FROSTLINE

SPRAY IRRIGATION

Patent Application Publication Number – US-2019-0015846-A1

TECHNICAL & INSTALLATION

&

MANUAL

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Background: Septic Effluent Irrigation Systems (spray systems) – Several years ago a sewage treatment process was developed using three separate processes. Anaerobic, aerobic, and ultra violet light processes working together were found to perform at a much higher bacterium kill rate than the typical septic and septic/aeration systems that are currently

being used today. The required water quality for a spray irrigation system specified by the Ohio Department of Health states;

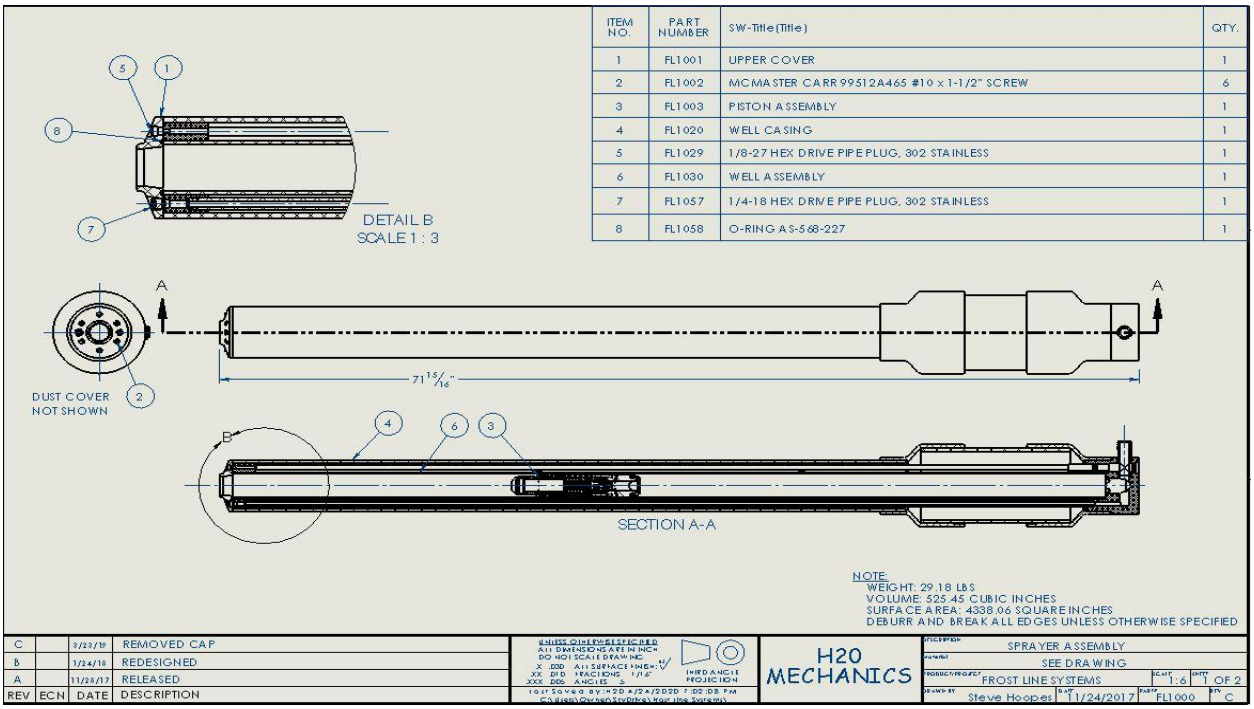
Total Suspended Solids (TSS): less than eighteen milligrams/liter, carbonaceous biochemical oxygen demand (CBOD): less than fifteen milligrams/liter, and Fecal Coliform: 20 colony-forming units (CFU) per 100 milliliters (ml) for surface application in unrestricted access sites.

The higher quality water that is being produced allows new technology to be practiced for dispersing the effluent over the property surface. The treated water is to be sprayed over a thirty one foot radius in most cases, thirty five and thirty nine feet for larger homes. There is no smell and the effluent water color is water/white. There are several advantages to this system including there is no leach field, mound or filter bed required, you can install systems all year long, if you are replacing a septic system you actually gain more usable property and in most cases it's more economical for families.

Problem: The problem is that the current spray systems are susceptible to freezing in really low temperatures. This problem has existed since the introduction of residential effluent spray in Ohio and Pennsylvania. The current spray heads consist of typical lawn sprinklers that are not designed for cold weather use when temperatures fall well below freezing they simply can't perform.

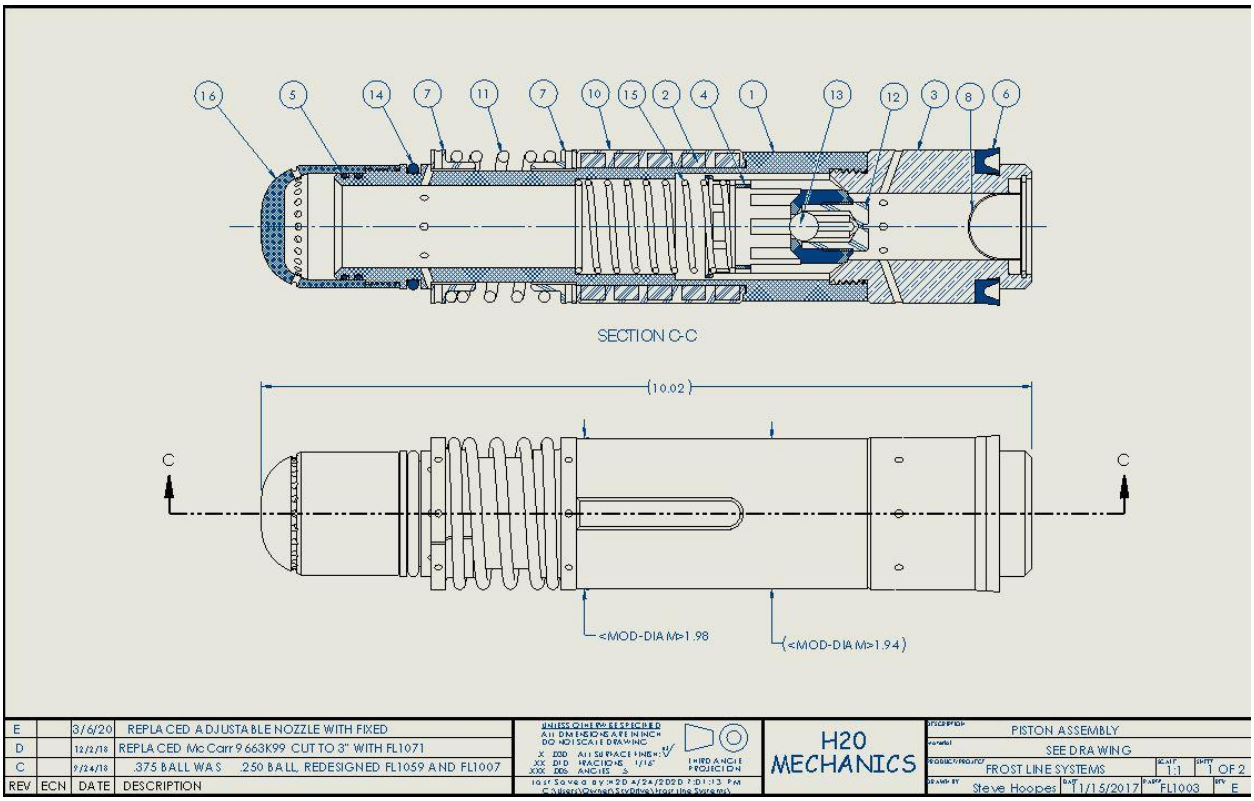
New Design: H2O Mechanics LLC was asked by Klarich Septic to come up with a design that would eliminate freezing of the spray towers during the harsh winter months. We started out with a clean sheet of paper and came up with a design utilizing the **geothermal heat** from the earth that in our opinion would solve the freezing issue not only in the Sanitary Spray Systems but any residential or commercial sprinkler

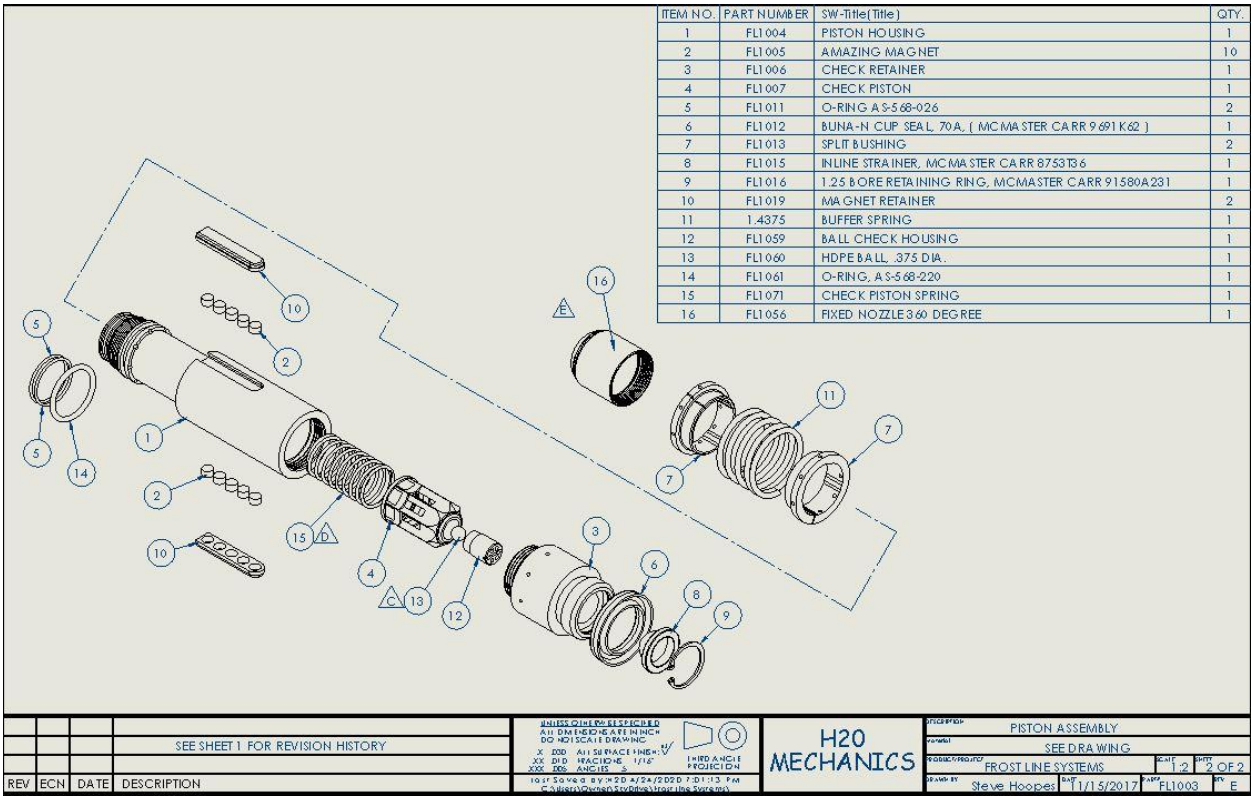
system. Please see drawing number FL1000 – SPRAYER ASSEMBLY. This is a layout assembly of what H2O Mechanics has designed / manufactured and has been using in the field for the last three years.



1. **The piston assembly** – item 3, # FL1003 (communicates the effluent spray water) is designed to rest at the bottom of the geothermal tube which is shown in Section A-A. The geothermal tube is responsible for creating a heat source that keeps the temperature above freezing and enough heat volume to allow air circulation between the outer in inner barrel tubes to minimize icing in the coldest of temperatures. When it is time to spray (between 2:00 and 5:00 AM) the piston assembly upon pump start is designed to travel up the barrel tube approximately seventy inches. The piston contains a lower spring-loaded check piston (#4) shown in the piston assembly drawing below. When the piston engages with the upper cover (FL1001 Spray Assembly DWG) at the top of the

barrel tube it meets resistance from the upper split bushing (#8 piston assembly drawing). This resistance causes the Split Ring to compress the buffer spring (#13) until the piston assembly is in position to spray. Once the upper spring is compressed the lower spring-loaded check piston (#4) opens and allows water to communicate to the top spray nozzle where the effluent is dispersed over a 31 - 43 foot radius.





2. **AIR CHECK**: The check ball shown in the drawing above (#15) is for bleeding air on cycle start and to also provide the drain path at the end of cycle assuring that the water in the piston is completely drained out.

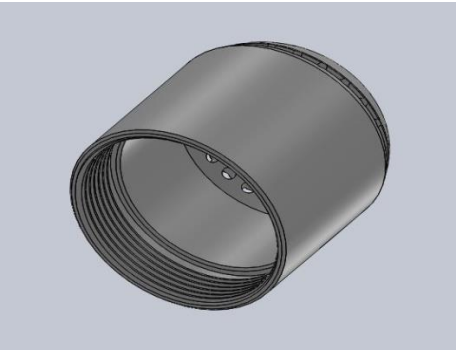
3. **PISTON ALIGNMENT**: The position of the piston when **not** using a 360 spray has to be identical every time upon spraying, we use super magnets that press-fit into place on the piston housing (#2, 12) shown in the drawing above. On the outside of the 2-inch barrel we attach metal strips so once the piston is placed in the tube you line up the magnets with the strips, you can feel the attraction as you rotate the piston. Once the piston is installed you can aim the nozzle to its desired position and you are ready to go. This allows an **alignment rail system** without any grooves assuring that the spray direction is always identical.

4. **UMBRELLA SEAL**: The umbrella seal (#7) is designed to inflate under pressure. When the pump is turned on and water pressure is applied to the spay system inlet it inflates the seal outer walls which engage with the inside diameter of the 2" pipe and this forces the piston assembly to rise to the top of the tower.

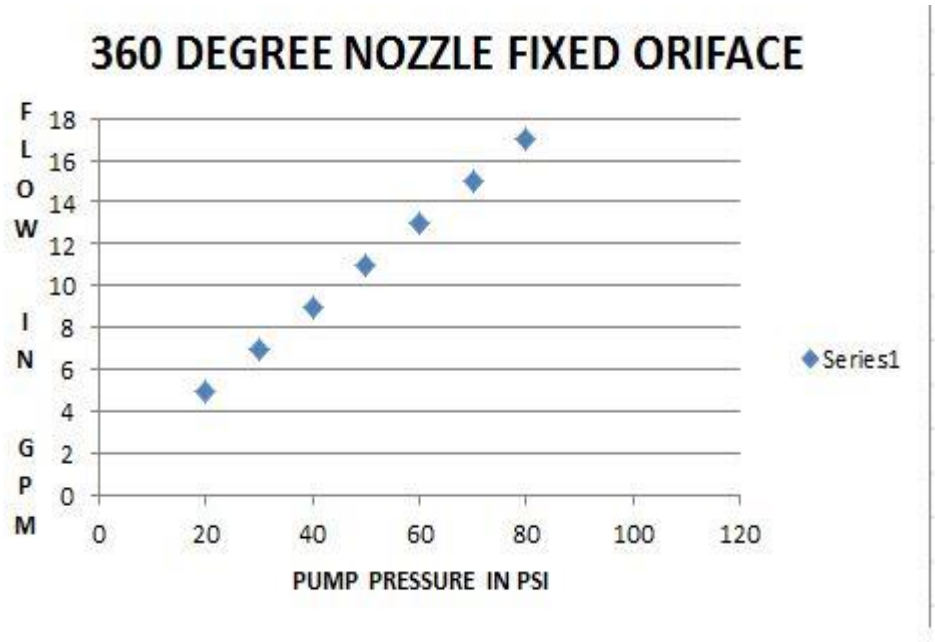
5. **CHECK PISTON**: The check piston (#4) and spring (#19) are designed to stay closed until the piston assembly rises up and makes contact with the upper cover (#10). The backpressure builds and opens the check piston initiating flow. The check piston does not have any rubber seals it is a plastic to plastic seal.

6. **Adjustable Nozzle**: The adjustable nozzle shown in the Piston Assembly drawing FL1003 (#5, 6, & 9) shows the 180-degree nozzle assembly which is adjustable by turning the top weight (#17) counter-clockwise to increase flow rate and clockwise to **decrease flow and increase spray distance.**

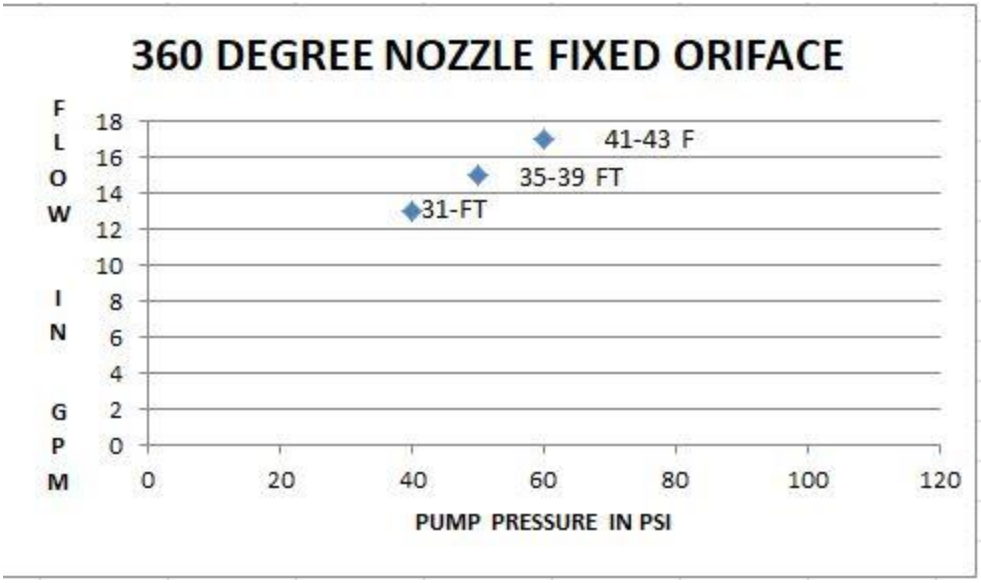
7**. Fixed Orifice Nozzle**: The fixed orifice nozzle below is our most popular nozzle, able to spray from 31 to 43 foot radius and handle up to a five-bedroom home. We also manufacture fixed orifice nozzles in 90, 180, and 270 degrees should you need to engineer a property where it's not possible to apply a 360 spray system (the nozzle shown would be in place of the adjustable nozzle in drawing FL1003-item 5 above).



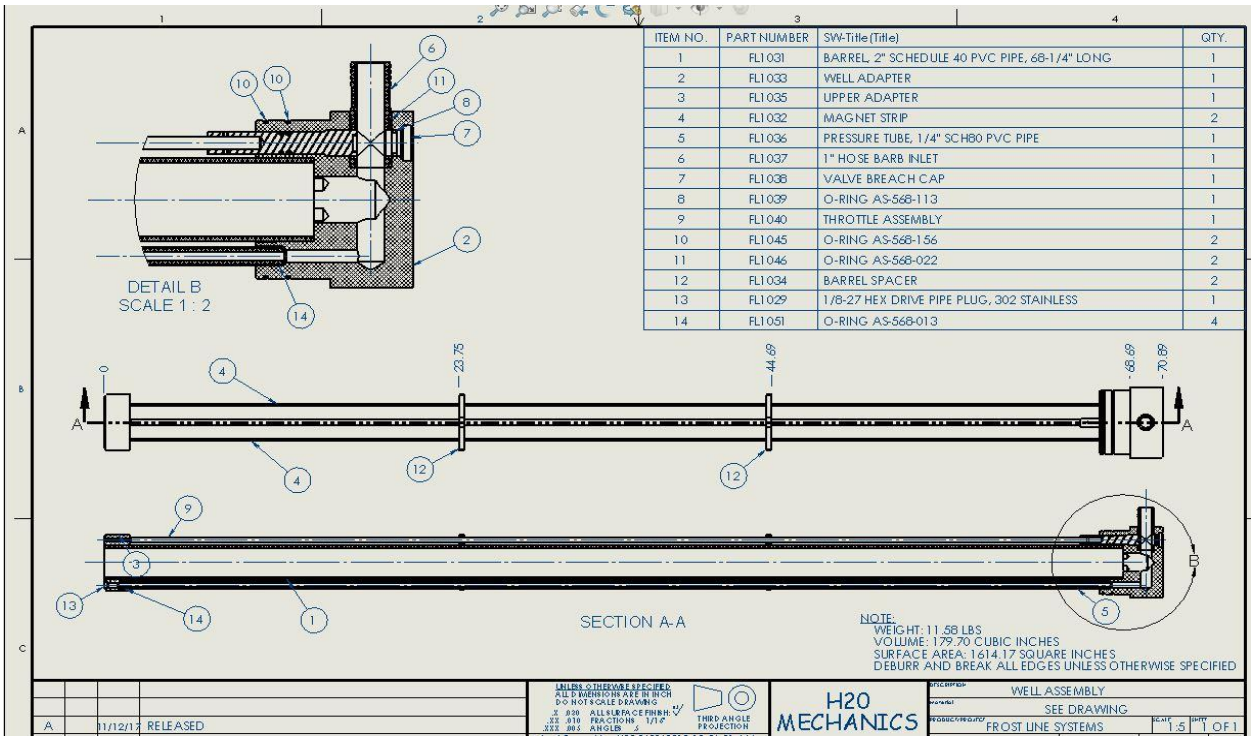
8. I have attached a graph below of the performance curve showing the pressure vs GPM of the 360 nozzle. As you can observe the curve is very linear and is used as an approximate guide for flow rate.



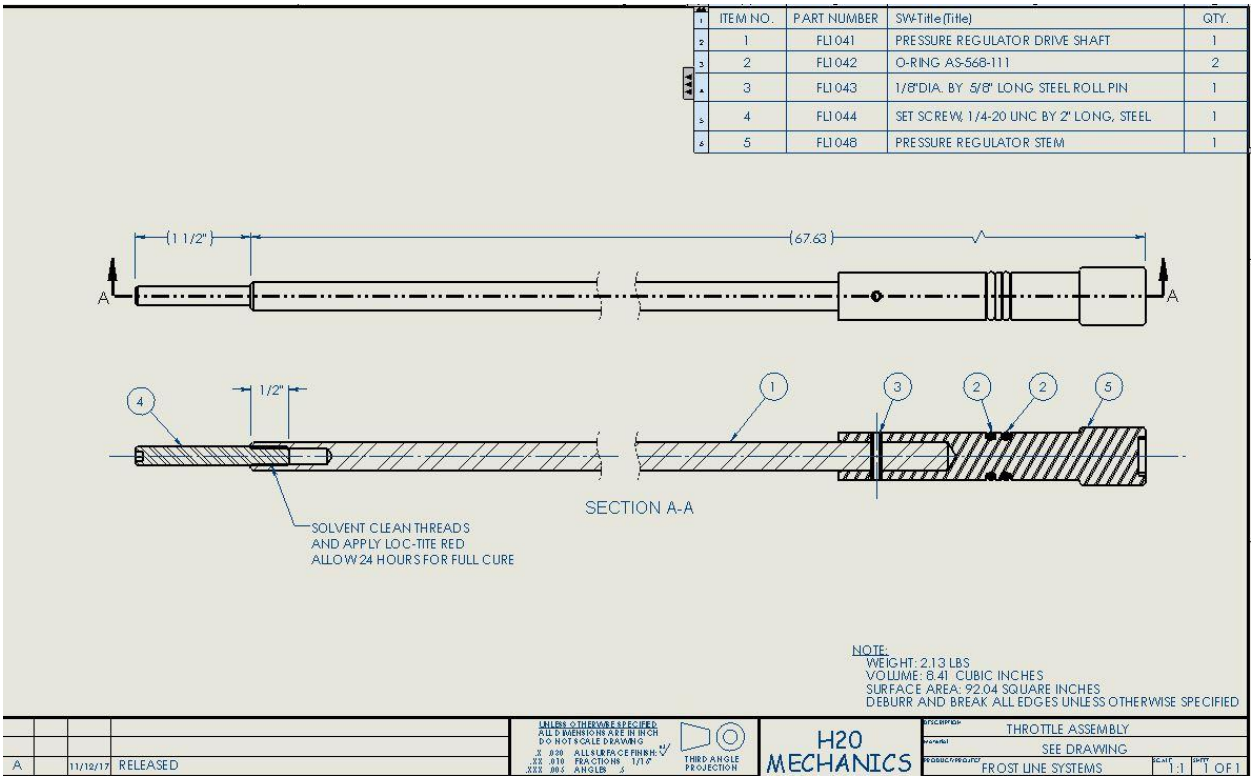
9. I have posted another graph below that shows the relationship between pressure and distance for the 360-degree nozzle. I am showing 31, 35, 39, and 43 feet on the graph. We recommend when trying to achieve 43 feet (180 fixed oriface) that you use 2-inch pipe from the effluent tank to the spray head. As a rule to thumb if you are more than 250 feet from the tower you will get noticeably improved performance using 2-inch pipe (minimizes friction loss). The graph should be interpreted as a guideline as elevation, spray system height, contours are all contributors when setting spray distance.



10. **Well Assembly:** The well assembly below consists of an upper adapter (#3) and well adapter (#2) attached to the inner barrel (#1). The throttle assembly (#9 in section A-A) is how you set the amount of



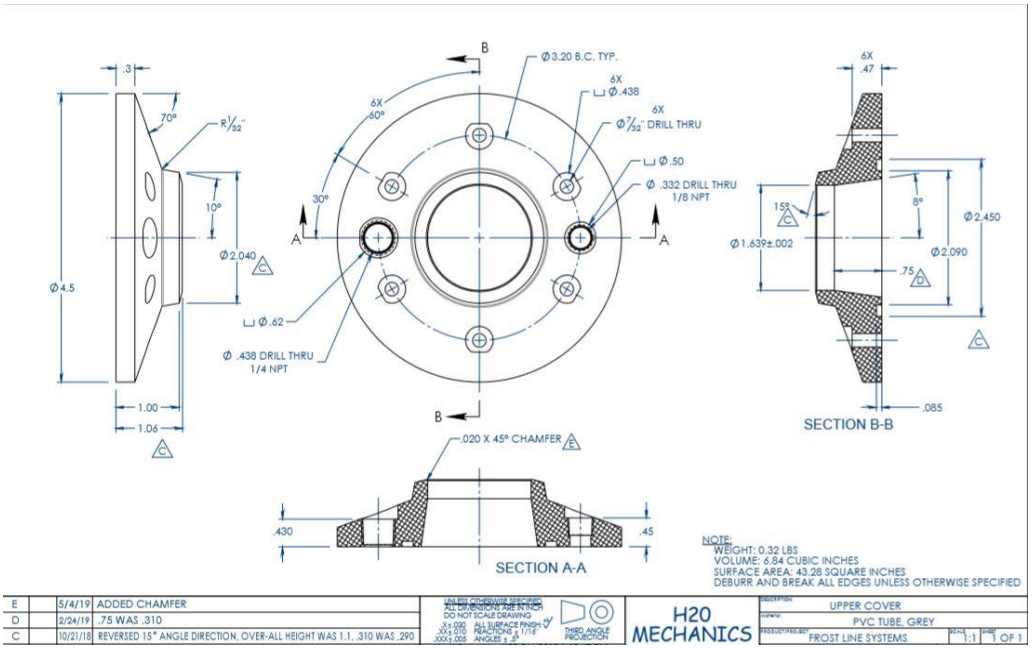
water flow & pressure. In the upper adapter there are two 1/8 hex drive plugs (see detail B in the sprayer assembly drawing). One uncovers the pressure port should you need to have a pressure gage present for adjustments or approvals. The other plug uncovers the 1/8" hex drive set screw that moves the throttle assembly (#9) up+ and down- to increase or decrease the flow rate. This is accomplished by moving the pressure regulator stem (#5) using a 1/8 hex wrench. The drawing below shows the detail of the throttle assembly.



The drawing above (throttle assembly) shows the pressure regulator stem (#5), now you can see how the stem is located in the well assembly drawing detail B. As you move the stem lower in cuts off the inlet port (#6) reducing the amount of water allowing you to adjust the spray to the desired distance or flow rate. Detail B in the well assembly drawing

also shows the relationship of the stem, barb inlet (#6) and breach cap (#7). These parts are assembled with no glue and interact with each other to allow the throttling stem or the inlet port to be replaced if needed.

Note: When looking at the upper cover (spray assembly drawing) there is a 1/8" pipe plug, this uncovers the 1/8 pipe plug in the upper adapter that is removed to access the hex drive set screw to adjust the throttle assembly. The 1/4" pipe plug when removed from the upper cover gives access to a 1/8" pipe plug which is for a pressure gage if needed.



Note: When adjusting the throttle assembly using a 1/8" hex wrench be sure to set your drill on low torque – the hex set screw and pressure regulator drive shaft (#1) - (throttle assembly dwg FL1040) are bonded with lock tight red and are very strong but on full reverse power engaged at the stop may cause the set screw to break loose.

Below is a complete parts list for the Frostline Spray System, this will be imported to our web site which will be active in the near future and kept up to date.

PART NUMBER	Revision	SW-Title(Title)	QTY.
FL1001	E	UPPER COVER	1
FL1002		MCMASTER CARR 99512A465 #10 x 1-1/2" SCREW	6
FL1004	E	PISTON HOUSING	1
FL1005	A	AMAZING MAGNET	10
FL1006	B	CHECK RETAINER	1
FL1007	E	CHECK PISTON	1
FL1010	C	ADJUSTABLE NOZZLE	1
FL1011	A	O-RING AS-568-026	3
FL1012	A	BUNA-N CUP SEAL, 70A, (MCMASTER CARR 9691K62)	1
FL1013	C	SPLIT BUSHING	2
FL1014	B	NOZZLE ADJUSTER	1
FL1015	A	INLINE STRAINER, MCMASTER CARR 8753T36	1
FL1016	A	1.25 BORE RETAINING RING, MCMASTER CARR 91580A231	1
FL1019	A	MAGNET RETAINER	2
FL1021	A	CONNECTOR PIPE, 6" SCHEDULE 40 PVC	1
FL1022	A	WELL HOUSING, 4" SCHEDULE 40 PVC	1
FL1023		4" TO 6" SCHEDULE 40 ADAPTER, MCMASTER CARR 4880K688	2
FL1029	A	1/8-27 HEX DRIVE PIPE PLUG, 302 STAINLESS	2
FL1031	A	BARREL, 2" SCHEDULE 40 PVC PIPE, 68-1/4" LONG	1
FL1032	A	MAGNET STRIP	2
FL1033	C	WELL ADAPTER	1
FL1034	B	BARREL SPACER	2
FL1035	B	UPPER ADAPTER	1
FL1036	B	PRESSURE TUBE, 1/4" SCH80 PVC PIPE	1
FL1037	A	1" HOSE BARB INLET	1

PART NUMBER	Revision	SW-Title(Title)	QTY.
FL1038	A	VALVE BREACH CAP	1
FL1039	A	O-RING AS-568-113	1
FL1041	A	PRESSURE REGULATOR DRIVE SHAFT	1
FL1042	A	O-RING AS-568-111	2
FL1043	A	1/8"DIA. BY 5/8" LONG STEEL ROLL PIN	1
FL1044	A	SET SCREW, 1/4-20 UNC BY 2" LONG, STEEL	1
FL1045	A	O-RING AS-568-156	2
FL1046	A	O-RING AS-568-022	2
FL1048	A	PRESSURE REGULATOR STEM	1
1.4375	A	BUFFER SPRING	1
FL1051	A	O-RING AS-568-013	4
FL1057	A	1/4-18 HEX DRIVE PIPE PLUG, 302 STAINLESS	1
FL1058	A	O-RING AS-568-227	1
FL1059	B	BALL CHECK HOUSING	1
FL1060	B	HDPE BALL, .375 DIA.	1
FL1061	A	O-RING, AS-568-220	1
FL1062	C	WEIGHT	1
FL1063	A	SHCS 5/16-18 UNC-3A, 1-1/2" LONG, 18-8 STAINLESS	1
FL1071	B	CHECK PISTON SPRING	1

MASTER B.O.M.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCH
DO NOT SCALE DRAWING
X ± .030
.XX ± .010
.XXX ± .005
ALL SURFACE FINISH:
FRACTIONS ± 1/16"
ANGLES ± .5°
THIRD ANGLE PROJECTION

H2O MECHANICS

DESCRIPTION: SPRAYER ASSEMBLY
MATERIAL: SEE DRAWING
PRODUCT PRO.MGT: FROST LINE SYSTEMS
SCALE: 1:6
SHEET: 2 OF 2

Summary of Design and Features:

1. No Electricity – Fully automatic utilizing pump pressure and geothermal heat

2. No moving parts in the piston nozzle head when spraying

3. All contact of internal parts have been designed for low surface area engagement (point to point surface)

4. Rugged design using PVC schedule 40 pipe for the internal and exterior piping

5. High flow nozzles minimize the time that the piston is exposed to the elements 9-18 GPM.

6. Adjustable throttle valve in the lower well housing actuated by turning a 1/8 hex set screw in the top adapter

7. Pressure port for gage reading located in the top cap.

8. We can produce any length of housing to accommodate different frost lines.

9. The only irrigation system to have a floating piston that rests below frostline when not in use

10. The only patented irrigation system specifically designed for cold weather use.

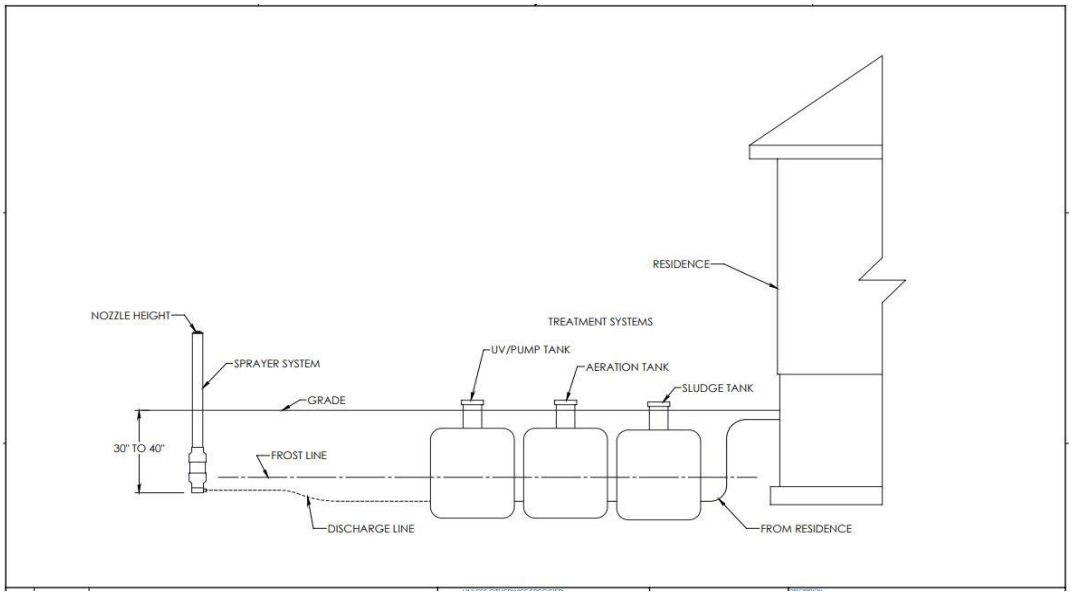
Design Benefits

1. Long service life
2. Ease of installation
3. Low Maintenance
4. Excellent distribution to maximize evaporation and uniform coverage
5. Screw-threaded spray nozzles for easy removal and cleaning (if needed).

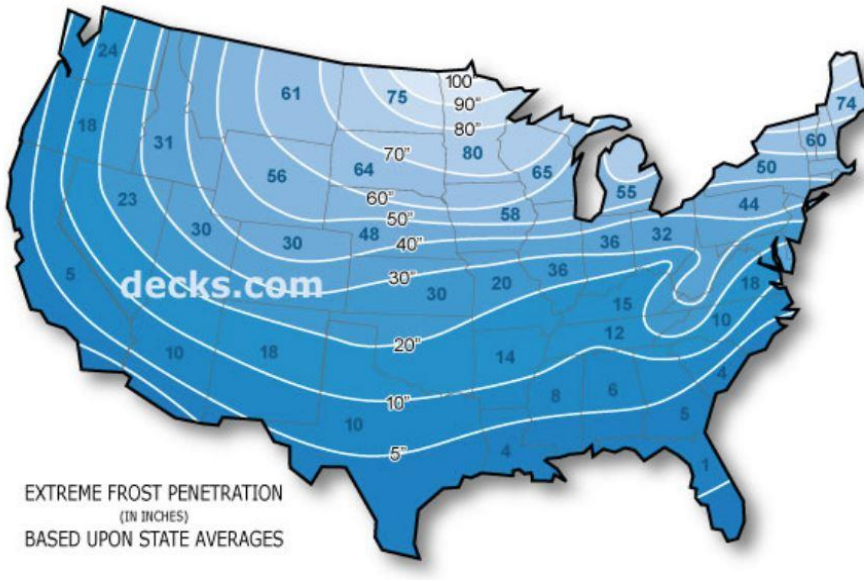
INSTALLATION GUIDELINES

1. The most important thing that you will be doing during your installation is making sure your distribution line (regardless of length) is clean. It is recommended that when your line is installed before hooking it up to the spray tower you purge the line with clean water (make sure there is enough freshwater in the effluent tank to run an adequate purge). I suggest 5x the line volume; if you're using 1.5" line you have 9 gallons/100 feet. If you using 2" line you have 16 gallons per foot. This works out to roughly 50 gallons of purge 100 feet of 1.5" line, 80 gallons of purge for 100 feet of 2" line. **The reason I recommend purging the line before the tower is hooked up is simply the velocity in the tower at full flow is not adequate to expel sand, grit and fine gravel 70 inches high (**purging tower instructions #9 below*).*

1. Frost line (F) shown below for Ohio is 32 inches, I recommend that the base of the unit should be 36 to 40 inches deep (if you can't get 36 inches deep you must build up the surface).



2. The map below is a guideline that shows the frost line by state. As you can see there are many areas that have severe cold which will lead to several different system lengths as the technology is applied in these areas.



3. The recommended pump (P) for the Spray System is a 115 or 220 volt 20 GPM Gould submersible. It is paramount that the tank drains back to the effluent tank or the line empties into an approved french drain or filter bed. The recommended pitch is ¼ inch/ft.

4. The one inch connection to the barbed inlet at the bottom of the spray tower should be reinforced one inch black rubber hose with hose clamps (see picture below). It is recommended that you nest the one inch line in coarse gravel before covering so that it does not allow compression loads to compress the line.

Note**: the white PVC flexible 1” hose is not reliable and is susceptible to cracking and leaking underground.**

5. If you are not able to achieve the stated depth of the spray tower you may consider mounding up earth on the topside at a five to ten degree slope. You can mound the earth around the spray tower without grade providing you make the mound 36 inches wide regardless of how tall. Make sure the earth is packed without voids to minimize air penetration.

6. Remove the Upper Cover (6 #10 x 1-1/2” screws) by removing the six screws and lifting the cap off the 4" well housing. Make sure you do not lose the cap O-Ring and the upper adapter O-Ring. See pictures below;

7. Once you have removed the Upper Cover do yourself a favor and put a clean rag or paper towel in the 2" barrel tube to assure you don't drop a screw or other material down it. *See picture below*;

8. You need to reinstall the six screws directly into the upper adapter finger tight. **The installed screws will make sure no water enters the spray towers inside wall through screw holes when purging with fresh water.**

9. Purging the tower with fresh water for at least one minute (**Providing you have purged the line as stated in item one**) at full flow should be adequate, observe to make sure the water quality is excellent, and repeat if unsure.

10. Now you are ready to insert the piston, when installing the piston assembly it is important to make sure you do not crimp or role-up the cup seal at the base of the piston assembly. When inserting the piston make sure the seal doesn't role (see pic below). You can do this by running your thumbnail along the base of the cup seal while applying light downward pressure. **When the installation of the piston is complete you can tell if the seal is correctly in by moving the piston up and down, you should not feel any drag.**

Wrong

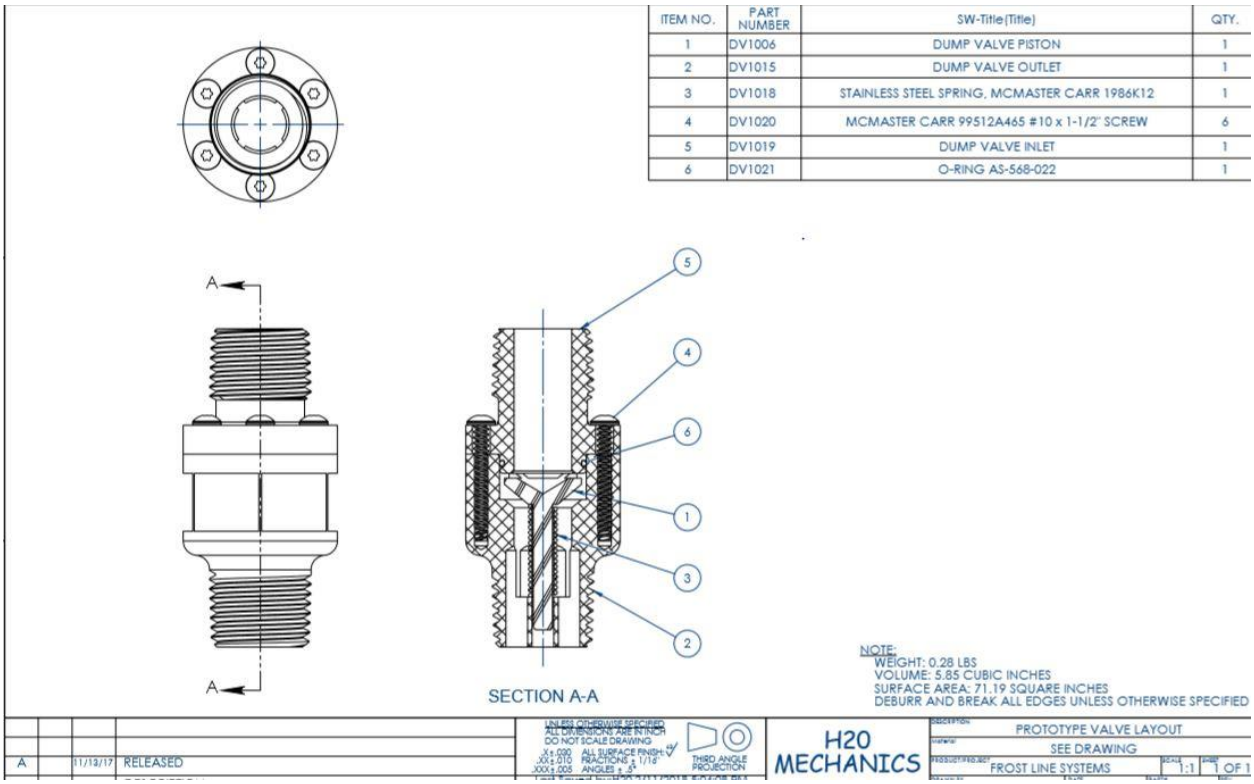
Right

11. Now the piston assembly is in place you want to reassemble the upper cover**. Important**: **Make sure the O-Rings are in the right groove on the botton side of the upper cover and the top of the upper adapter** (using a silicone grease helps it stay in place). See the picture below of the cap O-Ring (right) and upper adapter O-Ring (left).

(9) (10)

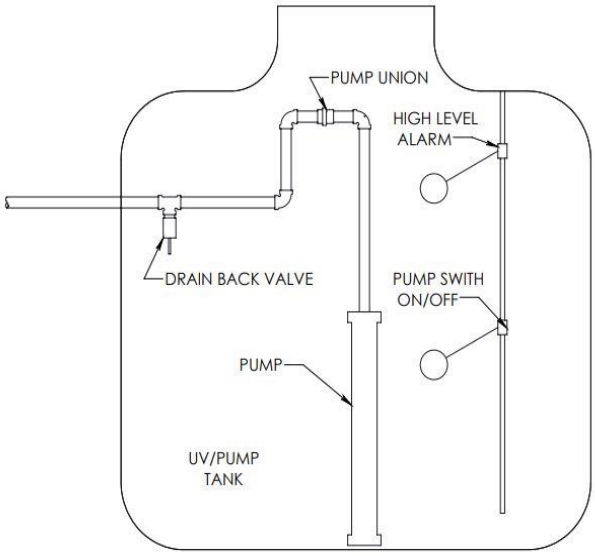
12. Reinstall the six #10 self-threading screws – Hint; if you set the screw in place and rotate backwards you will feel the screw drop into its thread groove. Doing this minimizes the chance of cross-threading. If you're using an electric drill, set the available torque at half and that should be a good starting place. **Do not use full torque as you will strip the screw threads prematurely.**

13. To assure complete drain back into the effluent tank when the spray cycle is complete you need to install the drain-back valve in the effluent tank plumbing. See assembly view below;



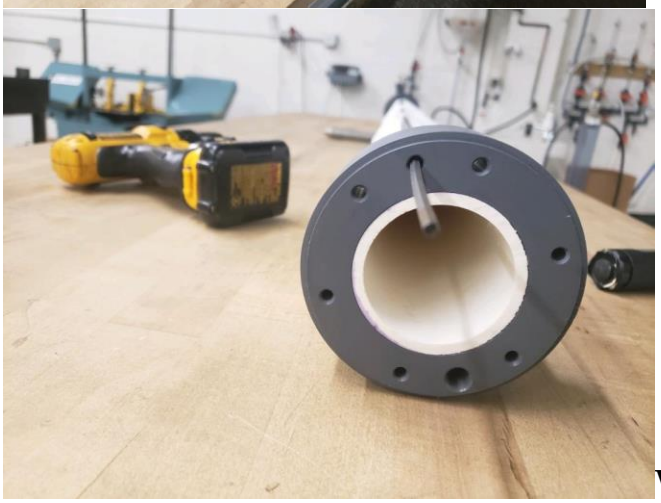
This valve is designed to stay open when there is no pressure in the line, which is why water can back-flow into the effluent tank (pump tank). It closes when the pump is energized and water flow is initiated through the spray system. The valve works automatically with the pump cycle with no electricity. Backpressure in the line closes the plunger and when the pump shuts off the plunger opens allowing water to flow back to the pump tank. Depending on how long your lines are; it may take 20 to 30 seconds for the valve to close on start-up.

Installation of the valve is important, below left shows an example of the tee fitting and adapter needed for plumbing. Below right is a sketch showing an example of plumbing inside the pump tank, this position should be the lowest elevation of your spray line.



The screw head side is the inlet to the valve and the outlet has seven visible ports. When installing into the tank, make sure you have access to the valve should you need to service.

14. At this point your installation of the spray tower is complete and now you can dial in the spray distance using the throttle assembly shown in the WELL ASSEMBLY drawing (illustrated in the design section). At the factory, we open up the throttle so when you first turn it on you should have a very strong spray. We have experienced pumps that have more head at maximum flow than needed. This can cause heavy misting simply because you're overpowering the nozzle. If this is the case or you simply want less spray distance (less area) you can use a 1/8 allen wrench to adjust flow. See pictures below;



WELL ASSEMBLY ABOVE

1/8 ALLEN WRENCH INSERTED

Using an electric drill set the torque at a level just above what it takes to turn the 1/8 allen set screw (you won't break the thread locker this way). The adjuster is wide open as shown in figure A and closed in figure B.

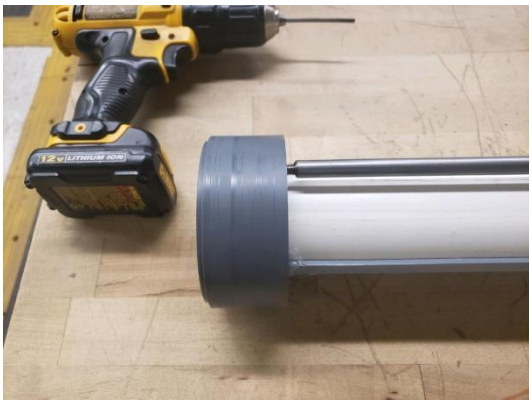


FIGURE A - OPEN

FIGURE B - CLOSED

We show the well adapter regulator stem position open and closed respectively to the above figures. See below

FIGURE C - OPEN

FIGURE D - CLOSED

Figure C shows the stem in the open position and closed in figure D. The following two pictures (E & F) show the actual valve in open and closed positions.

FIGURE E - OPEN

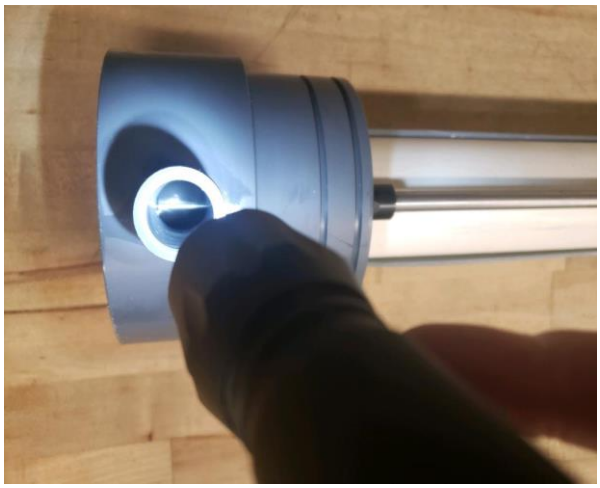


FIGURE F - CLOSED

As you can see in figure E the port is open to the barrel tube. In figure F the throttle stem is blocking the port (when closed you will reduce flow to a small drip). When making this adjustment in the field you need a raincoat and stand between the flow streams (**make all adjustments using fresh water**).

If you have any questions regarding the material in this manual please don't hesitate to call Chris Hansen at H2O Mechanics LLC, or Frank Klarich at Klarich Septics LLC.

Chris Hansen/H2O Mechanics LLC – 1-440-554-9515
12381 Kinsman Rd. Newbury, Ohio 44065

Frank Klarich / Klarich Septics LLC – 1-440- 285-2550