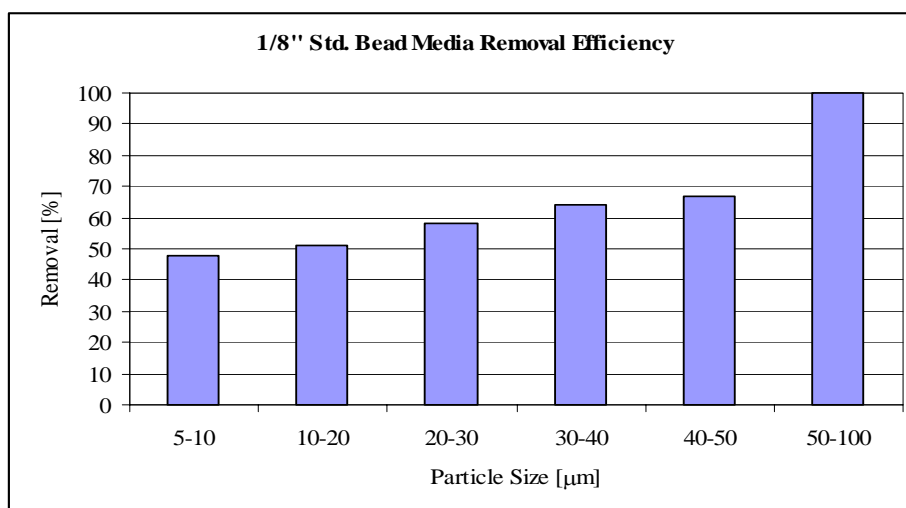


Figure 1. All particles above 50 microns are removed in the first pass through the filter and the remainders are removed with multiple passes.

The flowrate delivered to a bead filter is the principle management factor influencing suspended solids removal. The efficiency (single pass percent reduction in TSS) of a bead filter generally increases as the flowrate to the filter decreases; however, the capture rate (mass of TSS captured) tends to increase with flowrate. This apparent contradiction occurs because per pass efficiency is relatively insensitive to changes in flowrate, and so, minor drops in efficiency that occur with flow increases are more than compensated for by enhanced solids transport to the filter. Generally, recirculating rates used with closed or partially recycled systems should be maximized to obtain the lowest possible TSS level in the holding tanks.

Separation of captured solids from the bead bed is accomplished by sedimentation of released sludge after the bed is backwashed. Materials such as fats or wood chips merely float upward with the beads and are not removed. In sufficient quantity, these materials will eventually foul the bed requiring media replacement. Bead filters are also not well suited for the clarification of waters suffering from mineral turbidity problems caused by fine clays or other colloidal particles. Lacking good biofilm development, the mechanisms for the capture efficiencies are unacceptably low. Finally, the bead filters will impact but cannot control planktonic algal blooms. Although some capture occurs as a general rule, the algae can grow faster than they can be caught and thus little progress towards clarification is made. Application of the bead filter technology to the problem of colloidal mineral turbidity or algal blooms requires the use of supplemental treatments (chemical flocculation or U.V. disinfection, respectively) or the filter will be ineffective.

Biofiltration

In the biofiltration mode, bead filters are classified as fixed film reactors. Each bead (Figure 2) becomes coated with a thin film of bacteria that extracts nourishment from the wastewater as it passes through the bed. There are two general classifications of bacteria, heterotrophic and nitrifying, that are of particular interest (Table 2). The two bacteria co-exist in the filter, and understanding their impact on each other as well as on the filter is critical.

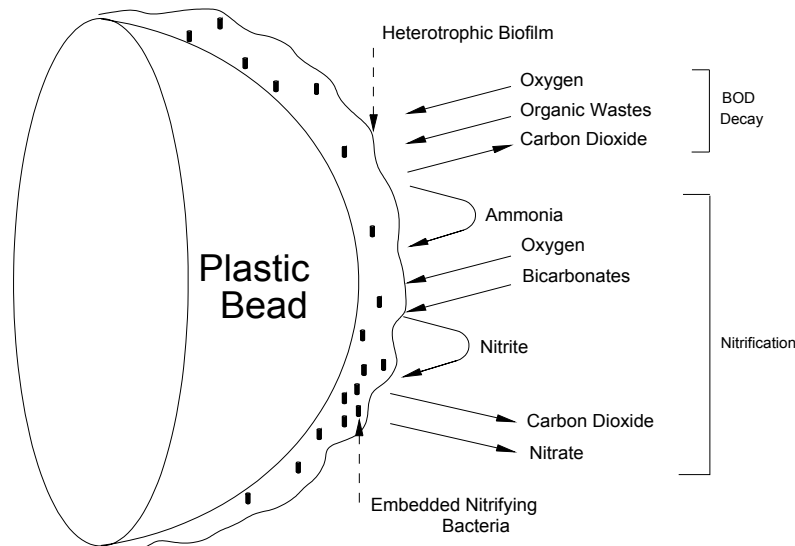


Figure 2. The bacterial film that coats each bead contains the nitrifying bacterial population. Heterotrophic bacteria also form a thin biofilm layer on each bead. The nitrifying bacteria compete with the heterotrophic bacteria for space.

Table 2. In the Biofiltration Mode, Bead Filters Cultivate Two Types of Bacteria which Perform the Critical Biofiltration Function.

	Heterotrophic Bacteria	Nitrifying
Function	Remove dissolved organics (BOD) from the water column; breakdown and decay organic sludges.	Convert toxic ammonia and nitrite to nitrate.
Reproduction Rate	Very fast (10 – 15 minutes)	Slow (12 – 36 hours)
Yield (mg bacteria/mg waste consumed)	0.6 – 0.8	0.05 – 0.10
Bead adhesion	Poor	Good

The classification of heterotrophic bacteria encompasses a great number of genera/species that share the common characteristics of extracting their nourishment from the breakdown (decay) of organic matter. Biochemical oxygen demand (BOD) is largely an indirect measure of the biodegradable organic material in water. Heterotrophic bacteria reduce BOD levels, consuming oxygen in the process. About 60 percent of the organic matter consumed is converted to bacterial biomass; whereas, the balance (40 percent) is converted to carbon dioxide, water, or ammonia. Heterotrophic bacteria grow very fast, capable of doubling their population every ten to fifteen minutes. If the BOD in the water being treated is very high (> 20 mg -O₂/l), the heterotrophs will quickly dominate the bead bed, overgrowing the slower growing nitrifying bacteria and consuming tremendous amounts of oxygen.

The second, yet more important, classification of bacteria is the nitrifying bacteria. These bacteria are specialists, extracting energy for growth from the chemical conversion of ammonia to nitrite and from nitrite to nitrate (Figure 3). Nitrate is a stable end product which, although a valuable nutrient for plants, displays little of the toxic impacts of ammonia and nitrite. Composed principally of two genera (Nitrosomonas and Nitrobacter), nitrifying bacteria are very slow growing and sensitive to a wide variety of water quality factors. It is not surprising that most bead filters used for biofiltration are managed to optimize conditions for nitrification.

FILTER ACCLIMATION

Development of a biofilm layer on the media is required for biofiltration. The bacterial culture, which grows attached to the beads, performs the biochemical transformations that are so critical in the purification of recycled waters. Initially the biofilter has no bacteria and the culture must be started. The process of growing the initial bacterial culture in the biofilter or adjusting an established culture to a change in loading is called acclimation. Fortunately, the process of biofilter acclimation is easy. It just takes a little time and food for the bacteria.

The best way to acclimate a recirculating system with a biofilter is to just add a few hardy fish, turtles, or mollusks to the system and start to feed them. The total suspended solids in the system will pose no problem because bead filters capture solids primarily by physical processes that are not dependent on the development of a biofilm. The heterotrophic bacteria will grow rapidly and quickly attach themselves to the beads, so BOD accumulation should pose no problem. The nitrifying bacteria, however, are very slow reproducers and may require almost thirty days under warm water conditions (2 - 3 weeks is more typical) to establish themselves.

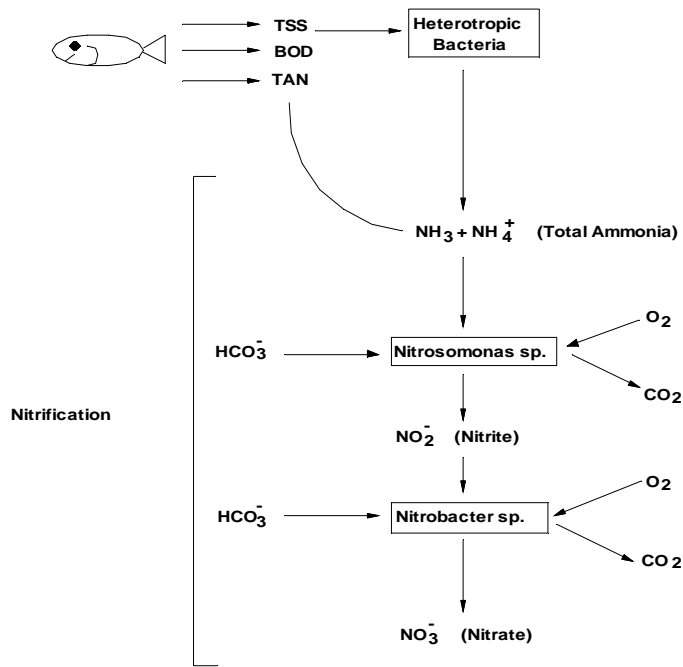


Figure 3. Two specialized types of nitrifying bacteria convert toxic ammonia and nitrite to the relatively safe nitrate. Bicarbonate ions and oxygen are required in large amounts.

During acclimation the backwash frequency of your *PolyGeysers* filter should be 1-2 backwashes per day. This will keep the bead mixed and promote homogenous growth of nitrifying bacteria throughout the bead bed.

Figure 4 illustrates the classical pattern of TAN (total ammonia nitrogen) and nitrite concentrations observed during filter acclimation with animals. The process starts with an increase in TAN concentrations. This indicates that the first group of nitrifiers responsible for ammonia conversion to nitrite are present in large numbers when the ammonia excreted by the fish stops accumulating and suddenly (within 36 hours) drops to near zero levels. At the same time there will be a sudden rise in nitrite levels, followed by a gradual increase which will continue until suddenly the second group of bacteria, Nitrobacter, catch up with their new food supply and the nitrite concentrations plummet. The filter is now considered acclimated to a light loading. This initial stage of acclimation is critical because during this period populations of bacteria which can effectively attack the specific waste produced by the animals become established and these bacterial populations adjust to operate under the water quality conditions and temperature regime found in your system. This unique culture of bacteria will remain in the biofilter for years if it is just treated with a little common sense.

Table 3 summarizes things you can do to accelerate the initial acclimation of the bead filter. These procedures can reduce acclimation time to as little as two weeks in a warm freshwater system. One of the principal limitations of acclimating a filter with animals is that little or no nitrite is available for the growth of Nitrobacter until the Nitrosomonas population has become established. This means that the very slow growing Nitrobacter cannot even get started for over a week. Therefore, you can simply reduce the acclimation time by adding nitrite at the start. The acclimation process becomes moot if you have an acclimated bead filter on your premises. Just exchange a few cubic feet of acclimated beads from the old filter with new beads and both filters will adjust rapidly. Lacking the beads, have a friend provide you with backwash water

from an established filter. Just dump the sludge into the system. The bead filter will pick it up and leave the solids in intimate contact with the beads where the transfer of desirable bacteria will rapidly take place.

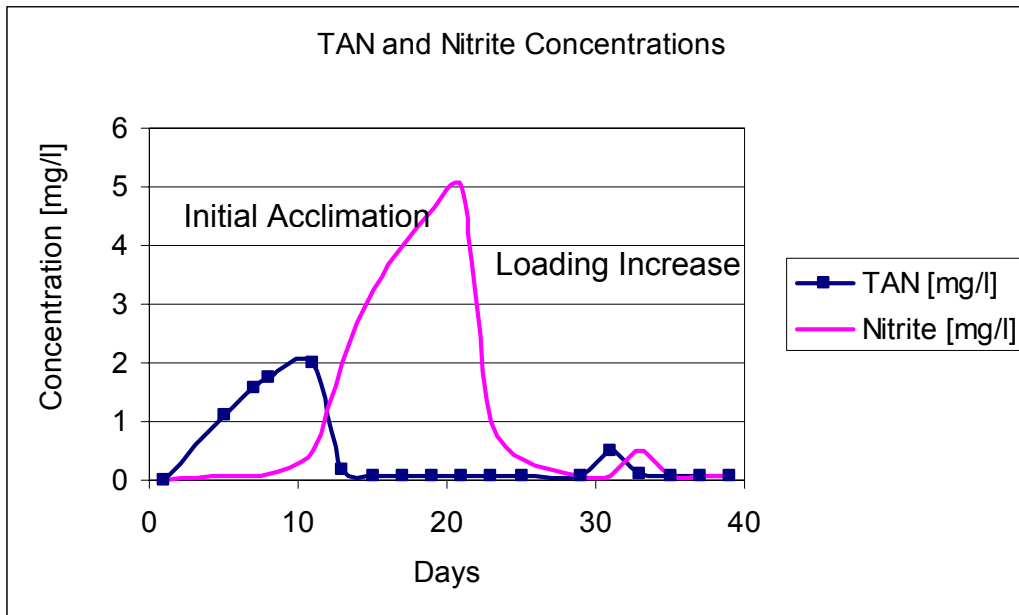


Figure 4. Tan and nitrite concentration build-ups are normally observed during the initial acclimation of a biofilter.

Table 3. Things You can do to Accelerate the Initial Acclimation of a Bead Filter

	Procedure	How does it help?
1	Add sodium nitrite at a concentration of 1 mg-N/l on the first day.	Allows growth of <u>Nitrobacter</u> to start immediately.
2	Add backwash waters or beads from an established biofilter. *	Introduces species/strains of bacteria that are well suited for the bead filter's ecosystem.
3	Reduce Filter Backwash Frequency	Minimizes the loss of biofloc.
4	Raise the temperature of the system to 30° C.	Accelerates bacterial growth rates by increasing metabolic rates.
5	Adjust the pH to 8.0.	Accelerates bacterial growth rates by increasing ammonia (NH ₃) concentrations.
6	Add sodium bicarbonate to raise the alkalinity to 150 mg-CaCO ₃ /l	Accelerates bacterial growth rates by increasing bicarbonate availability.
* Disease may be spread with the biofilm, so make sure the source is healthy.		

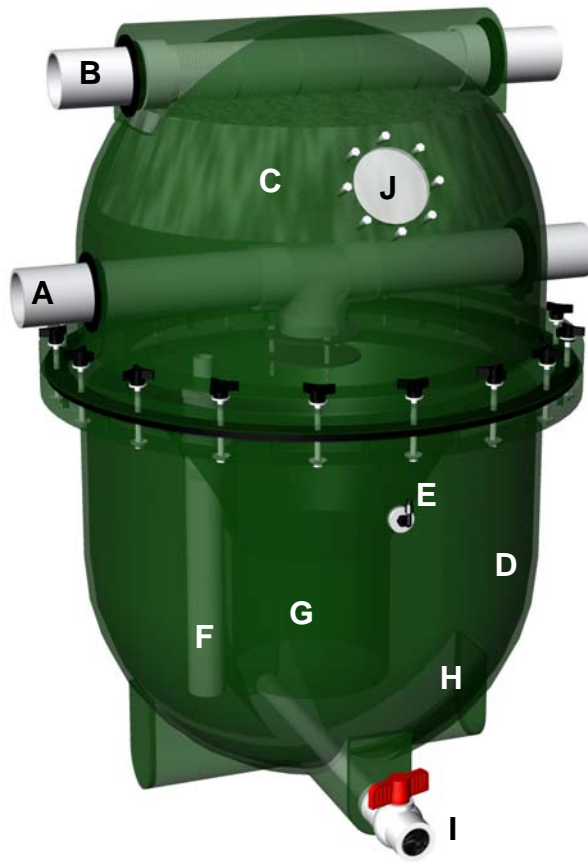
You should be careful not to kill the animals which are used to acclimate the filter. The animals you select to use do not need to be the same as you will be culturing. The best choice for freshwater systems is turtles. The ammonia and nitrite concentrations that will be reached will not affect these animals. So you do not have to worry. In-expensive domestic Koi or goldfish

are good choices if fish are used. However it is important that the fish or animals used during acclimation are disease free so as not to infect your high quality fish later. These animals can tolerate **short-term** exposure to TAN and nitrite levels of about 5 mg-N/l without harm if you keep the pH between 7.5 and 8.0 and add some sodium chloride (rock salt) or calcium chloride. Chlorides help prevent nitrite toxicity by blocking nitrite transfer in the gills. The pH range keeps the TAN in the less toxic NH_4^+ form. It is usually the nitrite peak, which is twice to three times as high as the TAN peak, which damages the fish. If the fish show signs of stress (inactivity, lack of hunger, or gaping near the surface), remove them; you will have plenty of food for the bacteria in the water column already. The fish should be reintroduced into the system once both the TAN and nitrite levels fall below 1 mg-N/l.

The initial acclimation assures that the biofilter contains the right type of bacteria. However, you then must adjust the amount of bacteria to assure there are enough of them to process the ammonia produced by the animals in the system. So the next step in the acclimation process is to increase the density of animals in moderate steps allowing some time for the bacterial population to grow to meet the increased demand. This process of acclimation to increased loading is normally undertaken with the animals of choice, since the TAN and nitrite peaks are small and quickly disappear. As a general statement, an acclimated filter will completely adjust to a sudden increase in fish density (or feed level) within 72 hours. If the step increase is moderate (< 33 percent of current load), the acclimation will probably occur without noticeable peaks. The heights of the acclimation peaks are actually controlled by the density of fish in the system, not by the size of the biofilter. That is, the nitrite peak in a system with a fish density of 0.25 pounds/gallon will display a peak concentration one-half as high as a system with a density of 0.5 pounds/gallon. Table 4 summarizes additional methods that can be used to decrease transitional peaks. The process of acclimation to increased loading occurs naturally if the bacteria and animals are allowed to grow together. The bacteria always grow faster, maintaining the proper balance between the biofilm and the animal density. For example, within a Koi pond, once the filter is acclimated to the fingerling density, the biofilter's ecosystem will take over and maintain the proper balance. Your management responsibility occurs when the natural growth processes are disrupted by sudden (unnatural) changes in the system.

Table 4. Things that Can be Done to Decrease Transitional Peaks of TAN and Nitrite When the Animal Density or Feed Rates are Increased

	Procedure	How does it help?
1	Increase your waterloss from the system until the biofilters adjust.	TAN and nitrite will be flushed with the water.
2	Discontinue or reduce feedrate during the transition.	TAN excretion rates from most animals increases with feeding.
3	Make loading increases in small increments (< 33 percent of current load) and separate steps by about 3 days.	Existing bacteria will absorb most of the increased load and reproduce rapidly.
4	Extend backwashing interval.	Decreases biofloc loss during the critical transition.
5	Adjust pH and alkalinity to optimum range.	Accelerates reproduction of nitrifying bacteria.
6	Artificially increase the TAN loading prior to the increase by dosing of ammonia chloride (NH_4Cl) and sodium nitrite (NaNO_2) to a level of 1 mg-N/l.	Promotes growth of the critical nitrifying bacteria, enriching their density in the biofilm.



PolyGeyser Bead Filter Major Components

Filter Specifications	English Units	Metric Units
Height	47"	1.20 m
Diameter	33.25"	84.5 cm
Shipping Weight	175 lbs	80 kg
Bead Media Volume	3 ft ³	85 L
Max. Flow Rate	45 gpm	170 lpm
Max. Pressure	10 PSI	0.7 bar
Air Volume for Backwash	4.5 ft ³	127.43 L

Major Component List – Basic Configuration

Item	Description
A	3" SCH40 PVC Water Inlet Distribution Assembly
B	3" SCH40 PVC Water Outlet and Bead Retention Screen, 0.066in. slots
C	Filtration Chamber Housing
D	Charge Chamber Housing
E	Air Inlet, ¼" NPT x 3/16" hose barb
F	Trigger
G	Drop Chute
H	Sludge Storage Zone
I	Sludge Drain Valve, 1.5" FIPT Valve, machined nipple & screen pipe
J	Window

INSTALLATION

The DROP Filter is designed to accommodate two different operational configurations, i.e. **Air Lift** and **Pump** flows.

Air Lift Configuration

In the Air Lift version, existing headspace (18-24 in / 46-60 cm required) is exploited to gravity flow treatment water through the filter and return clean water by airlifting it back into the tank/pond. The Air Lift version is supplied with the external plumbing fittings listed below.



DF-3 Air Lift External Plumbing Fittings

Item	Qty.	Description	Part No.
A	4	3" Rubber couplings w/hose clamps	QC-RC226

Airlift Configuration Plumbing

For airlift applications, we recommend using both sides of the 3" inlet pipe. An effective way to maintain low turbidity is to employ the dual-drain scheme, in which the heavier particles are drawn from the bottom of the tank/pond and lighter particles through a surface skimmer or side drain. Connect the inlet line to the filter using the 3" rubber couplings supplied and tighten hose clamps.

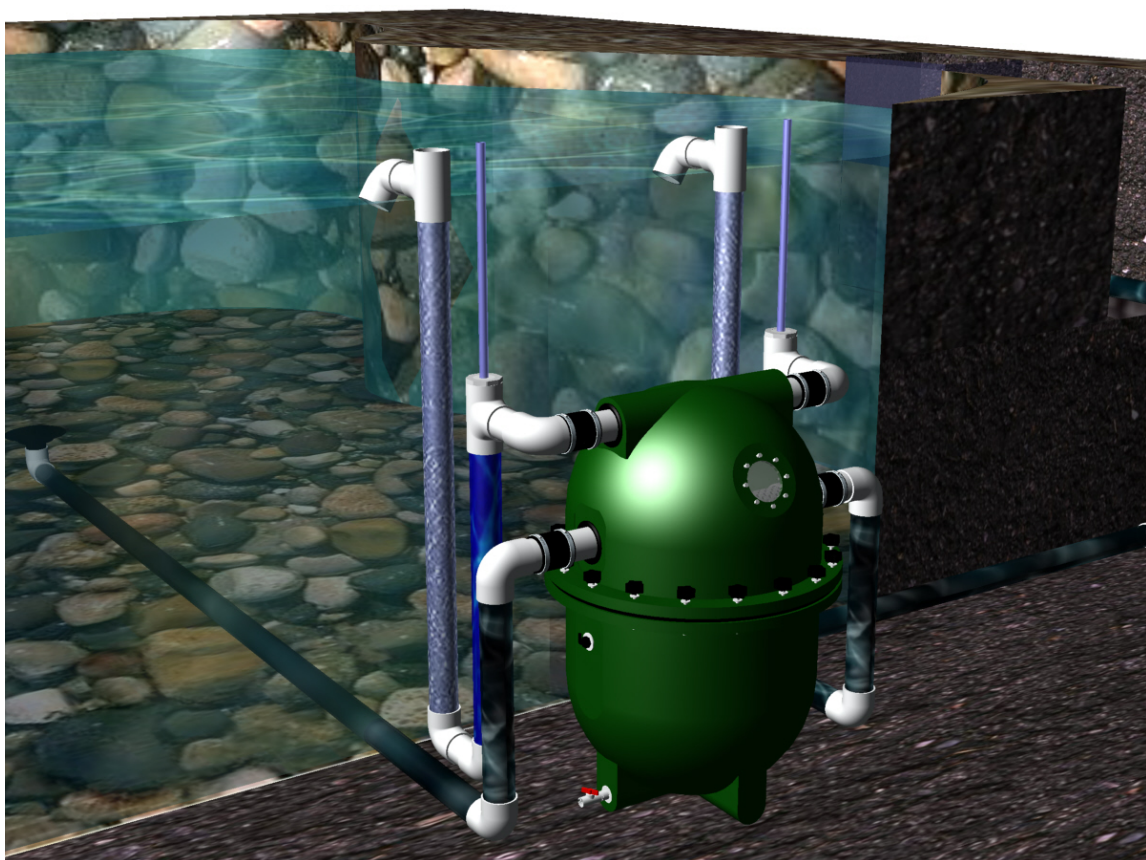
Connect the outlet pipe (top most outlets) to the two airlifts with the supplied 3" rubber couplings and tighten hose clamps.

Attach air supply line to the 3/16" barb connector. Install the air pump above the water level to prevent flooding in case of power shortage.

Connect drain line to the 1.5" FIPT sludge drain valve.

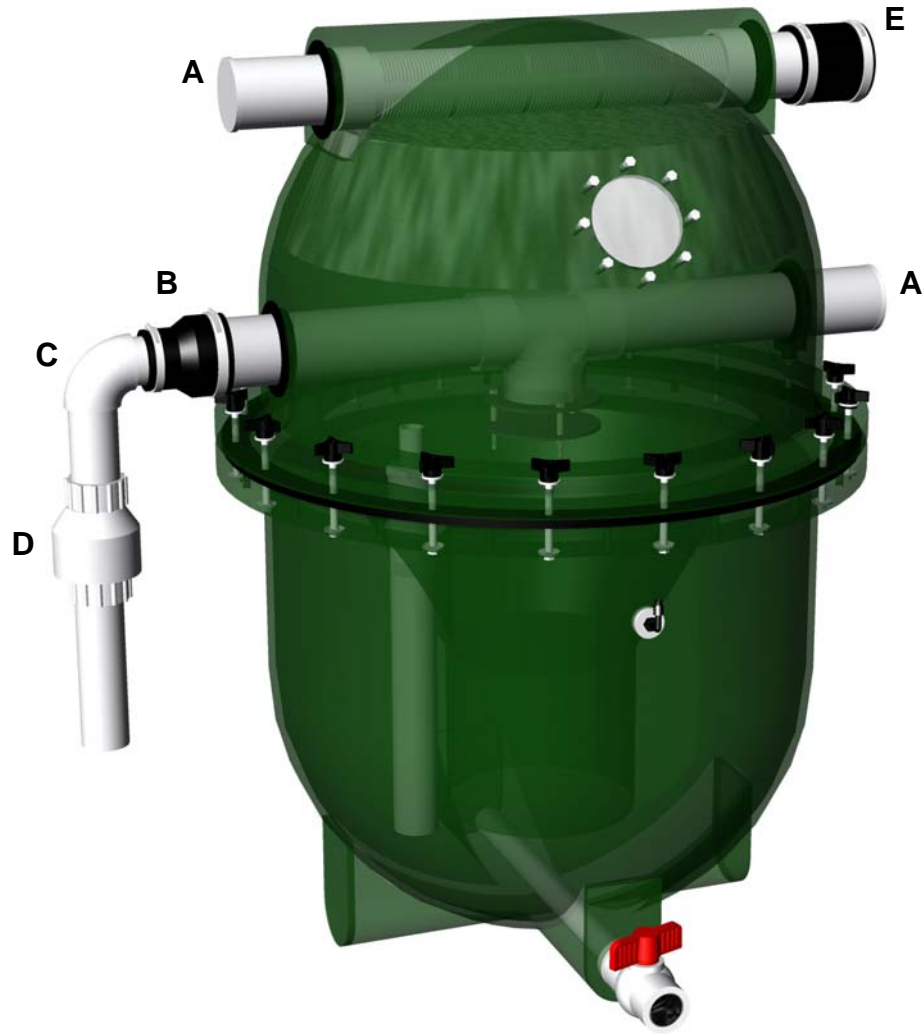
Appendix A contains schematics showing an example of how to install the unit for Airlift Operation.

AFTER INSTALLING THE FILTER IT IS NECESSARY TO SET THE BACKWASH FREQUENCY AT THE HIGHEST RATE POSSIBLE FOR 24 HOURS TO FACILITATE THE MOVEMENT OF THE BEAD MEDIA FROM THE CHARGE CHAMBER TO THE FILTRATION CHAMBER. DURING SHIPPING, THE BEADS NATURALLY MIGRATE INTO THE CHARGE CHAMBER. MULTIPLE BACKWASHES ARE NECESSARY TO FLUSH THEM FROM THE CHARGE CHAMBER ONCE THE FILTER IS PUT INTO OPERATION.



Pump Configuration

In applications where the available headspace either cannot be utilized or is too small, water can be circulated through the unit with a pump. The Pump version is supplied with the external plumbing fittings listed below.



DF-3 Pumped External Plumbing Fittings

Item	Qty.	Description	Part No.
A	2	3" Insert Caps	RD-SP300
B	1	2"x3" Reducing rubber coupling with hose clamp	QC-RC246
C	1	2" Street Ell (Spigot x Soc)	409-020
D	1	2" Swing check valve (Soc x Soc)	1520-20
E	1	3" Rubber coupling with hose clamp	QC-RC226

Pump Configuration Plumbing



If possible, it is a good idea to install the filter above ground level to facilitate 1) putting a bucket under the sludge line for easy sludge collection or 2) providing the necessary head to allow the sludge to flow to a drain.

Connect the pump discharge to the supplied 2" check valve.

Installation of a ball valve (not shown) between the pump and the filter is recommended to allow for flow control.

Connect the return line to the filter outlet with the supplied 3" rubber coupling and tighten clamps. *We do not recommend the installation of a flow control ball valve on the outlet side of the filter, if inadvertently closed it could result in over pressurization of the unit an/or plumbing failure (i.e. failure of rubber couplings).*

Install and glue the two 3" insert caps into the unused inlet and outlet pipes.

Attach air supply line to the 3/16" barb connector. Install the air pump above the water level to prevent flooding in case of power shortage. *We also recommend the installation of a check valve in this line to prevent back flow of water into the air pump, which can present an electrical hazard.*

Connect drain line to the 1.5" FIPT sludge drain valve.

Exceeding the recommend flow rate of 45 gpm can result in fluidization of the bead media. If this occurs, simply throttle back the flow until the beads are no longer fluidized.

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AIR PUMP REQUIREMENTS FOR BACKWASHING

The 3-ft³ *PolyGeyser* Bead Filter charge chamber capacity is 4.5 standard cubic feet of air (127.4 L), once this volume is met, the trigger will fire and the filter will backwash.

In selecting an appropriate air pump for the system, the air flow capacity (scfh or lpm) required to effect backwashes at the desired intervals as well as the air delivery pressure must be taken into consideration. If the filter is operated with a water circulation pump, the air delivery pressure must exceed that of the water pump to prevent ***accidental flooding of the air pump, which may present an electrical hazard.*** Additionally, a check valve should be installed in the air line to prevent flooding of the air pump in the event of a power outage and to protect the air pump in case of excessive pressure development in the filter.

We recommend using an air pump capable of producing the most frequent backwash intervals that may be required. The flow rate can then be regulated by installing an air flow meter, with a built-in regulating valve with a range of 0 to 5 scfh (0-100 L/hr). AST offers an air flow meter kit Part # DF-SUFLOWKIT which includes an acrylic 0-5 scfh flow meter, aluminum mounting bracket and two 3/16" barb fittings.

Selection of proper air pumps is of less concern when operating in the airlift mode, since the system operates at a very low head (18-24" / 46-60cm TDH). Several commercially available air pumps are capable of delivering the required volume and meeting the pressure demands for a single unit. However, the selection of air pumps is ultimately dependent on the selection of water pumps.

Some recommended air pumps include:

- Tetrattec Deep Water Air Pumps (0.15cfm @ 3.5 PSI / 4.25L/min @ 0.24 bar)
- Luft Pump (0.05 cfm @ 3 PSI / 1.42 lpm @ 0.21 bar)
- Imported Silent High Pressure Air Pump (0.10 cfm @ 6 PSI / 2.83 L/min @ 0.41 bar)
- Thomas Diaphragm Pump 1/20 Hp (0.30 cfm @ 20 PSI / 8.5 L/min @ 1.38 bar)

Another option is to use a small oil-less air compressor with a storage tank and built in pressure regulator. The storage tank will provide improved overall stability and means the air compressor does not run continuously. Additionally, the pressure regulator allows you to set the air output pressure so that it will be greater than the pump output pressure at all times. We also recommend this set up for operating multiple units. Sears, Home Depot and Lowe's all sell

these types of portable air compressors. A possible disadvantage of using an air compressor is the sound produced when the compressor turns on to re-fill the storage tank.

The size of the compressor depends on the number of units you wish to backwash. A portable air compressor, which stores air in a tank at 90-100 psi, holds approximately 1.1 ft³ (8.2 gal or 31 L) of air per gallon (3.8 L) of tank storage space. We recommend you choose a compressor with a tank volume of at least 4 gallons (15 L) per filter. The estimated time between successive compressor operations using a 4 gallon storage tank is approximately 30 minutes and the relationship seems to be linear so that an 8 gallon tanks runs only once per hour. Note the time between compressor operations is approximate and may vary depending on a number of conditions including compressor manufacturer, temperature, and elevation above sea level. Note a larger tank storage volume is always better and simply means your air compressor will run less often to keep the tank full.

BACKWASH FREQUENCY

The optimum frequency of backwash intervals varies with feed loading. The table below presents recommended backwash regimes and associated air flowrates.

Feed Loading Rate	Air Flow	Backwash Frequency
0.5 lbs/ft ³ Media	0.75 SCFH (0.0125cfm)	4/day
8.0 kg/m ³ Media	21.24 L/hr	
1.0 lbs/ft ³ Media	1.5 SCFH (0.025cfm)	8/day
16.0 kg/m ³ Media	42.48 L/hr	
1.5 lbs/ft ³ Media	2.25 SCFH (0.0375cfm)	12/day
24 kg/m ³ Media	63.71 L/hr	

PUMP SELECTION

The DF3 is designed as a low-head filter. Operating pressure should therefore not exceed 10 PSI (0.7 bar). Installation of devices causing excess backpressure on the discharge side of the filter should also be avoided.

Recommended Pumps

Pump	US Units	Metric Units
Wave Pump 1/8 Hp	45 gpm @ 4.8 PSI	170 L/min @ 0.3 bar
Wave Pump ¼ Hp	45 gpm @ 7 PSI	170 L/min @ 0.5 bar
Dragon Pump ¼ Hp	45 gpm @ 6.5 PSI	170 L/min @ 0.4 bar
Sequence 750 Model 3600SEQ12 1/8 Hp	45 gpm @ 2.2 PSI	170 L/min @ 0.2 bar
Sequence 750 Model 4200SEQ12 1/8 Hp	45 gpm @ 3 PSI	170 L/min @ 0.2 bar
Sequence 1000 Model 4300SEQ20 1/6 Hp	45 gpm @ 5.2 PSI	170 L/min @ 0.4 bar
Sequence 1000 Model 5000SEQ22 ¼ Hp	45 gpm @ 7.4 PSI	170 L/min @ 0.5 bar
Sequence 1000 Model 5800SEQ23 1/3 Hp	45 gpm @ 8.3 PSI	170 L/min @ 0.6 bar
Sequence Primer Model 4200PRM15 ¼ Hp	45 gpm @ 3.5 PSI	170 L/min @ 0.2 bar
Sequence Primer Model 6000PRM17 1/3 Hp	45 gpm @ 5.7 PSI	170 L/min @ 0.4 bar
Sequence Primer Model 7200PRM23 1/2 Hp	45 gpm @ 8.3 PSI	170 L/min @ 0.6 bar

REPLACEMENT PARTS

Description	Part No.
Filter Bolt Knobs	DF3-KNOB3
Air Trigger Assembly	DF3-TRIGGERASMB
3" SCH40 PVC Water Inlet Distribution Assembly	DF3-INTEE
3" SCH40 PVC Water Outlet and Bead Retention Screen, 0.066" Slots	DF3 EFFLUENT ASSBLY
3" Uni-Seals	10108
2" Uni-Seals	10107
3/8" Stainless Flat Steel Washers	36W037
3/8"x 3" all thread Stainless Steel Bolt	30BT0370300
Drop Filter Gasket w/ Bolt holes	ASTM D1056-00 2C2
1/4" npt x 3/16" barb air inlet fitting (polyethylene)	TE2043P
1.5" FIPT Ball valve	HMIP150TE
Sludge Screen Assembly with 1.5" machined nipple	DF3-BMDRN1.5
Enhanced Nitrification (EN) Bead Media	ENMEDIA2
External Plumbing Kit - Airlift	DF3-EXPLUMBA
External Plumbing Kit - Pumped	DF3-EXPLUMBP

Trouble Shooting

I Cannot See the Beads in the Window

- After installing the filter, it is necessary to set the backwash frequency at the highest rate possible for 24 hours to facilitate the movement of the bead media from the charge chamber to the filtration chamber. During shipping, the beads naturally migrate into the charge chamber. Multiple backwashes are necessary to flush them from the charge chamber once the filter is placed into operation.

The Beads Seem to Be Fluidizing / I Can See Under the Bottom of the Bead Bed Through the Window

- The *PolyGeysler* DF-3 is designed for a flow rate of 45 gpm. If you exceed this flow rate, you can cause the beads to fluidize. To correct this problem, simply reduce the flow through the filter.

Leveling

- In order for the filter to operate properly, it must be set up on a flat level surface. If the filter is not level, the air charge chamber may "short-circuit", allowing air to escape from the charge chamber before a complete charge has been established, thus air will continuously burp up through the drop chute. If this occurs the trigger will not fire and the filter will not backwash. To correct this issue simply level the filter.
- If the filter is level and the trigger still does not fire properly, raising the trigger 1/8" to 1/4" may be required. Note we test fire each trigger at AST to ensure they are set correctly before and after we add the bead media to the filter. The trigger should be set as low as

possible against the uni-seal and the air inlet holes must be below water level. Also ensure that the trigger is level. To re-set the trigger you must drain your filter, remove the beads and unbolt and remove the top half of the filter unit. Once you have done this, re-fill the filter with water, ensure that the trigger is full of water and turn on your backwash air at a rate high enough to initiate a backwash within several minutes. This will allow you to observe what is actually occurring. If air bubbles come up the drop shoot before the trigger fires, then you do, in fact, have to raise the trigger. To raise the trigger simply grasp it firmly and pull it up 1/8" to 1/4". Note the higher you set the trigger the less volume of air available during a backwash. To ensure a vigorous backwash the trigger should be set as low as possible. Before attempting to raise the trigger I suggest you contact the dealer from whom you purchased your filter or call Aquaculture Systems Technologies at (800) 939-3659.

Elevated Nitrite (NO₂) Levels

- Elevated levels of Nitrite may occur if the dissolved oxygen concentration in the effluent leaving the filter drops below 2 mg/l. Low DO concentrations leaving the filter can often be solved by increasing the dissolved oxygen levels in the tank or pond through increased aeration or by increasing the flow rate through the filter. The model DF3 is rated for 45 gpm (170 Lpm).
- Elevated Nitrite levels may also occur if your total alkalinity (as CaCO₃) drops below 80mg/l. We recommended you maintain your alkalinity at 100-200 mg/l as CaCO₃ at all times. If you experience low alkalinity simply add baking soda to the system periodically to maintain proper levels.
- Elevated Nitrite levels can also occur from over washing the bead bed. If the flow rate, effluent oxygen and alkalinity are satisfactory, the backwash frequency can simply be reduced. This situation typically occurs when you go from periods of high loading and frequent backwashing to periods of reduced loading but still maintain frequent backwashing.

Low Effluent Dissolved Oxygen

- Low Effluent Dissolved Oxygen concentrations are usually the result of too low a flow rate. Effluent D.O. concentrations should be maintained above 2 mg/l at all times. If you are not flowing water through the filter at the filters maximum flow rate (45 gpm) simply increase the flow through the filter.
- Or you can increase the amount of aeration in the tank or pond to increase influent D.O. concentrations which will usually result in increased effluent D.O. concentrations.
- Low DO concentrations may also occur if the backwash frequency is set too low. If the bead bed is allowed to clog, reduced flow and effluent oxygen concentrations will occur, which will affect the nitrification performance. Please refer to "Backwash Frequency" section for recommended backwash frequencies at various feeding rates.
- Low D.O. concentrations can also result if you do not remove sludge and waste from the filter often enough. The sludge should be drained every 2-3 days to prevent excessive oxygen consumption by the activity of heterotrophic bacteria.

Pressure Loss/Reduced Flowrate

- Pressure loss and subsequently reduced flowrates may occur if the backwash frequency is set too low. The filter is designed to backwash frequently with minimal energy input, so if you do not backwash frequently enough the bed may clog. To overcome this problem, simply increase the air flow to effect a more frequent backwash.
- If this does not solve the problem, check the outlet screen for clogging and clean if necessary.

Sulfide Production

- Sulfide production in the *PolyGeyser* filter can occur in the offline sludge storage basin. These sulfides are isolated within the sludge. Water slowly returned to the pond from this basin **may** contain a low level of sulfides, however, it is first diluted by the recirculating flow (at a ratio of over 100 to 1) and then must pass through a two foot aerobic bead bed. **The aerobic bed assures any sulfide residuals are converted to the safe sulfur form of sulfate.** The processes that produce the sulfides are identical to the natural processes that occur in the bottom of virtually every mud pond and are instrumental in the recycling of trace elements essential for plant and fish nutrition. Sludge storage in the off line basin is a matter of convenience, the filter's operation does not require it, but, given the fact that there has been no observation of sulfide accumulation in any tank or recirculating pond waters, there seems to be no reason not to take advantage of this time saving feature.

Sludge is Slow to Drain from the Filter

- Sludge normally drains rapidly from the filter, but now drains very slowly. The screen on the sludge discharge line may be clogged. Cleaning it may be as simple as connecting a garden hose to it and flushing the line. If this does not solve the problem it may be necessary to remove screen for cleaning. Simply turn off the flow of water to the filter. Drain the filter completely. Loosen and disconnect the rubber couplings on the inlet and outlet lines, tilt the filter back so the beads slide away from the sludge valve and unscrew the sludge valve assembly. After cleaning the screen, apply Teflon tape or thread sealant to the threads and screw the sludge valve assembly back into the filter. Note after re-starting the filter it may be necessary to backwash the unit multiple times to release any trapped beads from the charge chamber.
- If your system is heavily loaded and the screen clogs frequently you can remove it and operate the system without a sludge screen. However, you should be aware that if you operate the system without a sludge screen you may experience a small amount of bead loss during sludge removal.

LIMITED WARRANTY

Aquaculture Systems Technologies, LLC, (AST) warrants the material and workmanship to be free of defects under designated use and normal service on its **DROP Filters** for a period of one (1) year from the date of shipment. All warranty claims must be presented in writing to AST. Normal use and service requires the following:

1. The filter must be installed and operated according to the installation and operational instructions supplied by the manufacturer.
2. Excessive weight due to heavy pipes, valves, etc. must not be carried by the inlets or outlets.
3. The filter hull pressure must never exceed the maximum pressure rating of 10 psi as specified by the manufacturer.

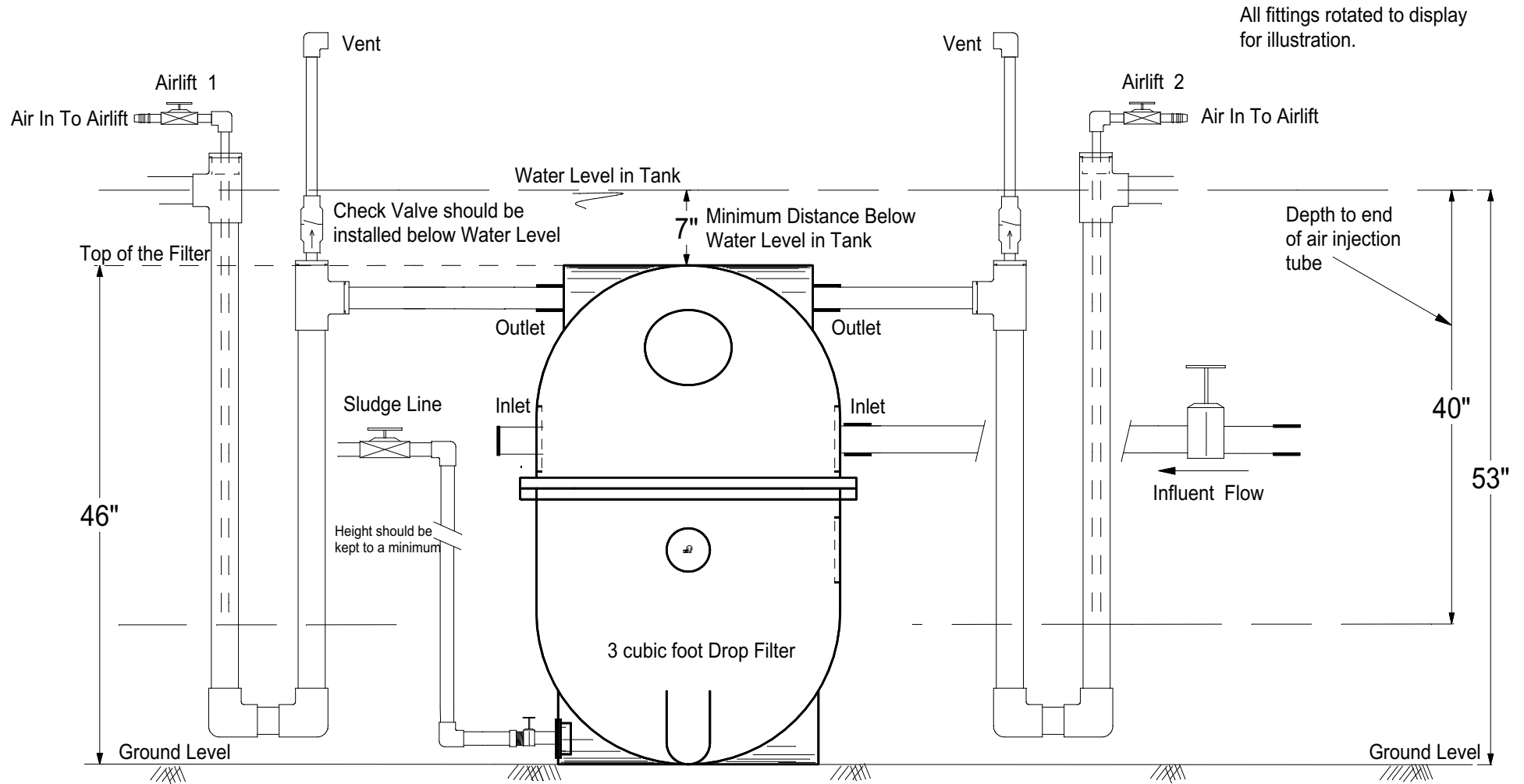
This warranty applies only to the original purchase price, and is good only when the total payment for the equipment has been received. The limited warranty (expressed or implied) during the warranty period shall consist of the repair or replacement of the items of manufacture, at the discretion of **AST**, and said warranty applies only to the original purchaser. This warranty is void if the items are damaged by negligence or accident after purchase; used for other than the intended purpose; altered; repaired at other than an authorized service center; or used with other items that affect the integrity, performance, or safety of these items. Liability does not cover indirect or consequential cost, including materials lost, labor or installation/reinstallation cost, injury, property damage, or damages caused by mishandling. Returns for repairs must be pre-approved and the return authorization number prominently displayed on the outside of the shipping container. Returns will not be accepted without a "return authorization number". Returns for repair should be sent to the following address "FREIGHT PREPAID":

Aquaculture Systems Technologies, LLC
P.O. Box 15827
New Orleans, LA 70175
108 Industrial Ave.

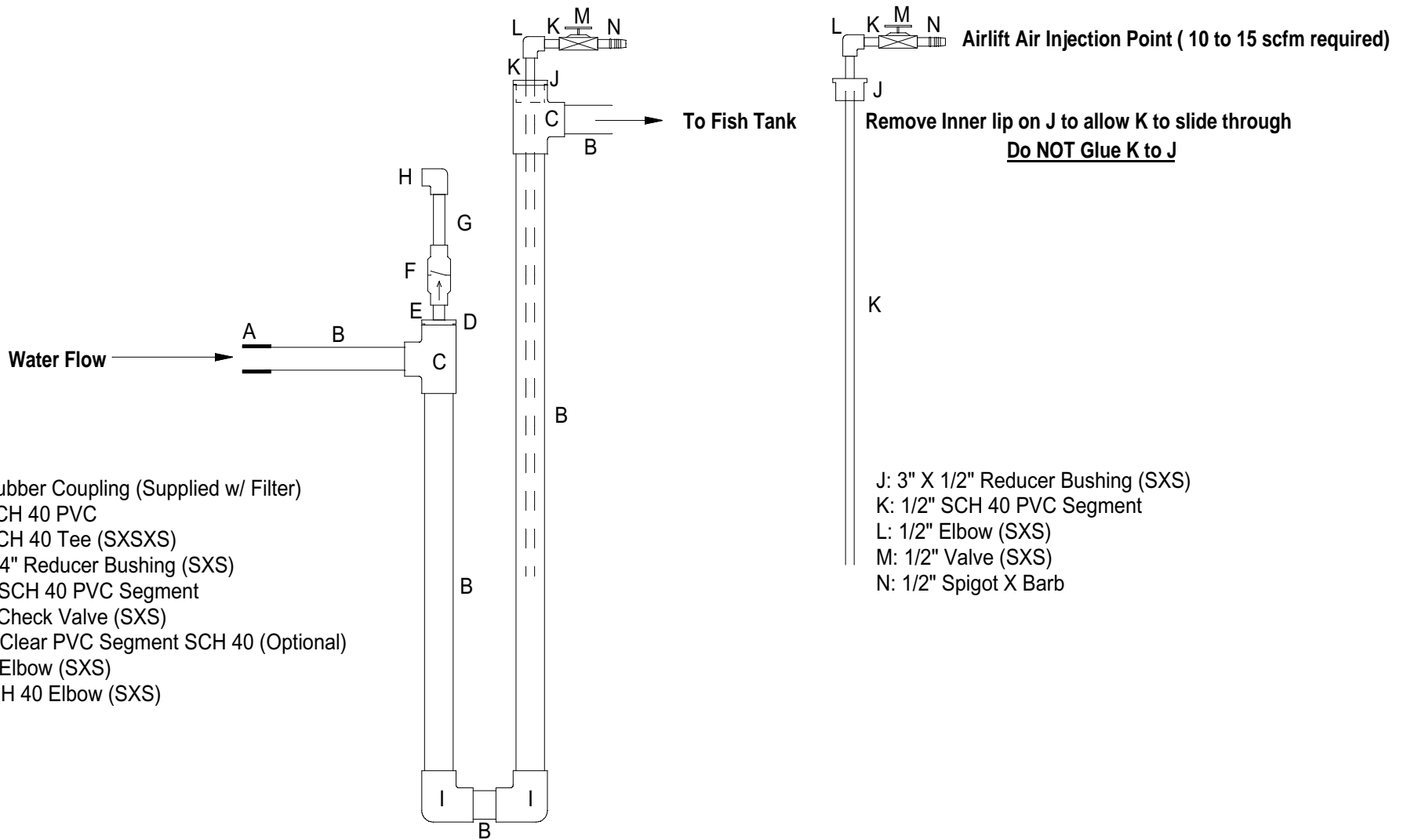
Jefferson, LA 70121 Manufacturer's liability for incidental or consequential damages is specifically excluded to the full extent permitted by the applicable law. This warranty gives you specific legal rights, and you may also have other rights, which may vary from state to state.

THIS WARRANTY IS EXCLUSIVE OF ALL OTHER IMPLIED WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

3 CuFt Drop Filter: Airlift Plumbing Overview with Critical Depths



3 CuFt Drop Filter: Parts List for Airlifts



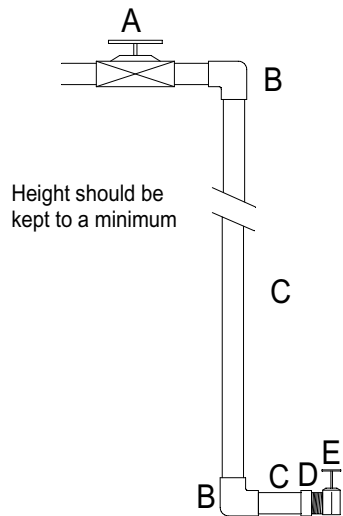
- A: 3" Rubber Coupling (Supplied w/ Filter)
- B: 3" SCH 40 PVC
- C: 3" SCH 40 Tee (SXSXS)
- D: 3"-3/4" Reducer Bushing (SXS)
- E: 3/4" SCH 40 PVC Segment
- F: 3/4" Check Valve (SXS)
- G: 3/4" Clear PVC Segment SCH 40 (Optional)
- H: 3/4" Elbow (SXS)
- I: 3" SCH 40 Elbow (SXS)

3 CuFt Drop Filter: Parts List for Sludge and Influent Line

Plate 3 of 3

Sludge Line

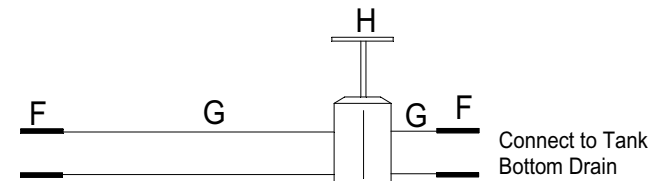
- A: 1 1/2" PVC Ball Valve (SXS) (NOT Supplied w/ Filter)
- B: 1 1/2" SCH 40 Elbow (SXS)
- C: 1 1/2" SCH 40 PVC Segment
- D: 1 1/2" Male Adapter
- E: 1 1/2" Knife Gate Valve (TXT) (Supplied w/ Filter)



Sludge Line

Influent Line

- F: 3" Rubber Coupling (Supplied w/ Filter)
- G: 3" SCH 40 Pipe
- H: 3" Knife Gate Valve (SXS)



Influent Line