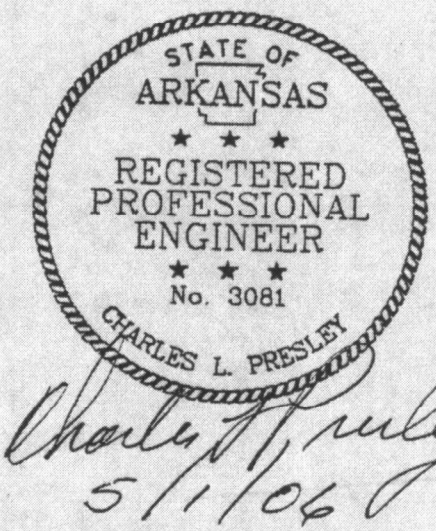
[redacted] SEWER IMPROVEMENTS FOR

DEER HAVEN SUBDIVISION

AVOCA, BENTON COUNTY, ARKANSAS



PRESLEY, BRANNAN, & ASSOC., INC.,
CONSULTING ENGINEERS
Charles Presley, P.E. & R.L.S., Steve Brannan, P.E.
2143 Worth Lane
Springdale, Arkansas 72764
Office (479)756-8720
Fax (479)756-8714

Recordall® Cold Water Bronze Disc Meter	Size 1" (DN 25mm)	Technical Brief

DESCRIPTION

Badger Meter offers the Recordall Disc meter in Cast Bronze and a Low Lead Alloy. The Low Lead Alloy (Trade Designation: M70 LL) version complies with NSF/ANSI Standard 61 and carries the NSF-61 Mark on the housing. All components of the Low Lead Alloy meter, i.e., disc, chamber, housing, seals, etc., comprise the certified system.

APPLICATIONS: For use in measurement of potable cold water in residential, commercial and industrial services where flow is in one direction only.

OPERATION: Water flows through the meter's strainer and into the measuring chamber where it causes the disc to nutate. The disc, which moves freely, nutates on its own ball, guided by a thrust roller. A drive magnet transmits the motion of the disc to a follower magnet located within the permanently sealed register. The follower magnet is connected to the register gear train. The gear train reduces the disc nutations into volume totalization units displayed on the register dial face.

OPERATING PERFORMANCE: The Badger Recordall Disc meters meet or exceed registration accuracy for the low flow rates (95%), normal operating flow rates (100 ± 1.5%), and maximum continuous operation flow rates as specifically stated by AWWA Standard C700.

CONSTRUCTION: Badger Recordall Disc meter construction, which complies with ANSI/AWWA standard C700, consists of three basic components: meter housing, measuring chamber, and permanently sealed register. The water meter is available in bronze and Envirobrass II with externally-threaded spuds. A corrosion-resistant thermoplastic material is used for the measuring chamber.

To simplify maintenance, the register, measuring chamber, and strainer can be replaced without removing the meter housing from the installation. No change gears are required for accuracy calibration. Interchangeability of parts among like-sized meters also minimizes spare parts inventory investment.

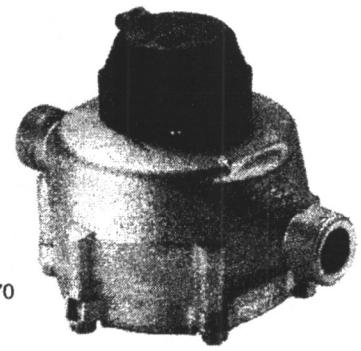
MAGNETIC DRIVE: Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling for straight-reading, remote or automatic meter reading options.

SEALED REGISTER: The standard register consists of a straight-reading odometer-type totalization display, 360° test circle with center sweep hand and flow finder to detect leaks. Register gearing consists of self-lubricating thermoplastic gears to minimize friction and provides long life. Permanently sealed; dirt, moisture, tampering and lens fogging problems are eliminated. Multi-position register simplifies meter installation and reading. Generator-type remote reading and automatic meter reading systems are available for all Recordall Disc meters. (See back of sheet for additional information.) All reading options are removable from the meter without disrupting water service.

TAMPER-PROOF FEATURES: Customer removal of the register to obtain free water can be prevented when the optional tamper detection seal wire screw or TORX® tamper resistant seal screw is added to the meter. Both can be installed at the meter site or at the factory.

MAINTENANCE: Badger Recordall Disc meters are designed and manufactured to provide long-term service with minimal maintenance. When maintenance is required, it can be performed easily either at the meter installation or at any other convenient location. As an alternative to repair by the utility, Badger offers various maintenance and meter component exchange programs to fit the needs of the utility.

CONNECTIONS: Tailpieces/Unions for installations of meters on various pipe types and sizes, including misaligned pipes, are available as an option.



Model 70

SPECIFICATIONS

Typical Operating Range (100% ± 1.5%)	1 1/4-70 GPM (.28 to 16 m³/hr)
Low Flow (Min. 95%)	3/4 GPM (.17 m³/hr)
Maximum Continuous Operation	50 GPM (11.3 m³/hr)
Pressure Loss at Maximum Continuous Operation	6.5 PSI at 50 GPM (.45 bar at 11.3 m³/hr)
Maximum Operating Temperature	80°F (26°C)
Maximum Operating Pressure	150 PSI (10 bar)
Measuring Element	Nutating disc, positive displacement
Register Type	Straight reading, sealed magnetic drive standard. Remote reading or Automatic Meter Reading units optional.
Register Capacity	10,000,000 Gallons, 1,000,000 Cubic Feet, 100,000 m³. 6 odometer wheels.
Meter Connections	Available in bronze and thermoplastic to fit 1" (DN 25mm) spud thread bore diameter sizes. See table below.

METER SPUD AND CONNECTION SIZES

Size Designation	x	"L" Laying Length	"B" Bore Dia.	Coupling Nut and Spud Thread	Tailpiece Pipe Thread (NPT)
1"	x	10 3/4"	1"	1 1/4" (1")	1"

MATERIALS

Meter Housing	Cast Bronze, Low Lead Alloy
Housing Bottom Plates	Bronze, Cast Iron, Low Lead Alloy
Measuring Chamber	Thermoplastic
Disc	Thermoplastic
Trim	Stainless Steel, Bronze
Strainer	Thermoplastic
Disc Spindle	Stainless Steel
Magnet	Ceramic
Magnet Spindle	Stainless Steel
Register Lid and Shroud	Thermoplastic, Bronze
Generator Housing	Thermoplastic

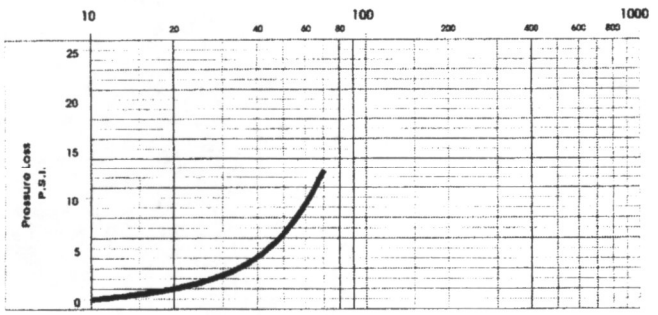
Automatic Meter Reading Systems

AMR

The Itron®, ORION® and TRACE® radio frequency systems easily integrate with all Recordall® Disc meters. All technologies provide an efficient meter data retrieval and information management system. The Itron 50W ERT®, ORION Transmitter and the TRACE Transponder all connect to the Recordall Transmitter Register (RTR®) assembly. Complete systems, including hardware and software, are available to provide a wide range of meter reading information.

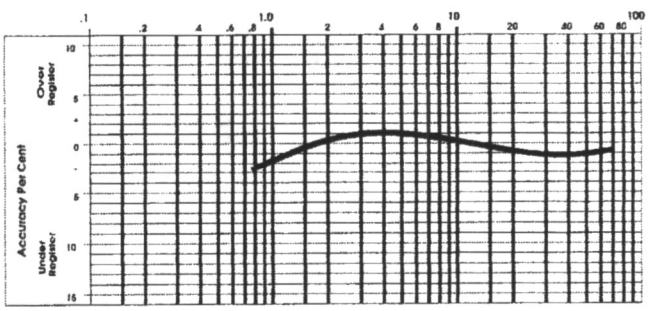
PRESSURE LOSS CHART

Rate of Flow, in Gallons per Minute



ACCURACY CHART

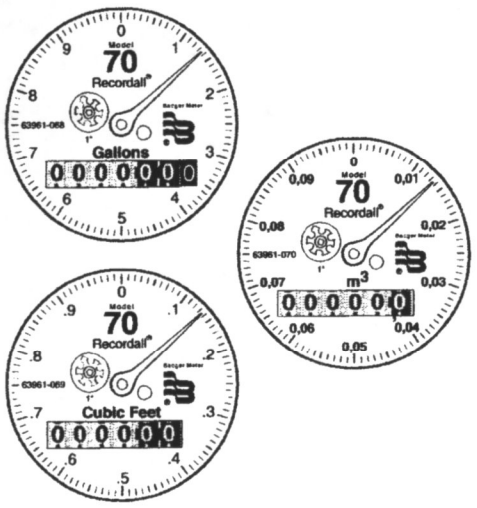
Rate of Flow, in Gallons per Minute

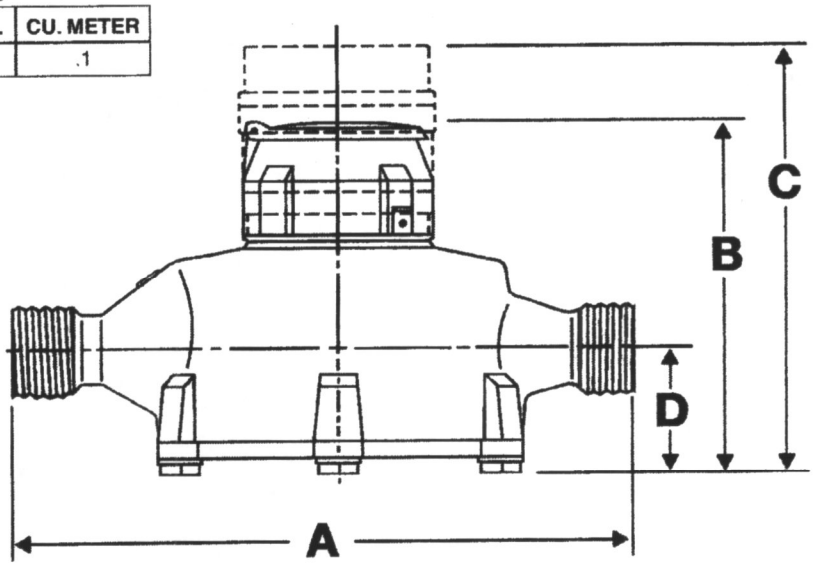


METER SIZE	METER MODEL	A LAYING LENGTH	B HEIGHT REG./RTR	C HEIGHT GEN.	D CENTERLINE TO BASE	WIDTH	APPROX. SHIPPING WEIGHT
1" (25mm)	70	10 3/4" (273mm)	6 1/2" (165mm)	7 7/8" (200mm)	2 5/16" (59mm)	7 3/4" (197mm)	11 1/2 lb. (5.2kg)

Sweep Hand Registration

MODEL	GALLON	CU.FT.	CU. METER
M70	10	1	.1





Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists.

TÜV MANAGEMENT SERVICE ISO 9001

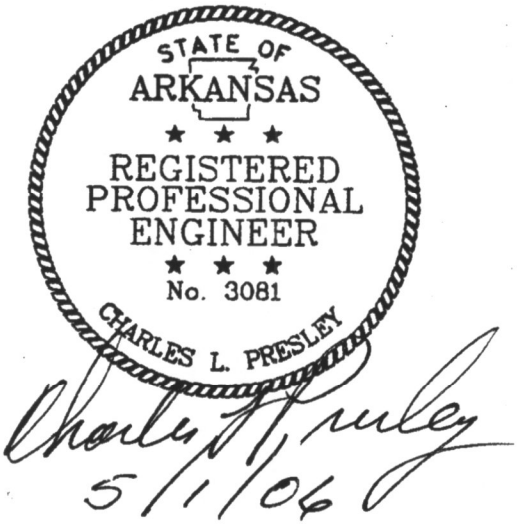
Please see our website at
www.badgermeter.com
for specific contacts.

BadgerMeter, Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
(800) 876-3837 / Fax: (888) 371-5982
www.badgermeter.com

PROPOSED SEWER IMPROVEMENTS FOR

DEER HAVEN SUBDIVISION

AVOCA, BENTON COUNTY, ARKANSAS



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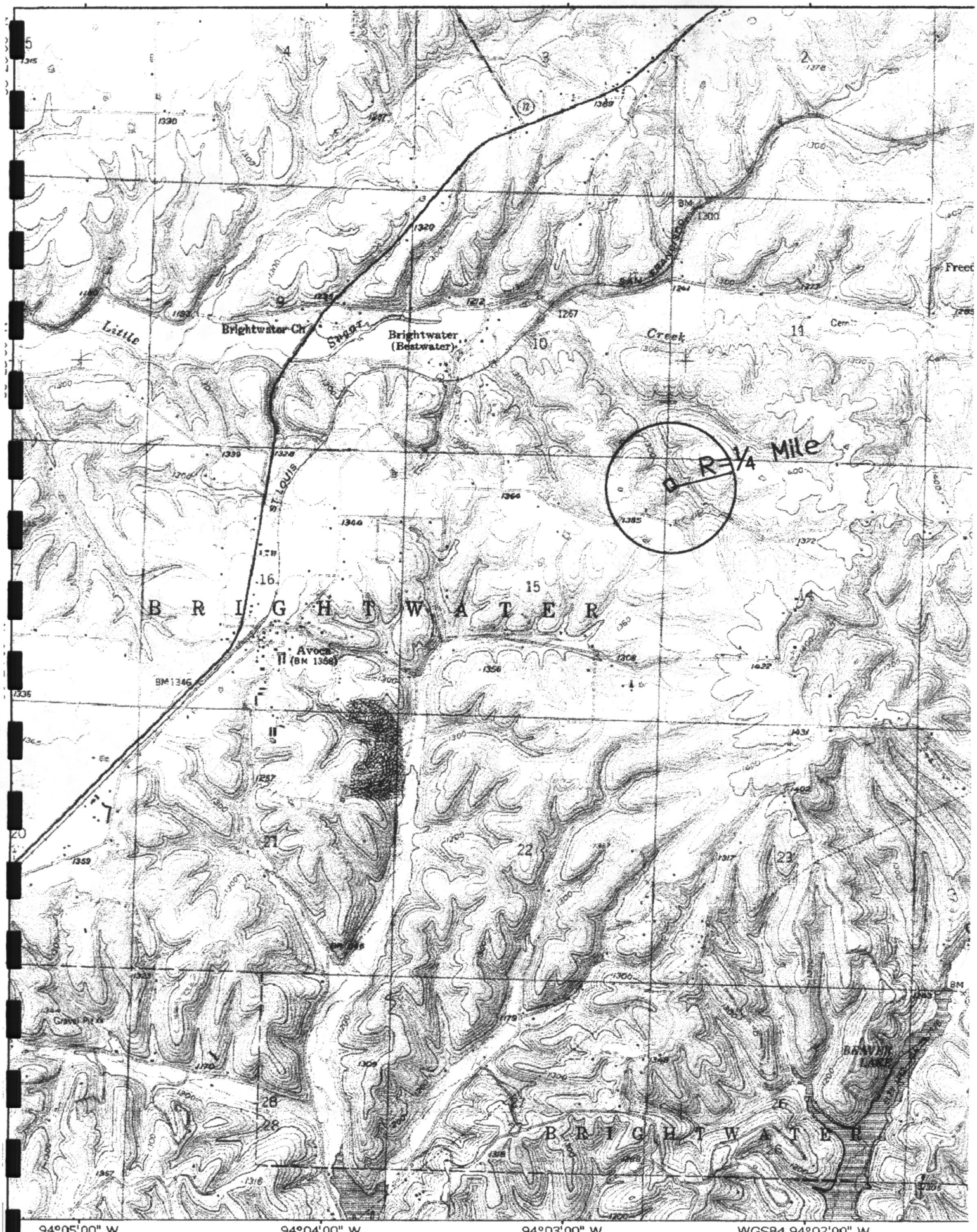
LOCATION MAP
(PEA RIDGE, ARK. – MO. QUAD MAP)



Map created with TOPO!® ©2001 National Geographic (www.nationalgeog

AquaPoint™
Performance Based Wastewater Treatment Solutions

BIOCLERE WASTEWATER TREATMENT SYSTEM DESIGN SPECIFICATIONS

SITE: Deer Haven Subdivision, Avoca, AR

A Bioclere package treatment plant is proposed to treat the wastewater from the Deer Haven residential development located in Avoca, AR. The system will consist of the following components in series: a pre-equalization tank, two model 36/24 Bioclere units operated in parallel and a 7,000 gallon settling tank. The system will be capable of treating the daily design wastewater flow with the following maximum influent characteristics.

	Bioclere influent	Effluent
Design flow (gpd)	33,280	33,280
BOD5 (mg/l)	200	-
CBOD5 (mg/l)	-	<15
TSS (mg/l)	200	<15
TKN (mg/l)	45	-
Total Nitrogen (mg/l)	45	-
Fecal Coliform	-	<10,000

PRIMARY TANK(s)
Please see site plans by Presley, Brannan & Associates to review the primary settling tank and equalization tank details.

PRE-EQUALIZATION

Primary settled wastewater shall be pumped to the pre-equalization tank (pre-EQ). The pre-EQ system consists of a precast concrete tank located ahead of the Bioclere unit(s). The following equipment is included in this tank: 2 Barnes SE effluent pumps, associated piping, slide rails, controls and appurtenances.

This two alternating submersible pumps that deliver primary settled wastewater to the Bioclere units at a rate that should be approximately 30 gallons/minute. The rate is controlled mechanically using a timer and pump impeller size inside the equalization tank.

Four control float switches are located in the tank and govern the following functions:

Low level Alarm float: The low level alarm float will act as a redundant pump shut off and will activate an audio/visual alarm signal when the float switch is in the extended position (open circuit).
Low level float In the extended position this float switch will create an open circuit and prevent operation of the pumps. However, the pumps may be manually activated when the low level float switch is extended and the circuit is open. When the circuit is closed the float switch will activate the timer and alternate the Barnes SE pumps, transferring wastewater to the Bioclere unit.
Mid level float A mid level float will create a closed circuit and activate the lag pump. Upon this occurrence, a counter will be triggered to alert the operator that a high level condition has occurred and that the timer setting may need adjusting.
High level float The high level float switch will activate the audio/visual alarm when the circuit is closed. This will allow the operator to periodically test the high level alarm.

IMPORTANT NOTES:

1) The EQ pumps will alternate between dosing cycles. However, if one pump fails the remaining pump will take over the failed pump's cycle and an audio/visual alarm will be activated.

2) The effects of recirculation from the Bioclere units must be taken into consideration when determining the timing for the EQ pumps. Initially the recycle timers will be set to recycle approximately **1/2 the average daily flow** back to the pre-equalization tank.

3) All Bioclere units contain a float switch to terminate the recycle pump operation. This will prevent excessive recycling and always maintain the Bioclere dosing pumps below water level. This will also keep the biological growth functional when the primary tanks are pumped.

BIOCLERE UNITS

Two model 36/24 Bioclere units operated in parrallel followed by a settling tank will be required to produce an effluent with quality of <15 mg/l CBOD5 and <15 mg/l TSS, and a fecal coliform of <10,000. Each Bioclere consists of a trickling filter that is situated over a final settling tank. The Bioclere is manufactured with fiberglass inner and outer skins with the cavity between filled with polyurethane foam insulation for maximum treatment efficiency.

As wastewater is generated it will flow through the septic tank and then pumped from the pre-equalization tank and subsequently to the center baffled chamber in the Bioclere clarifier. Wastewater is supplied to the filter by means of two alternating stainless steel submersible pumps that are situated in the center baffle. In case of one pump failure, the operational pump automatically takes over both dosing cycles. Dosing is controlled using fully adjustable timer and the wastewater is uniformly distributed over the entire surface area of the filter by means of fixed nozzles that are constructed of nylon. Each Bioclere contains a PVC dosing array and nozzles centered above the filter media to ensure uniform dosing.

Recirculation of sludge and wastewater is accomplished in each unit using a submersible stainless steel pump controlled by fully adjustable timers. The pump is located on the bottom of the cone shaped clarifier. The diameter of each settling tank is 12 feet with 60-degree sloping sides. Internal baffling is provided in the secondary settling tank to prevent short-circuiting of wastewater and biological solids. The biological solids generated in the filter are returned to the sludge storage facility at regular intervals, typically every hour. Both Bioclere recycle pumps will be set to run 4.5 minutes per 30 minutes (202.5 gallons) respectively. This equates to approximately 8,910 gallons per day per Bioclere. Therefore, the sludge will not collect in the secondary settling tank and a sludge blanket will not form. The efficiency of the Bioclere secondary settling tank has been proven by the numerous installations and successful operating experience.

The benefits of recirculation are numerous and include: 1) removing biological sludge from the Bioclere so that only the primary tank(s) need periodic pumping, 2) diluting the influent pollutant concentrations which results in a thinner and more effective biofilm on the media bed, 3) odors are reduced in the primary tanks and the treatment components, 4) diluting biological inhibitors (cleaning agent, sanitizers, etc.) that may exist in the wastewater, 5) achieving nitrogen removal through denitrification due to the recirculation of nitrate to the primary tank.

The filter media consists of manufactured PVC randomly packed media. The media has a void ratio of >95%, is UV resistant and resistant to a wide range of aqueous solutions, acids, alkalis, oxidizing agents, oils, fats and alcohols.

Forced air ventilation is provided in the Bioclere since it is a covered trickling filter. Each Bioclere contains an axial fan with an airflow capacity of 240 cfm. The fan is exposed to the atmosphere due to its enclosure location on top of the Bioclere. Air flows subsequently through the filter, underdrain, and is discharged through the effluent pipe. A PVC vent is installed after each Bioclere.

Filter and clarifier sizing calculations

The media loading rates are based on over 10,000 municipal, commercial and industrial installations throughout the world and approximately 700 in the United States. The loading rates conform with those that are accepted by the United States Environmental Protection Agency (*Nitrogen Control* 1993 and *Assessment of Single Stage Trickling Filter Nitrification* 1991),

Water Environment Federation (Aerobic Fixed Film Reactors 2000) and Metcalf & Eddy, (Wastewater Engineering 1991).

The filter media organic loading rates are based on the design criteria outlined on page 1 of this document. The media in the Bioclere units will have specific surface areas of 140 m^2/m^3.

Bioclere Organic and Hydraulic Loading:

Organic Loading:
The organic loading to the Bioclere units takes into account an approximate BOD5 reduction to 160 mg/l through the septic tank. Assuming a recirculation rate of approximately 50%, the system will receive 47.0 lbs. BOD_5/day based on the design flow of 33,640 gpd. **Note that each Bioclere unit will receive 16,820 gpd.**

BOD5 (lbs./day) = Influent from primary tank + Recirculation

$$= \frac{(16{,}820 \text{ gpd} \times 8.34 \text{ (lbs./gal)} \times 160 \text{ (mg/l)})}{1 \times 10^6} + \frac{(0.5 * 16{,}820 \text{ (gpd)}) * 8.34 \text{ (lbs./gal.)} * 15 \text{(mg/l)}}{1 \times 10^6}$$

= 23.5 lbs. of BOD_5/day

Each model 36/24 Bioclere unit contains 24.0 m^3 of PVC media (848 ft^3). The specific surface area of 140 m^2/m^3 and the void ratio is >95%. Therefore, the media organic loading rate in the Bioclere will be:

= 23.5 lbs. BOD_5/day / (848 ft^3 media) = **0.028 lbs. BOD_5/ft^3-day (0.98 lbs. BOD_5/m^3-day)**

This loading rate will reduce the $CBOD_5$ to <15 mg/l and oxidize approximately 30% of the influent ammonia (USEPA - Nitrogen Removal 1993 and Assessment of Single Stage Trickling Filter Nitrification 1991, Metcalf & Eddy 1991 and WEF Aerobic Fixed-Growth Reactors 2000).

Hydraulic loading: Note that each Bioclere unit will receive 16,820 gpd.

Each Bioclere settling tank is sized to provide a secondary settling tank surface overflow rate that will not exceed a value of 1.2m^3/m^2 (712 gal/day-ft^2) during peak loading conditions. The calculations are detailed below:

Tank Diameter	12 feet
Surface Area	113 ft^2
Tank Volume	3500 gallons

Surface overflow rate (SOR): Note that each Bioclere unit will receive 16,820 gpd.

SOR = Flow to clarifier (gpd) / Surface area of clarifier (ft^2)

SOR at average daily flow assuming a 24 hour flow distribution:
= (16,820 (gpd) / 113 (ft^2) = **149 gal/day/ ft^2**

SOR at peak hourly flow: (Four times the average hourly flow)
Peak hourly flow = 16,820 gpd/24 hour = 701 gallons/hour (in 24 hours)
701 gph * 4 = 2,804 gph @ peak
2,804*24 = 67,296 gpd
= 67,296 gal/day / 113 (ft^2) = **596 gal/day/ft^2**

The recommended SOR for design average flow and peak flow is between 400-800 gal/day/ft^2 and 1000-1200 gal/day/ft^2 respectively (EPA and Metcalf & Eddy). Therefore, the SOR for the Bioclere settling tank is conservatively below the recommended ranges for design average and peak flow rates.

CONTROLS

The controls for the Bioclere units are housed in a single NEMA 4X cabinet. All pumps and mechanical components are connected to audio and visual alarms to alert the operator in case of failure. The control panels contain contacts for a common external alarm.

WASTEWATER MANAGEMENT PLAN

Decentralized Sewer System With Bioclere Treatment and Gravity Collection

Deer Haven Subdivision

Avoca, Benton County, Arkansas

Engineering Report

PROJECT DESCRIPTION:

This sewer system is located west of Avoca, Arkansas in the NW ¼ of Section Fourteen (14) and the NE ¼ of Section Fifteen (15) Township Twenty (20) North, Range Twenty-Nine (29) West, approximately 1.5 miles northeast of Avoca, Arkansas. It will provide wastewater treatment and subsurface disposal for one hundred and twenty-eight (128) homes. The design flow for this project is thirty-three thousand, two hundred eighty (33,280) GPD.

The sewage will gravity flow from each house via a 4" building sewer to a sewer main which will carry it to a lift station located in the lower portion of the subdivision. The lift station will then pump all the combined sewage to the Bioclere Treatment Plant. After this, the relatively clean effluent is settled and pumped into a dripper field for final treatment and disposal.

Design Flow/Sizing Calculations:

Q design: (128 lots)(260 GPD/lot) = 33,280 GPD

(2.6 people/home)(100 GPD/person) = 260 GPD

Dripper Field Loading Rate = 0.385 GPD/ft²
(see soils report by Rebecca Corbitt)

Dripper Field Area = $\frac{33,280}{0.385}$ = 86,442ft²

$\frac{86,442ft^2}{43,560ft^2/Ac}$ = 1.98 Acres

Alternate Area = (86,442ft²) (0.50) = 43,221ft²
(50% of Primary Area)

$\frac{43,221ft^2}{43,560ft^2/Ac}$ = 0.99 Acres

Dripper lines are on two (2) foot centers, Emitters are on two (2) foot centers, therefore, each Emitter covers four (4) ft^2.

Total number of Emitters = $\frac{86{,}442 ft^2}{4 ft^2/\text{Emitter}}$ = 21,611

Total length of Dripper Line = $\frac{86{,}442 ft^2}{2 ft}$ = 43,221ft. in the Dripper Field

See treatment plant layout sheet #3/4 for more design information.

GEOFLOW WASTEFLOW P/C dripper line has a constant flow rate (0.53 GPH) at all pressures from 10 to 60 psi. The risk of root intrusion in the emitters is eliminated by the installation of GEOFLOW ROOTGUARD within the dripper lines, which protects emitters from vegetative invasion.

GEOFLOW uses turbulent flow "in line" emitters with large flow paths, these have proven to be the most reliable and dependable emitters because of the resistance to blocking. GEOFLOW'S WASTEFLOW has an inner lining impregnated with a bactericide, Ultra Fresh DM-50, to inhibit bacterial growth on the walls of the tube, and in the emitters.

The Benton County Water Authority, District #1, shall own and operate this sewer system. Wayne Allen, the Water District Manager, has a Class #3 operator's license.

There are no wells within one-quarter (1/4) mile of the treatment plant.

AquaPoint

Performance Based Wastewater Treatment Solutions

Design Criteria 1/16/06
Tel: (508) 998-7577
Fax: (508) 998-7177

SYSTEM DESIGN CRITERIA

Date: 4/7/06 | Requested Response Time: ASAP

Engineer: Presley Burnham	Customer/Contact: Deer Haven
Address: Springdale, AR	Project Name: Franklin Miller
Mail: Presley@Presleyburnham.com	Address: [redacted] Avoca, AR
Tel: 479-256-8720 Fax:	

Application / Description: ☑ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ School ☐ Other

Provide relevant details: 128 lots x 260

Type of Collection System: ☑ Gravity ☐ Grinder Pumps ☐ S.T.E.P. ☐ Pump Stations ☐ S.T.E.G ☐ Other

w/ Lift Station 3,500' away

Type of Disposal System: ☐ Stream ☐ Conventional Leach Field ☑ Drip Disposal ☐ Spray ☐ Other

Wastewater Flow Calculations:
(Please show calculations that are basis of the design).

Design Flow: 33,280 GPD
Actual Daily Flow:
Maximum Daily Flow:
Peak Hourly Flow or peaking factor (please specify):

Comments: (topography, permits, flow calculations, technology requests, containerization requests, etc. Please append information as needed.)

Figure Bioclere Technology

Residential, Municipal, Commercial or Industrial Applications*

** Please obtain composite samples at the septic tank effluent tee for the parameters listed under INFLUENT DATA*
Please provide Aquapoint with all applicable Material Safety Data Sheets (MSDS)

INFLUENT DATA

Specify sample type & location: ☐ Grab Sample ☐ Composite Sample
☐ Septic tank influent ☐ Septic tank effluent
Seasonal Flows: ☐ Y ☑ N when?
Will low flow devices be utilized?: ☐ Y ☐ N
Will garbage disposal/grinders be utilized?: ☑ Y ☐ N Probably
Wastewater Temperature (10° C assumed unless specified):
Site Elevation (feet above sea level):

Parameter	Raw	Settled	
pH:			
BOD_5:	200		
COD:			
TSS:	200		
TKN:	45		
Alkalinity:			
Ammonia-N:			
Oil & Grease (are traps included?):			
Phosphorus:			
Other:			

EFFLUENT REQUIREMENTS

Please specify location of effluent requirements:
e.g. System effluent pipe; groundwater interface; property line

Please specify $CBOD_5$ for organic load when allowed

pH:	
$CBOD_5$:	15
BOD_5:	
COD:	
TSS:	15
Ammonia-N:	
Nitrate-N:	
Total Nitrogen:	
Oil & Grease:	
Phosphorus:	
Fecal Coliform:	< 10,000
Dissolved Oxygen:	
Turbidity:	
Other:	

NOTES: ** Commercial installations require baffled septic tanks and a gas baffle under the effluent tee*

Aquapoint Representative: 4/7/06 Date:

Engineer Signature: Charles Presley 4/7/06 Date:

IMPORTANT: *The information provided by you on this form will be relied upon by Aquapoint Inc. in determining project specifications and pricing. Accordingly, all such information must be complete and accurate and any fact or circumstance that comes to your attention after the date hereof that may in any way render any information contained herein incomplete or inaccurate must be brought to the attention of Aquapoint Inc. immediately.*

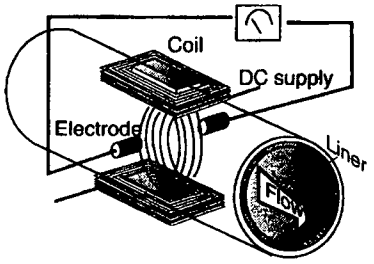
Magnetoflow® Mag Meter	Model Magnetoflow Flanged	Technical Brief

GENERAL

Badger's Magnetoflow line is the result of 35 years of research and field use in electromagnetic flow meters. Based on Faraday's law of induction, these meters can measure almost any liquid, slurry or paste that has a minimum of electrical conductivity. Designed, developed and manufactured under the strictest quality standards, the Magnetoflow meter ranks among the best in the market. Its sophisticated, processor based signal conversion represents the state of the art in the industry with accuracies of 0.25% or better. The wide selection of liner and electrode materials insures maximum compatibility and minimum maintenance over a long operating period.

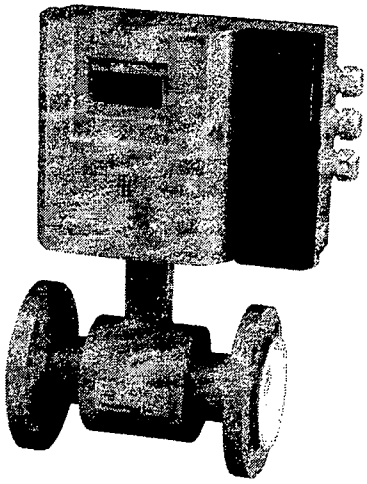
OPERATION

The flow meter is basically a stainless steel tube lined with a nonconductive material. Outside the tube two DC powered electromagnetic coils are positioned diametrically opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. When the coils are energized, a magnetic field is created across the whole diameter of the pipe. When a conductive fluid flows through this magnetic field, a voltage is induced across the electrodes. This voltage is directly proportional to the average flow velocity of the fluid and is picked up by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce a very accurate analog or digital signal. The signal can then be used to indicate flow rate, totalization or to communicate to remote sensors and controllers. The main advantages of this technology are that with no parts in the flow stream, there is no pressure loss, the accuracy is not affected by temperature, pressure, viscosity, density or flow profile and with no moving parts there is practically no maintenance required.



APPLICATION

Because of its inherent advantages over other more conventional technologies, this meter can be used in the majority of industrial flow applications. Whether the fluid is water or something highly corrosive, very viscous, contains a moderate amount of solids or requires special handling, this meter will be able to accurately measure it. Today Magnetoflow meters are successfully being used in most industries including food and beverage, pharmaceutical, water and wastewater, and chemical.



Magnetoflow® Flanged

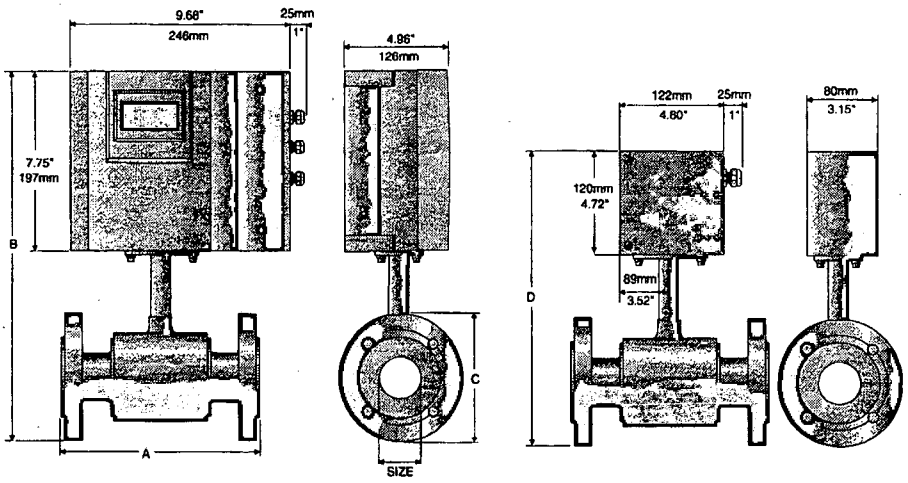
FEATURES

- 0.25% accuracy independent of fluid viscosity, density and temperature
- Unaffected by most solids contained in fluids
- Pulsed DC magnetic field for zero point stability
- No pressure loss for low operational costs
- Long life corrosion resistant liners
- Calibrated in state of the art facilities
- Integral and remote signal converter availability
- Optional grounding rings or grounding electrode
- Measurement largely independent of flow profile
- NSF listed

Electrodes

The two measuring electrodes, when looking from the end of the meter into the inside bore, are positioned at 3 o'clock and 9 o'clock. Badger Meter's Magnetoflow Mag meters have an "Empty Pipe Detection" feature. This is accomplished by the use of a third electrode that is positioned between 12 o'clock and 1 o'clock in the meter. At any time this electrode is not covered by fluid, (for a minimum of a five second duration), the meter will display an Empty Pipe Detection condition, send out an error message if desired, and stop measuring to maintain accuracy. When the electrode again becomes covered with fluid, the error message will disappear and the meter will continue measuring.

As an option to the use of a set of grounding rings, to assure proper grounding in a given installation a grounding electrode (4th electrode) can be installed in the meter when initially fabricated. The position of this electrode is about 5 o'clock.



Meter with Primo® Amplifier Meter with junction box for remote Primo® Amplifier

Size		A		B		C		D		Est. Weight with Primo		Flow Range LPM		Flow Range GPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	Lbs	Kg	Min	Max	Min	Max
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.063	20	0.02	5
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.114	34	0.03	9
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.177	53	0.05	14
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.416	125	0.11	33
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5	0.75	225	0.2	59
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0	1.20	350	0.3	93
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0	2.00	575	0.5	152
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5	3.00	900	0.8	239
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5	4.70	1400	1	373
2 1/2	65	11.0	280	17.1	434	7.0	178	14.4	366	54	24.5	8	2400	2	631
3	80	11.0	280	17.3	440	7.5	191	14.7	372	56	25.5	12	3600	3	956
4	100	11.0	280	18.4	466	9.0	229	15.7	398	58	26.5	19	5600	5	1493
5	125	15.8	400	19.6	498	10.0	254	16.9	430	60	27.0	30	8800	8	2334
6	150	15.8	400	20.6	524	11.0	279	17.9	456	62	28.0	40	12700	11	3361
8	200	15.8	400	22.5	572	13.5	343	20.4	518	88	40.0	75	22600	20	5975
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0	120	35300	30	9336
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0	170	50800	45	13444
14	350	19.7	500	30.8	782	21.0	533	28.2	716	260	118	230	69200	60	18299
16	400	23.6	590	33.7	856	23.5	597	31.0	788	308	140	300	90400	80	23901
18	450	23.6	590	35.0	890	25.0	635	32.4	822	402	182	380	114000	100	30250
20	500	23.6	590	38.2	969	27.5	699	35.5	901	495	225	470	140000	125	37346
22	550	23.6	590	39.6	1005	29.5	749	36.9	937	525	238	570	170000	150	45188
24	600	23.6	590	42.2	1071	32.0	813	39.5	1003	554	252	680	200000	180	53778
28	700	23.6	590	46.2	1173	36.5	927	44.0	1118	650	295	920	275000	240	73100
30	750	31.5	800	48.3	1228	39.0	984	45.7	1161	704	320	1060	315000	280	84000
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350	1200	361000	320	95600
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386	1500	457000	400	121000
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420	1900	565000	500	149300
42	1050	36.0	914	66.0	1675	53.0	1346	63.4	1610	1100	500	2100	620000	550	164600
48	1200	39.4	1000	69.9	1775	59.4	1455	67.2	1707	1210	550	2700	814000	720	215100
54	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620	3700	1100000	980	292700

SPECIFICATIONS - Detector

Flow Range: 0.1 - 39.4 fps (0.03-12 m/s)
Sizes: 1/4" to 54" (16 to 1400 mm)
Min. Conductivity: ≥ 5 micromhos/cm
Accuracy:
± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Electrode Materials: Standard: Alloy C
Optional: 316 Stainless Steel, Gold/Platinum Plated, Tantalum, Platinum/Rhodium
Liner Material: PFA up to 3/8", PTFE 1/2" thru 24", Soft and Hard Rubber from 1" to 54", Halar® from 14" to 40"
NSF Listed: Models with Hard Rubber Liner 4" size and up; PTFE Liner - All sizes.

"Only products bearing the NSF Mark are Certified."

Fluid Temperature:
With Remote Converter:
PFA, PTFE & Halar 311°F, (155°C)
Rubber 178°F, (80°C)
With Meter Mounted Converter:
PFA, PTFE & Halar 212°F, (100°C)
Rubber 178°F, (80°C)
Pressure Limits:
150 psi (10Bar) optional 300psi (20Bar)
Coil Power: Pulsed DC
Ambient Temperature: -4°F to 140°F, (-20°C to 60°C)
Pipe Spool Material: 316 Stainless Steel
Meter Housing Material: Carbon Steel welded

Flanges: Carbon Steel - Standard (ANSI B16.5 Class 150 RF) 316 Stainless Steel - Optional
Meter Enclosure Classification: Nema 4
Optional: Submersible Nema 6P (Remote Amplifier Required)
Junction Box Enclosure Protection:
(For Remote Converter Option) Powder coated die-cast aluminum, Nema 4
Cable Entries: 1/2" NPT Cord Grip
Optional Stainless Steel Grounding Rings:

Meter Size	Thickness (of one ring)
up thru 10"	.135"
12" to 20"	.187"

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists.

Please see our website at
www.badgermeter.com
for specific contacts.

BadgerMeter, Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Magnetoflow® Mag Meter	Model Magnetoflow Primo® (3.1 Electronics)	Technical Brief

GENERAL

Badger's Primo amplifier was specifically designed to be used with the entire line of Magnetoflow electromagnetic flow meters. This amplifier represents the culmination of years of research into mag meter signal processing and includes the latest developments in microprocessor signal conditioning technology. The advanced design of the unit allows the accuracy of the detector to be better than .25% and the flow range better than 300:1. The Primo amplifier can be used as an integral part of the detector or it can be mounted remotely when necessary. The Primo electronics are housed in a NEMA 4X aluminum powder coated enclosure with easy access to all wiring and programming functions.

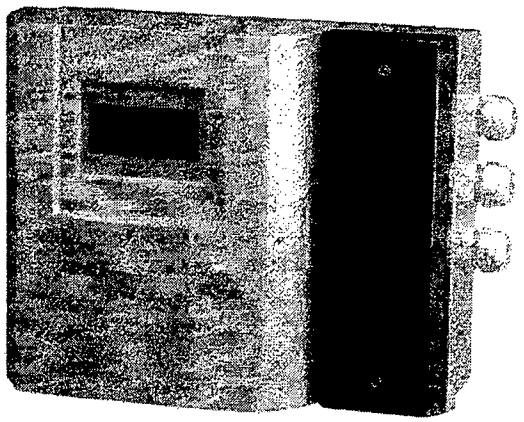
OPERATION

As the analog signal is received from the detector, the Primo unit amplifies the signal and converts it into digital information. At the processor level, the signal is analyzed through a series of sophisticated software algorithms and after separating it from electrical noise, it is converted into both analog and digital signals that are used to display rate of flow and totalization. In addition the processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Primo's 4 line, 16 character LCD display simultaneously indicates rate of flow, forward and reverse totalizers and diagnostic messages. It also serves to guide the user in simple English terms through the user-friendly programmable routines.

Programmable parameters of the Primo amplifier include: calibration factors, reset of totalizers, pulse value with auto decimal point position, selection of unit of measure, selection of flow direction, analog signal output, relay and open collector high and low flow alarm signals, low flow cut-off percent of flow and noise dampening factor.

APPLICATION

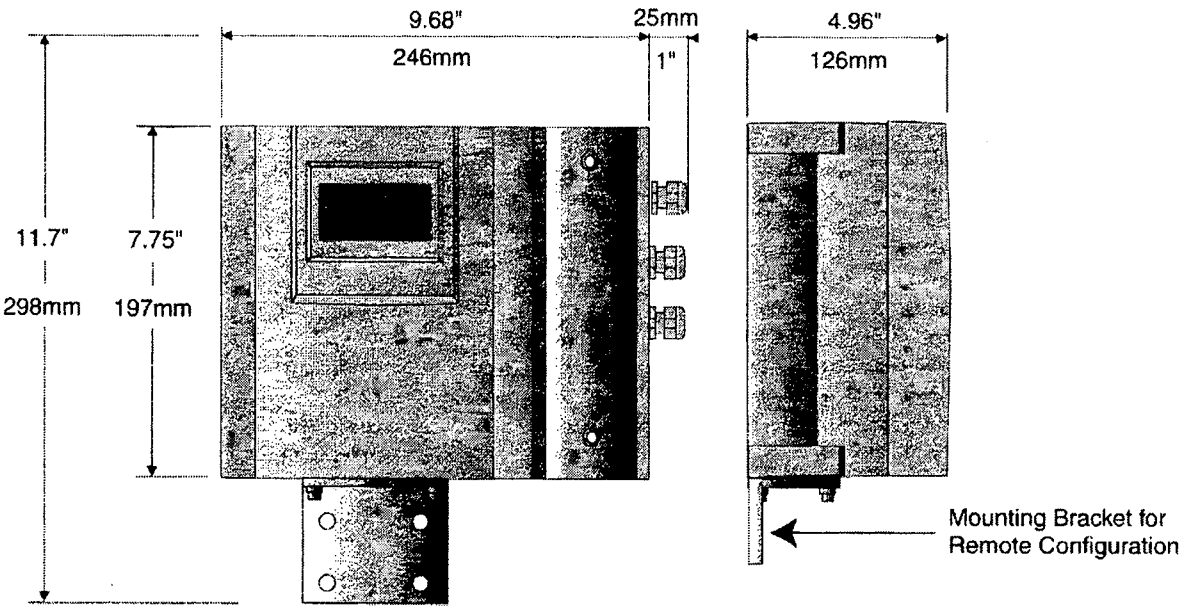
The Primo amplifier main function is to detect and condition the flow information from the electromagnetic detector. The unit is ideally suited for use in applications where the flow is continuous and indication of rate and totalization is required. Also, in applications where a minimum and/or a maximum flow rate must be kept and carefully monitored, the unit also provides pulse signals that can be fed to dedicated batch controllers, PLCs and other more specialized instrumentation.



Magnetoflow® Primo®

FEATURES

- Microprocessor based
- Large 4 line x 16 character back-lit LCD display
- User friendly programming procedure
- Digital and analog outputs
- NEMA 4X enclosure
- Sensor or remote wall mount
- Bidirectional flow sensing/totalization
- Automatic zero point stability
- Better than 0.1% repeatability
- Measures fluids with as low as 5.0 micromhos/cm conductivity
- Empty pipe detection



SPECIFICATIONS

Power Supply: 85-265 VAC, 45-65 Hz
Power Consumption: 20W
Accuracy: ± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from .1-1 fps.
Repeatability: <0.1%
Minimum Fluid Conductivity: 5.0 micromhos/cm
Processing: Microprocessor H8 (16 bit)
Flow Direction: Unidirectional or bidirectional, 2 separate totalizers (programmable)
Analog Outputs:

Current
4 - 20mA < 800 Ω
2 - 10mA < 800 Ω
0 - 20mA < 800 Ω
0 - 10mA < 800 Ω

Ouput Frequency: Scaled Pulse output (open collector), Max 5Khz
Digital Outputs:
Voltage sourcing transistor, 24VDC, 100mA max
(3) AC Solid state relays, 48VAC, 0.5 amp max

Outputs: All outputs are short circuit safe.
Noise Dampening: Programmable from 1 to 6
Pulse Width: Programmable from 5ms to 500ms
Min-Max Flow Alarm: Programmable relay outputs 0 to 100% of flow
Units of Measure: Gallons, Ounces, Pounds, MGD, Liters, Cubic Meters, Cubic Feet, Acre Feet
Galvanic Separation: £ 500 volts
Low-flow-cutoff : Programmable 0-10% of max flow
Zero-point Stability: Automatic correction
LCD Display: 4 lines x 16 character back-lit alphanumeric; Displays (2) Totalizers, Flow Rate, Alarm Conditions
Programming: Three button manual
Housing: Cast aluminum, powder coated paint
Housing Rating: NEMA 4X
Mounting: Detector mount or remote wall mount (bracket supplied)
Cable Connection: 1/2" NPT Cord Grip
Ambient Temperature: -4 to 140° F (-20 to 60° C)
Serial Communication: RS232

Please see our website at
www.badgermeter.com
for specific contacts.

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

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www.badgermeter.com

AquaPoint™
Performance Based Wastewater Treatment Solutions

BIOCLERE
Project Estimate

5/5/2006

To: AquaTech Systems Inc.

Project: Deer Haven, Avoca, AR

Track #: 6258

Thank you for your request for an Aquapoint treatment system estimate for the referenced project.

Project Scope and Design Considerations:

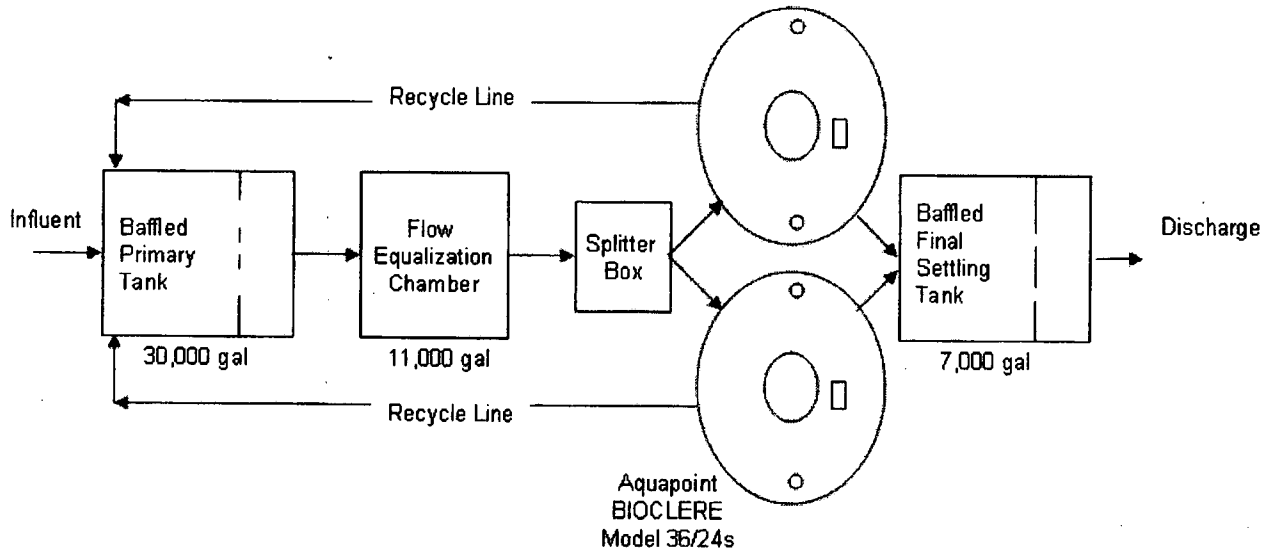
Based on the preliminary information that you have provided, we have used the following wastewater characteristics and effluent quality requirements for the purpose of this estimate. We understand that that this project consists of gravity collection with a lift station approximately 3,500 feet from the plant and that the treated effluent will be discharged to a drip irrigation field.

FLOW	Q (GPD)		INFLUENT (MG/L)	EFFLUENT (MG/L)
Design	33,280	PH	6.5 – 8.5	6.5 – 8.5
128 lots x 260 gpd/lot		Temperature (degrees)	Min. 10 C	
		BOD_5	250	
		$CBOD_5$		< 15
		TSS	250	< 15
		TKN	65	NA
		Fecal Coliform		< 10,000

Equipment & Process Flow Description:

1. Wastewater will be delivered to the WWTP via gravity collection lines and a pump station.
2. Influent will enter a 30,000 gallon primary settling tank baffled at 2/3 volume.
3. Primary settled effluent will flow by gravity to an 11,000 gallon flow equalization chamber (EQ).
4. The EQ will time dose wastewater to a dual weir flow splitter box that will distribute the water equally to two (2) Aquapoint Bioclere model 36/24s in parallel. Both Biocleres will recycle secondary sludge back to the head of the primary settling tank.
5. Treated Bioclere effluent will flow by gravity to a 7,000 gallon final settling tank baffled at 2/3 volume.
6. Final settled effluent will flow by gravity to a drip pump tank for distribution to the drip field.

Flow Diagram: This flow diagram is a visual reference designed to compliment the equipment & process flow description and does not represent scale or actual layout of the wastewater treatment plant.



Equipment Supplied by AquaPoint: Please note that several Aquapoint products are installed in tanks that are the responsibility of a project contractor or others. Pricing for these products includes all components except for the tanks and access hatches. Aquapoint products requiring tanks by others are written in **blue** text below.

#	MODEL	NOTES	PRICE
2	Aquapoint Bioclere Model: 36/24s	Complete with fiberglass tankage, pumps, media and PLC / HMI controls.	
1	Flow Equalization Package(s)	**Includes:** dual submersible pumps, stainless steel lifting rails, floats, brackets and controls. **Note:** Fiberglass or concrete tank(s) and access hatch by others.	
1	Dual weir flow splitter box	Baffled fiberglass box w/ 2 weirs. **Note:** Requires small concrete dry well and access hatch by others.	
	Onsite Consultation	**Includes:** 2 days onsite consultation with an Aquapoint representative for installation, commissioning and operator training.	
	Total equipment cost		
	Estimated Freight	Delivery typically within 8 to 10 weeks of receipt of an order.	
	Total Delivered Cost		

Optional Aquapoint Equipment: The following options are upgrades to equipment listed above. Water tight flanges may be required by state codes and will be needed for installations where high groundwater levels are present.

UPGRADE	NOTES	PRICE
Aqua Alert Telemetry upgrade	Aqua Alert remote wireless telemetry controls are available upon request. **Note:** Aqua Alert telemetry has a $20 monthly service charge for the wireless transmission of system data.	+ $ 700/panel (2)
Bioclere water tight flange	Fiberglass Bioclere flanges may be required for sites with high ground water.	+ $ 1,300/unit
Ultrasonic Flow Meter (Doppler)	**Includes:** Control panel and digital display	+ $ 6,500

Equipment Not Included: The following items are recommended tanks and suggested equipment to be supplied by others. **TANK CAPACITIES ARE RECOMMENDED MINIMUMS ONLY AND ARE TO BE CONFIRMED BY THE DESIGN ENGINEER**

#	ITEM	NOTES
1	Primary settling tank(s)	Minimum recommended capacity 30,000 gallons (Baffled at 2/3 volume)
1	Flow equalization tank(s) & hatch	Minimum recommended capacity 11,000 gallons
1	Splitter box dry well(s) & hatch	Dry well capable of housing a 1 cubic yard fiberglass weir box
2	Bioclere mounting pad(s)	12' diameter, 10" thick concrete pad w/ 4 mounting eyes to chain down, balance and level the Bioclere.
1	Final settling tank(s)	Minimum recommended capacity 7,000 gallons (Baffled at 2/3 volume)
✓	Control room / building	Controls panels utilize NEMA 4 watertight enclosures and can be installed outside if desired. However, a control building provides O&M advantages and prevents vandalism of electronic equipment.
✓	Domestic water supply	A fresh water source would be a valuable resource for the operator and would enable him or her to clean equipment on site.
✓	Final effluent pump chamber w/ pumps	By others if pressure distribution system is specified
✓	External connective piping	See site plans
✓	Power supply and wiring	Bioclere: 230v-60Hz-1Ph Max 30a, EQ: 115v-60Hz-1Ph Max 30a

Installation:

- Estimate includes 2 MAN-DAYS onsite consultation with an Aquapoint representative for installation, system commissioning and operator training.
- Auxiliary tanks, piping and site work are the responsibility of the project contractor or others.
- Bioclere and clarifier installations in ground water conditions require anti-floatation concrete ballast backfill as necessary and may require watertight fiberglass flanges. It will be critical to determine groundwater elevation prior to system installation.
- Bioclere modules do not require any special buildings or enclosures. The units are delivered with a lifting harness (supplied by Aquapoint) and can be handled by an excavator or crane for attachment to concrete mounting pads supplied by the contractor.
- Flow Equalization equipment requires tanks and hatches by others. Aquapoint will supply the internal equipment to be installed by the site contractor.
- Electrical contract work includes mounting of the control panels, connection of power feed to each panel, installation of a conduit and connection of control wires to the treatment unit(s). Aquapoint will install and wire the pumps during commissioning.

Additional Considerations & Review:

This estimate reflects the design parameters as indicated above and assumes no other environmental factors that will adversely affect treatment. Floor strippers and products such as cleaners and sanitizers containing Quaternary Ammonium Chlorides (QAC's) are highly toxic to the wastewater treatment system bacteria and should not be discharged to the wastewater system. We recommend that toxic products be replaced with oxidizing cleaners.

IMPORTANT: This estimate is for planning purposes only and shall under no circumstances be binding upon Aquapoint Inc. The actual fees assessed and/or prices charged by Aquapoint Inc. may be higher or lower than those listed. Aquapoint Inc. has relied exclusively on information provided by the addressee in providing this estimate. The addressee acknowledges and affirms that Aquapoint Inc. assumes no liability with respect to the addressee or any third party for the estimates provided.

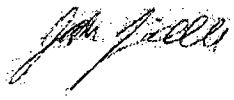
To attain a final bid price on a project the following steps must be taken:

- *Provide Aquapoint with an engineer signed design sheet indicating site characteristics and treatment parameters.*
- *Request a project design package. The package will include: specifications, drawings and design calculations. This will provide the project engineer with the tools he/she needs to create site plans and a schematic of the entire wastewater treatment system.*

- *Site plan review by Aquapoint to ensure proper design and use of treatment equipment.*
- *Final BID/QUOTE. Aquapoint will produce a bid used for purchasing purposes once the site plans have been completed by the project engineer and reviewed by Aquapoint.*

Thank you for your consideration. Please call if you have any questions or comments.

Sincerely,



Josh Lindell

Aquapoint, Inc.
(508)998-7577 ex: 14
jlindell@aquapoint.com

SOILS REPORT BY
REBECCA CORBITT

05-076

Corbitt Environmental Consulting
P.O. Box 937
Lowell, AR 72745
(479) 466-6183

The Deer Haven Subdivision

The Deer Haven Subdivision
Soil Test Pit Information &
Seasonal water table depths and loading rates for drip irrigation

Zone 1 (Power Line easement along North property line)

Lot #	Brief SWT	Moderate SWT	Adj. Moc. SWT	Loading rate (g/ft²/d)
1	Full	Of	water	NA
2	20"	26"	24"	.164
3	NA	28"	28"	.191
4	NA	27"	27"	.185
5	Full	of water	at 20"	NA
6	NA	27"	27"	.185
7	NA	30"	30"	.205
8	NA	26"	26"	.178
9	NA	25"	25"	.171
10	NA	34"	34"	.232
11	NA	30"	30"	.205

Average loading rate= .191

250 GPD per home divided by .191= 1308.9 sq ft. of drip x 1.5 (for alternate area)=

1963.35 total sq ft. of drip field divided by 43,560 sq. ft per acre=

.04 acres per house of drip field

Zone 2 (Along NE property line and toeslope of stream terrace)

12	None	NA	NA	.738
13	Too	close to	creek	NA
14	20"	NA	NA	.410
15	24"	34"	31"	.212
16	25"	32"	30"	.205
17	28"	33"	31"	.212
18	Pit	Filled	In	NA
19	22"	31"	28"	.191
20	27"	34"	32"	.219
21	22"	NA	NA	.451
22	None	NA	NA	.738
23	23"	NA	NA	.472
24	28"	NA	NA	.574
25	25"	31"	29"	.198

Average loading rate=.385

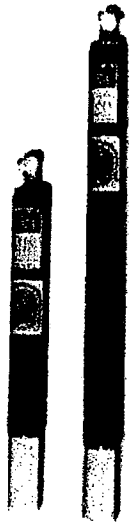
250 GPD per home divided by .385= 649.35 sq ft. of drip x 1.5 (for alternate area)=

974 total sq ft. of drip field divided by 43,560 sq. ft per acre=

.02 acres per house of drip field

LYSIMETER SPECIFICATIONS

Lysimeters



Soil Water Sampler

The soil water sampler allows simple and convenient collection of water samples from within the soil profile. The porous ceramic cup allows water in the soil profile to be drawn into the sampler when a vacuum is applied. The water sample is collected and stored in the 31mm (1.2in) diameter PVC body tube. The sample is then extracted from the sampler and analyzed for the presence and concentration of various chemicals.

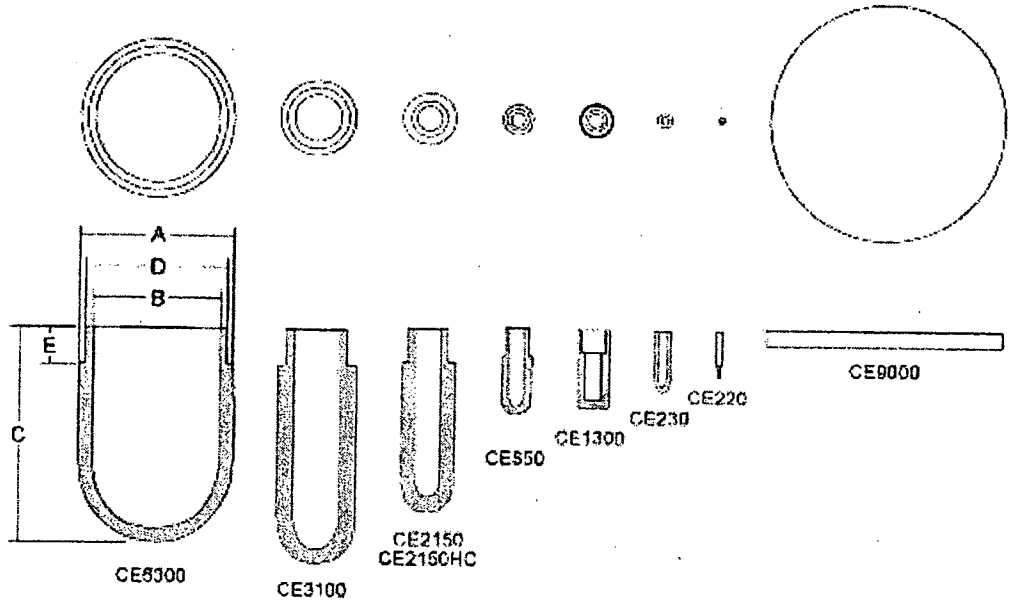
Part Number	Total Length	Installed Depth
SPS22531	25cm (10in)	15cm (6in)
SPS24031	40cm (16in)	30cm (12in)
SPS27031	70cm (28in)	60cm (24in)
SPS210031	100cm (39in)	90cm (36in)
SPS213031	130cm (51in)	120cm (48In)
SPS216031	160cm (63in)	150cm (60In)
SPS219031	190cm (75in)	150cm (72in)

Note: The total length of the soil water sampler is measured for the centerline of the ceramic cup to the top of the sampler body tube. Approximately 10cm (4in) should protrude above the soil surface in order to allow access for evacuation and sample collection.

Ceramics

Porous Ceramics

Porous Ceramics are an integral part of many soil-monitoring and sampling instruments. The ceramic matrix serves as the interface between the soil matrix and the instrument, and allows water to pass into and out of the instrument. Ceramics are available in a variety of shapes and sizes for use in replacing damaged components on existing instruments or for constructing new ones.



Part number	Outside diameter A mm (in)	Inside diameter B mm (in)	Length C mm (in)	Shoulder diameter D mm (in)	Shoulder height E mm (in)
CE6300	63 (2.5)	52 (2.0)	88 (3.5)	57 (2.2)	15 (0.6)
CE3100	31 (1.2)	19 (0.7)	96 (3.8)	25 (1.0)	15 (0.6)

CE2150	21 (0.8)	10 (0.4)	75 (3.0)	15 (0.6)	14 (0.6)
CE2150HC	21 (0.8)	10 (0.4)	75 (3.0)	15 (0.6)	14 (0.6)
CE850	12 (0.5)	6 (0.2)	35 (1.4)	9 (0.4)	11 (0.4)
CE1300	13 (0.5)	6 (0.2)	32 (1.3)	11 (0.4)	9 (0.4)
CE230	6 (0.2)	3 (0.1)	25 (1.0)		
CE220	2 (0.1)	1 (0.1)	20 (0.8)		
CE9600	96 (3.8)		6 (0.2)		

Earth Systems Solutions
Post Office Box 6157, Santa Barbara, CA 93160-6157 USA Phone:1+805-964-1200

Top of Page

GEOFLOW DRIPPER FIELD
PUMP CALCULATIONS

Revised 7/21/04

Geoflow Subsurface Dripline Dispersal: Field Calculation

Job Description:	Deer Haven Subdivision- Avoca, Benton County, AR
Contact:	Charles Presley
Prepared by:	Richard Burleigh
Date:	7/25/2006

Please fill in the shaded areas and drop down menus below:

Note. This worksheet can be found in Geoflow's Design and Installation Manual

Worksheet - Field Design

		Dispersal Field as Single Zone	Dispersal Field as Multiple Zones	
Number of Zones		1	36	zone(s)
A)	Quantity of effluent to be disposed per day	33,750	938	gallons / day
B)	Hydraulic loading rate	0.25	0.25	gallons / sq.ft. / day
C)	Determine total area required	135,000	3,750	square ft.
D)	Choose spacing between WASTEFLOW lines	2	2	ft.
D)	Choose spacing between WASTEFLOW emitters	2 ft.	2	ft.
E)	Total linear ft.	67,500	1,875	each
F)	Total number of emitters	33,750	938	each
G)	Select Wasteflow dripline	Wasteflow PC - 1/2gph	Wasteflow PC 1/2 gph	dripline
H)	Pressure at the beginning of the dripfield	30 psi	30	psi
I)	Feet of Head at the beginning of the dripfield	69.3	69.3	ft.
J)	What is the flow rate per emitter in gph?	0.53	0.53	gallons per hour
K)	Total flow for the area (gph)	17,888	497	gallons per hour
	Total flow for the area (gpm)	298.13	8.28	gallons per minute
L)	Select pipe diameters for manifolds and submains	Refer to a PVC chart	1	inch
M)	Select Vortex Filter (item no.)	Consult Factory	AP4E-100 (1in.)	
N)	Maximum length of each WASTEFLOW line. For additional technical flow, pressure and flushing data please refer to Geoflow's Design Manual and WASTEFLOW hydraulics worksheet.	535	535	ft.

Check below to choose quantity and length of daily doses

Dosing			
Number of doses per day/zone:	20	20	
Pump run time per dose/zone (minutes):	5.66	5.66	minutes
Pump run time per day/zone (hours):	1.89	1.89	hours / day
Pump run time per day/all zones (hours):	1.89	67.92	hours

Geoflow Subsurface Dispersal: Pump Size Calculation

Job Description:	Deer Haven Subdivision South 1/2
Contact:	Charles Presley
Prepared by:	Richard Burleigh
Date:	5/2/2006

Note. This worksheet can be found in Geoflow's Design and Installation Manual

Worksheet - Pump Sizing

O)	Minimum pump capacity	8.28 gpm	
P)	Header pipe size	1 inch	
Q)	Pressure loss in 100 ft. of pipe	1.58 psi	
R)	Friction head in 100 ft. of pipe	3.65 ft.	
S)	Static head		
	i) Height from pump to tank outlet	8 ft.	
	ii) Elevation increase or decrease	25 ft.	
T)	Total static head	**33 *ft.***	
U)	Friction head		
	i) Equivalent length of fittings	100 ft.	
	ii) Distance from pump to field	515 ft.	
	iii) Total equivalent length of pipe	615 ft.	
	iv) Total effective feet	22.44627 ft.	
	v) Head required at dripfield	69.3 ft.	
	vi) Headloss through filter or Headwork	25.41 ft.	11 psi
	vii) Head loss through zone valves	3.927 ft.	1.7 psi
V)	Total friction Head	**121.08327**	
W)	**Total dynamic head**	**154.08 ft.**	
X)	**Minimum pump capacity**	**8.28 gpm**	
Y)	Choose the pump	***	

*** Note a few States + counties require additional flow for flushing. Please check your local re

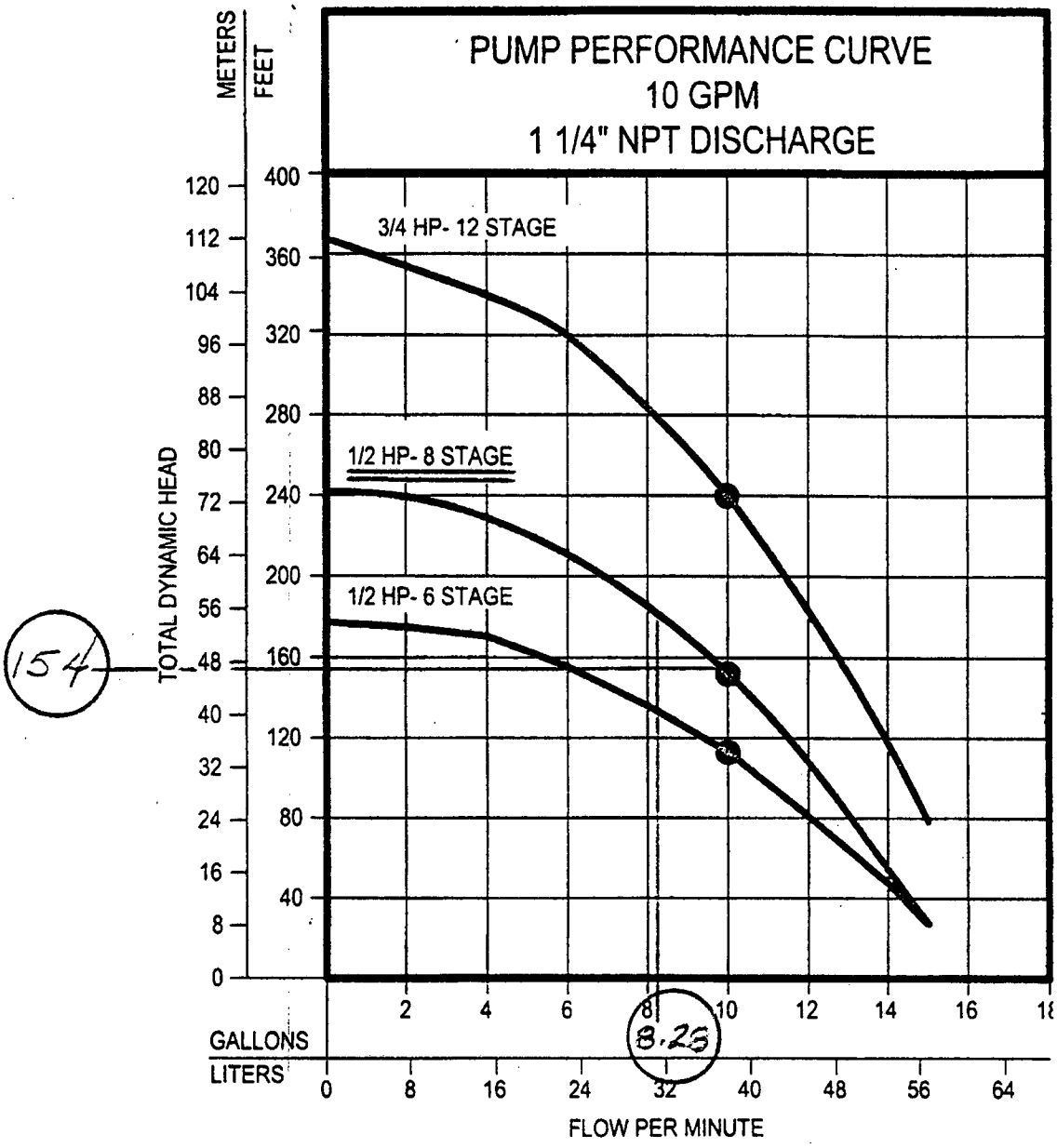
If you need assistance designing for this additional flow, please

a. See Geoflow flushing worksheet or

b. Contact Geoflow at 800-828-3388.

Multi-Stage Effluent Turb

10 GPM Models



015413

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5030-0005	1/2	115	1	12.0	6	22-3/8"
5030-0006	1/2	230	1	6.0	6	22-3/8"
5030-0007	1/2	115	1	12.0	8	25-1/4"
5030-0008	1/2	230	1	6.0	8	25-1/4"
5030-0009	3/4	230	1	8.0	12	29-15/16"

Use this Pump

"Quality Pumps Since 1939"

Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

ZOELLER PUMP CO.

MAIL TO: P.O. BOX 16347 • Louisville, KY 40256-0347
SHIP TO: 3649 Cane Run Road • Louisville, KY 40211-1961
(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

visit our web site:
www.zoeller.com

SECTION: 3.20.022
FM2091
0105
Supersedes
0104

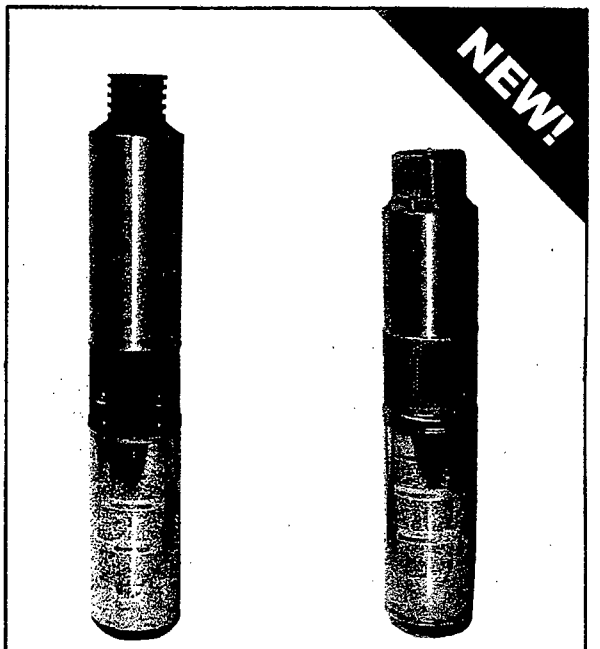
ZOELLER ON-SITE WASTEWATER PRODUCTS

Multi-Stage Effluent Turbine Submersible Pumps

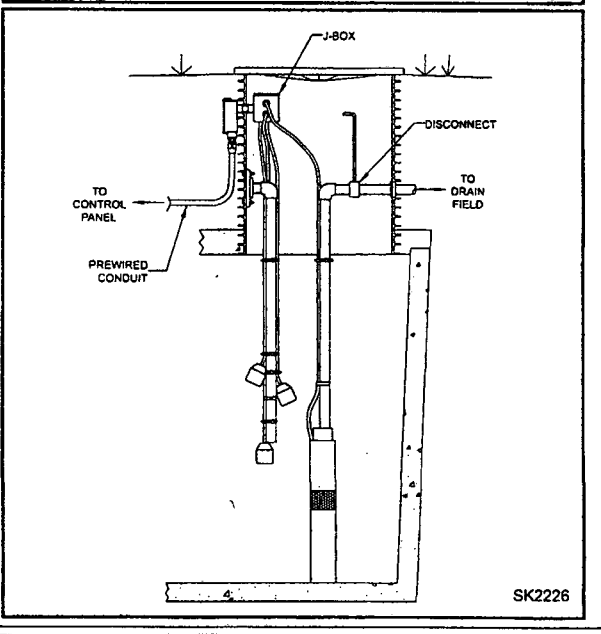
Effluent turbine pumps are used in on-site applications that demand more head than a traditional single stage centrifugal submersible pump. Zoeller Pump Company is able to meet this need by offering a complete line of submersible effluent turbine pumps. These pumps have been proven in field applications and have many years of development behind them. Typical applications include mound systems, drip systems, and recirculating media filters. All units include cool running submersible motors that do not require external water flow to prevent overheating. Therefore, an outer pump sleeve is not required for models less than 2 HP. Pumps can be installed directly in a dose tank as long as an effluent filter is used on the septic tank outlet. These pumps can also be used in conjunction with the Zoeller Effluent Turbine Filtered STEP system.

FEATURES:

- Corrosion resistant.
- Many models available - 10, 19, 27, 35, 55 and 85 gpm.
- 1/2 thru 3 HP units.
- 115 and 230 Volt.
- 1-1/4" discharge (10, 19, 27 gpm) or 2" discharge (35, 55 and 85 gpm).
- Heavy wall stainless steel pump shell.
- Franklin Electric submersible motors.
- Stainless steel hex drive pump shaft.
- High Efficiency floating stack.
- Glass-filled Noryl discharge and mounting ring (10, 19, and 27 gpm models).
- Stainless steel discharge and mounting ring (35, 55 and 85 gpm models).
- No external capacitors or relays required for starting (½-1½ HP).
- Starting box provided for 2 & 3 HP units.
- External check valves available.
- Pressure effluent filter available.
- 10 feet of jacketed SO type power cord (½ - 1½ HP units only). Consult Factory for longer lengths.
- Timed dosing panels available.

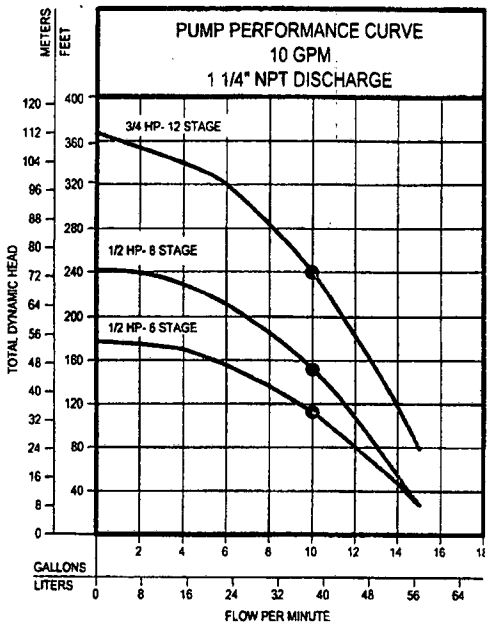


10, 19, 27 gpm Models 35, 55, 85 gpm Models



Multi-Stage Effluent Turbine Submersible Pumps

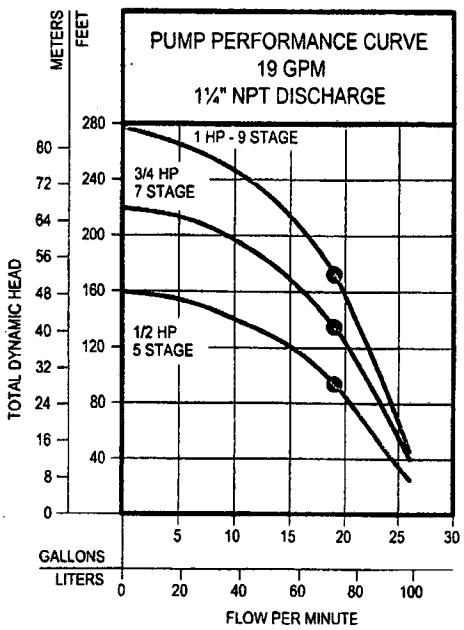
10 GPM Models



015413

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5030-0005	1/2	115	1	12.0	6	22-3/8"
5030-0006	1/2	230	1	6.0	6	22-3/8"
5030-0007	1/2	115	1	12.0	8	25-1/4"
5030-0008	1/2	230	1	6.0	8	25-1/4"
5030-0009	3/4	230	1	8.0	12	29-15/16"

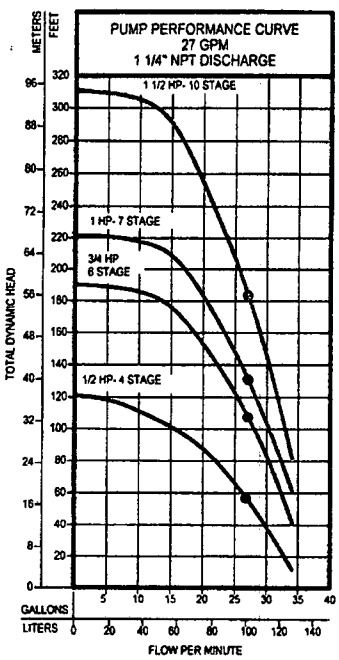
19 GPM Models



015414

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5031-0005	1/2	115	1	12.0	5	21-15/16"
5031-0006	1/2	230	1	6.0	5	21-15/16"
5031-0007	3/4	230	1	8.0	7	25-1/16"
5031-0008	1	230	1	9.8	9	28-1/8"

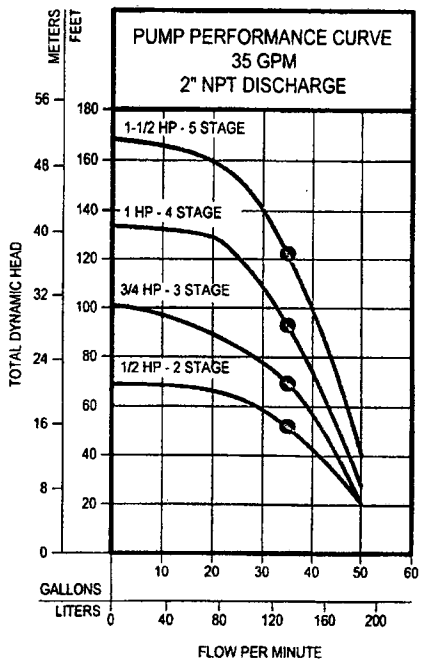
27 GPM Models



015045

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5032-0005	1/2	115	1	12.0	4	21-3/16"
5032-0006	1/2	230	1	6.0	4	21-3/16"
5032-0007	3/4	230	1	8.0	6	24-3/16"
5032-0008	1	230	1	9.8	7	26-7/16"
5032-0009	1-1/2	230	1	13.1	10	30-3/16"

35 GPM Models

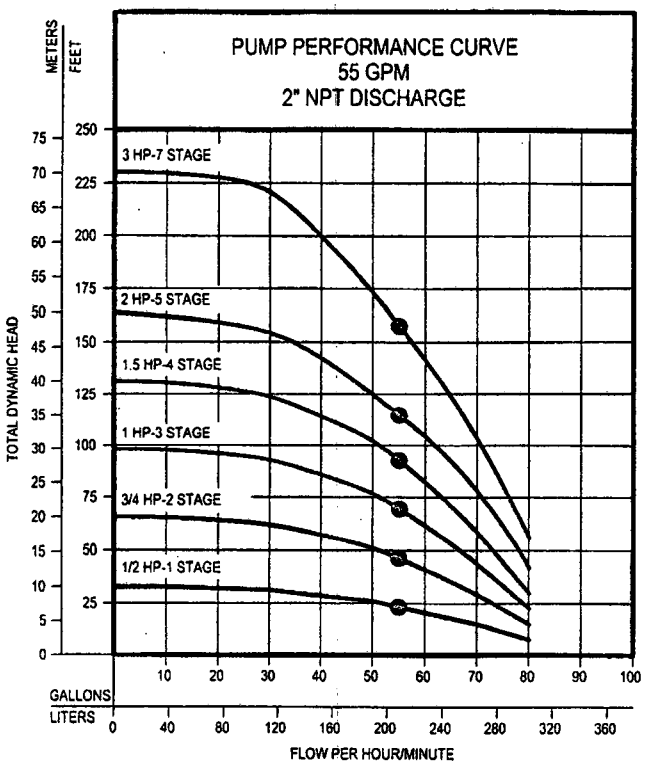


015044

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5033-0005	1/2	115	1	12.0	2	18-7/8"
5033-0006	1/2	230	1	6.0	2	18-7/8"
5033-0007	3/4	230	1	8.0	3	20-1/4"
5033-0008	1	230	1	9.8	4	21-9/16"
5033-0009	1-1/2	230	1	13.1	5	22-7/8"

Multi-Stage Effluent Turbine Submersible Pumps

55 GPM Models

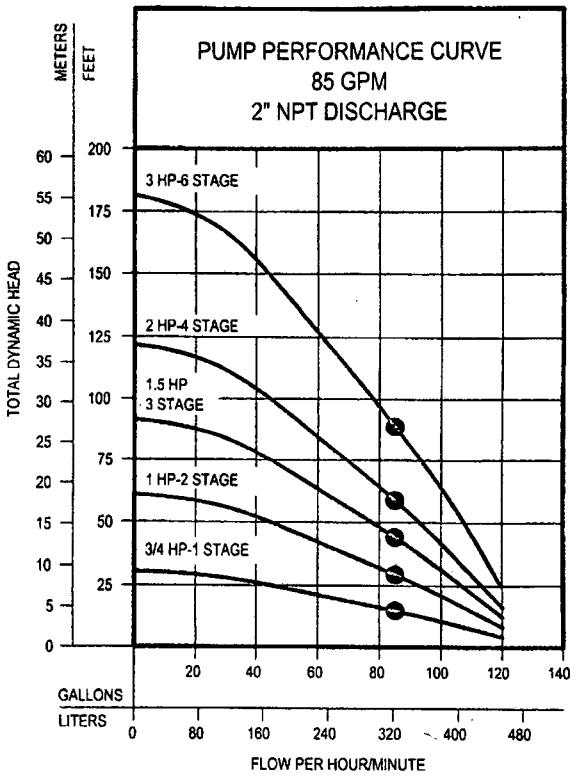


015649

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5034-0005	1/2	115	1	12.0	1	17-3/4"
5034-0006	1/2	230	1	6.0	1	17-3/4"
5034-0007	3/4	230	1	8.0	2	21"
5034-0008	1	230	1	9.8	3	24-3/16"
5034-0009	1-1/2	230	1	13.1	4	29-5/8"
5034-0010*	2	230	1	13.2	5	31-3/4"
5034-0011*	3	230	1	14.5	7	39-15/16"

*Includes starter box and 25' long flat wire cable assembly.

85 GPM Models



015845

Part Number	H P	Voltage	Phase	Amps	Stages	Height
5035-0005	3/4	230	1	8.0	1	19-9/16"
5035-0006	1	230	1	9.8	2	22-3/8"
5035-0007	1-1/2	230	1	13.1	3	29-9/16"
5035-0008*	2	230	1	13.2	4	32-5/16"
5035-0009*	3	230	1	14.5	6	41-13/16"

*Includes starter box and 25' long flat wire cable assembly.

Accessories

Filtered STEP System

This Zoeller Filtered STEP System is designed as an economical and reliable solution to an On-Site pumping requirement. When the effluent must be pumped up hill, for enhanced flow, or where alternative systems require high head, the Filtered STEP System is the answer without the extra cost of a pumping chamber. The Filtered STEP System fits into almost any septic tank. The Zoeller STEP System filters the effluent, removes solids, and supports the pump and float tree. It effectively replaces a pump chamber and therefore no extra pump chamber is necessary. However, the system will fit in the secondary pump chamber if required.

For use with pumps up to 1½ HP only.

See FM1635 for more information.

Check Valves

Brass

All brass spring loaded check valves are designed to screw directly into the pump discharge. Check valves are assembled with components suitable for a septic environment. Check valves should be used at the pump in a pressure sewer system. A redundant PVC check valve and isolator (ball) valve should also be used at the sewer connection in pressure sewers.

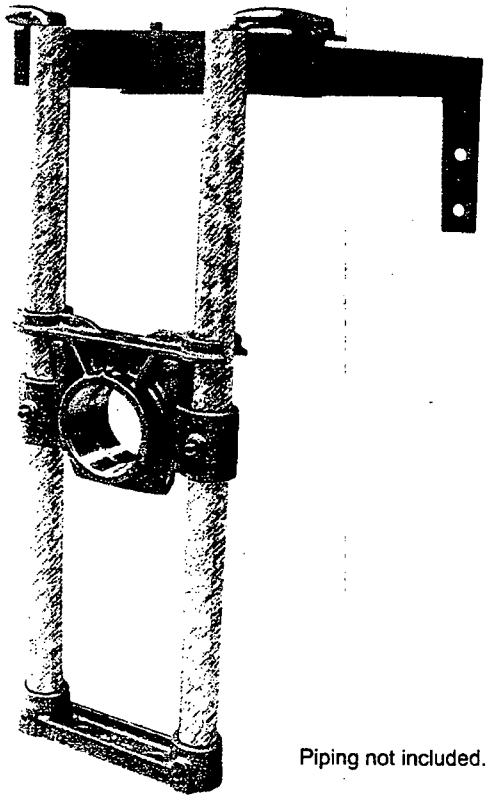
Part Number	Piping Size	Pressure Rating	Weight
30-0187	1-1/4"	400 psi	2 lbs.
30-0189	2"	400 psi	3 lbs.

PVC

PVC check valves can be used inline with the pump discharge piping or at the street service connection in a pressure sewer system. Check valves are a true-union design so they can be removed and serviced without cutting the pipe. Clean PVC for easy inspection and connection via a glue joint.

Part Number	Piping Size	Pressure Rating	Weight
30-0207	1"	125 psi	1 lb.
30-0209	1-1/2"	125 psi	1 lb.
30-0210	2"	125 psi	3 lbs.

Rail Systems



Piping not included.

Rail systems are used for easy pump removal from effluent pit. Service personnel will not need to enter hazardous environment. Pump sits on floor and engages piping system via a sliding disconnect fitting. All parts are stainless steel or brass and suitable for a septic environment.

Part Number	Piping Size	Weight
39-0098	1-1/4" Female pipe thread	10 lbs.
39-0099	1-1/2" Female pipe thread	11 lbs.
39-0100	2" Female pipe thread	12 lbs.

Disconnects Only

Part Number	Pipe Size	Weight
39-0053	1-1/4"	2 lbs.
39-0001	1-1/2"	2 lbs.
39-0002	2"	2.5 lbs

Stainless Steel Pull Rods

3/8"-16 UNC	
Part Number	Length
39-0069	1'
39-0006	2½'
39-0007	3½'
39-0008	4½'
39-0009	5½'
39-0018	7'
39-0010	8'

ALL ZOELLER ON-SITE WASTEWATER PRODUCTS MUST BE INSTALLED IN ACCORDANCE WITH LOCAL AND/OR STATE PLUMBING AND/OR HEALTH DEPARTMENT CODES.

SECTION

BIOCLERE TREATMENT SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. The work of this section includes furnishing all labor, materials, tools and equipment necessary to furnish and install an AQUAPOINT factory built, Bioclere fixed film aerobic process type treatment system with all necessary equipment and appurtenances for efficient operation as specified herein and as shown on the drawings.

B. The manufacturer of the Bioclere process system shall be AQUAPOINT of New Bedford, MA.

1.02 DESIGN CRITERIA

A. The materials and equipment covered by this specification are intended to be standard materials and equipment of proven ability as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations and the Contract Documents.

B. The Bioclere system shall be designed to operate under the design criteria detailed in SECTION 2.01 (A).

1.03 PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance. The Bioclere unit(s) shall be stored outdoors in a secured location according to the manufacturer's recommendations. Loose-shipped items shall be stored in a clean, dry location free from precipitation and excess moisture.

1.04 SUBMITTALS

A. Three complete sets of shop drawings and/or site specific Technical Manuals shall be submitted for all items to be furnished by AQUAPOINT. Submittals shall include all equipment and components, catalogue cuts, wiring diagrams, control schematics and all pertinent installation, operation and maintenance procedures to maintain efficient operation.

PART 2 – MATERIALS

2.01 BIOCLERE TREATMENT SYSTEM

A. General

1. The Bioclere treatment system shall include a trickling filter situated over a final settling tank. The Bioclere treatment system shall be delivered complete from the supplier and shall include: random packed PVC manufactured media, ventilation fan, dosing pump(s), sludge return pump, internal piping, wiring and controls for a complete operational treatment system. The trickling filter portion of the tank shall have fiberglass inner and outer skins with the cavity between filled with polyvinyl chloride foam insulation. The remainder of the unit shall be constructed of FRP or plastic as recommended by the equipment manufacturer. All internal piping shall be Schedule 40 PVC plastic pipe. The Bioclere unit shall withstand normal pressures from the interior hydrostatic load and from the soil.

B. Pre-Cast Mounting Pad

1. The contractor shall be responsible for providing a precast mounting pad upon which to set each Bioclere vessel. The mounting pads shall be as shown on the drawings.

C. Filter Media

1. The PVC randomly packed filter media shall have a void ratio of greater than 95 percent. The media shall be resistant to ultraviolet radiation and resistant to a wide range of aqueous solutions, acids, alkalis, oxidizing agents, oils, fats and alcohols.

D. Settling Tank

1. The settling tank shall be cone shaped and have 60 degree sloped sides to prevent the accumulation of biological and inorganic suspended solids and shall contain the necessary internal baffling to prohibit short-circuiting of the wastewater.

E. Ventilation Fan

1. The CSA and UL approved ventilation fan shall be a 115v/1ph/60hz, painted metal, ball bearing fan with a minimum manufactured rated airflow rate of 106 cubic feet per minute.

F. Pumps

1. The two CSA and UL approved alternating dosing pumps and one recycle pump shall be 115v/1ph/60hz stainless steel submersible pumps. All pumps shall have an internal high temperature shut off switch. Each pump shall be capable of 45 gpm at 20 ft. of head. Each pump shall be rated for intermittent or continuous duty when fully submerged between 0°C-55°C. The alternating dosing pumps shall be controlled such that when one pump fails the remaining will complete both dosing cycles.

G. Float Switches

1. The CSA and UL approved low level 115v/1ph/60hz float switch shall be installed to prevent the recycle pump from operating when water levels are abnormally low in the Bioclere (i.e. during primary tank pumping). The float switch shall be a mercury activated wide-angle switch.

H. Power Supply

1. Each Bioclere treatment unit shall have a dedicated 30 amp, 115v/1ph/60hz, power supply.

I. Control Panel

1. The UL approved control panel shall be furnished with an audio and visual alarm for pump failure and tripped circuit breaker conditions, an exterior alarm silence button, and an on/off/test power/alarm toggle switch. Within the NEMA 4X enclosed fiberglass panel pump timers, relays, terminal strip, on/off/test switches, run lights, dosing pump alternator, circuit breakers and current sensors shall be provided. A dry contact shall be installed in each control panel so that a common Bioclere alarm may be wired to a convenient location.

J. Wiring

1. The electrical contractor shall complete the wiring between the Bioclere control panel and the terminal strip within the Bioclere fan module meeting all local, state, and federal codes.
2. All fittings, connections, etc. shall be weatherproof and water tight construction. Ground terminals are provided in both the main panel and the junction box for each unit. Each ground terminal shall be wired to an earth ground.
3. Care shall be taken to match the wires between the control panel and the terminal strip within the Bioclere fan module located on each unit.

K. Warranty

1. All equipment provided shall be warranted against defects in materials and workmanship for a period of one year from the date of installation.

L. Spare Parts

1. A recommended list of spare parts shall be detailed in the site specific Technical Manual that details the Installation, Operation & Maintenance procedures.

M. Services Provided

1. AQUAPOINT or an approved manufacturer's representative shall provide the following services for each project. The general contractor shall install the Bioclere unit(s) and all related components.

    a. Provide onsite technical assistance for the handling and positioning of the Bioclere unit(s) the day of installation.
    b. Return to the site for testing and/or commissioning of the Bioclere unit(s) upon substantial completion of site work by the general contractor (backfill, piping, electrical, grading, etc.). AQUAPOINT shall install the randomly packed PVC media and pumps into the Bioclere unit(s). AQUAPOINT shall be available to train the operator(s) and instruct the owner on Bioclere operation the day of testing/commissioning.
    c. Remain accessible to the owner and/or operator for phone consultation.
    d. Be available on a contract basis for additional site visits or consultation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner.
B. Installation of the Bioclere treatment system and ancillary equipment supplied by AQUAPOINT shall be in accordance with written instructions provided by the manufacturer or approved representative.
C. The Bioclere and all applicable treatment units supplied by AQUAPOINT shall be installed with sufficient ballast to offset buoyant forces due to induced or high groundwater conditions.

3.02 CLEAN UP

A. Prior to start-up and field-testing, all foreign matter shall be removed from the grease trap(s), septic tank(s), pump station(s) and Bioclere unit(s).

3.03 FIELD TESTING

A. The Bioclere treatment system shall be field-tested using clean fresh water prior to acceptance. The system shall be operated to test the efficiency of all components. All systems, controls, and sequences shall be operated and demonstrated as operating as approved. The contractor shall perform all tests and shall be responsible for all necessary temporary connections, testing equipment and utilities and shall provide and dispose (if necessary) of all water used. A factory trained representative shall be present for the testing.

3.04 PROHIBITIONS

A. Organic solvents, fuel oils, paints and thinners, photographic fluids, floor waxes and strippers, solutions containing copper compounds, cleaning agents containing quaternary ammonium chlorides and products containing compounds that are documented to inhibit biological growth should not be discharged to the sewage treatment system.

AquaPoint™

Making Waves in Water Resource Technology™

LEADERS IN DECENTRALIZED
WASTEWATER TREATMENT

Aquapoint, Inc.
241 Duchaine Boulevard
New Bedford, MA 02745

508-998-7577 ext. 3
Technical Sales

AquaPoint™
Making Waves in Water Resource Technology™

Aquapoint™ At a Glance

Aquapoint provides comprehensive solutions where decentralized wastewater treatment is desired. Our staff includes environmental engineers, licensed treatment plant operators, field engineers and technical representatives who will assist you with the design, permitting, manufacture, installation and operation of decentralized treatment systems.

Aquapoint works directly with design and consulting professionals to develop performance based modular systems to meet requirements for decentralized wastewater treatment based on client requirements and permit conditions. Aquapoint's principal technologies are the Bioclere trickling filter and Lotus, which has two basic configurations, a submerged aerated fixed film reactor and LOTUS-OH a fluidized bed reactor.

Aquapoint has over 800 units installed at 570 + sites in 22 states. Application capability ranges from **200 to 2,000,000 gpd** and include **subdivisions, fast food restaurants, shopping centers, visitor's centers, schools, nursing homes, light industrial, and municipalities.** Because the processes we employ are primarily biological rather than mechanical the cost of acquisition, installation and O&M extremely competitive.

The Bioclere system is certified by the NSF, EPA/ETV Program (16/12-350) is cited as an accepted treatment system by the New England Interstate Water Pollution Control Commission and conforms to The Ten States Standards for trickling filters, under which it has been permitted for stream discharges and small communities. It has been permitted in 27 states.

The Bioclere is very effective in reducing high strength wastes, such as those from restaurants and food processors, to an effluent with superior clarity at low costs. The quality of the effluent guarantees virtually unlimited life for leaching fields.

The Lotus, fixed film reactor is available with static or dynamic media, and extends the treatment range of Aquapoint to 2,000,000 gpd and allows for the treatment of high strength and complex waste streams. As a self-contained system, the Lotus is available for slab on grade or in-ground installations.

In addition to manufacturing Bioclere™ trickling filters and Lotus fixed film reactors & fluidized bed reactors Aquapoint employs a range of proprietary technologies to create performance based modular treatment solutions. Technologies include: Aquapoint aeration systems, sand filters, Anoxic filters, UV disinfection, Wallax™ phosphorous removal units, and drip disposal systems for wastewater distribution.

Please contact us to discuss your decentralized wastewater treatment requirements. References technical documents, installation guidelines and complete O&M manuals are available for specific projects.

For additional information please visit our website at www.aquapoint.com

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Fx: 770-220-2952

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Fx: 508-998-7177
Technical Sales ext: 3

Rochester, NY Office
1900 University Avenue
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Rochester, NY 14610
Ph: 585-473-3300
Fx: 585-244-7931

AquaPoint™

Making Waves in Water Resource Technology™

Bioclere™

Wastewater Treatment Systems

The Bioclere™ Advantage

Bioclere™ is a modified tickling filter over a clarifier. It is designed to treat wastewater with varying organic and nutrient concentrations as well as intermittent flows. Its natural fixed film process is stable, simple to maintain and inexpensive to operate.

Bioclere™ reduces the biochemical oxygen demand (BOD_5) and total suspended solids (TSS) to levels that meet or exceed NSF and EPA standards. As wastewater trickles through the biological filter, organic material is absorbed into the biological mass, which forms on the media surface. Secondary sludge that sloughs off the self-purging filter are returned to the primary tank. Clarified wastewater is displaced to the disposal area.

The Bioclere™ is a modular technology. Units can be installed in parallel for larger flows or in series to achieve higher levels of treatment. Bioclere™ is sealed and insulated to minimize the impact of seasonal temperature variations on the treatment process. The biofilter is positioned over a clarifier containing pumps that maintain a consistent dosing pattern throughout flow variations.

Bioclere™ Nitrogen Reduction

Bioclere™ may be designed to consistently reduce ammonia nitrogen in wastewater despite seasonal temperature variations. Nitrogen is reduced substantially and cost effectively by recirculating nitrified wastewater from the Bioclere™ to the primary settling tank.. In larger systems, a nitrifying Bioclere™ may be added to the process train. Similarly, an anoxic tertiary up-flow filter may be added to the treatment chain to achieve <10 mg/l total nitrogen.

The Bioclere™ 16/12-350 is NSF certified under Standard 40/Class 1.

Visit us at www.aquapoint.com to see a variety of Bioclere™ installations.

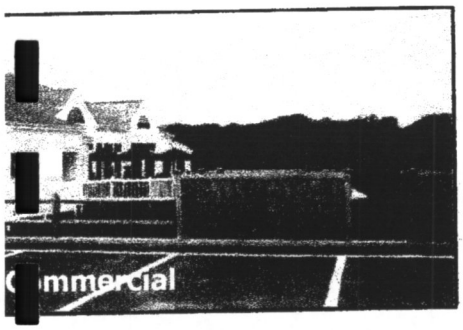
- Cost effective treatment with low installation and operating costs
- Modular units allow increased capacity, High performance levels and phased projects
- Stable, quiet treatment process
- Sealed, insulated units for cold weather Environments
- Internal flows stabilization allows for intermittent flows
- Capable of treating high strength waste
- Easily integrated with related treatment systems for advanced nutrient removal

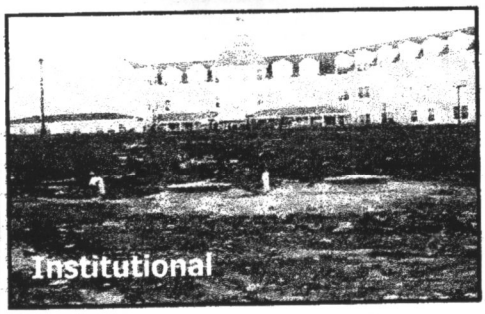
Applications Include:

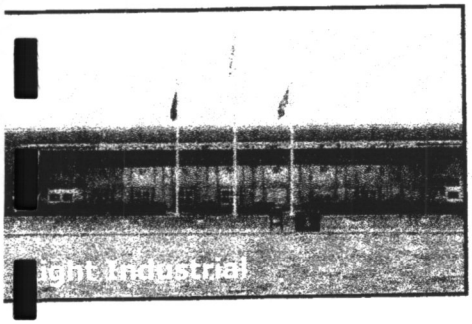
Commercial
Residential
Institutional
Small Community
Light Industrial

Now Available:

Fieldwatch Remote Monitoring System
Ask your sales representative for more information about this cutting-edge technology







ETV Joint Verification Statement

Technology Type: Biological Wastewater Treatment-Nitrification and Denitrification for Nitrogen Reduction

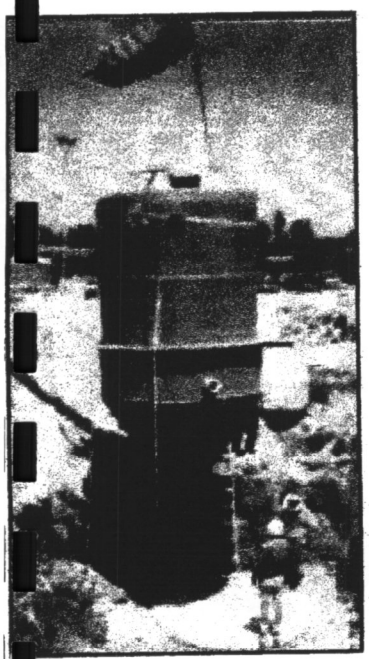
Application: Reduction of Nitrogen in Domestic Wastewater from individual Residential Homes

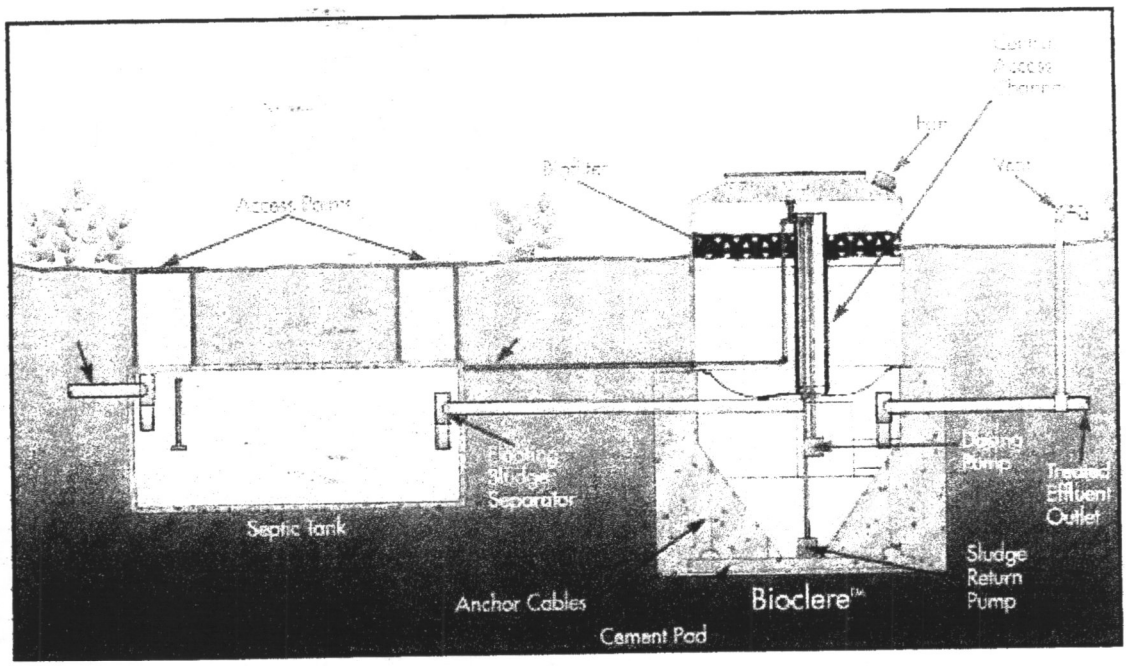
U.S. EPA's Environmental Technology Verification Program
www.epa.gov/etv

Technology Name: Bioclere™ Model 16/12

	TKN (Mg/l)		Ammonia (mg/l)		Total Nitrogen (mg/l)		Nitrate (mg/l)	Nitrite (mg/l)	Temp. C
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Effluent	Effluent	Effluent
Average	37	10	23	6.2	37	16	5.2	0.45	15
Median	38	6.3	23	2.8	38	14	4.4	0.34	15
Maximum	46	35	27	22	46	36	14	1.5	23
Minimum	24	1.9	18	0.7	24	6.2	<0.1	0.07	7.4
Std. Dev.	4.4	10	2.1	7.0	4.4	8.4	3.5	0.26	4.9

Information on the performance characteristics of this technology can be found at www.epa.gov/etv or call Aquapoint, Inc. At 508-998-7577 for a copy of the ETV verification report. Use of the ETV Name or Logo does not imply approval or certification of this product nor does it make any explicit or implied warrantees or guarantees as to product performance.





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Published 3/2004

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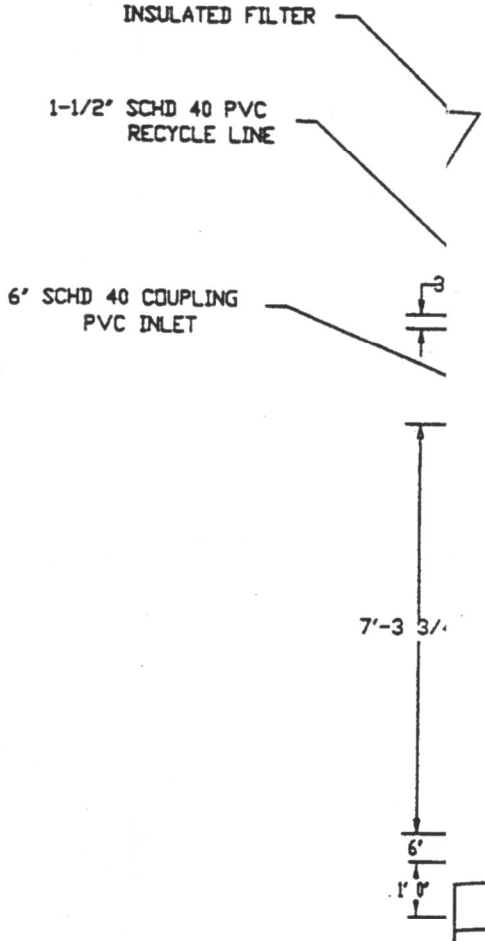
NON-SKID GELCOA

AUXILIARY VENT
@ 4" SCHD 40 | UP THE SIDE OF BUILDING.



SHIPPING WEIGHTS
WEIGHT DRY WITH MEDIA = 2350 lbs
WEIGHT DRY WITH NO MEDIA = 1600 lbs

nt

NE BLVD.
X 50120
MA 02745
98-7177

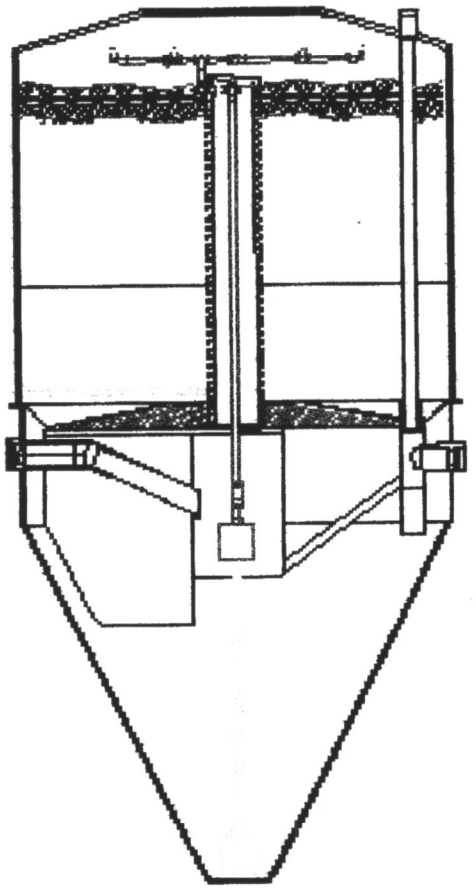
TITLE:	BIOCLERE 24/20 GENERAL ARRANGEMENT
DRAWING NO.:	UK.1261-3
REVISION:	
DATE:	10/26/00
DWN BY:	P.Willey
SCALE:	N.T.S. SIZE: B
SHEET #:	1 of 1

Aquapoint

BIOCLERE™

SELF CONTAINED
200-150,000 GPD

WASTEWATER TREATMENT PLANTS



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BIOCLERE
WASTEWATER TREATMENT SYSTEMS

Introduction

The Bioclere is a modified trickling filter which was developed in Finland in the early 1960's and which is used extensively throughout Europethe U.S. and the Middle East for secondary treatment of wastewater and the conversion and reduction of nitrogen. Tertiary treatment equipment for nitrogen and phosphorus removal may be added to the process chain.

An 8,000 gpd Bioclere system serving a housing development. Standard effluent requirements are:15 mg/l BOD, 25 mg/l TSS, 3 mg/l Ammonia and 1 mg/l Phosphorus. The final stage of treatment is UV disinfection.

BIOCLERE FEATURES

NSF APPROVED - Standard 40: Test results and Executive Summary are listed on pages 10 and 11. The Bioclere is also approved in many States nationwide. Contact Aquapoint for approval status in your State.

Treatment capacities from 200 to 150,000 gpd: A wide range of Bioclere filter sizes are available. The modular units may be installed in parallel to accommodate larger flows or in series to achieve higher levels of treatment.

Low operating costs are characteristic of the trickling filter heritage. The simple design and stability of the fixed film process, minimizes O&M costs associated with wastewater treatment.

Broad range of Applications: Bioclere installations include homes, residential clusters, shopping malls, nursing homes, schools, supermarkets, restaurants, gas stations, golf courses, hotels and small communities.

Fixed film treatment process: Naturally occuring microorganisms attach themselves to a highly permeable media creating a biological filter through which wastewater is trickled allowing organic matter to be absorbed by the microorganisms. The filter is self-purging and requires minimal maintenance.

Performance Based Engineered Systems: Each system is sized by Aquapoint engineers. Hydraulic and organic influent characteristics must be specified in the design of the Bioclere to meet effluent requirements. Specification sheets are included for this purpose.

Fully Enclosed - Sturdy Construction: The Bioclere is constructed of insulated and UV resistant fiberglass and PVC. The biofilter is positioned over a clarifier. Automatically controlled media dosing and recycle pump systems are set at pre-determined rates minimizing maintenance and enhancing treatment. Oxygen is introduced to the system through a small fan in the Bioclere housing and is vented through the discharge line.

Unaffected by short term power failures: Because the treatment process is above the gravity flow line, electrical outages do not interrupt flow. High recycle rates of treated water within the system dilute the septic tank effluent thus minimizing the impact of a short-term power failure on effluent quality.

Easily Retrofit : The Bioclere may be readily installed between the septic tank and distribution system to upgrade existing facilities as well as new construction.

The fixed film process and hydraulic capacity ameliorate fluctuation in organic and hydraulic loads: Generally Bioclere installations do not require flow equalization prior to treatment. The ability of the biological film which forms in the filter to self-regulate over daily & seasonal variations in hydraulic and organic loading, and environmental variations in temperature, pH and process inhibitors is widely acknowledged.

BIOCLERE PROCESS

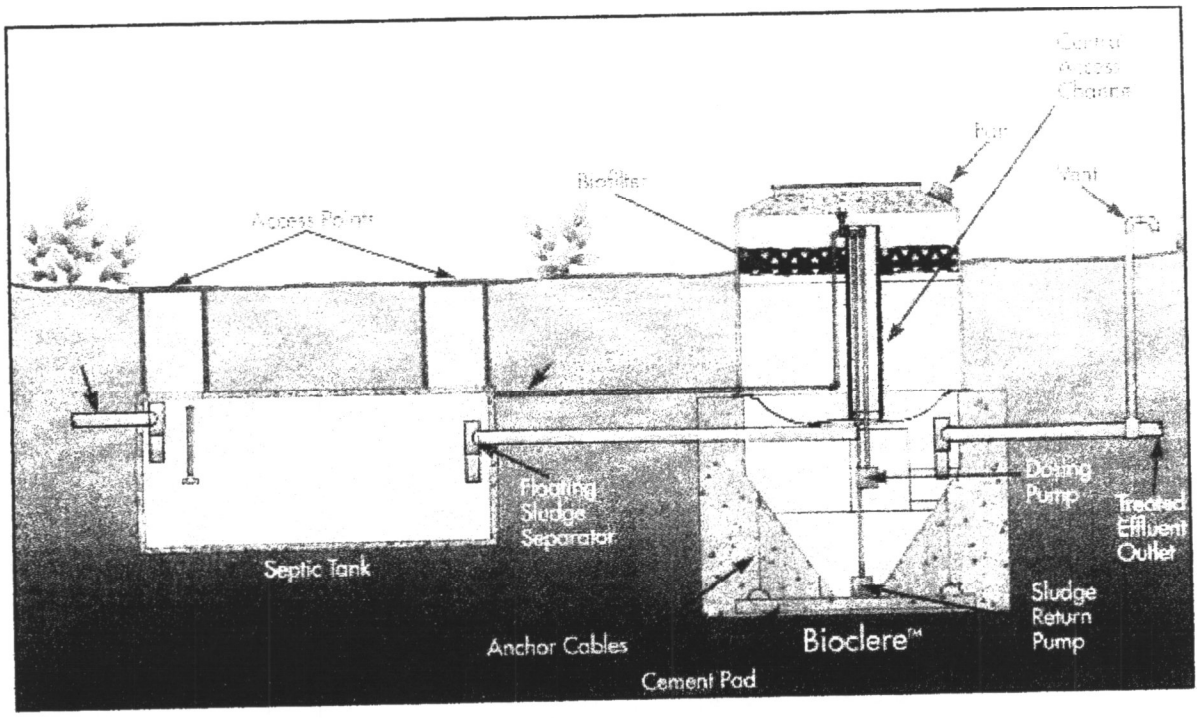
Wastewater flows from the septic tank or primary settling tank into a baffled chamber in the clarifier of the Bioclere. Dosing pumps are automatically activated by timers and periodically dose the filter media with the wastewater.

In the trickling filter the organic material in the wastewater is reduced by a population of microorganisms which attach to the filter media and form a biological slime layer. Treatment is accomplished in the outer portion of the slime layer by aerobic microorganisms. As the microorganisms multiply the biological film thickens and diffused oxygen and organic substrate are consumed before penetrating the full depth of the slime layer. Consequently the biological film develops aerobic, anoxic and anaerobic zones.

As the microorganisms near the media surface become starved for oxygen and organic carbon that is consumed by the surface layer, they lose their ability to cling to the media. The wastewater flowing over the media washes the slime layer off the media and a new slime layer begins to form. This process of losing the slime layer is called "sloughing". The rate of sloughing is primarily a function of organic and hydraulic loading on the filter. This natural process allows a properly designed media bed to be self-purging and maintenance free.

The sloughed biomass settles to the bottom of the sump as secondary sludge. This sludge is periodically pumped back to the primary tank for storage and eventually removed.

This physical process is essentially the same for the reduction of BOD_5 and nitrification (conversion of ammonia nitrogen to nitrate nitrogen).



NITRIFICATION / DENITRIFICATION

Removing ammonia nitrogen from wastewater is a well-established and quantifiable biological process. Nitrogen exists in the influent primarily in the form of organic nitrogen and ammonia nitrogen (Total Kejldahl Nitrogen = TKN). The principle part of the organic nitrogen is mineralized to ammonia nitrogen by bacterial activity in the septic tank. Therefore, ammonia-N is commonly regarded as the starting point in the nitrogen reduction process. Nitrification: the conversion of ammonia nitrogen (NH_3-N) to nitrate nitrogen (NO_3-N) is a biological process accomplished in the presence of dissolved oxygen. Bioclere effluent ammonia-N concentrations from 1 to 3 mg/l, are reliably accomplished.

Successful nitrification is accomplished with a healthy microorganism population and an environment where pH, temperature, organic loading and supply of oxygen are relatively stable. In a Bioclere system the pH is buffered by the carbonate system associated with the wastewater; the temperature remains consistent because of the insulated environment and the relatively constant temperatures generated by the biomass. The organic loading is relatively constant because treated wastewater is recycled through the septic tank and the Bioclere filter; and the fan provides an adequate supply of oxygen.

Facultative heterotrophic organisms under anoxic conditions (0.5-1.5 m/g DO) accomplish biological denitrification. In this process bacteria convert the nitrate-N to nitrite-N then to nitrogen gas that is released into the atmosphere.

Denitrification occurs by several different means and through process control adjustments. As the microorganisms multiply the biological film thickens on the submerged media and the diffused oxygen is consumed before penetrating the full depth of the slime layer. Consequently the film develops aerobic, anoxic and anaerobic zones. It is this fact which accounts for significant nitrogen removal in the Bioclere via simultaneous nitrification and denitrification.

Denitrification utilizing septic tank carbon is widely considered to be the most economical and efficient method for nitrogen removal. Utilizing prescribed re-circulation rates this method of returning Bioclere nitrified wastewater to the carbon source in the anoxic zone of the primary tank has achieved reductions of nitrogen of approximately 80 percent. Nitrogen removal may be enhanced further in a tertiary anoxic zone following the Bioclere.

NITROGEN TRANSFORMATIONS AND REMOVAL

Forms of Nitorgen	Responsible Microorganisms	Representive Equations	Control and Removal Process
Organic-N (Protein) to Ammonia-N NH_3	Facultative Heterotrophs		Mineralization
Nitrite-N NO_2 Nitrate-N NO_3	Aerobic Autotrophs, Nitrosomonas and Nitrobacter	$2NH_4+3O_2=>2NO_2+2H+2H_2O$ $2NO_2+0_2=>2NO_3$	Biological Nitrification "aerobic"
Nitrite-N NO_2 Nitrogen Gas N_2	Facultative Heterotrophs	$3NO_3+CH_3OH=>3NO_2+2H_2O+CO_2$ $2NO_2+CH_3OH=>N_2+H_2O+2OH+CO_2$	Biological Denitrification "anoxic"

PHOSPHORUS PRECIPITATION

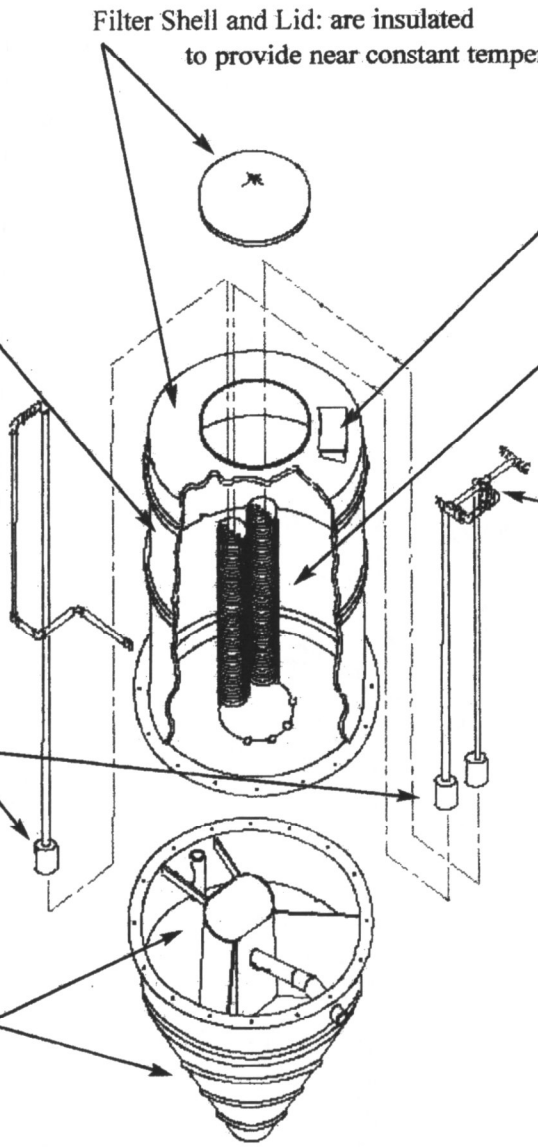
P-removal with metal salts, typically aluminum or iron is by far the most popular method used in the United States. Controls for this type of P removal are considered to be simple and straightforward (*Phosphorus Removal 1987*). It consists of adding metal salts as coagulants that react with phosphates in the wastewater to form insoluble precipitates. Dosing of coagulant is based on the stoichiometric metal salt to phosphorus ratio dictated by the concentration of phosphorus in the daily wastewater flow. The efficiency of P-removal is simply related to the coagulant dose provided that alkalinity is present in sufficient quantities. The sludge produced may be processed in the same manner as non-P-removal systems. Systems utilizing metal salt addition can effectively achieve 80-95 percent total phosphorus removal and effluent-P concentrations less than 1.0 mg/l (*Phosphorus Removal 1987*).

The Bioclere onsite system incorporates a separate stage Wallax chemical precipitation unit which is placed in line after carbonaceous BOD_5 and nitrification have been accomplished, thus minimizing sludge production. These systems have been used for over 20 years in Europe and typically reduce effluent phosphorus concentrations to >1 mg/l.

Coagulant dosing requires a coagulant storage tank and chemical feed system, which are housed in the top portion of the Wallax systems or in a separate storage facility for larger volumes. The rapid mixing and flocculation devices are fixed in the clarifier located directly beneath the dosing system. Sludge produced by the reaction is typically returned to the septic tank for storage and eventual removal.

BIOCLERE COMPONENTS

Major Components of the Bioclere are constructed of UV resistant insulated fiberglass or PVC plastic.



Control options include analog and PLC based components.

GENERAL INFORMATION

The septic tank forms the primary treatment stage of the Bioclere process. Sizing the primary tank should take into consideration the effect of re-circulation on detention time.

Bioclere units are constructed with the effluent pipe 180° opposite the influent pipe.

The only routine service procedures required by the Bioclere are pump and fan maintenance and infrequent cleaning of the distribution system. Tertiary treatment equipment added to the process chain will require additional service. In most states a licensed wastewater treatment plant operator must perform this maintenance.

Bioclere units may be easily installed into new or existing facilities. Generally the pre-assembled, self-contained Bioclere is delivered with a lifting harness. Concrete pads with mounting eyes are set at appropriate elevations and the Bioclere is set on the pad. The Bioclere is leveled using four adjusting cables from the top of the clarifier to the rings on the cement pad. Multiple units may be installed in a few hours with adequate site preparation.

The Bioclere is commissioned by filling the clarifier with fresh water. Four to eight weeks are required to develop a functioning biomass for treatment.

A 7,250 gpd Bioclere system serving a 24 home cluster in Cape Cod, Massachusetts. Standard effluent requirements are: 30 mg/l BOD5 and TSS, <5 mg/l Ammonia and <19 mg/l Total Nitrogen.

SUMMARY OF BIOCLERE ANALYTICAL RESULTS
TESTED TO STANDARD 40 BY NATIONAL SANITATION FOUNDATION

		Average	Std. Dev.	Minimum	Maximum	Median	Interquartile Range
$CBOD_5$ (mg/l)	influent	154	42	40	300	150	120-170
	effluent	11	4	4	26	11	8-14
Suspended Solids (mg/l)	influent	109	35	46	240	100	84-130
	effluent	5	2	<2	15	5	4-7
Volatile Suspended Solids (mg/l)	influent	103	34	46	240	96	77-130
	effluent	5	2	<2	14	4	4-6
pH	influent	-	-	6.5	7.8	7.4	7.3-7.5
	effluent	-	-	6.1	8.1	7.7	7.6-7.8
Temperature (°C)	influent	16	5	8	22	15	12-20
	effluent	15	5	6	24	15	11-19
Dissolved Oxygen (mg/l)	effluent	5.0	0.7	3.2	7.0	5.0	4.5-5.5

NOTES: The median is the point where half of the values are greater and half are less.

The Interquartile range is the range of values about the median between the upper and lower 25 percent of all values.

Testing of the Aquapoint, Inc. Bioclere Model 16/12 was conducted under the provisions of ANSI/NSF Standard 40 for Residential Wastewater Treatment Systems (January 1999 revisions). ANSI/NSF Standard 40 was developed by the NSF Joint Committee on Wastewater Technology.

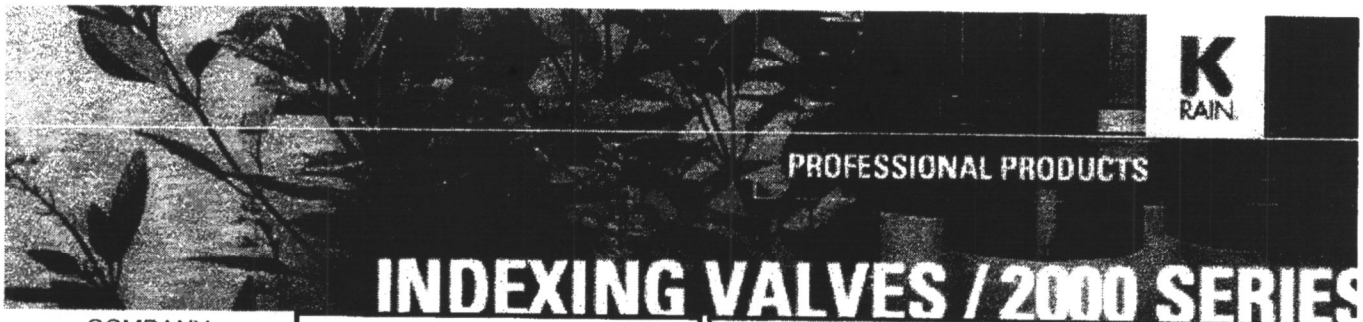
The performance evaluation was conducted at the Buzzard's Bay Project Test Center located on the Otis Air National Guard Base in Massachusetts, using residential wastewater diverted from the base. The Buzzard's Bay Project Test Center in cooperation with Barnstable County is a Standard 40 subcontractor for NSF. The evaluation consisted of 2 weeks of dosing without sampling to allow for plant start-up, sixteen weeks of dosing at design flow, seven weeks of stress test and three weeks of dosing at design flow. Sampling started in late summer and continued through winter, covering a range of operating temperatures.

Over the course of the evaluation, the average effluent $CBOD_5$ was 11 mg/l, ranging between 4 and 26 mg/l, and the average effluent suspended solids was 5 mg/l, ranging between <2 mg/l and 15 mg/l.

The Bioclere Model 16/12 produced and effluent that successfully met the performance requirements established by ANSI/NSF Standard 40 for Class I effluent:

The maximum 7-day arithmetic mean was 22 mg/l for $CBOD_5$ and 9 mg/l for suspended solids, both below the allowed maximums of 40 and 45 mg/l respectively. The maximum 30-day arithmetic mean was 15 mg/l for $CBOD_5$ and 6 mg/l suspended solids, both below the allowed maximums of 25 and 30 mg/l respectively.

The effluent pH during the entire evaluation ranged between, 6.1 and 8.1, within the required range of 6.0 to 9.0. The plant also met the requirements for noise levels (less than 60 dbA at a distance of 20 feet) and color, threshold odor, oily film and foam.



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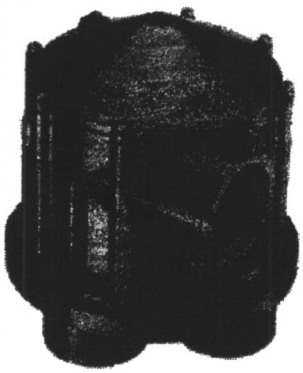


6000 Series Indexing Valves

Features and Benefits

- **Metal Die-Cast Body-Double** – Durable, long lasting, and capable of high pressure applicatio
- **Available in 4 and 6 Outlet Models** – Can quic and easily change from two to six watering zone
- **Simplicity of Design** – Valves are easily maintained and serviced for long product life.
- **Operates at low 15 GPM at Pressure of 25-15 PSI** – Ideal for pump-fed systems or high-flow c water systems.
- **Built-in Atmospheric Vacuum Breaker** – Releases any vacuum created between the pun and the valve on shut down.

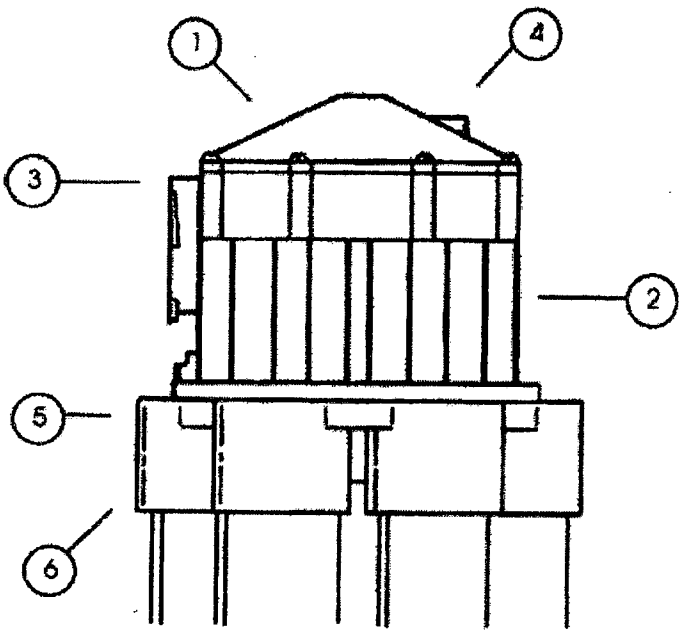
6000 Series Indexing Valve

The 6000 line of indexing valves offers exceptional reliability and durability even under the dirtiest water conditions.

Model	Description
Four Outlet Models	
6402	**Cammed for 2 Zone Operation**
6403	**Cammed for 3 Zone Operation**
6404	**Cammed for 4 Zone Operation**
Six Outlet Models	
6605	**Cammed for 5 Zone Operation**
6606	**Cammed for 6 Zone Operation**
Other options: Add to part number	
RCW	**Reclaimed Water Use**

HYDROTEK® 6000

VALVE FUNCTIONS



1. Valve Top: A high strength metal die cast top which is secured to the valve body by eight stainless steel screws.

2. Valve Body: A high strength metal die cast housing.

3. Inlet: Female 1 ½" NPT inlet for connection to water source.

4. Vacuum Breaker Port: Used to prevent back-siphon of water to source.

5. Valve Bottom: High strength ABS plastic bottom which is secured to valve body with 6 stainless steel screws.

6. Outlets: Allows for slip and glue connection to 1 ½" PVC pipe.

CAM REPLACEMENT INSTRUCTIONS

Replacement cams are available to increase or decrease the number of outlets to be used on the HYDROTEK® 6000 Series Valve

6400 Series four outlet valves have interchangeable cams for two, three or four zone operation.

6600 series six outlet valves have interchangeable cams for five or six zone operation.

To replace cam,first remove valve top by removing eight valve top retaining screws. Remove two cam retaining screws which hold cam on the underside of the valve

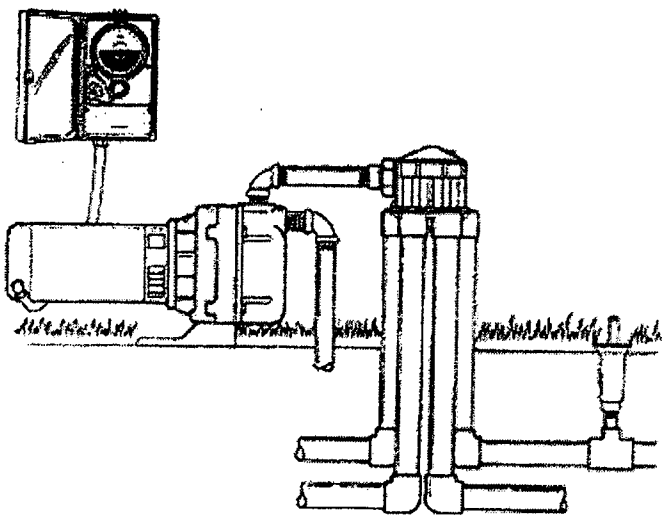
top.

Insert replacement cam into valve top, ensuring that the wide notch on cam is aligned with notch on valve top, and secure with two cam retaining screws.

Replace top, ensuring body seal is in place.

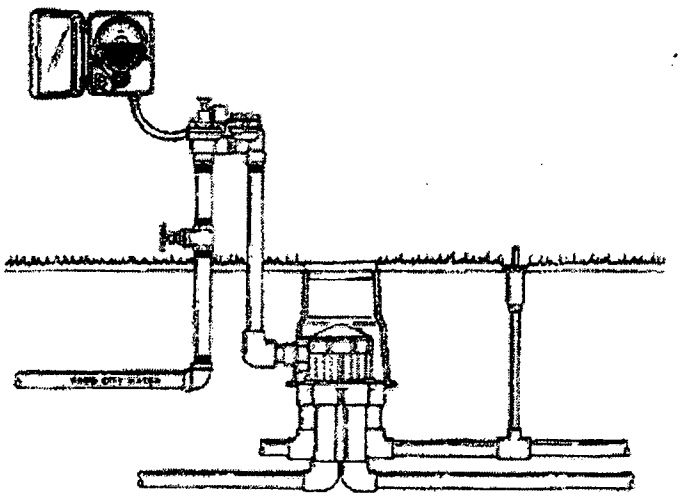
VALVE APPLICATIONS

Pump Fed application



For direct pump - fed installations, the HYDROTEK® 6000 Series Valve is directly connected to the discharge side of the pump and is cycled from one zone to the next by turning the pump off and on . Install the valve as close to the pump as possible and ensure suction line to the pump has a proper check valve installed and all joints are completely sealed.

In-line Valve Application



For high flow city water supplied installations using and in-line valve, ensure the HYDROTEK® Valve is installed as close to the in-line valve as possible. The 6000 Series Valve may be mounted below ground in a valve box (do not direct bury). Ensure backflow prevention is in compliance with local codes.

VALVE INSTALLATION

Prior to installation of HYDROTEK® 6000 Series Valve,make sure that the system is designed using adequate pipe sizes and control valves to ensure maximum performance of the valve.

For installation with large terrain elevations, or applications with high lift requirements such as overhead systems in greenhouses, the valve should be installed at the highest point in the system, or check-valves should be installed near the valve in the elevated lines to prevent the back-flow of water from the higher locations to the lower zones.

When connecting the lines to the valve outlets, ensure that the correct cam is installed. See diagram for proper zone hookup of outlets.

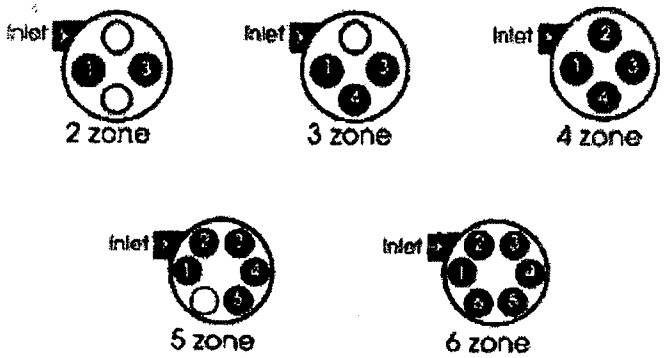
Do NOT turn the valve upside down when gluing the lines into the valve outlets. Glue may run down into the valve and interfere with valve operation. Allow glue to dry for at least two hours before operating or testing the valve. For best results, use a multi-purpose glue which is compatible with ABS plastic.

To seal off any unused outlets, install a piece of PVC pipe at least six inches in length to the outlet and cap the pipe .This will allow additional zones to be added easily at a later time.Make sure proper cam is installed for number of zones to be used.

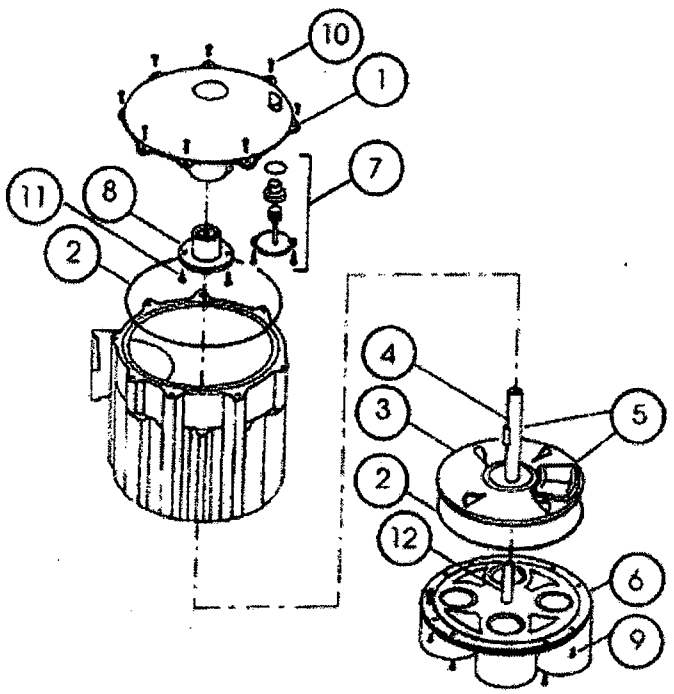
In regions of the country where winter temperatures may cause damage to exterior pipes, the HYDROTEK® 6000 Series Valve should be winterized. To protect the control valve and other irrigation components from damage, the entire system should be drained or cleared using compressed air. Contact your K-Rain dealer for information on the winterization requirements in your area.

Active Zone Diagram

Black dots indicate active outlets for cam being used



HYDROTEK® 6000 VALVE PARTS



1	4 Outlet valve top 6 Outlet valve top	8002804 8002806
2	Valve body seal	8600000
3	Rubber flap disk	8003000
4	Stem with .032 spring Stem with .028 spring	8004002 8004003
5	Stem/disk assy.with .032 spring Stem/disk assy.with .028 spring	8003050 8003051

6	4 Outlet valve bottom 6 Outlet valve bottom	8002704 8002706
7	Vacuum breaker assy.	8005001
8	Two zone, 4 outlet cam Three zone, 4 outlet cam Four zone, 4 outlet cam Five zone, 6 outlet cam Six zone, 6 outlet cam	8002902 8002903 8002904 8002905 8002906
9	Valve bottom screws (6) (10-24 x3/4 Phil Pan SS)	8004410
10	Valve top screws (8) (10-24 x5/8 Slt.phst SS)	8004412
11	Cam retaining screws (2) (6 x1/2 Phil Pan SS)	8004414
12	Valve bottom S.S Pin (1/4" dia.)	8600001

TROUBLESHOOTING

1. Problem: Valve Does Not Change or Cycle to Next Zone or Outlet

Cause: Debris or foreign objects preventing proper movement of stem and disk assembly.

Solution: Remove valve top and check for foreign objects. Clean build-up from walls of valve as necessary.

Solution: Check for freedom of movement of stem and disk assembly up and down over the center pin in bottom of valve. Scale deposits may build up on the pin and hold stem and disk assembly down. Clean pin and again check for freedom of movement.

Cause: Disk may have expanded and is rubbing against inside walls of body.

Solution: Replace disk and clean build-up from walls of valve as necessary.

Cause: Restriction of flow causing pressure in valve to build up, preventing valve from cycling.

Solution: Be sure that all operating outlets are not capped and that the flow to operating zones is not restricted in any manner.

Solution: The backflow of water from uphill lines may be preventing the valve from cycling properly. This can happen when the valve is placed too far below an elevated irrigation line. If the valve cannot be placed close to the high point of the system, a check valve should be installed near the valve in the outlet line that runs uphill from the valve.

2. Problem: Water Comes Out of all the Valve Outlets

Cause: Stem and disk assembly not seating properly on valve outlet.

Solution: Check for sufficient water flow . A minimum of 15 GPM is required to properly seat the disk.

Solution: Remove the valve top and clean the inside walls as necessary to ensure that nothing is interfering with the up and down movement of the stem and disk assembly inside the valve.

Solution: Make sure that the operating outlets are not capped and that the flow to the operating zones is not restricted in any manner.

Solution: Replace disk if necessary.

Cause: Too many sprinkler heads on a zone will cause insufficient pressure for disk to seat firmly over valve outlet.

Solution: Reduce the number of heads on the zone to obtain the proper sprinkler operating pressure.

3. Problem: Valve Skips Outlets or Zones.

Cause: For a pump installation, the pump may be losing its prime, causing the water flow to surge. This will cause the valve to cycle quickly several times, skipping one or more zones. Verify that the flow to the valve is constant by turning ON after having been OFF for at least 15 minutes. The flow should be steady and uninterrupted.

Solution: Seal any pump suction line leaks.

Solution: Replace or install suction line check valve to prevent pump from losing its prime.

Cause: The stem and disk assembly is being advanced past the desired outlet.

Solution: Ensure that the correct cam for the desired number of zones is installed and that the outlet lines are installed to the correct outlet ports of the valve.

TECHNICAL INFORMATION

Valve Top and Body Construction:	Die Cast Metal
Valve Bottom Construction:	ABS High Strength Plastic
Flow Range:	15-100 G.P.M
Inlet:	Threaded 1 1/2" NPT
Outlets:	Allows for 1 1/2" PVC pipe slip and glue connection

FLOW AND PRESSURE LOSS CHARACTERISTICS

6400 Series 4 Outlet Valve

FLOW (GPM)	15	20	30	40	50	60	70	80	90	100	110	120	130	140	150
PSI LOSS	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.5	9.0	10.0	10.5	11.0	12.0	12.5	13.0

6600 Series 6 Outlet Valve

FLOW (GPM)	15	20	30	40	50	60	70	80	90	100	110	120	130	140	150
PSI LOSS	2.0	3.0	3.5	4.0	5.0	6.0	7.5	9.0	10.0	11.0	11.5	12.0	12.5	13.0	14.0

AUXILLARY GENERATOR SPECIFICATIONS

WHY CUTLER-HAMMER?

The top 5 questions to consider before you buy.

IS IT A NAME YOU CAN TRUST?

No one knows more about power than Eaton's electrical business. They've been manufacturing quality Cutler-Hammer products for over 100 years.

IS THE ENGINE A PROVEN PERFORMER?

The heart and soul of any generator starts with the engine. Briggs & Stratton® OHV and V-Twin OHV engines are well known for long lasting, reliable performance – perfect for standby power.

IS IT QUIET AND COMPACT?

The Cutler-Hammer generator boast the smallest footprint in the industry for a subtle, functional yard presence. Sound absorbing weather protected panels and a spark arrest muffler also provide neighbor-friendly sound levels.

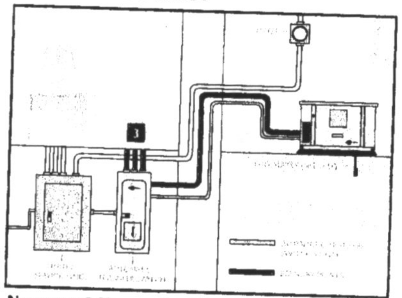
WHO OFFERS THE OVERALL BEST VALUE?

Packed with cost saving, consumer-friendly features, our industry leading engine/fuel regulation system will save you hundreds of dollars over our competitors on the installation.

WHO CAN OFFER ME A TOTAL POWER SOLUTION?

From sizing and delivery to installation and service, every Cutler-Hammer Home Standby Generator is backed by a network of service experts.

HOW IT WORKS:

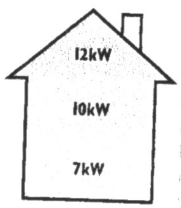


No power? No worries, it's all automatic.

Advanced electronics continually monitor your home's connection to local utility power 1. When an outage occurs the system senses it immediately and starts your standby generator 2, automatically switching from utility power to standby power 3.

When utility power is restored, the system senses it and automatically transfers service back to your local utility, while shutting down your standby generator. It's all automatic.

DETERMINE YOUR POWER REQUIREMENTS



Most homes of 1,200 to 3,000 sq. ft. will have ample standby power with a 7kW, 10kW or 12kW standby generator. The most common items that require backup power during a blackout are the furnace, refrigerator, freezer, lights, TV, sump pump, and water heater.

HOME STANDBY GENERATORS

10kW, 12kW

Fully Featured Home Standby Power.

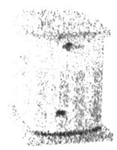
Computer Friendly

LISTED

Whether you are home or away, 10kW and 12kW Home Standby Generators quietly protect your home and family with an immediate, automatic, reliable response to power failure.

- Vanguard™ OHV V-Twin Engine
- Diagnostic Panel with Remote System Status
- Weekly Exercise Function
- Automatic Battery Charger
- Run Time Meter
- 4 Sound Absorbing, Weather Protected Panels
- CSA and UL 2200 Listed and Approved

Includes: Synthetic oil, battery, polymer installation pad, remote system status panel, sound shield (12kW).



7kW

Compact, Affordable Standby Power.

ELS

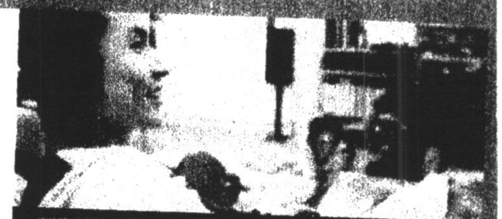
Computer Friendly

c UL us LISTED

Designed to power essential loads automatically during a power outage, the permanently installed 7kW system proves that big power can come in small packages.

- Briggs & Stratton ELS™ OHV engine
- Diagnostic Panel with Remote System Status
- Weekly Exercise Function
- Automatic Battery Charger
- cUL and UL 2200 Listed and Approved

Includes: Synthetic oil, battery, polymer installation pad, remote system status panel, disconnect box, 6 ft. of conduit.



Home Standby Generator Specifications

Model No.			
Running Watts (LP)			
(NG)			
Starting Watts (LP)			
(NG)			
Operation			
Run Time			
Engine Brand			
Engine			
Engine Type			
RPM			
Sound Rating			
System Exerciser			
Remote Status			
Diagnostic Alerts			
Dimensions			
Weight			
Warranty			

Transfer Switch Specifications:

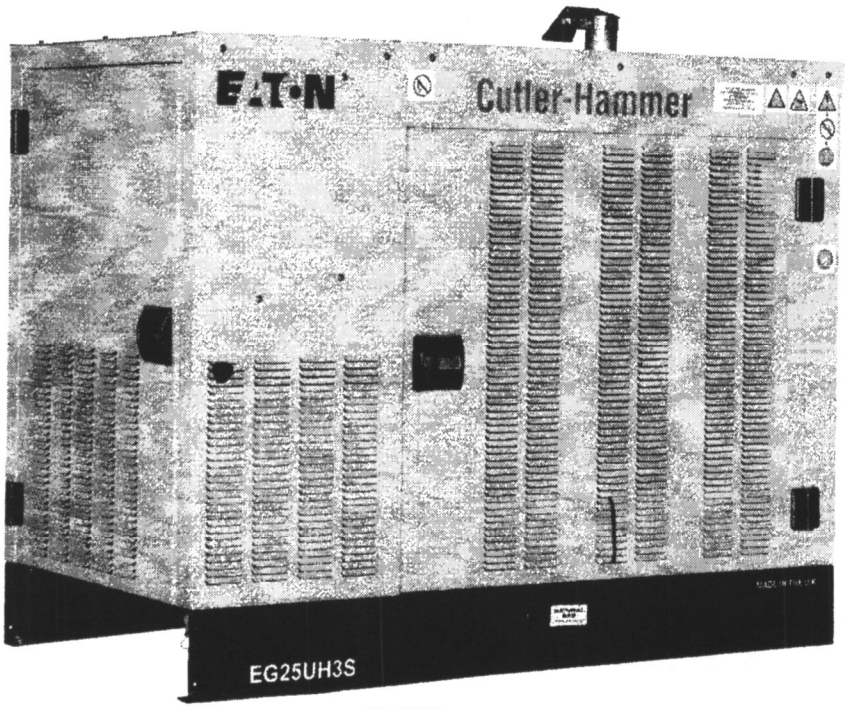
Model No.				
Amps				
Voltage				
Circuits				
Poles				
Frequency				
UL Listed				
Enclosure				
Rating				

EATON | Cutler-Hammer

Residential Standby Generators
CHGEN17500I (17.5 kW)
CHGEN25000I (25 kW)

Technical Data

New Information



25 kW Shown

Product Description

LP and Natural Gas Generator Sets from Eaton's electrical business are rated Residential Standby 17.5 – 25 kW at 60 Hz.

Features, Functions and Benefits

Generator Set

- Complete system designed and built at ISO® 9001 certified facilities.
- Factory tested to design specifications at full load conditions.

Engine

- Governor, Woodward electronic.
- Electrical system, 12 Vdc.
- Cartridge type filters.
- Natural gas fuel system, LP gas options available.
- Gas shutoff valve, solenoid operated.
- Gas pressure regulator.
- Low oil pressure shutdown.

Generator

- Insulation system, class H.
- Drip-proof generator air intake (NEMA® Type 2, IP23).
- Electrical design in accordance with BS5000 Part 99, IEC 60034-1, EN61000-6, NEMA MG-1.33, UTE51100.

Automatic Voltage Regulator

- Voltage within ± 1.0% single-phase at steady state from no load to full load.
- Provides fast recovery from transient load changes.

Cooling System

- Radiator and cooling fan complete with protective guards.
- Standard ambient temperatures up to 110°F (43°C).
- Coolant heater, 110/120 volts.

Mounting Arrangement

- Heavy-duty fabricated steel base with lifting points.
- Anti-vibration pads to ensure vibration isolation.
- Coolant and lube oil drains piped to edge of base.
- Complete OSHA guarding.
- Stub-up pipe ready for connection to silencer pipework.
- Fuel line terminated at base with NPT connections.
- Seismic vibration isolators (Zone 4).

Circuit Breaker

- 2-pole with solid neutral, UL®/CSA® listed.
- NEMA Type 1 steel enclosure, vibration isolated.
- Electrical stub-up area directly below circuit breaker.

Control System

- Autostart control panel.
- Vibration isolated NEMA Type 1 enclosure with hinged access door.
- Automatic start with three attempts, and Automatic Crank Disconnect with adjustable Start and Stop timers and Fail to Start indication.
- Configurable energize to run function.
- Low oil pressure and high engine temperature shutdown.
- Overspeed and underspeed (frequency) protection.
- Charge fail alarm.
- Two fully configurable auxiliary outputs.

Enclosure

- Weatherproof enclosure (includes internal silencer system).
- Large cable entry area for installation ease.
- Lockable access doors allow full 180° opening rotation and are removable with 45° opening in confined locations.
- Hinged radiator fill cover.
- Roof outlet exhaust with sealed roof aperture and rain cap.
- Stub-up cover sheets for "rodent proofing."

Equipment Finish

- All electroplated hardware.
- Anticorrosive protection prior to painting.
- High gloss polyurethane paint for durability and scuff resistance.

Quality Standards

- UL 2200, BS4999, BS5000, BS5514, IEC60034, EN61000-6, NEMA MG1-33, ISO8528.

Documentation

- Operation and maintenance manuals provided.
- Wiring diagrams included.
- UL/CSA certification.

Warranty

- All equipment carries full manufacturer's warranty. Extended warranty terms available.
- One year from date of startup, 18 months from date of shipment.

Optional Equipment

Some options may not be available on all models. Not all options are listed.

Silencer System Kit

- Residential exhaust silencer (field installable).

Engine

- Battery heater.
- Lube oil sump heater, 110/120 volts.
- Battery trickle charger.

Generator

- Anti-condensation heater.

Fuel System

- Vaporizer kit.

Transfer Switches

- 100 ampere NEMA 3R:
  - ❑ CHGENLC100ATSR
  - ❑ CHGENLC100ATSRSE (Service Entrance)
- 200 ampere NEMA 3R:
  - ❑ CHGENLC200ATSR
  - ❑ CHGENLC200ATSRSE (Service Entrance)

Miscellaneous Accessories

- Additional operator's manual pack.

Extended Warranty

- 24 months:
  - ❑ CHGENW2417K (17 kW)
  - ❑ CHGENW2425K (25 kW)
- 36 months:
  - ❑ CHGENW3617K (17 kW)
  - ❑ CHGENW3625K (25 kW)

Note: See warranty policy for details of coverage.

Generator Set Dimensions and Weights

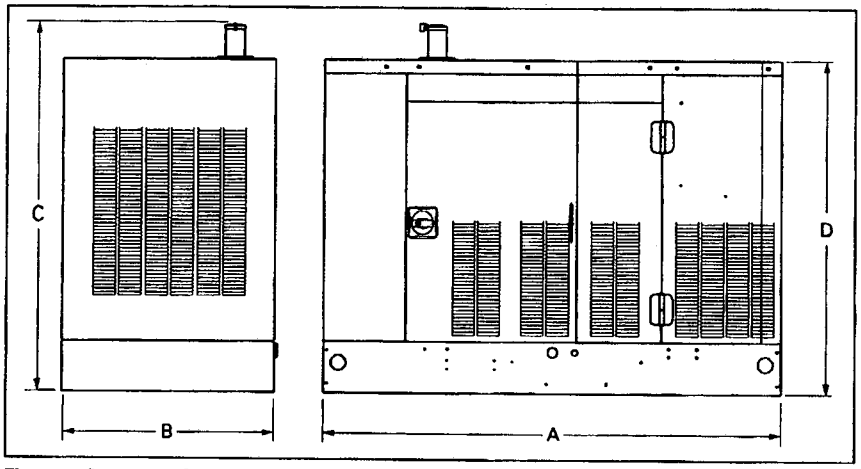


Figure 1. Generator Set Dimensions — see Table 1

Table 1. Generator Set Dimensions in Inches (mm)

A	B	C	D	Weight Lbs. (kg) ①	Catalog Number
53.10 (1348.7)	28.00 (711.2)	46.90 (1191.3)	42.50 (1079.5)	950 (432)	CHGEN17500I
53.10 (1348.7)	28.00 (711.2)	46.90 (1191.3)	42.50 (1079.5)	994 (452)	CHGEN25000I

① Includes oil and coolant.

Note: General configuration not to be used for installation. See specific dimensional drawings for detail.

Table 2. Concrete Pad Dimensions in Inches (mm)

Length	Width	Depth	Catalog Number
59.10 (1501.1)	34.00 (863.6)	7.00 (177.8)	CHGEN17500I
59.10 (1501.1)	34.00 (863.6)	7.00 (177.8)	CHGEN25000I

Product Specifications

Table 3. Generator Specifications

Specification	Description
Voltage Regulation	±1.0% single-phase at steady state from no load to full load
Frequency	±0.25% for constant load, no load to full load
Waveform Distortion	THD less than 4%
Radio Interference	EN61000-6
Telephone Influence Factor	TIF <50, per NEMA MG 1-32.11
Telephone Harmonic Factor	THF <2%
Stator Winding	2/3 Pitch
Type	Brushless, self-excited, self-regulated, drip-proof, 2-pole, sealed bearings, direct coupled by flexible disk
Insulation	Class H per NEMA MG1-1.66
Temperature Rise	Within Class H limits
Overspeed Capability	125%
Available Voltages	Single-Phase — 240/120, 220/110
Deration	Please consult factory for available outputs
Ratings	At 77°F (25°C), 500 ft. (152.4 m), 60% humidity, 1.0 pf (single-phase)

Table 4. Engine Specifications

Specification	Description
Manufacturer	HM Ltd.
Model	4ZB1 Isuzu
Type	4-Cycle
Aspiration	Natural
Cylinder Configuration	In-line 4
Displacement — cu in (L)	111 (1.82)
Bore — Inches (mm)	3.30 (84.0)
Stroke — Inches (mm)	3.23 (82.0)
Compression Ratio	8.5:1
Governor	
Type	Electronic
Class	A1
Piston Speed — ft/sec (m/sec)	32.2 (9.84)
Air Cleaner Type	Dry, light duty, disposable
LP Gas:	
Engine Speed — rpm	3600
Maximum Power at Rated rpm — hp (kW)	
Standby	48 (35.9)
BMEP — psi (kPa)	
Standby	96 (658)
Natural Gas:	
Engine Speed — rpm	3600
Maximum Power at Rated rpm — hp (kW)	
Standby	43.7 (32.6)
BMEP — psi (kPa)	
Standby	87.0 (600)

Table 5. Control Panel Specifications

Specification/Description
NEMA 1 steel enclosure with hinged access door.
Vibration isolated mounted Autostart control panel.
Single location customer connector point.
Electrical stub-up area directly below control panel.

Table 6. Recommended Battery Specifications

Specification	Description
Minimum Ratings	
Voltage	12 V
Cold Cranking Amperes	440 A
Maximum Dimensions in Inches (mm)	
Length	13.90 (353.1)
Width	6.90 (175.3)
Height	7.50 (190.5)

Note: Battery is not included with generator. The above specifications are recommended for use in battery procurement.

Rating Definitions

Standby — Applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. The generator is peak rated (as defined in ISO8528-3).

Consult your Eaton representative for more information.

Technical Data

Table 7. Standby Generator Sets CHGEN17500I and CHGEN25000I (Single-Phase) — 3600 rpm/60 Hz

Description	Units	CHGEN17500I		CHGEN25000I	
		LP Gas	Natural Gas	LP Gas	Natural Gas
Ratings					
Kilowatt Power	kW (kVA)	17.5 (17.5)	17.5 (17.5)	25.0 (25.0)	25.0 (25.0)
Amperes at 240 Volts	Amperes	73	73	104	104
Lubricating System					
Type: Full Pressure Oil Filter: Spin-On, Full Flow Oil Type Required: API CF-4 Total Oil Capacity Oil Pan	 U.S. gal. (L) U.S. gal. (L)	 1.2 (4.5) 1.1 (4.0)	 1.2 (4.5) 1.1 (4.0)	 1.2 (4.5) 1.1 (4.0)	 1.2 (4.5) 1.1 (4.0)
Fuel System — Generator Set Fuel Consumption					
100% Load 75% Load 50% Load	Cfh (m^3/hr) Cfh (m^3/hr) Cfh (m^3/hr)	118.0 (3.3) 92.0 (2.6) 66.0 (1.9)	326.0 (9.2) 255.0 (7.2) 184.0 (5.2)	162.0 (4.6) 125.0 (3.6) 89.0 (2.5)	447.0 (12.7) 347.0 (9.8) 245.0 (6.9)
Engine Electrical System					
Ignition System: Electronic, Distributorless Voltage/Ground: 12/Negative Battery Charging Generator Ampere Rating at 240 V	 Amperes	 45	 45	 45	 45
Cooling System					
Water Pump Type: Centrifugal Radiator System Capacity Incl. Engine Maximum Coolant Static Head Coolant Flow Rate Minimum Temperature to Engine Temperature Rise Across Engine Heat Rejected to Coolant at Rated Power Total Heat Radiated to Room at Rated Power Radiator Fan Load	 U.S. gal. (L) Ft H_2O (m H_2O) U.S. gal./min. (L/min.) °F (°C) °F (°C) Btu/min. (kW) Btu/min. (kW) hp (kW)	 1.6 (6.1) 31.5 (9.6) 23.8 (90) 169.0 (76) 7.2 (4) 1565.0 (27.5) 788.0 (13.9) 3.8 (2.8)	 1.6 (6.1) 31.5 (9.6) 23.8 (90) 169.0 (76) 7.2 (4) 1565.0 (27.5) 788.0 (13.9) 3.8 (2.8)	 1.6 (6.1) 31.5 (9.6) 23.8 (90) 169.0 (76) 8.1 (4.5) 2153.0 (37.9) 1085.0 (19.1) 3.8 (2.8)	 1.6 (6.1) 31.5 (9.6) 23.8 (90) 169.0 (76) 8.1 (4.5) 2153.0 (37.9) 1085.0 (19.1) 3.8 (2.8)
Air Requirements					
Combustion Air Flow Maximum Air Cleaner Restriction Radiator Cooling Air (Zero Restriction) Generator Cooling Air Allowable Air Flow Restriction (After Radiator) Cooling Air Flow (at Rated Speed) Rate with Restriction	Cfm (m^3/min.) In H_2O (kPa) Cfm (m^3/min.) Cfm (m^3/min.) In H_2O (kPa) Cfm (m^3/min.)	77.8 (2.2) 5.9 (1.5) 4386.0 (124.2) 551.0 (15.6) 1.0 (0.247) 4237.0 (120)	73.7 (2.1) 5.9 (1.5) 4386.0 (124.2) 551.0 (15.6) 1.0 (0.247) 4237.0 (120)	113.0 (3.2) 5.9 (1.5) 4386.0 (124.2) 551.0 (15.6) 1.0 (0.247) 4237.0 (120)	106.0 (3.0) 5.9 (1.5) 4386.0 (124.2) 551.0 (15.6) 1.0 (0.247) 4237.0 (120)
Exhaust System					
Maximum Allowable Backpressure Exhaust Flow at Rated kW Exhaust Temperature at Rated kW — Dry Exhaust	In Hg (kPa) Cfm (m^3/min.) °F (°C)	5.1 (17.3) 367.0 (7.0) 1171.0 (633)	5.1 (17.3) 367.0 (7.0) 1180.0 (638)	5.1 (17.3) 367.0 (10.4) 1234.0 (668)	5.1 (17.3) 370.0 (10.5) 1247.0 (675)
Generator Set Noise Rating ①					
at 7 Meters	dB(A)	87.2	87.2	88.5	88.5

① dB(A) levels are for guidance only.

Table 8. Generators CHGEN17500I and CHGEN25000I (Single-Phase) — 120/240 Volts

Description		CHGEN17500I	CHGEN25000I
Motor Starting Capability (kVA):	Self Excited	22	35
Full Load Efficiencies:	Standby	82.6	85.6
Reactances ② **(per unit):**	X_d X'_d X''_d X_q X''_q	3.35 0.22 0.109 1.68 0.157	3.33 0.17 0.083 1.67 0.130
Time Constants:		t'_d = 40 ms t''_d = 5 ms	t'_d = 40 ms t''_d = 5 ms

② Reactances shown are applicable to the LPG standby rating.

Eaton Electrical Inc.
1000 Cherrington Parkway
Moon Township, PA 15108-4312
United States
tel: 1-800-525-2000
www.EatonElectrical.com

Here is your list of appliances :

Quantity	Appliance	Rated (Running) Wattage	Surge (Starting) Wattage
10	Furnace Fan -1/2 HP	875	2300
10	Well Pump - 1/2 HP	1000	2100

Your Total Starting(surge) wattage is : **21050**

Your Total Rated(running) wattage is : **18750**

You would require a **20.0**kW generator.

ELECTRIC

Rogers 501.636.4190
Fayetteville 501.443.4948
Siloam Springs 501.238.1561

Quotation

Thank you for the opportunity to quote you on your bill of material. Please call if you have any questions or require clarifications.

Date:02-25-05

To: Mr. Steve Brannan

Company: Presley,Brannon & assoc.

Project Name: Stand-by Pump Generators

Terms: 25th

Shipment:

CHGEN25000I------25KW 120/240V GENERATOR
CHGENNLC100ATSRSE AUTO TRANSFER SWITCH
(per Attached bom)
PRICE: $8,008.00EA

Thank you again for the opportunity to work with you on this project.

Gilbert Bloyed

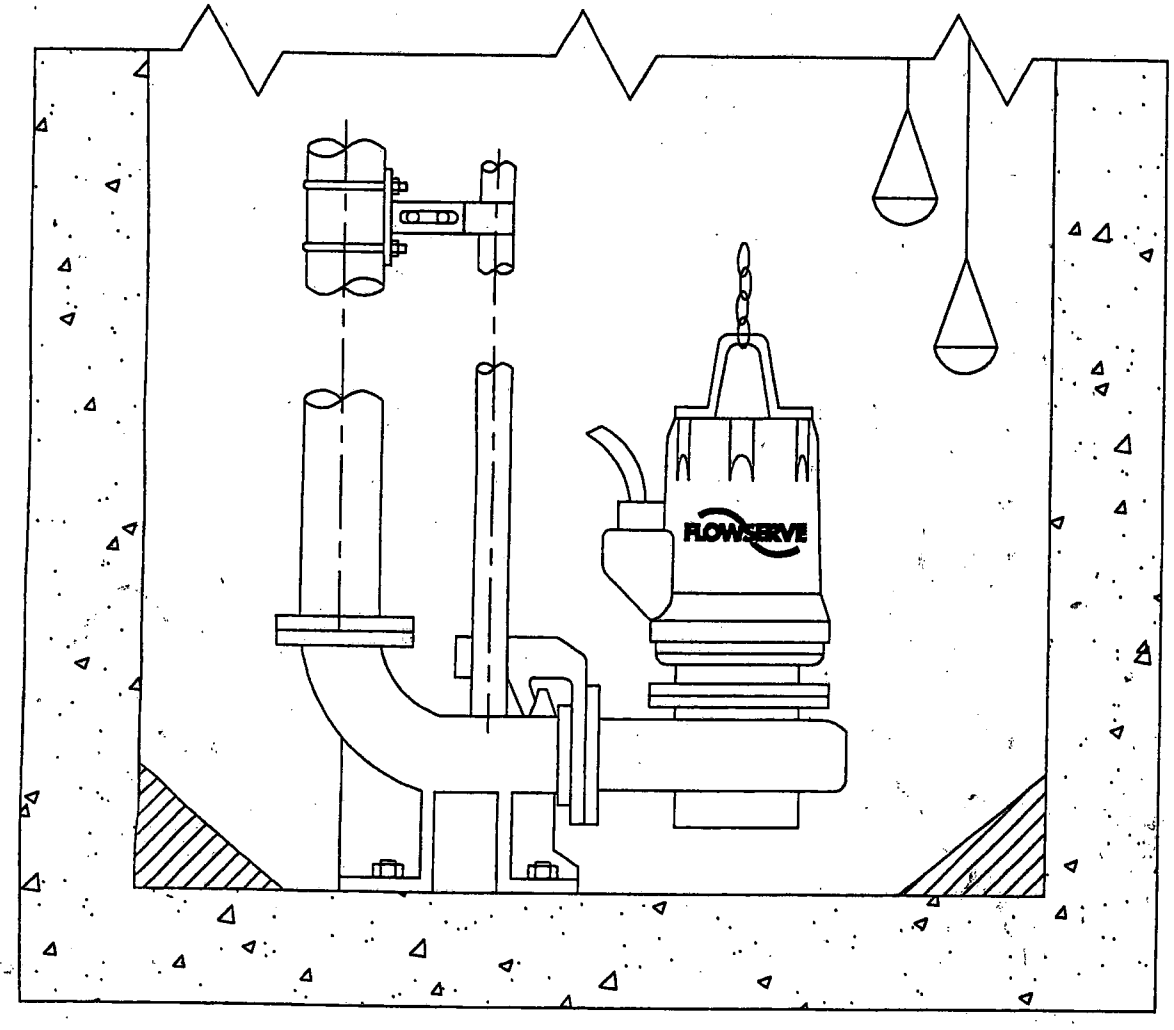
DEER HAVEN SUBDIVISION

WASTEWATER TREATMENT SYSTEM

OPERATIONS AND MAINTENANCE MANUALS

FLOWSERVE PUMP DIVISION

Type MSX - Series 1/Barbarian Non-Clog Submersible Pump



Installation, Operation and Maintenance Manual

P/N 81975302

WARNING

Read this installation, operation and maintenance manual prior to installing, operating or maintaining this product.

Use of non-Flowserve Pump Division parts will void the manufacturer's warranty.

TABLE OF CONTENTS

TABLE OF CONTENTS

FLOWSERVE Submersible Pump Start-Up/Warranty Registration

End User Information

Name _____

Address _____

City _____

State _____ Zip _____ Phone _____

Operator's Name _____

Model Number _____ HP _____

Serial Number _____

New / Replacement – Replaces _____ Mfr)

Describe Overall Condition of Pump(s) at Start-Up

_____

Pump(s) Storage - No. of Months _____

Indoors ____ Outdoors ____

Condition of Motor Cable _____

Were pump ends properly protected? Y / N If not, explain _____

Discharge Elbow and Guide Rail System

Upper guide rail bracket(s) bolted securely: Y / N

Slide rail base(s) properly bolted down: Y / N

Guide rails exactly vertical: Y / N

Base elbow exactly level: Y / N

Debris in bottom of station: Y / N

Liquid being pumped _____

Installation of Float Switches

Circle type of float arrangement: (Free Hanging) (Fixed to pipe)

Are float switches hanging free? Y / N

On cable fixed to pipe or rail, free length set at _____ ft.

Check/confirm that influent flow will not tangle floats: Y

Float Switch Location:

	Simplex	Duplex	
Pump off	_____	_____	ft. above top of pump
Pump on	_____	_____	ft. above off level
Lag pump on	_____	_____	ft. above on level
High level alarm	_____	_____	ft. above lag pump on

Control Panel

General condition at start-up _____

Manufacturer's identification No. _____

How is it mounted? _____

Approximate distance from pump _____ ft.

Is there a junction box in pit? Y / N Where? _____

Electrically connect the pump leads, float switches and power supply leads per instructions located in the control panel door.

Does panel include water-sensing relay? Y / N

Make/Model of relay: _____

Confirm winding thermostat leads were correctly connected to appropriate relay in control box: Y / N

Confirm wiring was done correctly: Y / N

Pump Rotation Check

Check rotation by laying the unit on its side, bumping the motor starter for rotation and viewing the impeller rotation. Confirm that the correct rotation is clockwise when viewed from above. Y / N

Caution - Stand clear of pump when testing.

Meg OHM Check of Insulation

B-G _____ R-G _____ W-G _____

Install Pump in Pit

WARNING: Do not use pump power cables to lower pump.

Line Voltage

Power supply line voltage:

B-R _____ R-W _____ W-B _____

Power supply frequency: _____ Hz

See instruction manual if voltage variance exceeds 10%.

Average Pump Running at Rated COS

B _____ Amps R _____ Amps W _____ Amps

List Any Equipment Difficulties During Start-Up

Final Check

Is pump seated properly: Y / N

Do valves operate properly: Y / N

Nameplate Data

Phase _____ Hz _____ Voltage _____ RPM _____

Capacity _____ Head _____

Start-Up Information

Name	Present at Start-Up
Customer _____	Y / N
Contractor _____	Y / N
Consult. Eng. _____	Y / N
Representative _____	Y / N

Started by: _____

Firm: _____

Date: _____ Title: _____

I certify that the equipment has been inspected and is ready for permanent operation.

Signed: _____ Date: _____

This report must be submitted to Flowserve Pump Division to activate warranty.

Mail or Fax to:
Flowserve pump Division
5310 Taneytown Pike
Taneytown MD 21787
Attention: MSX Service Department

Fax 410-756-2615

WARNING: Consult Instruction Manual before performing any start-up functions listed above.

FOREWORD

Flowserve Pump Division products are the result of more than a century of progressive study and development. Advanced design, proper selection of materials and precision construction reflect this wide experience.

Flowserve Pump Division products are designed to give trouble-free, efficient operation with minimum maintenance and repair. This instruction book will familiarize management and operating personnel with pertinent details and procedures for the installation, operation and maintenance of these pumps.

The spaces below are for your identification of the equipment to which the book applies.

Unit Size	Serial No.	Identification No.

WARNING: **THESE PUMPS (OR PROTOTYPES) HAVE BEEN SHOP TESTED AND FOUND SATISFACTORY FOR THE CONDITION FOR WHICH THEY WERE SOLD.**

DO NOT OPERATE IN EXCESS OF THEIR RATED CAPACITY, SPEED, PRESSURE, AND TEMPERATURE. REFER TO MOTOR NAMEPLATE FOR APPLICABLE RATINGS

BE SURE THAT THE FOLLOWING GUIDELINES ARE MET WITH RESPECT TO AC POWER:

1. **SUPPLY POWER IS WITHIN 10% OF RATED VOLTAGE AT RATED FREQUENCY.**
2. **SUPPLY POWER IS WITHIN 5% OF RATED FREQUENCY AT RATED VOLTAGE.**
3. **COMBINED VARIATION IN VOLTAGE AND FREQUENCY IS WITHIN 10% (SUM OF ABSOLUTE VALUES) OF RATED VALUES.**

STUDY THIS INSTRUCTION BOOK

The descriptions and instructions contained within this manual cover the standard equipment design and many common variations. This manual does not cover all design details and variations, nor does it provide for every possible contingency that may be encountered. When information cannot be found in this manual, contact the nearest Flowserve Pump Division Representative.

Section I: Introduction and General Description

INTRODUCTION

The Flowserve Pump Division MSX Series 1 non-clog submersible pump is a volute-type centrifugal pump designed for handling sewage and industrial waste. The pump is driven directly by a motor, which must be partially submerged in the pumped fluid during operation.

CAUTION: **MOTOR COOLING IS ACCOMPLISHED BY HEAT TRANSFER FROM THE MOTOR HOUSING TO THE PUMPED FLUID. CONTINUOUS OPERATION WITH THE MOTOR ABOVE THE PUMPED LIQUID (NOT SUBMERGED) MAY CAUSE THE MOTOR TEMPERATURE TO RISE AND MAY TRIP THE THERMAL DISCONNECTS.**

CAUTION: **THE RECOMMENDED MINIMUM SUBMERGENCE FOR CONTINUOUS OPERATION OF MSX PUMP UNITS ARE AS SHOWN ON THE GENERAL ARRANGEMENT DRAWING.**

MOTOR

The Flowserve Pump Division submersible motor is a three-phase, squirrel cage motor with a watertight stator housing designed specifically for the submerged operation of Flowserve Pump Division non-clog pumps. The power cable is brought into the motor through a watertight cable gland. The rotor is impregnated under vacuum with a baked-on varnish to protect it against corrosion and is then dynamically balanced. The motor is constructed to meet the requirements of the ANSI/NFPA 70 (National Electric Code) Class 1, Division 1, Group C & D explosion proof service. However, only motors nameplated Class 1, Division 1, Group C & D are certified as explosion proof.

CAUTION: **MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. SERVICE BY PERSONS OTHER THAN FLOWSERVE PUMP DIVISION PERSONNEL VIOLATES SAFETY REGULATIONS, NEGATES THE EXPLOSION PROOF CERTIFICATION AND VOIDS THE FACTORY WARRANTY.**

Prior to installing or operating your MSX Series 1 pump, become familiar with the following:

1. NEMA Publication MG-1 (or latest release) Safety Standards for Construction and Guide for Selection Installation and Use of Electric Motors and Generators
2. The National Electric Code
3. Local codes and practices

MOTOR THERMAL PROTECTION

The motor winding is protected by three thermal switches installed in series with normally closed contacts. The contacts will open when the winding temperature within the motor exceeds 275° F (135° C). The thermal switches must be wired into the motor starter inside the control panel such that the motor automatically shuts down in the event of overheating; see Figure 4: Motor Connection Diagram. Observe the amperage rating of the thermal contacts at the connected voltage.

WARNING: **FAILURE TO PROPERLY CONNECT THE MOTOR THERMAL SWITCHES MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.**

MOISTURE DETECTION SENSOR

A moisture detection sensor located in the oil chamber of the bearing housing will detect failure of the lower mechanical seal by measuring the electrical conductivity of the fluid in the oil chamber. Contamination of the oil with the pumped liquid will cause the conductivity to increase. The sensor must be wired into an approved moisture detection sensor relay to illuminate a light on the pump motor control panel with increased conductivity of the fluid. The unit should be taken off-line for service with illumination of the light.

WARNING:	**FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSOR MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.**

CAUTION: **FAILURE TO INSPECT AND REPLACE THE SEALS AS NECESSARY MAY RESULT IN LEAKING OF PUMPED FLUID INTO THE MOTOR HOUSING RESULTING IN DAMAGE TO THE MOTOR AND POSSIBLE ELECTRIC SHOCK.**

CAUTION: **THE LEAKAGE DETECTION CIRCUIT FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SUPPLIED FROM AN ISOLATED SECONDARY CIRCUIT: 30 Vrms; 60 Vpk; 0.5 ma MAX.**

CABLE

The motor is supplied with cable available in 35, 50, 75 and 100 foot (10.5, 15, 23, 30.5 m) lengths. The cable jacket is suitable for extra hard usage and meets the requirements of Type W, GW or SOOW per ANSI/NFPA 70 Article 400.

MECHANICAL SEAL

The motor is equipped with two mechanical seals designed to prevent the entrance of the pumped liquid into the motor cavity. The lower mechanical seal prevents the pumped liquid from entering the oil-filled bearing housing. The upper mechanical seal prevents the pumped liquid from coming into contact with the bearings and the motor windings. Lower mechanical seal failure is indicated by a moisture detection probe in the oil-filled bearing housing.

BEARINGS

MSX Series 1 pumps are equipped with double-row, angular contact thrust and single-row, deep-groove ball line bearings. The line and thrust bearings are lubricated for life with grease.

IMPELLER AND WEARING RINGS

The pump impeller is of the enclosed, non-clog type capable of passing solids of limited size. The impeller hub is keyed to the shaft and held in position by an impeller screw and impeller washer. A radial wearing ring is supplied on the casing between the impeller and the casing. A radial impeller wearing ring is available as an option.

SECTION II: Pre-Installation Instructions

Inspect the equipment and check it against the shipping manifest immediately upon receipt. EXAMINE THE CRATE AND WRAPPING BEFORE DISCARDING. Parts or accessories are sometimes wrapped individually or fastened to the crate. Report any damage or shortage to the transportation company's local agent.

HANDLING

To prevent damage to the pumping unit, it is absolutely necessary that the unit be handled carefully. Lifting of the pumping unit must only be accomplished by using the lifting bail bolted to the motor. Check the torque (refer to chart on page 24) on the lifting bail bolts prior to lifting the unit. Lifting must be done slowly and continuously, avoiding jerks. When using cranes or lifting devices, take care to avoid bumping, walls, floors, etc.

During handling of the motor, the bending radii of the motor power and signal cable leading out of the motor cable junction box **MUST NOT FALL BELOW 4 TIMES THE CABLE DIAMETER.**

CAUTION: DO NOT LIFT THE MOTOR OR PUMPING UNIT BY THE POWER CABLE.

STORAGE

General

Submersible pump units need special preparations for storage. The power cable must be protected from direct exposure to sunlight and the open ends must be sealed against moisture.

The lower mechanical seal may leak a small amount of the barrier fluid onto the top shroud of the impeller during long periods of storage. This can be expected until the pump has been operated, giving the seals an opportunity to wear in. Excessive leaking (more than a few drops) should be reported to your local Flowserve Pump Division Service Center, as it may indicate a problem with the mechanical seals. If there is excessive leaking, the situation should be resolved prior to installing your pump.

Short Term (Less Than 6 Months)

When it is necessary to store a pump for a short time before it can be installed, place it in a dry location and protect it from moisture. When protective flanges are bolted to suction and discharge flanges at the factory, they should not be removed until the unit is ready for installation. Rotate the shaft a minimum of 5 revolutions every two weeks to keep the bearings coated with grease and to minimize the effects of false brinelling.

Long Term (More Than 6 Months)

More thorough precautions are required if the pump is scheduled to be stored for an extended period of time. The following is the procedure:

1. The storage area should be a clean, dry location not subject to rapid changes in temperature, light (no direct light) or humidity, and relatively free of ground transmitted vibration due to heavy construction and/or machinery. A temperature range of 40° to 120° F (5° to 50° C) with non-condensing humidity is recommended.
2. Drain water from the pump casing, rotate the pump rotor once in the proper direction and blow the liquid end dry with air.
3. Coat the interior surfaces of the liquid end with rust inhibitor by brushing, spraying or fogging. Rotate the pump shaft one turn in the proper direction while coating.
4. Coat all threaded openings with rust inhibitor and plug. Coat machined surfaces of exposed flanges with rust inhibitor and then cover with fiberboard or wood flange covers. Desiccant bags should be secured to the covers prior to putting them in place and must not contact metal surfaces.
5. Coat exposed, unpainted, machined surfaces with a rust inhibitor.
6. Cover the entire pump with a clear plastic sheet for protection from dust, dirt, moisture, etc. and to allow for visual inspection. The cover should be open near the top to allow for ventilation.

7. Rotate the pump shaft a minimum of 5 revolutions every two weeks to keep the bearings coated with grease and to minimize the effects of false brinelling.
8. Prior to start-up or installation, a Flowserve Pump Division Representative should be hired to inspect all equipment to determine if any damage or deterioration of parts has occurred and that the equipment is in "as shipped" condition.

PRIOR TO INSTALLATION

Inspect the pump. The winding insulation resistance should be checked prior to installation; see Section III: Insulation Testing. Any significant change in the insulation resistance should be investigated with a Flowserve Pump Division Representative.

MANUFACTURER'S SERVICE

We recommend that the services of a Flowserve Pump Division Service Engineer or Flowserve Pump Division Authorized Representative be employed for start-up of pump equipment. The purchaser is then afforded the opportunity to receive adequate and authoritative instructions, validating the Flowserve Pump Division warranty.

SECTION III: Installation

GENERAL

Use the lifting bail bolted to the motor for handling the pumping unit. Exercise care in slinging and handling the unit. Observe the minimum cable bending radius given below.

CAUTION: **THE OIL LEVEL AND QUALITY IN THE BEARING HOUSING MUST BE CHECKED BEFORE THE UNIT IS OPERATED; see Section III, Bearing Housing Oil Filling.**

CAUTION: **FLOWSERVE PUMP DIVISION RECOMMENDS THAT THE MOTOR WINDING INSULATION BE CHECKED ONCE THE UNIT IS IN PLACE AND PRIOR TO APPLYING POWER TO THE UNIT; see Section III, Insulation Testing.**

POWER CABLE

Pay special attention to the power cables during installation. Where the power cables are subject to chafing and vibration, fasten them in wooden blocks or protect them by means of cable guards.

CAUTION: **DO NOT BEND THE CABLE TO A RADIUS BELOW 4 TIMES THE CABLE DIAMETER.**

CAUTION: **DO NOT LIFT THE UNIT BY THE POWER CABLES.**

CAUTION: **PER ANSI/NFPA 70 (NEC) SECTION 400-9, POWER CABLES MAY NOT BE SPLICED DURING INITIAL INSTALLATION. SPLICES FOR NON-EXPLOSION PROOF MOTORS OCCURRING AFTER INITIAL INSTALLATION MUST CONFORM TO ANSI/NFPA 70 (NEC) SECTION 400-9.**

CAUTION: **POWER CABLES FOR MOTORS CERTIFIED AS EXPLOSION PROOF PER ANSI/NFPA 70 (NEC) MUST BE CONTINUOUS PER SECTION 501-11. NO CABLE SPLICES ARE PERMITTED.**

CAUTION: **POWER CABLES ARE TO BE REPLACED ONLY WITH AN APPROVED POWER CABLE PURCHASED FROM FLOWSERVE PUMP DIVISION. POWER CABLE REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

CAUTION: **A CABLE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND A TERMINAL BOARD MUST BE PERFORMED BY AUTHORIZED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

LOCATION OF EQUIPMENT

The pump should be located to allow an overhead crane or lifting device with sufficient capacity to lift the entire unit. The suction eye of the pump must be located far enough above the bottom of the wet pit to allow for the maximum rated solid size to pass under the pump; i.e., a pump rated for 4-inch (100 mm) solids must have at least a 4-inch (100 mm) clearance between the bottom of the well and the suction eye of the pump; see Elevation Drawing.

SITE PREPARATION

Flowserve Pump Division MSX Series 1 wet well pumps can be installed in a permanent well via a guide rail system or on a fabricated stand so that they are transportable. A guide rail installation can be either with a single, square guide rail or with a double, round guide rail system; see Figure 1: Guide Rail System.

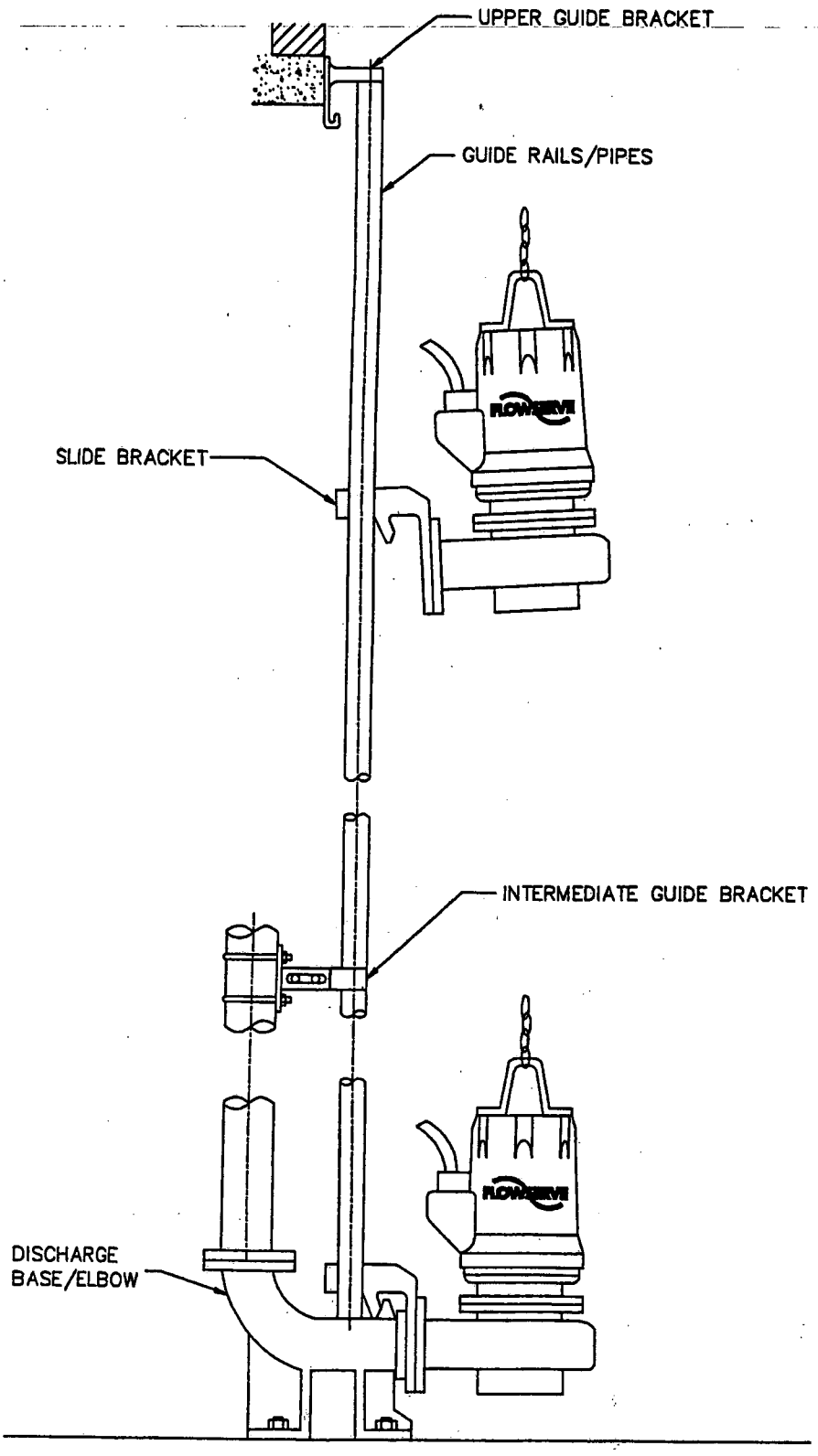


Figure 1: Guide Rail System

Foundation

The foundation should be of sufficient strength to absorb vibration (at least five times the weight of the pump unit) and form a permanent, rigid support for the pump. Foundation bolts of the specified size should be embedded in concrete and located according to the Elevation Drawing. Flowserve Pump Division recommends that the piping be installed rigidly and anchored close to the pump connections and that the anchor bolts are securely embedded in a concrete foundation of adequate mass and rigidity.

GUIDE RAIL INSTALLATION

1. Install anchor bolts in the bottom of the wet well for the discharge elbow/base. Install the discharge elbow/base. Secure the base with hex nuts and washers.
2. Cut the guide rail pipe(s) to length. The CUSTOMER SUPPLIED guide rail pipe is 1 1/2-inch galvanized or stainless steel square tubing (single rail systems) or galvanized or stainless steel, 2-inch round, Sch 40 pipe (double rail systems). Install the guide rail(s) over the tapered plug(s) on the discharge elbow/base.
3. Place tapered plug(s) of the upper guide rail bracket in the guide rail pipe(s) and position the upper guide rail bracket so that the guide rail pipe(s) are plumb. Secure the upper guide rail bracket to the top of the well.

PEDESTAL MOUNTING

Pumps intended for portable use are supplied with a transportable stand. Either flexible hose with quick disconnect couplings or rigid piping can be attached to the discharge; see Figure 2: Transportable Stand.

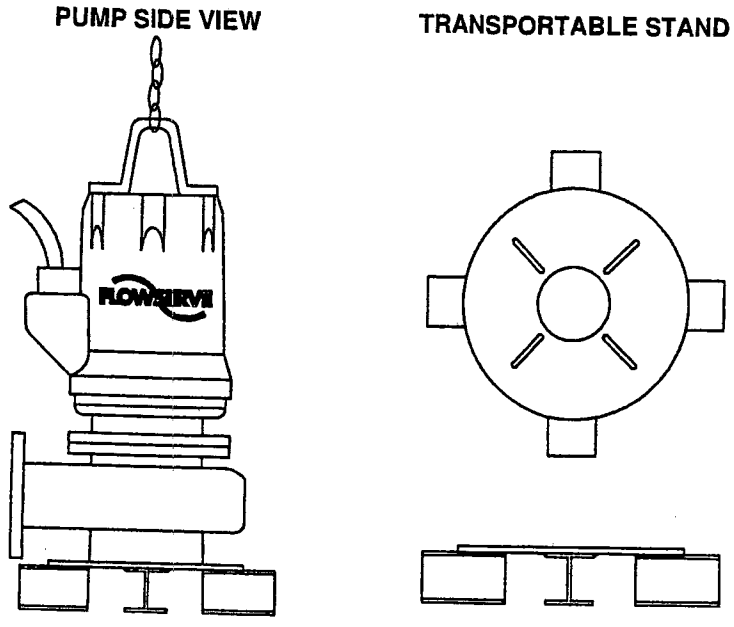


Figure 2: Transportable Stand

FLOAT SWITCHES

Customer supplied float switches are typically used to control the starting and stopping of the pump(s) based on the fluid level of the well. The switches hang freely from a bracket mounted to the frame of the wet well. The float switches should be located such that they are not in direct line with the flow into the wet well, and such that they will not tangle with each other or with the discharge piping. Either of these situations may give erroneous signals.

A typical arrangement for a float switch control system for a wet well is shown in Figure 3: Float Switch Installation. The four switches are as follows: 1) Pump(s) off; 2) Lead pump on; 3) Lag pump on (for arrangements with two or more pumps); 4) High level alarm. There could be additional lag pump switches depending on the number of pumps in the system.

CAUTION: THE SYSTEM SHOULD BE DESIGNED TO MINIMIZE THE NUMBER OF STARTS. THE FREQUENCY OF RESTARTS SHOULD NOT EXCEED RECOMMENDATIONS BY NEMA MG-1, TABLE 2-3.

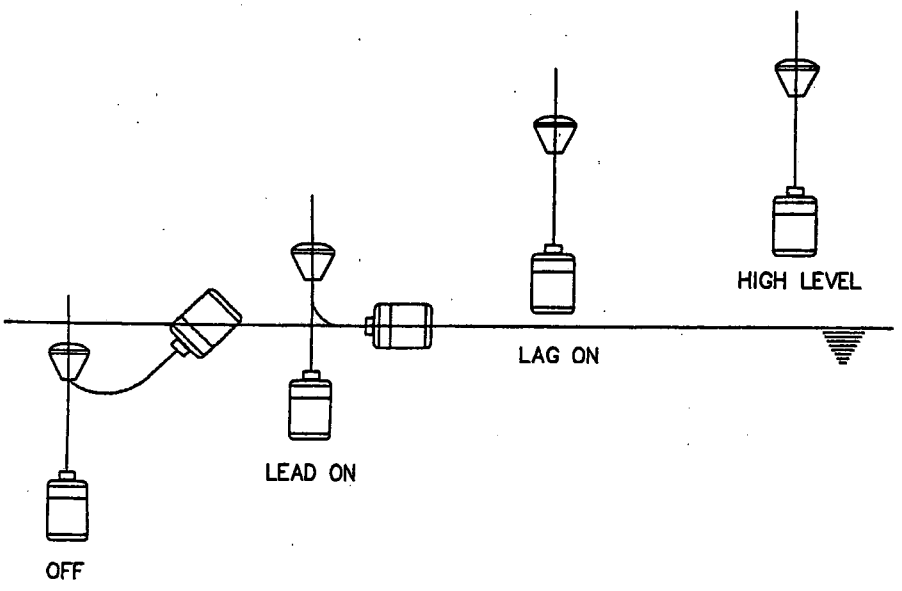


Figure 3: Float Switch Installation

ELECTRICAL

CAUTION: FOLLOW LOCAL PRACTICES AND THE NATIONAL ELECTRIC CODE WHEN CONNECTING EQUIPMENT.

Motor Power Wiring

Electrical power is supplied to the motor through the power supply cable leading out of the pump stator junction box. Each motor is supplied with a standard 35 foot (10.5 m) power cable (50, 75 and 100 foot cables are also available). The motor rated voltage can be found on the pump/motor nameplate. The motor is connected to the power cable at the factory according to Figure 4: Motor Connection Diagram. Installation and operation instructions for power service at other voltages may vary from those listed in this manual. Contact Flowserve Pump Division directly for variations in installation and performance at other voltages.

Dual Voltage Motors

Dual voltage motors are connected at the factory according to the purchase order and are labeled with the voltage connection. A change in voltage requires rewiring of the motor. Motors capable of having the voltage changed in the field require an optional junction box with a terminal board.

CAUTION: **A VOLTAGE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND TERMINAL BOARD MUST BE PERFORMED BY PERSONS QUALIFIED AND AUTHORIZED BY FLOWSERVE PUMP DIVISION. AUTHORIZATION CAN BE OBTAINED BY ATTENDING A FLOWSERVE PUMP DIVISION SERVICE SCHOOL FOR MSX PUMPS. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

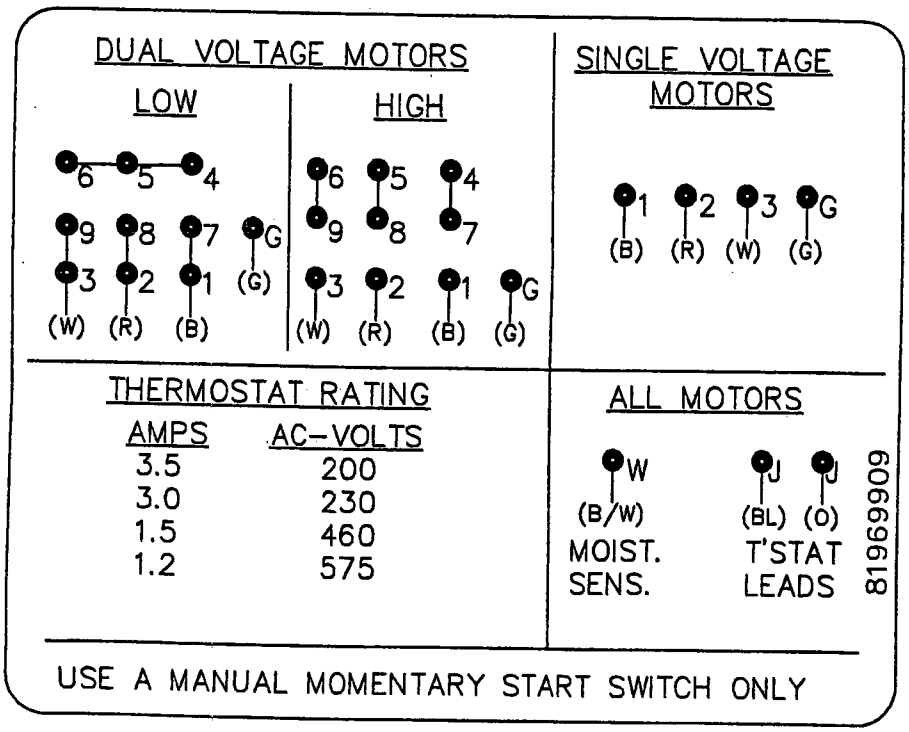


Figure 4: Motor Connection Diagram

Checking Rotation

After connection of the electric service and prior to installing the unit, the rotation must be checked. Incorrect rotation will result in poor performance of the unit and can cause damage to the pump. Check rotation by laying the unit on its side, bumping the motor starter for rotation and viewing the impeller rotation. The correct rotation is clockwise when viewed from the above.

CAUTION: **USE BLOCKS TO PREVENT THE UNIT FROM ROLLING AS IT IS BUMPED. DO NOT BUMP THE MOTOR WHILE THE UNIT IS SUSPENDED BY CHAINS AS IT COULD HAVE A CONSIDERABLE REACTION FORCE.**

WARNING: **DO NOT PLACE HANDS, LOOSE ARTICLES OF CLOTHING, ETC. NEAR THE SUCTION EYE. WEAR SAFETY GOGGLES. FAILURE TO HEED THIS WARNING MAY CAUSE SERIOUS PERSONAL INJURY.**

If the pump rotation is wrong, make sure that the power is off and interchange the L1 and L2 motor lead connections at the control panel. Verify the pump rotation direction before you continue.

Insulation Testing

Flowserve Pump Division recommends that the motor winding insulation be checked once the unit is in place and prior to applying power to the unit. If the insulation resistance of the motor winding and power supply cable is to be tested, use an instrument designed for this purpose (500 VDC). To measure the insulation resistance, use to following procedure:

1. Disconnect all leads of the power supply cable and clean them carefully.
2. Measure the insulation resistance between one cable core and ground. All other cable leads are kept away from ground during this procedure.
3. The insulation resistance of the new motor measured at the factory exceeds 500 megaohms (connected to frame). If the test results in an insulation value less than 6 megaohms, contact Flowserve Pump Division.

WARNING: **WINDINGS AND POWER SUPPLY CABLES WILL, DURING INSULATION TESTING, BE CAPACITIVELY CHARGED TO THE TEST VOLTAGE.**

THE BARE CABLE ENDS MUST NOT BE TOUCHED DURING THE TEST AND BEFORE THE WINDINGS AND CABLE BARE CONDUCTORS HAVE BEEN DISCHARGED.

AFTER COMPLETION OF THE TEST, DISCHARGE THE CABLES BY APPLYING THE CABLE BARE CONDUCTORS TO THE PROTECTIVE GROUND CONNECTION.

Current and Voltage Imbalance

Upon installation, the amount of current imbalance should be calculated. The pump should be operated while submerged to simulate normal operating conditions and the current imbalance should be calculated as described below. Current imbalance between phases should not exceed 4%. The current imbalance is defined as follows:

Imbalance = (max current - average current of the three phases) / average current of the three phases

The current imbalance will further increase any imbalance in the line voltage. It is advisable to find the "most even" balance by changing the phase connections of the motor in a clockwise order until the smallest difference is obtained.

An imbalanced voltage of more than one percent will result in an even larger imbalanced current and excessive heat generation. The motor should be derated according to NEMA MG-1, 14.35 in order that the winding temperature not affect the life of the motor.

Motor Overload Protection

A motor overload relay with an approved heater element is to be used. Overload protection and grounding should be in accordance with the National Electric Code and also be consistent with sound local practices.

Protection Against Inadmissible Starting Frequency

Flowserve Pump Division recommends protecting the motor from frequent restarting via a time delay relay. The frequency of restarts should not exceed recommendations by NEMA MG-1, Table 2-3. Motors of this type are capable of making the following starts:

1. Two starts in succession, coasting to rest between starts, with the motor initially at ambient temperature.
2. One start with the motor initially at a temperature not exceeding its rated load operation temperature.

If additional starts are required, it is recommended that none be made until all conditions affecting operation have been thoroughly investigated and the motor is checked for excessive heating. The number of starts should be minimized in order to maintain the life of the motor.

MOTOR THERMAL PROTECTION

The motor winding is protected by three thermal switches installed in series with normally closed contacts. The contacts will open when the winding temperature within the motor exceeds 275° F (135° C). The thermal switches must be wired into the motor starter within the control panel such that the motor automatically shuts down in the event of overheating; see Figure 4: Motor Connection Diagram. Observe the amperage rating of the thermal contacts at the connected voltage.

WARNING: FAILURE TO PROPERLY CONNECT THE MOTOR THERMAL SWITCHES MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND THE EXPLOSION PROOF CERTIFICATION.

MOISTURE DETECTION SENSOR

A moisture detection sensor located in the oil chamber of the bearing housing will detect failure of the lower mechanical seal by measuring the electrical conductivity of the fluid in the chamber. Contamination of the oil with the pumped cooling fluid will cause the conductivity to increase. The sensor must be wired into an approved moisture detection sensor relay to illuminate a light on the pump motor control panel with increased conductivity of the fluid. The unit should be taken off-line for service with illumination of the light.

WARNING FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSOR MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY.

CAUTION: THE LEAKAGE DETECTION CIRCUIT FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SUPPLIED FROM AN ISOLATED SECONDARY CIRCUIT: 30 Vrms; 60 Vpk; 0.5 ma MAX.

BEARING HOUSING OIL FILLING

In order to fill the bearing housing with oil, the pump and motor assembly should be in a vertical orientation. Remove the upper NPT pipe plug on the bearing housing and fill the chamber level with the NPT fitting with approximately 2 quarts (1.9 L) of an approved oil (see below). It is easiest to use a nozzle to fill the chamber, which will protrude through the NPT opening without blocking the entire opening. This allows for the air in the chamber to escape and will speed up the filling process. In the event that oil leaks onto the pump or into the environment it should be cleaned and disposed of according to the Material Safety Data Sheet.

Your pump was supplied with Chevron Lubricating Oil FM ISO 68, which is a biodegradable, light hydraulic oil which passes the acute aquatic toxicity (LC-50) criteria adopted by the U.S. Fish and Wildlife Service and the U.S. EPA. The oil is designed to give maximum protection in high performance industrial applications as well as in environmentally sensitive areas. This oil is not formulated with metal containing performance additives, which will persist in the environment in the event of a leak.

DISCHARGE PIPING

A check valve is normally installed in the discharge line to protect the pump from any excessive backpressure and reverse rotation caused by water running back through the casing during a driver or power failure. Any such reverse flow through the pump or excessive backpressure should be kept to an absolute minimum.

SECTION IV: Operation

The following procedures outline the most important steps involved in pump operation. Any procedure modification due to particular installation peculiarities should conform to good engineering practices.

MOTOR COOLING

Flowserve Pump Division MSX Series 1 non-clog submersible pump is driven directly by a motor that must be partially submerged in the pumped fluid during operation.

CAUTION: MOTOR COOLING IS ACCOMPLISHED BY HEAT TRANSFER FROM THE MOTOR HOUSING TO THE PUMPED FLUID. CONTINUOUS OPERATION WITH THE MOTOR ABOVE THE PUMPED LIQUID (NOT SUBMERGED) MAY CAUSE THE MOTOR TEMPERATURE TO RISE AND MAY TRIP THE THERMAL DISCONNECTS.

CAUTION: THE RECOMMENDED MINIMUM SUBMERGENCE FOR CONTINUOUS OPERATION OF MSX PUMP UNITS ARE AS SHOWN ON THE GENERAL ARRANGEMENT DRAWING.

REDUCED CAPACITY OPERATION

In general, Flowserve Pump Division MSX Series 1 non-clog pumps are designed for continuous operation within 25% to 130% of the best efficiency point at maximum RPM and impeller diameter. They are suitable for occasional or intermittent operation at capacities outside these limits; however, pump operation may be noisy and component life may be reduced.

These limitations are placed because the impellers have wide discharges and at other capacities, large radial reactions are encountered and flow recirculation may occur. This is an inherent design characteristic for pumps of this type.

In many cases, particularly in sewage pumping applications, reduced capacities are met by a reduction in pump speed and no throttling is used. Under these circumstances, the low-capacity applications are not nearly as critical because of lower pump speed and relatively lower pump operating heads.

For applications where pump operation at other capacities is anticipated contact the nearest Flowserve Pump Division Sales Representative.

PRELIMINARY TO STARTING

Read this instruction manual thoroughly before starting the unit. Make sure the following items are checked before starting:

1. Ensure that the bearing housing is filled with oil and that the moisture detection sensor and thermal disconnects are functioning properly; see Section III: Moisture Detection Sensor, Section III: Motor Thermal Protection, and Section III: Bearing Housing Oil Filling.
2. Check the direction of rotation of the driver. The arrow on the pump casing will show the correct rotation; see Section III: Checking Rotation.

STARTING

The procedure for starting the unit will vary somewhat with each installation; however, the following steps generally apply:

1. Verify that the pump rotor turns freely. If it is bound, do not operate the pump until the cause of the trouble is located.
2. Make sure the pump is submerged.
3. Start the driver.
4. If the discharge valve is closed, open the valve slowly as pressure is built up on the discharge side of the pump.
5. Monitor noise and power consumption for several hours. When starting a unit and after the starting current has faded, the ammeter may, for a short time, indicate a higher current than given on the motor data sheet.

STOPPING

Although the procedure for stopping may vary slightly with each installation, typically the driver is simply shut down.

SECTION V: Maintenance

DURING THE WARRANTY PERIOD, FACTORY APPROVAL MUST BE OBTAINED PRIOR TO MAKING REPAIRS. FAILURE TO GET APPROVAL WILL VOID THE WARRANTY.

WARNING:	**MOTORS NAMEPLATED CLASS 1, DIVISION1, GROUP C & D MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. THIS INCLUDES, BUT IS NOT LIMITED TO SERVICE ON THE ROTOR, STATOR, BEARINGS, CABLE, CABLE GLANDS AND GROMMETS. SERVICE BY PERSONS OTHER THAN CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL VIOLATES SAFETY REGULATIONS, NEGATES THE EXPLOSION FROOF CERTIFICATION AND VOIDS THE FACTORY WARRANTY.** **ALL MOTORS UNDER WARRANTY MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. SERVICE BY PERSONS OTHER THAN CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL VOIDS THE FACTORY WARRANTY.**

POWER CABLE

Pay special attention to the power supply cables during maintenance. Where the power supply cables are subject to chafing and vibrating, fasten them in wooden blocks or protect them by means of cable guards.

CAUTION: **DO NOT BEND THE CABLES TO A RADIUS BELOW 4 TIMES THE CABLE DIAMETER.**

CAUTION: **DO NOT LIFT THE UNIT BY THE POWER CABLES.**

CAUTION: **PER ANSI/NFPA 70 (NEC) SECTION 400-9, POWER CABLES MAY NOT BE SPLICED DURING INITIAL INSTALLATION. SPLICES FOR NON-EXPLOSION PROOF MOTORS OCCURRING AFTER INITIAL INSTALLATION MUST CONFORM TO ANSI/NFPA 70 (NEC) SECTION 400-9.**

CAUTION: **POWER CABLES FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE CONTINUOUS PER ANSI/NFPA 70 SECTION 501-11. NO CABLE SPLICES ARE PERMITTED. POWER CABLES ARE TO BE REPLACED ONLY WITH AN APPROVED POWER CABLE PURCHASED FROM FLOWSERVE PUMP DIVISION. POWER CORD REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

CAUTION: **A CABLE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND TERMINAL BOARD MUST BE PERFORMED BY AUTHORIZED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

INSPECTIONS

Regular observations should be made of the pump operation to avert trouble. Whether or not you consider a log of these inspections necessary, the operator must be alert for irregularities in the operation of the pump(s). Any trouble symptoms that are detected should be reported immediately. Motor noise, power consumption, vibration, and pump output should be checked periodically. An abrupt change in any of the above is much more indicative of trouble than a consistently high reading.

Semi-Annual and Annual Inspection

Check for stable and smooth operation. Check the unit running records for hourly usage vs. power consumption, vibration and pump output to determine if internal inspection is required.

Complete Overhauls

Frequency of a complete overhaul depends upon the hours of operation of the pump, the severity of the conditions of service, the materials used in the pumping unit construction, and the care the pump receives in operation.

Do not open your unit for inspection unless there is definite evidence that the capacity has fallen off excessively or unless there is indication of trouble inside the pump or the motor.

PUMP DISMANTLING PROCEDURE

Care must be exercised in the dismantling operation. For convenience at re-assembly, lay out all parts in the order in which they are removed matchmarking to disassembly. Protect all machined faces against metal to metal contact and corrosion. Proceed as follows; reference Motor/Pump Sectional Drawing.

Impeller and Casing

1. Disconnect power from the motor. Use lifting bail and chain to remove the pump from wet pit.
2. Transport pump to a Flowserve Pump Division approved service shop.

CAUTION: TAKE PRECAUTIONS TO PROTECT THE PUMP DURING TRANSPORTATION.

3. Remove bolts holding the adapter plate to the pump casing. Draw out the pump rotating assembly complete with the motor. Set the motor on a mounting stage or wooden vee-blocks. Care must be taken in handling the unit.

CAUTION: DO NOT REMOVE THE BOLTS THAT HOLD THE BEARING HOUSING TO THE ADAPTER PLATE AS THIS MAY LEAK OIL, AND COULD DAMAGE THE MECHANICAL SEAL.

4. Drain fluid from the oil chamber in the bearing housing.
5. Remove the impeller mounting screw. The screw was mounting using Loctite 271 and may require heating to 400° F (204° C) for removal.
6. Remove the impeller and the impeller key. Note that upon removal of the impeller, the lower mechanical seal will be disengaged and residual oil may leak from the bearing housing.
7. Remove the wear ring(s) as necessary. Reference maintenance of wearing rings.

Bearing Housing

1. Drain cooling fluid from the oil chamber in the bearing housing.
2. Remove primary ring (rotating face) of the mechanical seal from the shaft.
3. Remove the adapter plate from the bearing housing. Take care not to damage the mating ring while removing the adapter plate. The mating ring (stationary face) of the mechanical seal should not be removed unless it is being replaced.
4. Remove primary ring of the upper mechanical seal by removing the snap ring on the shaft. The mating ring (stationary face) of the mechanical seal should not be removed unless it is being replaced.

CAUTION: BEARING REMOVAL OR INSTALLATION MUST ONLY BE DONE BY PERSONS QUALIFIED AND AUTHORIZED BY FLOWSERVE PUMP DIVISION. AUTHORIZATION CAN BE OBTAINED BY ATTENDING A FLOWSERVE PUMP DIVISION SERVICE SCHOOL FOR MSX PUMPS.

Carefully examine all individual parts, important joints and all wearing surfaces as the pump and rotor are dismantled. As a general rule, regardless of the performance of the unit, parts appreciably worn should be replaced if it is not intended to examine the pump until the next overhaul period. It is recommended that the mechanical seals and O-rings be replaced whenever the bearing house is disassembled.

PUMP ASSEMBLY

To assemble the pump, reverse the dismantling instructions previously described. Follow the mechanical seal and wearing ring instructions. Torque all assembly bolts and screws to the torque values listed at the end of this section. Assemble in the following order:

1. Replace upper mechanical seal.
2. Install the adapter plate onto the bearing housing.
3. Replace the lower mechanical seal.
4. Assemble the components of the rotating element. The impeller screw is locked in place using Loctite 271. Mating surfaces must be thoroughly cleaned and dry prior to application of the Loctite compound.
5. Install the casing wearing ring.
6. Install the rotating assembly in the casing.

MAINTENANCE OF CASINGS

The casing waterways should be kept clean and clear of rust. Whenever a unit is dismantled, clean the waterways of the casing.

MAINTENANCE OF WEARING RINGS

Generally, it is recommended that the wear rings be replaced or overhauled when pump performance has decreased appreciably due to excessive wearing ring clearance or when the radial clearance exceeds 0.030" (0.762 mm) diametrically.

Removal of Wearing Rings

The casing wearing ring and impeller wearing ring (optional) are mounted using an interference fit. Removing these rings may require cutting or machining.

Mounting of Wearing Rings

Clean the ring and location where the ring is to be mounted thoroughly and examine them for physical defects, wear, corrosion, and damage. Chill the wearing ring and mount it in the casing. If the impeller wearing ring was furnished with the original unit, heat the wearing ring prior to mounting it in the impeller. Ensure that the wearing rings are fully seated.

MECHANICAL SEALS

Removal of Seals

To remove mechanical seals, follow the procedure below:

1. The impeller (lower seal) or snap ring (upper seal) must be removed in order to remove the primary ring (rotating face). The shaft should be lightly lubricated so that the bellows will slide off the shaft. It is recommended that a soft hand soap and water mixture or glycerin be used. Light mineral oil may be used sparingly with nitrite and fluorocarbons.

CAUTION: **DO NOT USE WASHING-UP LIQUID, LIQUID SOAP OR HAND CLEANING GELS. DO NOT USE HYDROCARBON-BASED OILS OR ANY GREASE (INCLUDING SILICONE GREASE) ON ANY BELLOWS.**

2. The seat/mating ring is removed by gently prying it from the gland plate (the adapter plate for the lower seal and the bearing housing for the upper seal).

Installation of Seals

1. Inspect the primary seal and mating ring and wipe them clean.
2. Install the seal/mating ring in the gland plate (the adapter plate for the lower seal and the bearing housing for the upper seal) by gently pushing the ring and bellows into the bore. NOTE: IN ORDER TO APPLY EVEN PRESSURE AROUND THE ENTIRE MATING RING A SLEEVE SHOULD BE USED. Care must be taken not to damage the seal face during installation.
3. Clean and lightly lubricate the shaft. See the note above concerning which types of lubrication are acceptable with elastomer bellows.
4. Carefully slide the seal along the shaft far enough that the snap ring or impeller can be installed to hold the seal in place. The seal faces must meet perfectly or the seal will not perform properly.

REPLACING OIL

The oil in the bearing house should be inspected at yearly intervals, or sooner, depending on pump use. A small amount of oil should be drained from the bearing housing and examined. If the oil is clean, there is no need to replace it. If the oil is discolored or milky it should be drained and replaced with fresh oil. The oil should be checked again 2-3 weeks later. If the oil has become discolored or milky, the mechanical seal should be replaced. The replacement oil should be a low viscosity, environmentally friendly, hydraulic oil with additives for the following: oxidation stability, water separability, foam suppression and protection against wear, rust and corrosion. Flowserve Pump Division recommends the use of Chevron FM or equal hydraulic oil.

BEARINGS

MSX Series 1 pumps are furnished with grease-lubricated bearings, which are sealed for life. Proper grease lubrication is very important. Anti-friction bearings can be over-greased as well as under-greased. Any time maintenance is performed on the bearings, they should be repacked with grease, and the bearing chamber should be filled approximately 75% full.

The bearings are to be lubricated with a premium quality Lithium-Complex EP2 grease suitable for anti-friction bearing use. The grease contains rust and oxidation inhibitors. Flowserve Pump Division recommends using Exxon Infinitec EP2.

RECOMMENDED TORQUES FOR THREADED FASTENERS

The following tables are provided as a guide for the proper assembly of fasteners. Torques are for NON-lubricated threads.

Hex Head Cap Screw

HH Cap Screw Diameter	Number Threads	Wrench Torque (lb-ft)
0.250	20	5
0.313	18	9
0.375	16	16
0.438	14	25
0.500	13	39
0.563	12	55
0.625	11	77
0.750	10	134
0.875	9	215
1.000	8	320
1.125	8	465
1.250	8	649
1.375	8	874
1.500	8	1147

Note: Assemble joints without Adding lubricant.

Socket Head Cap Screw (Impeller Bolt)

SH Cap Screw Diameter	Number Threads	Wrench Torque (lb-ft)
0.375	16	14
0.500	13	35
0.625	11	68

Note: Apply Loctite 271 liberally to threads at assembly.

CAUTION: FOR ASSEMBLY OF A JOINT ALWAYS FINGER-TIGHTEN ALL NUTS OR BOLTS FIRST. THEN CROSS-TIGHTEN EVENLY IN ABOUT THREE EQUAL STEPS TO DEVELOP FINAL TORQUE VALUES.

SECTION IV: Locating Trouble

Common troubles that may occur with your pump and potential causes are listed below. The operator can often avoid unnecessary expenses by careful consideration of the points below.

FAILURE TO DELIVER FLUID OR INSUFFICIENT CAPACITY

1. Pump not primed
2. Liquid level is too low in the wet pit
3. Speed is too low; check voltage and current of each phase of the motor
4. Discharge pressure required by the system is greater than design pressure
5. Waterways of impeller, casing and /or piping are partially clogged
6. Wrong direction of rotation
7. Valves not open
8. Insufficient net positive suction head
9. Excess amount of gas or air in the liquid
10. Mechanical defects: impeller damage, wearing ring gap worn excessively

INSUFFICIENT DISCHARGE PRESSURE

1. Speed is too low
2. Excessive amount of air or gases in liquid
3. Discharge pressure required by the system is greater than the design pressure
4. Liquid viscosity is higher than that for which the pump was designed
5. Waterway of impeller, casing and/or piping are partially clogged
6. Wrong direction of rotation
7. Mechanical defects: impeller damaged, wearing ring gap worn excessively

PUMP POWER CONSUMPTION TOO HIGH

1. Speed is too high
2. The liquid being pumped is of a higher specific gravity or viscosity than that for which the pump was designed.
3. Mechanical damage
4. Excessive solid concentration is causing binding at the wearing ring gap area

PUMP VIBRATES

1. Foundation not sufficiently rigid or foundation bolts loose
2. Impeller partially clogged, causing imbalance
3. Mechanical defects
   - Bent shaft
   - Rotating element rubbing on stationary part
   - Worn bearings
   - Impeller or driver rotor out of balance
   - Loose impeller nut
4. The critical frequency of the system including pump, piping and foundation is being excited
5. The pump is being operated too far away from capacities for which it was designed
6. Insufficient net positive suction head
7. Inadequate piping support
8. Pump is not properly seated on the discharge elbow (wet pit applications)

BEARING LIFE IS SHORT

1. Internal misalignment due to piping strain or improper foundation
2. Shaft bent or damaged
3. Improper installation of bearings
4. Lubricant contaminated
5. Excessive imbalance of the rotating assembly
6. Pump being operated too far away from capacities for which it was designed
7. Pump vibrating excessively
8. Worn bearings

MECHANICAL SEAL HAS SHORT LIFE OR LEAKS EXCESSIVELY

1. Shaft bent
2. Mechanical seal improperly installed
3. Incorrect type of mechanical seal for the application
4. Excessive vibration
5. Abrasive material in seal cavity
6. Mechanical seal was run dry

SECTION VII: Service Parts and Parts Replacement

SERVICE PARTS

The severity of the conditions of service, the extent to which repairs can be carried out in the field and the number of units installed will determine, to a great extent, the minimum number of service parts which should be kept in stock at the site of the installation. It is suggested, as insurance against delays, that service parts be purchased when the order is placed or as soon after receiving the pump as possible.

A suggested spare parts list (priced if desired) can be furnished upon request.

SERVICE PARTS STORAGE

Spare parts and parts of a dismantled pump unit should be stored separately.

HOW TO ORDER SPARE PARTS

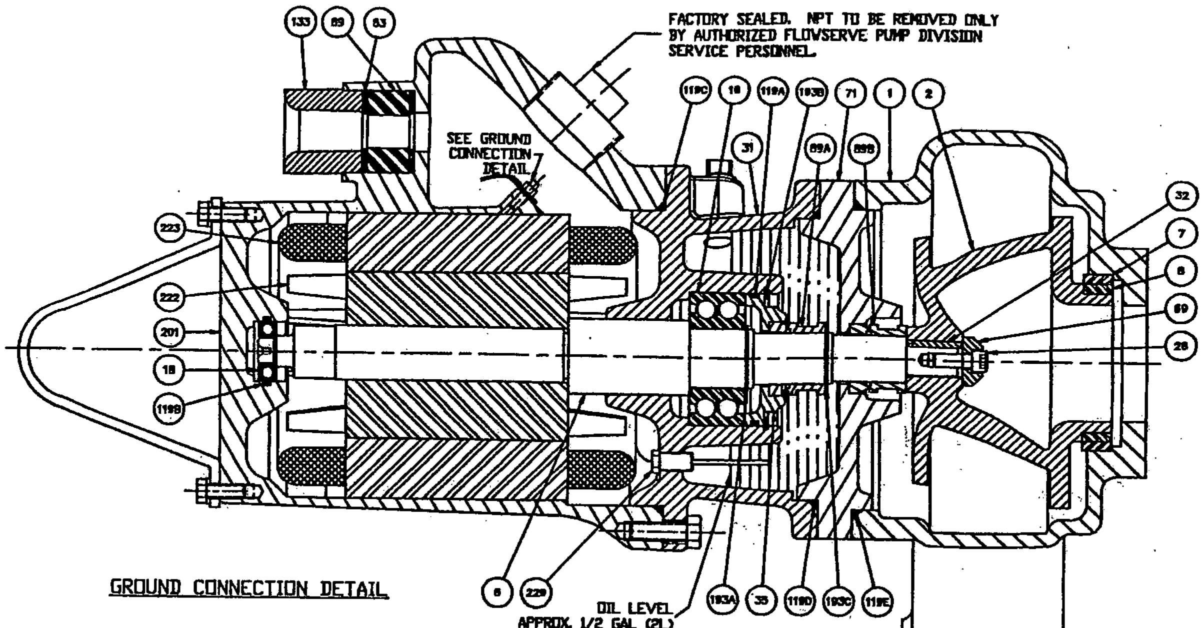
When ordering service parts the pump serial number and the size and type of pump must be given. Refer to the nameplate for this information. Give the name and number of the parts as listed on the Spare Parts List or the Sectional Drawing, the quantity required and, when possible, the complete symbol stamped on the old part. Orders for service parts should be sent to the nearest Flowserve Pump Division Sales Representative or Sales Office.

RETURNING PARTS

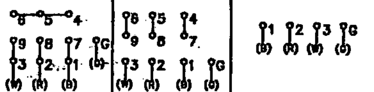
All material returned to the factory mast have a returned material (RM) tag attached. Consult the aforementioned sales office or factory from which the equipment was purchased for shipping instructions and RM tags. Unnecessary delays are avoided when parts or equipment are returned to the proper factory using the correct procedure.

1. When contacting the sales office or factory for return authorization, list the material to be returned and the reason for returning it.
2. Upon receipt of the RM tags, be sure to check the name and parts list, number of parts involved and the serial number of the equipment.
3. The RM tag must accompany the material shipped. Enclose it in the shipping container or attach it to the part being returned.
4. In cases where more than one part or box is returned, print or stencil your name, the name or each part and the RM tag number on each part or box and attach the tag to one of the parts. This will facilitate quick identification.
5. Articles being returned must be cleaned and free of sewage and carefully packed to prevent damage from handling or from exposure to weather.

ITEM	QTY.	DESCRIPTION
1	1	CASING
2	1	IMPELLER
6	1	SHAFT, ROTOR
7	1	RING, WEARING, CASING
8	1	RING, WEARING, IMPELLER (OPTIONAL)
16	1	BEARING, THRUST
18	1	BEARING, LINE
26	1	SCREW, IMPELLER
31	1	HOUSING, BEARING
32	1	KEY, IMPELLER
35	1	COVER, BEARING
193A	2	WASHER, GLAND
193A	1	WASHER, IMPELLER
193A	1	PLATE, ADAPTER
193A	1	BUSHING, CABLE
193A	1	MECHANICAL SEAL, SECONDARY
193A	1	MECHANICAL SEAL, PRIMARY
193A	1	O-RING, BEARING COVER
193A	1	O-RING, LINE BEARING
193A	1	O-RING, STATOR HOUSING/ADAPTER PLATE
193A	1	O-RING, BEARING HOUSING/ADAPTER PLATE
193A	1	O-RING, ADAPTER PLATE/CASING
193A	1	GLAND, CABLE
193A	1	SNAP RING, THRUST BEARING
193A	1	SNAP RING, BEARING COVER
193A	1	SNAP RING, MECHANICAL SEAL SECONDARY
193A	1	HOUSING, STATOR
193A	1	ROTOR
193A	1	STATOR
193A	1	SENSOR, MOISTURE



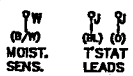
DUAL VOLTAGE MOTORS — **LOW** | **HIGH** — **SINGLE VOLTAGE MOTORS**



THERMOSTAT RATING

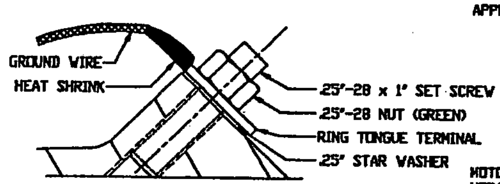
AMPS	AC-VOLTS
3.5	200
3.0	230
1.5	460
1.2	575

ALL MOTORS



USE A MANUAL MOMENTARY START SWITCH ONLY

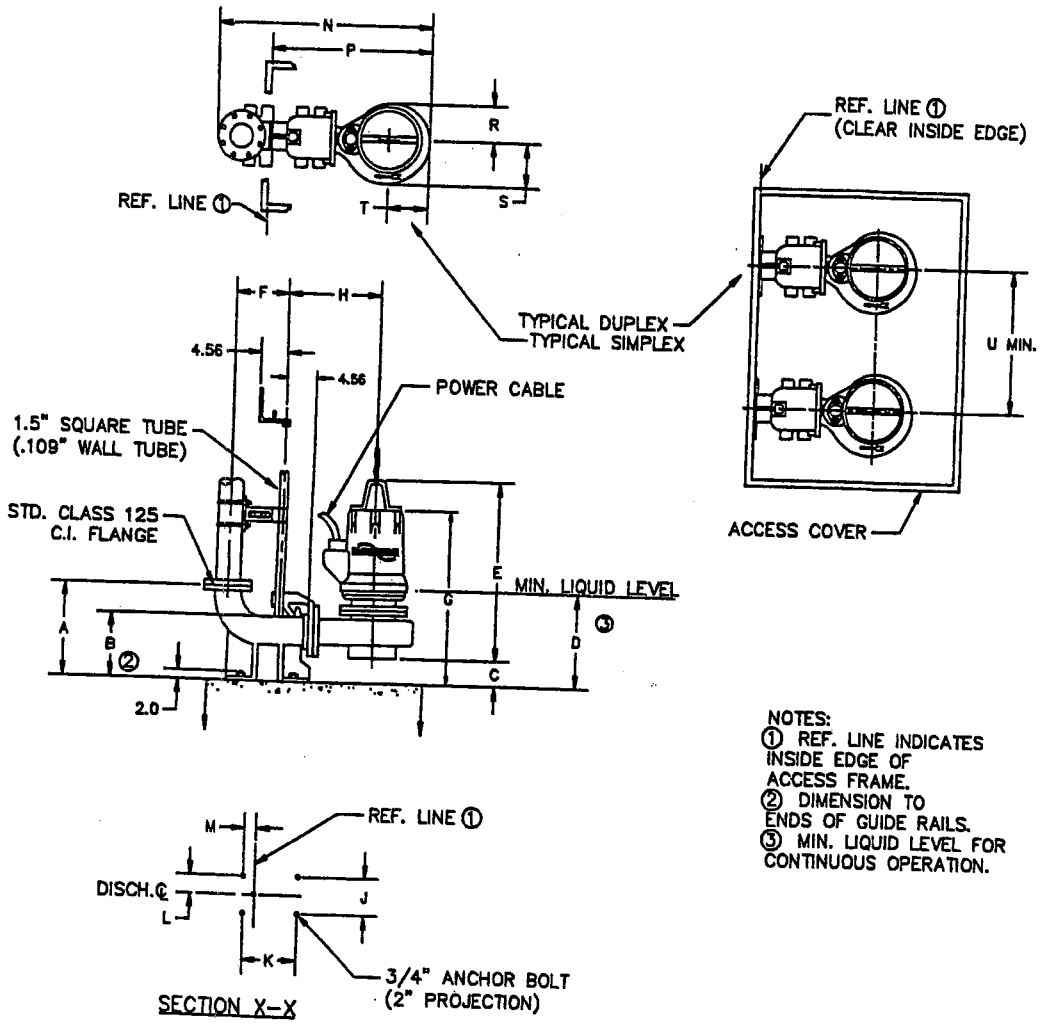
GROUND CONNECTION DETAIL



MOTOR MAY BE RATED FOR USE IN NFPA 70 CL. 1, DIV. 1, GROUP C&D HAZARDOUS LOCATION; SEE NAMEPLATE. MAINTENANCE ON ANY PART OF THE UNIT MUST BE PERFORMED BY AUTHORIZED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. MAINTENANCE BY ANY OTHER PERSONNEL WILL NEGATE THE CERTIFICATION AND VOID THE FACTORY VARRANTY.

FLOWSERVE	Pump Division Taneytown Operations		
CROSS SECTIONAL DRAWING			
AUTOCAD DRAWING NO MANUAL CHANGES PERMITTED	TITLE: MSX SERIES I SECTIONAL		
DRAWN: KJS			
CHECKED: RJC			
DATE: 5-05-99	DWG. NO. C0000001	DWG. TYPE: SECT	REV.: C
ORDER NO.			
GENERIC/CUSTOM: GENERIC	SCALE: NONE	000	PAGE 1 OF 1

GENERAL ARRANGEMENT
SERIES 1 WET PIT
SINGLE GUIDE RAIL

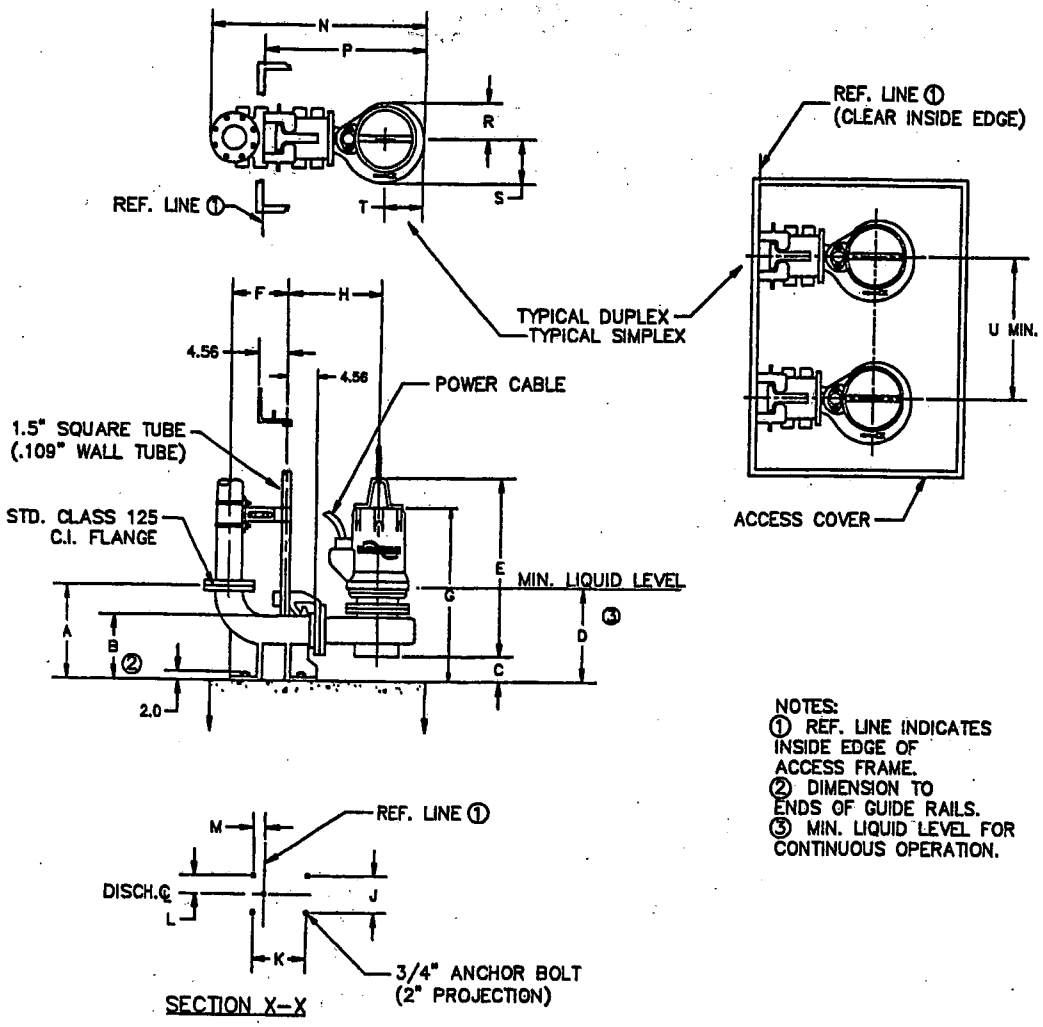


NOTES:
① REF. LINE INDICATES INSIDE EDGE OF ACCESS FRAME.
② DIMENSION TO ENDS OF GUIDE RAILS.
③ MIN. LIQUID LEVEL FOR CONTINUOUS OPERATION.

ALL DIMENSIONS IN INCHES

DIMENSIONS ARE FROM DRAWINGS, CASTINGS MAY VARY SLIGHTLY. FOUNDATION BOLTS MUST NOT BE FIXED RIGIDLY UNTIL MACHINE IS IN PLACE. EXPANSION JOINTS USED IN THE DISCHARGE AND/OR SUCTION PIPING SHALL HAVE SUITABLY SIZED TIE RODS TO PREVENT THE TRANSMISSION OF EXCESSIVE HYDRAULIC FORCES TO THE PUMP. THIS PRINT IS LOANED SUBJECT TO RETURN ON DEMAND AND UNDER CONDITION THAT IT IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO OUR INTERESTS. DO NOT SCALE; ADDITIONAL DIMENSIONS WILL BE FURNISHED UPON REQUEST.

GENERAL ARRANGEMENT
SERIES 1 WET PIT
DOUBLE GUIDE RAIL



NOTES:
① REF. LINE INDICATES INSIDE EDGE OF ACCESS FRAME.
② DIMENSION TO ENDS OF GUIDE RAILS.
③ MIN. LIQUID LEVEL FOR CONTINUOUS OPERATION.

ALL DIMENSIONS IN INCHES
DIMENSIONS ARE FROM DRAWINGS, CASTINGS MAY VARY SLIGHTLY. FOUNDATION BOLTS MUST NOT BE FIXED RIGIDLY UNTIL MACHINE IS IN PLACE. EXPANSION JOINTS USED IN THE DISCHARGE AND/OR SUCTION PIPING SHALL HAVE SUITABLY SIZED TIE RODS TO PREVENT THE TRANSMISSION OF EXCESSIVE HYDRAULIC FORCES TO THE PUMP. THIS PRINT IS LOANED SUBJECT TO RETURN ON DEMAND AND UNDER CONDITION THAT IT IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO OUR INTERESTS. DO NOT SCALE; ADDITIONAL DIMENSIONS WILL BE FURNISHED UPON REQUEST.

GENERAL ARRANGEMENT
DIMENSIONAL DATA

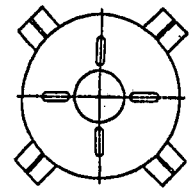
ALL DIMENSIONS IN INCHES

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS																				PUMP WEIGHT (lbs)	BASE WEIGHT (lbs)
			A	B		C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U			
				SINGLE RAIL	DOUBLE RAIL																			
3MSX7	11	3	16.87	11.06	12.06	5.00	17.38	32.13	9.44	28.87	15.94	7.75	9.88	3.88	1.75	35.48	26.66	6.00	6.65	6.16	19.30	395	81
		4	16.87	11.06	12.06	5.00	17.38	32.13	9.44	28.87	15.94	7.75	9.88	3.88	1.75	36.04	26.66	6.00	6.65	6.16	19.30	395	86
	12	3	16.87	11.06	12.06	5.00	17.38	34.51	9.44	31.25	15.94	7.75	9.88	3.88	1.75	35.48	26.66	6.00	6.65	6.16	19.30	480	81
		4	16.87	11.06	12.06	5.00	17.38	34.51	9.44	31.25	15.94	7.75	9.88	3.88	1.75	36.04	26.66	6.00	6.65	6.16	19.30	480	86
3MSX8	11	3	16.87	11.06	12.06	5.17	17.50	32.08	9.44	28.99	15.94	7.75	9.88	3.88	1.75	36.45	27.63	7.13	7.13	7.13	21.39	405	81
		4	16.87	11.06	12.06	5.17	17.50	32.08	9.44	28.99	15.94	7.75	9.88	3.88	1.75	37.01	27.63	7.13	7.13	7.13	21.39	405	86
	12	3	16.87	11.06	12.06	5.17	17.50	34.46	9.44	31.37	15.94	7.75	9.88	3.88	1.75	36.45	27.63	7.13	7.13	7.13	21.39	480	81
		4	16.87	11.06	12.06	5.17	17.50	34.46	9.44	31.37	15.94	7.75	9.88	3.88	1.75	37.01	27.63	7.13	7.13	7.13	21.39	480	86
3MSX9	12	3	16.87	11.06	12.06	5.17	17.50	34.46	9.44	31.37	15.94	7.75	9.88	3.88	1.75	36.45	27.63	7.13	7.13	7.13	21.39	552	81
		4	16.87	11.06	12.06	5.17	17.50	34.46	9.44	31.37	15.94	7.75	9.88	3.88	1.75	37.01	27.63	7.13	7.13	7.13	21.39	552	86
4MSX7	11	4	16.87	11.56	12.56	5.00	17.50	32.25	9.82	28.99	17.69	7.75	9.88	3.88	2.13	39.33	29.57	6.41	7.82	7.32	24.00	406	90
		6	17.75	12.63	13.63	5.88	18.38	32.25	11.00	29.87	17.69	9.50	11.00	4.75	3.87	41.62	29.57	6.41	7.82	7.32	24.00	406	112
	12	4	16.87	11.56	12.56	5.00	17.50	34.63	9.82	31.38	17.69	7.75	9.88	3.88	2.13	39.33	29.57	6.41	7.82	7.32	24.00	491	90
		6	17.75	12.63	13.63	5.88	18.38	34.63	11.00	32.26	17.69	9.50	11.00	4.75	3.87	41.62	29.57	6.41	7.82	7.32	24.00	491	112
4MSX9	12	4	16.87	11.56	12.56	4.24	17.00	34.88	9.82	30.87	17.22	7.75	9.88	3.88	2.13	38.77	29.01	6.54	7.93	7.26	24.00	562	90
		6	17.75	12.63	13.63	5.12	17.88	34.88	11.00	31.75	17.22	9.50	11.00	4.75	3.87	41.06	29.01	6.54	7.93	7.26	24.00	562	112
4MSX11	12	4	16.87	11.56	12.56	3.75	17.51	35.89	9.82	31.38	17.94	7.75	9.88	3.88	2.13	39.87	30.11	6.83	8.33	7.61	24.00	569	90
		6	17.75	12.63	13.63	4.63	18.39	35.89	11.00	32.26	17.94	9.50	11.00	4.75	3.87	42.16	30.11	6.83	8.33	7.61	24.00	569	112
6MSX9	11	6	17.07	13.45	14.45	4.48	18.18	33.44	11.00	29.68	20.37	9.50	11.00	4.75	3.38	45.52	33.47	7.40	9.55	8.54	26.50	407	125
		8	17.75	14.31	15.31	5.16	18.86	33.44	12.19	30.36	20.37	9.50	11.00	4.75	4.19	47.85	33.47	7.40	9.55	8.54	26.50	407	148
	12	6	17.07	13.45	14.45	4.48	18.18	35.82	11.00	32.05	20.37	9.50	11.00	4.75	3.38	45.52	33.47	7.40	9.55	8.54	26.50	407	148
		8	17.75	14.31	15.31	5.16	18.86	35.82	12.19	32.73	20.37	9.50	11.00	4.75	4.19	47.85	33.47	7.40	9.55	8.54	26.50	525	125
6MSX10	12	6	17.07	13.45	14.45	4.63	18.14	35.64	11.00	32.01	21.37	9.50	11.00	4.75	3.38	47.82	35.77	8.35	11.23	9.84	30.81	525	148
		8	17.75	14.31	15.31	5.31	18.82	35.64	12.19	32.69	21.37	9.50	11.00	4.75	4.19	50.15	35.77	8.35	11.23	9.84	30.81	576	125
6MSX13	12	6	17.07	13.45	14.45	4.44	19.01	36.69	11.00	32.88	21.38	9.50	11.00	4.75	3.38	48.12	35.07	9.22	10.99	10.13	31.20	576	148
		8	17.75	14.31	15.31	5.12	19.69	36.69	12.19	33.56	21.38	9.50	11.00	4.75	4.19	50.45	36.07	9.22	10.99	10.13	31.20	627	125
																						627	148

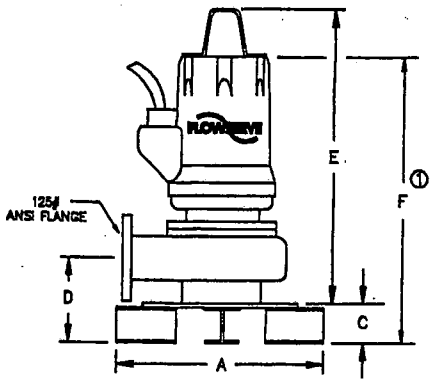
ALL DIMENSIONS IN MILLIMETERS

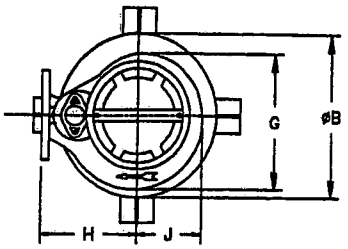
PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS																				PUMP WEIGHT (kg)	BASE WEIGHT (kg)
			A	B		C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U			
				SINGLE RAIL	DOUBLE RAIL																			
3MSX7	11	3	428.5	280.9	306.3	127.0	441.5	816.1	239.8	733.3	404.9	196.9	251.0	98.6	44.5	901.2	677.2	152.4	168.9	156.5	490.2	180	37
		4	428.5	280.9	306.3	127.0	441.5	816.1	239.8	733.3	404.9	196.9	251.0	98.6	44.5	915.4	677.2	152.4	168.9	156.5	490.2	180	39
	12	3	428.5	280.9	306.3	127.0	441.5	876.6	239.8	793.8	404.9	196.9	251.0	98.6	44.5	901.2	677.2	152.4	168.9	156.5	490.2	218	37
		4	428.5	280.9	306.3	127.0	441.5	876.6	239.8	793.8	404.9	196.9	251.0	98.6	44.5	915.4	677.2	152.4	168.9	156.5	490.2	218	39
3MSX8	11	3	428.5	280.9	306.3	131.3	444.5	814.8	239.8	736.3	404.9	196.9	251.0	98.6	44.5	915.4	677.2	152.4	168.9	156.5	490.2	184	37
		4	428.5	280.9	306.3	131.3	444.5	814.8	239.8	736.3	404.9	196.9	251.0	98.6	44.5	925.8	701.8	181.1	181.1	181.1	543.3	184	39
	12	3	428.5	280.9	306.3	131.3	444.5	875.3	239.8	796.8	404.9	196.9	251.0	98.6	44.5	940.1	701.8	181.1	181.1	181.1	543.3	184	39
		4	428.5	280.9	306.3	131.3	444.5	875.3	239.8	796.8	404.9	196.9	251.0	98.6	44.5	925.8	701.8	181.1	181.1	181.1	543.3	223	37
3MSX9	12	3	428.5	280.9	306.3	131.3	444.5	875.3	239.8	796.8	404.9	196.9	251.0	98.6	44.5	940.1	701.8	181.1	181.1	181.1	543.3	223	39
		4	428.5	280.9	306.3	131.3	444.5	875.3	239.8	796.8	404.9	196.9	251.0	98.6	44.5	925.8	701.8	181.1	181.1	181.1	543.3	251	37
4MSX7	11	4	428.5	293.6	319.0	127.0	444.5	819.2	249.4	736.3	449.3	196.9	251.0	98.6	44.5	940.1	701.8	181.1	181.1	181.1	543.3	251	39
		6	450.9	320.8	346.2	149.4	466.9	819.2	279.4	758.7	449.3	241.3	279.4	120.7	98.3	1057.1	751.1	162.8	198.6	185.9	609.6	185	41
	12	4	428.5	293.6	319.0	127.0	444.5	879.6	249.4	797.1	449.3	196.9	251.0	98.6	54.1	999.0	751.1	162.8	198.6	185.9	609.6	185	51
		6	450.9	320.8	346.2	149.4	466.9	879.6	279.4	797.1	449.3	196.9	251.0	98.6	54.1	999.0	751.1	162.8	198.6	185.9	609.6	223	41
4MSX9	12	4	428.5	293.6	319.0	107.7	431.8	886.0	249.4	784.1	437.4	196.9	251.0	98.6	54.1	984.8	736.9	166.1	201.4	184.4	609.6	223	51
		6	450.9	320.8	346.2	130.0	454.2	886.0	279.4	806.5	437.4	241.3	279.4	120.7	98.3	1042.9	736.9	166.1	201.4	184.4	609.6	255	41
4MSX11	12	4	428.5	293.6	319.0	95.3	444.8	911.6	249.4	797.1	455.7	196.9	251.0	98.6	54.1	1012.7	764.8	173.5	211.6	193.3	609.6	255	51
		6	450.9	320.8	346.2	117.6	467.1	911.6	279.4	819.4	455.7	241.3	279.4	120.7	98.3	1070.9	764.8	173.5	211.6	193.3	609.6	259	41
6MSX9	11	6	433.6	341.6	367.0	113.8	461.8	849.4	279.4	753.9	517.4	241.3	279.4	120.7	85.9	1156.2	850.1	188.0	242.6	216.9	673.1	259	51
		8	450.9	363.5	388.9	131.1	479.0	849.4	309.6	771.1	517.4	241.3	279.4	120.7	106.4	1215.4	850.1	188.0	242.6	216.9	673.1	185	57
	12	6	433.6	341.6	367.0	113.8	461.8	909.8	279.4	814.1	517.4	241.3	279.4	120.7	85.9	1156.2	850.1	188.0	242.6	216.9	673.1	185	67
		8	450.9	363.5	388.9	131.1	479.0	909.8	309.6	831.3	517.4	241.3	279.4	120.7	106.4	1215.4	850.1	188.0	242.6	216.9	673.1	239	57
6MSX10	12	6	433.6	341.6	367.0	117.6	460.8	905.3	279.4	813.1	542.8	241.3	279.4	120.7	85.9	1214.6	908.6	212.1	285.2	249.9	782.6	239	67
		8	450.9	363.5	388.9	134.9	478.0	905.3	309.6	830.3	542.8	241.3	279.4	120.7	106.4	1273.8	908.6	212.1	285.2	249.9	782.6	262	57
6MSX13	12	6	433.6	341.6	367.0	112.8	482.9	931.9	279.4	835.2	543.1	241.3	279.4	120.7	85.9	1222.2	916.2	234.2	279.1	257.3	792.5	262	67
		8	450.9	363.5	388.9	130.0	500.1	931.9	309.6	852.4	543.1	241.3	279.4	120.7	106.4	1281.4	916.2	234.2	279.1	257.3	792.5	285	5
																						285	

GENERAL ARRANGEMENT
SERIES 1
TRANSPORTABLE STAND - MOUNTED



STAND TOP VIEW





PUMP TOP VIEW

NOTES:
1. MIN. LIQUID LEVEL FOR CONTINUOUS OPERATION

ALL DIMENSIONS IN INCHES

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS A	B	C	D	E	F	G	H	J	PUMP STAND WEIGHT (lbs)	PUMP WEIGHT (lbs)	TOTAL WEIGHT (lbs)
3MSX7	11	3	25.00	19.00	4.66	8.67	32.13	28.54	12.65	9.44	6.16	67	384	451
	12	3	25.00	19.00	4.66	8.67	34.51	30.92	12.65	9.44	6.16	67	420	487
3MSX8	11	3	25.00	19.00	4.66	8.50	32.08	28.49	14.26	9.44	7.13	67	405	472
	12	3	25.00	19.00	4.66	8.50	34.46	30.87	14.26	9.44	7.13	67	490	557
3MSX9	12	3	25.00	19.00	4.66	8.50	34.46	30.87	14.26	9.44	7.13	67	552	619
4MSX7	11	3	25.00	19.00	4.66	8.67	32.25	28.66	14.23	11.13	7.32	67	406	473
	12	4	25.00	19.00	4.66	8.67	34.63	31.04	14.23	11.13	7.32	67	491	558
4MSX9	12	4	25.00	19.00	4.66	9.42	34.88	31.29	14.47	10.66	7.26	67	562	629
4MSX11	12	4	25.00	19.00	4.66	9.92	35.89	32.30	15.16	11.38	7.61	67	569	636
6MSX9	11	6	25.00	19.00	4.66	10.06	33.44	29.85	16.95	13.88	8.54	67	407	474
	12	6	25.00	19.00	4.66	10.06	35.82	32.23	16.95	13.88	8.54	67	525	592
6MSX10	12	6	25.00	19.00	4.66	9.92	35.64	32.05	19.58	14.88	9.84	67	576	643
6MSX13	12	6	25.00	19.00	4.66	10.10	36.69	33.10	20.21	14.88	10.13	67	622	689

ALL DIMENSIONS IN MILLIMETERS

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS A	B	C	D	E	F	G	H	J	PUMP STAND WEIGHT (lbs)	PUMP WEIGHT (lbs)	TOTAL WEIGHT (lbs)
3MSX7	11	3	635.0	482.6	118.4	220.2	816.1	724.9	321.3	239.8	156.5	30	175	205
	12	3	635.0	482.6	118.4	220.2	876.6	785.4	321.3	239.8	156.5	30	191	221
3MSX8	11	3	635.0	482.6	118.4	215.9	814.8	723.6	362.2	239.8	181.1	30	184	215
	12	3	635.0	482.6	118.4	215.9	875.3	784.1	362.2	239.8	181.1	30	223	253
3MSX9	12	3	635.0	482.6	118.4	215.9	875.3	784.1	362.2	239.8	181.1	30	251	281
4MSX7	11	3	635.0	482.6	118.4	220.2	819.2	728.0	361.4	282.7	185.9	30	185	215
	12	4	635.0	482.6	118.4	220.2	879.6	788.4	361.4	282.7	185.9	30	223	254
4MSX9	12	4	635.0	482.6	118.4	239.3	886.0	794.8	367.5	270.8	184.4	30	255	286
4MSX11	12	4	635.0	482.6	118.4	252.0	911.6	820.4	385.1	289.1	193.3	30	259	289
6MSX9	11	6	635.0	482.6	118.4	255.5	849.4	758.2	430.5	352.6	216.9	30	185	215
	12	6	635.0	482.6	118.4	255.5	909.8	818.6	430.5	352.6	216.9	30	239	269
6MSX10	12	6	635.0	482.6	118.4	252.0	905.3	814.1	497.3	378.0	249.9	30	262	292
6MSX13	12	6	635.0	482.6	118.4	256.5	931.9	840.7	513.3	378.0	257.3	30	283	313

The pump and motor are manufactured by Flowserve Pump Division. Contact the number below for parts or service:

Flowserve Pump Division
5310 Taneytown Pike
Taneytown MD 21787-0091 USA

Telephone: **(410) 756-2602**
Fax: **(410) 756-2615**

We recommend the use of original Flowserve Pump Division replacement parts in the maintenance of your unit. Precise tolerances, metallurgy, manufacturing processes and heat treatment are important factors in the design of each component and the service it will provide. Failure of any component can result in extensive damage to your unit.

CAUTION: **WARRANTY WILL BE TERMINATED BASED ON THE INSTALLATION OF NON-OEM PARTS.**

For repair parts or service contact your nearest Flowserve Pump Division Sales Office or Pump House Distributor. They're in the Yellow Pages.

Flowserve Pump Division
P/N 81975302; 15APR99
REV. A 21MAY99 EDC 943
REV. B 8SEP99 EDC 944
REV. C 17JUL03 EDC 2227

AquaPoint™

Performance Based Wastewater Treatment Solutions

BIOCLERE™

Pre-Equalization

TECHNICAL MANUAL

SITE/CLIENT: Deer Haven
Avoca, AR

Aquapoint Inc.

241 Duchaine Blvd.

New Bedford, MA 02745

Tel: 508-998-7577 **Fax: 508-998-7177**

www.aquapoint.com

BIOCLERE™ BIOLOGICAL TREATMENT SYSTEM

Congratulations on your purchase of a Bioclere™ biological treatment system. The Bioclere is a modification of the classic trickling filter. The trickling filter has been used over one hundred years for the treatment of wastewater due to its reliability and simplicity of operation.

Naturally occurring microorganisms break down waste (organic matter) in the Bioclere to harmless byproducts, mainly: water, carbon dioxide and additional microorganisms (sludge). The sludge created in the Bioclere is automatically returned and stored in your septic tank. Therefore, the Bioclere unit(s) do NOT require pumping.

However, regular pumping of your grease traps (if applicable) and septic tanks are required. Failure to maintain a regular pumping schedule will have an adverse impact on the biology in the Bioclere system. If pumping is ignored for an extended period it may become costly to get the system back to efficient operation.

Aquapoint Inc., recommends that the grease trap and septic tank are checked every 3 to 6 months respectively by a certified operator or septic hauler and pumped as needed. For seasonal applications, pumping of the tanks should occur during mid-season to protect the microbiology in the filter. Failure to adhere to this pumping schedule will result in compromised treatment and void the Bioclere warranty.

The Bioclere units are designed to reduce the effects of toxic substances that may enter the system from your facility. However, it is in your best interest to evaluate what is discharged to the system. Be aware of daily/weekly/monthly/annual activities and the quantities of chemicals that are being discharged. While the bacteria are resistant to many forms of toxic chemicals discharged in small quantities, large volumes or a combination of chemicals may have detrimental effects. Some items to be aware of include: cleaning agents, floor strippers, harsh chemicals, paints and solvents, as well as abnormal quantities of soaps and milk. If at any time you are unsure about using a particular chemical please call Aquapoint Inc. If necessary, we will arrange a site meeting to evaluate your products.

Remember that Aquapoint Inc. wants you to have a good experience with your new Bioclere treatment system. If you treat the Abugs≅ with respect, they will treat you to decades of clean water while preserving the environment.

Please call our office if you have ANY questions concerning your new system.

Sincerely,

AQUAPOINT
(508)-998-7577

CONTENTS

APPENDIX D: RECOMMENDED SPARE PARTS

APPENDIX E: PUMP CURVES

NOTE: This Technical Manual is for the use of the owner/operator and is applicable only to the specific Bioclere installation for which it is provided.

The specifications in this manual are subject to change by the manufacturer any time.

1.0 DESCRIPTION AND FUNCTION OF PACKAGED TREATMENT PLANT

Wastewater will be pumped from the homes to a (11,000)gallon pre-equalization tank (see site plan for system layout). the wasterwater is then pumped into a flow splitter box where it is evenly distributed to (2) 36/24 Bioclere units.

1.1 PRE-EQUALIZATION TANK DESCRIPTION

Primary settled wastewater is pumped to the pre-equalization tank (pre-EQ). The purpose of the (pre-EQ) is to transfer the wastewater to the Bioclere units. The pre-EQ system consists of a fiberglass tank located ahead of the Bioclere unit(s). The following equipment is included in this tank: 2 submersible Barnes SE effluent pumps, slide rail system, associated piping, controls and appurtenances. This system shall be capable of providing a 24 hour equalized flow for proper operation of the Bioclere unit. The control panel for this unit is labeled as "Pre-equalization".

This tank contains two alternating Barnes effluent submersible pumps that deliver primary settled wastewater to the Bioclere units. It is recommended that the flow rate be measured periodically by the operator and adjusted as needed. The flow rate should be calculated by measuring the draw down volume in the tank over a specified period of time.

Four control float switches are located in the tank and govern the following functions:

1. Low level Alarm float: The low level alarm float will act as a redundant pump shut off and will activate an audio/visual alarm signal when the float switch is in the extended position (open circuit).

2. Low level float: In the extended position this float switch shall create an open circuit and prevent operation of the pumps. When the circuit is closed the float switch shall allow activation of the timer and the pumps shall alternate between cycles, transferring wastewater to the downstream treatment reactor(s).
3. Mid level float: Upon closure the mid level float switch shall activate the lag pump and the two pumps shall draw down the liquid in the equalization tank until the mid level float is an open. Upon this occurrence, a counter shall be triggered to alert the operator that a high level condition has occurred and that the timer "on" setting may need adjusting.

4. High level float: The high level float switch shall activate the audio/visual alarm when the circuit is closed.

Timer Settings:
The equalization (EQ) pumps may be set for a "on/off" cycle between zero minutes and several hours using a timer in the control panel.

Hence, if the EQ pumps are set for (7) minutes on and (5) minutes off, the maximum volume they will dose per day is:

±60 gpd *** (7 /12) minutes dosing * 24 hours * 60 minutes/hr = (50,400) gpd**

IMPORTANT NOTES:

The EQ pumps will alternate between dosing cycles. However, if one pump fails the remaining pump will take over the failed pump's cycle and an audio/visual alarm will be activated.

The effects of recirculation from the Bioclere units must be taken into consideration when

determining the timing for the EQ pumps. Initially the recycle timers will be set to recycle ( ) gpd back to the Sludge holding recirculation tank.

All Bioclere units contain a float switch to terminate the recycle pump operation. This will prevent excessive recycling and always maintain the Bioclere dosing pumps below water level. This will also keep the biological growth functional when the primary tanks are pumped.

1.2 BIOCLERE UNITS

The Bioclere consists of a trickling filter that is situated over a final settling tank. The Bioclere is manufactured with fiberglass inner and outer skins with a cavity between filled with polyurethane foam insulation for maximum treatment efficiency.

Wastewater is pumped from the pre equalization chamber to the center baffled chamber in the Bioclere clarifier. Wastewater is supplied to the filter by means of two alternating Grundfos 1 hp stainless steel submersible pumps in the 36/30 Bioclere unit. In case of one pump failure, the operational pump automatically takes over both dosing cycles. Dosing is controlled using fully adjustable timer and the wastewater is uniformly distributed over the entire surface area of the filter by means of fixed nozzles that are constructed of nylon. Each Bioclere contains a PVC dosing array and nozzles centered above the filter media to ensure uniform dosing.

Recirculation of sludge and wastewater is accomplished in each unit using a submersible Grundfos pump controlled by a fully adjustable timer. The pump is located on the bottom of the cone shaped clarifier. Internal baffling is provided in the secondary settling tank to prevent short-circuiting of wastewater and biological solids. The biological solids generated in the filter are returned to the sludge storage facility every hour. Therefore, the sludge will not collect in the secondary settling tank and a sludge blanket will not form.

The filter media consists of manufactured PVC randomly packed media. The media has a void ratio of >95%, is UV resistant and resistant to a wide range of aqueous solutions, acids, alkalis, oxidizing agents, oils, fats and alcohols. Media with a specific surface area of $140m^2/m^3$ is used in each Bioclere unit.

Forced air ventilation is provided in the Bioclere since it is a covered trickling filter. The 36/30 Bioclere contains an axial fan with an airflow capacity of 240cfm. The fans are exposed to the atmosphere due to its enclosure location on top of the Bioclere. Air flows subsequently through the filter, underdrain, and is discharged through the effluent pipe. A PVC vent is installed after each Bioclere.

2.0 SPECIFICATIONS FOR:

2.1

Bioclere	Model	Media	Media Qty.
Stage 1A	36/24	Flocor - 140	24 m3
Stage 1B	36/24	Flocor - 140	24m3

2.2 Bioclere equipment supplied:

Item	Quantity Per Unit
Filter media	(see Section 2.1 above)
Dosing assembly	1 each
Dosing pumps	2 each
Recycle pump	1 each
Fan module assembly	1 each
Control panel	1 combined

2.3 Technical Manual — 3 each

2.4 Pump timer settings:

Upon commissioning of the Bioclere system the following pump timer settings are to utilized.

	Stage 1A	Stage 1B
Dosing pump on	10 min.	10 min.
Dosing pump off	2 min.	2 min.
Recycle pump on	4.5 min.	4.5 min.
Recycle pump off	30 min.	30 min.

Pre-equalization **On** 7 min. **Off** 5 min. @ ± 60 gpm = 50,400 gpd

Subsequent to the start-up period, the pump timer settings may need re-adjusting to provide proper treatment for the actual flow and influent characteristics.

Please contact Aquapoint before modifying the pump timers.

2.5 OTHER ITEMS SUPPLIED BY AQUAPOINT:

	Item	Quantity
A.	Equalization Assembly	One (1)
	Barnes SE 411 Pumps w/ 5.12 impeller	Two (2)
	Slide Rail Assembly	Two (2)
	SJE Rhombus Float Switches	Four (4)
	PLC Control Panel	One (1)

2.6 Primary Tank:

This Bioclere system was designed with primary tank capacity of (33,000) gallons.

Aquapoint recommends that the septic tank(s) be inspected quarterly a certified operator or septic hauler for sludge and scum and pump if needed.

2.7 Aquapoint recommends, if applicable, the grease trap be inspected and pumped every 3 months.

NOTE: Inadequate pumping of grease traps and primary tanks will have a detrimental effect on biological treatment. Therefore, it is imperative that pumping schedules are followe

3.0 BIOCLERE INSTALLATION:

3.1 INTRODUCTION:

This document establishes the installation procedures for the Bioclere secondary wastewater treatment system. It is recommended that these procedures be reviewed and approved by the engineer of record to ensure compatibility with specific site characteristics.

Aquapoint Inc. assigns a project manager for each installation.

Aquapoint provides onsite supervision of the installation, the fresh water commissioning of the Bioclere system and certification that the system is operational. Effective execution of these procedures requires coordination with the site contractor.

We request that the site contractor contact Aquapoint at 508-998-7577 to coordinate delivery, installation schedule and fresh water commissioning of the system. For a general flow schematic see drawing number UK.1265 that is attached.

3.2 BIOCLERE INSTALLATION PROCEDURE:

A. Locate Bioclere inlet/outlet inverts from site engineering plans.
B. Excavate to 12" below base of mounting pad. De-water excavation if required.
C. Add 12" (1.00 ft.) of clean 3/8" crushed stone.
D. Install pre-cast mounting pad approximately centered to Bioclere location. Anchoring points on pad must not be in direct alignment with inlet/outlet of Bioclere. (See dwg. # 1244-9)
E. Check to ensure mounting pad is level and elevation is correct. If pad is rough and uneven, smooth and level an area contained in this section 36" in diameter in the center of the pad.
F. Carefully lower Bioclere into position with proper rigging and lifting techniques.
G. Orient and align Bioclere to inlet and outlet directions. Check if Bioclere is level.
H. Fill Bioclere with clean fresh water to bottom of outlet pipe to stabilize unit.
I. If Bioclere is installed in groundwater refer to anchoring requirements on site plan and/or contact site engineer.
J. If Bioclere is not installed in groundwater backfill excavation with clean 3/8" peastone and/or sand to within 12" of the inlet pipe. Check level of Bioclere.
NOTE: Use care while backfilling to prevent Bioclere movement and/or damage to Bioclere.
K. Install inlet, outlet and vent/test port piping.
L. Install recycle piping from Bioclere back to the inlet end of primary (septic) tank. The recycle line is 2" Schedule 40 PVC from the Bioclere to the outside of septic tank and Schedule 80 PVC inside the septic tank. Schedule 80 PVC to be installed against inside wall and at 2 the septic tanks liquid depth terminating with a 90° elbow. (see dwg. PMW/1256)
M. Install wiring with watertight conduit from control location to Bioclere.
N. Back fill around Bioclere with sand and/or peastone to final grade.
O. Install control box in protected location, connect power feed and Bioclere wiring. (See Appendix B, drawing number 3116-Rev A)

The following items are performed by Aquapoint unless otherwise specified:

P. Install dosing and recycle pumps with safety ropes to the appropriate pipes.
Q. Install pump wiring by feeding wires through the filter and fan box feed-thrus. (See Appendix B, drawing number 3116 Rev. A)

3.3 BIOCLERE SYSTEM DESIGN CHECKLIST:

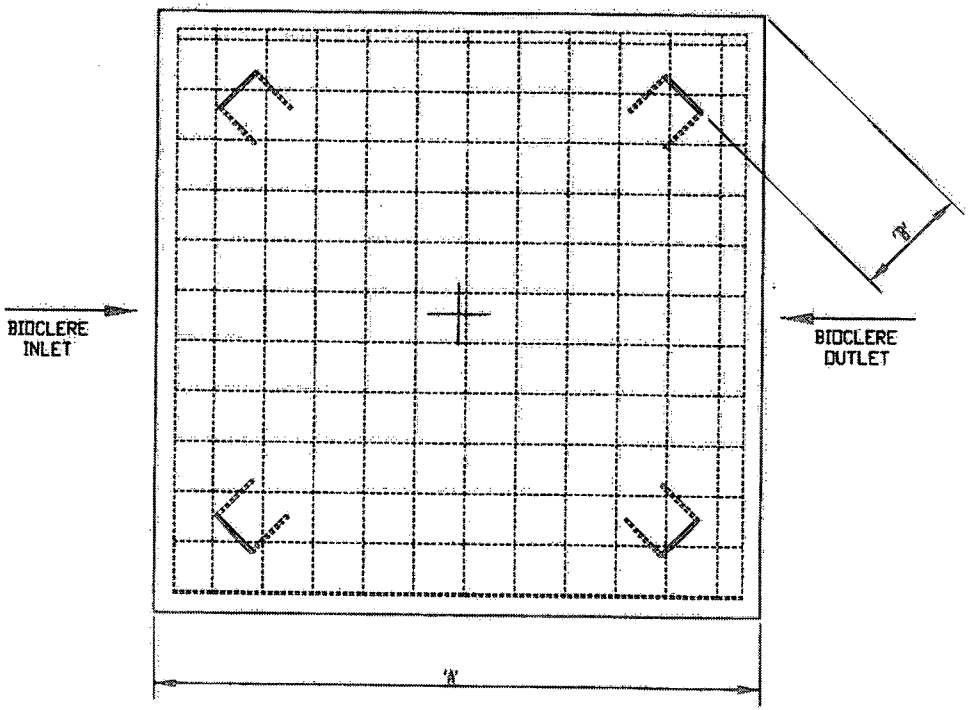
The following is a checklist for the design of an onsite wastewater treatment system that includes a 12 foot diameter Bioclere – **Models 36/24 & 36/30.**

NOTE: ***The following details should be shown on the site plan to facilitate installation.***

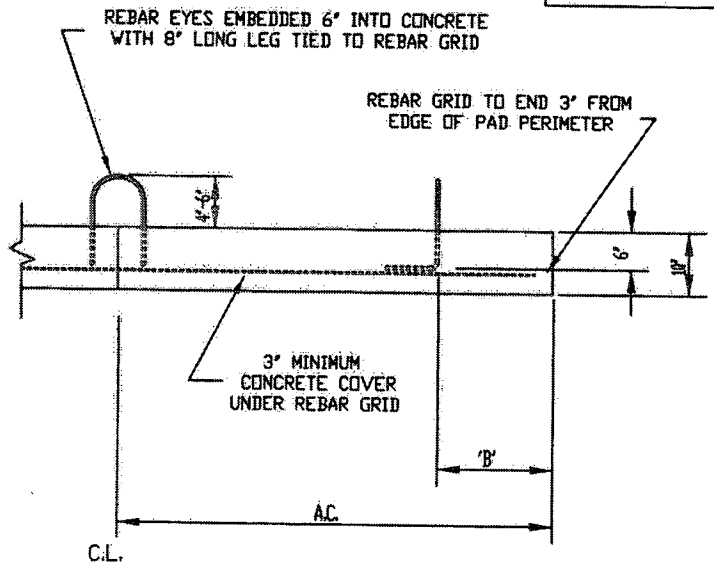
- ☐ Bioclere unit must be installed on a contractor supplied concrete mounting pad. The pad should be installed on 12 inches of crushed stone.
- ☐ The recycle line is a 2.0" diameter PVC coupling originating over the Bioclere inlet (dwg. PMW/1256-7).
- ☐ Inlet and outlet on the Bioclere unit(s) are 8" diameter PVC Schedule 40 couplings located 180 degrees apart. Any changes in direction between tanks should be made with pipefittings.
- ☐ A 6" diameter PVC vent must be installed after each Bioclere (dwg. UK.1265-8).
- ☐ Volume of concrete to be poured around the base of the Bioclere must be specified on the site plan if the unit(s) is installed in groundwater (see appropriate clarifier displacement curve). The concrete must extend 4 feet above the top of the mounting pad. **If the high groundwater table will extend above the Bioclere flange, please notify AQUAPOINT prior to manufacturing the unit(s).**
- ☐ Provide 4 feet of backfill (minimum) above the recycle line outlet on the Bioclere. Backfill to grade must be clean sand or pea stone.
- ☐ If necessary provide provisions for sampling the septic tank effluent and/or the effluent D-box/ final pump chamber.
- ☐ Each Bioclere unit requires a dedicated 30 Amp, (230V/60 Hertz/1 phase) power feed.

Finally, Aquapoint would appreciate reviewing the site plan as it becomes available. Please send a copy of the local permits applicable to this installation. Feel free to contact office personnel if you have questions or need additional information. Drawings of the Bioclere system are available on Autocad LT 2000 for Windows.

PLAN ON SQUARE PAD
(SEE NOTE 5)



PAD ELEVATION
(ACROSS CORNERS)



BIOCLERE MODEL	'A'	'B'	STEEL REINFORCEMENT GRID	APPROX PAD WEIGHT
24	8'	1'6"	#3 REBAR @ 8" O.C.	8,000 lbs
30	10'	2'0"	#3 REBAR @ 6" O.C.	12,500 lbs
36	12'	2'6"	#4 REBAR @ 10" O.C.	18,000 lbs

NOTES: UNLESS OTHERWISE SPECIFIED:

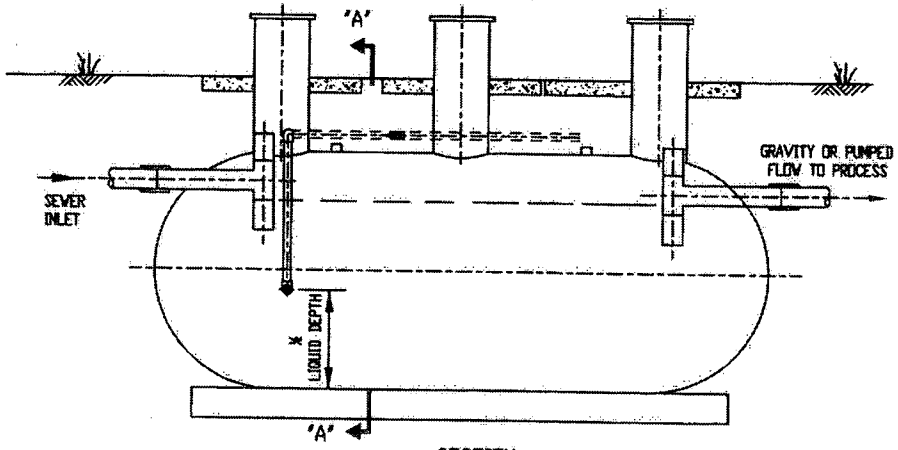
1. CONCRETE MINIMUM STRENGTH: 4,000PSI @ 28 DAYS.
2. DEFORMED REINFORCING BARS TO BE 60,000 PSI YIELD STRENGTH
3. EYES (4): 1/2" DIAMETER REBAR CAST IN PLACE AS SHOWN.
4. PAD TO BE SUPPLIED AND INSTALLED BY CONTRACTOR.
5. CIRCULAR PADS WITH "A" = DIAMETER, CAN BE SUBSTITUTED FOR SQUARE PADS. CIRCULAR PAD REBAR EYES INSTALLED 6" FROM PAD PERIMETER.

Bioclere Base Pad 24 30 36.dwg

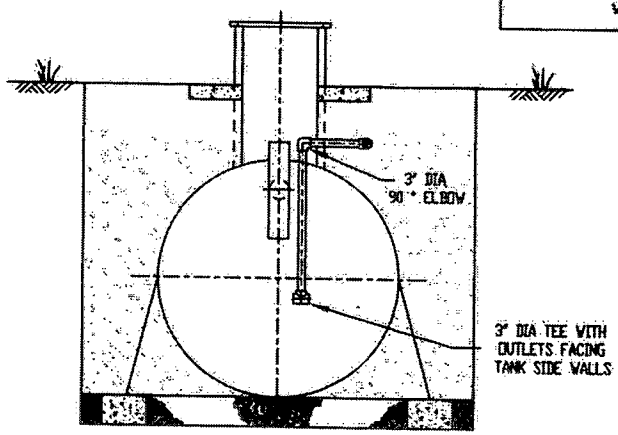
AquaPoint
Performance Based Wastewater Treatment Systems
241 DUCHAINE BLVD.
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	PRECAST MOUNTING PAD for BIOCLERE MODELS 24, 30 & 36.
DRAWING NO:	1244-9
REVISION:	--
DATE:	11 April 2006
DWN BY:	P.WILLEY
SCALE:	(1 : 20) SIZE: B (A3)
SHEET #:	

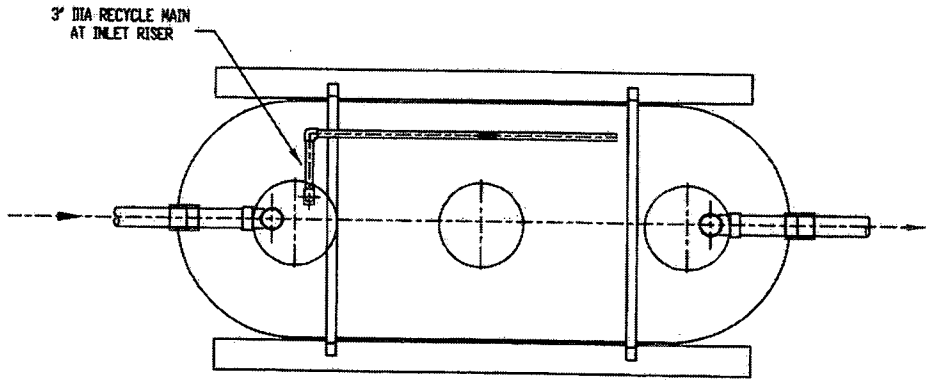
TYPICAL FIBERGLASS TANK WITH 3" DIA RECYCLE INLET



SECTION



SECTION A - A



PLAN -- FIBERGLASS TANK WITH RECYCLE INLET

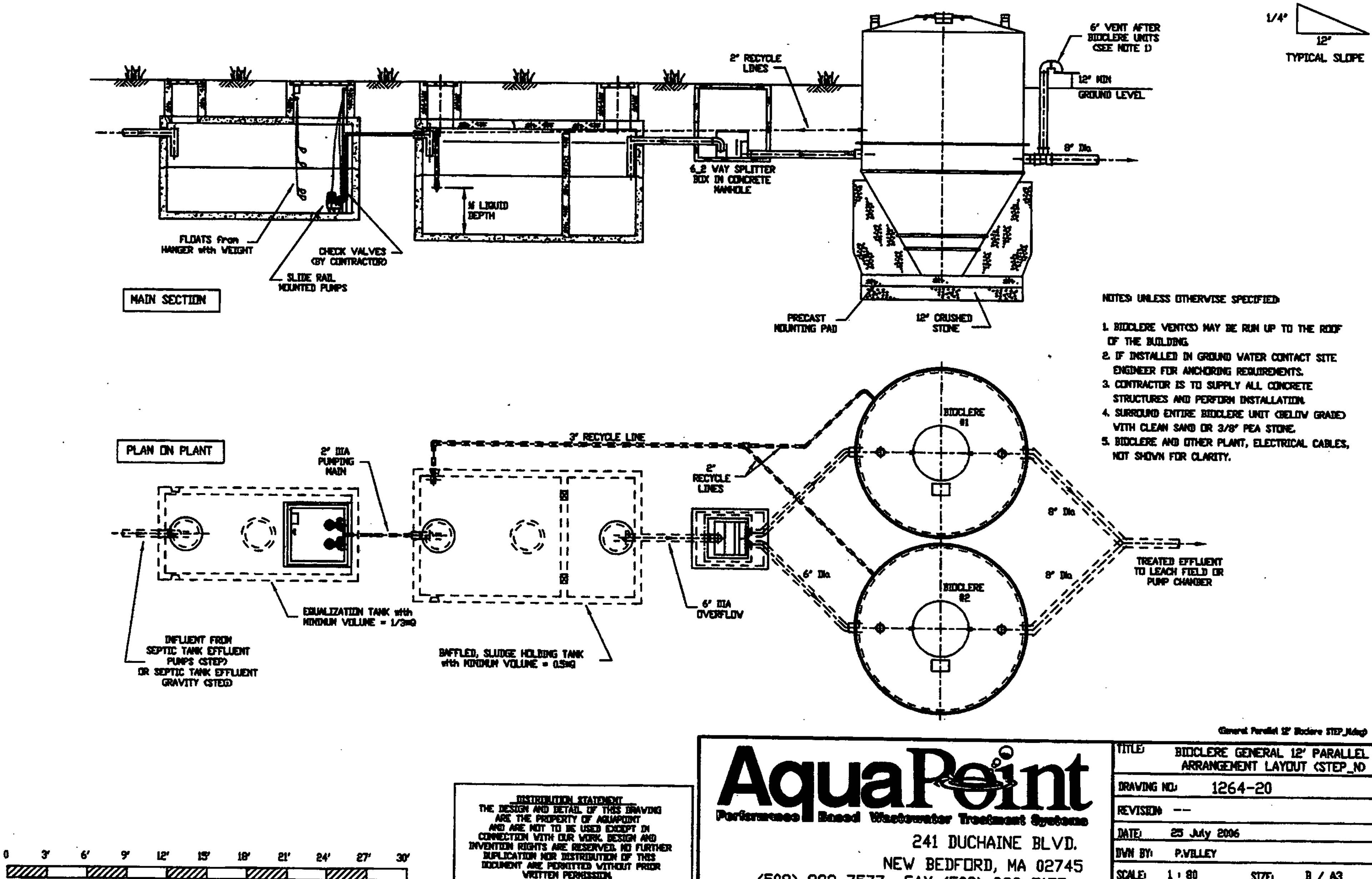
NOTES FOR CONTRACTOR:

1. RECYCLE PIPEWORK AND FITTINGS TO BE 3" PVC SCHD 40
2. TANK INSTALLATION AND SURROUND TO MEET MANUFACTURERS RECOMMENDATIONS AND LOCAL CODES.

3 Recycle_FGlass.dwg

AquaPoint
Performance Based Wastewater Treatment Systems
241 DUCHAINE BLVD.
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	TYPICAL GROUND INSTALLATION
DRAWING NO:	1285-6
REVISION:	-
DATE:	Jan 12 2006
DWN BY:	P.WILLEY
SCALE:	1 : 50
SIZE:	B / A3
SHEET #:	1 of 1



NOTES: UNLESS OTHERWISE SPECIFIED:

1. BIOCLERE VENT(S) MAY BE RUN UP TO THE ROOF OF THE BUILDING.
2. IF INSTALLED IN GROUND WATER CONTACT SITE ENGINEER FOR ANCHORING REQUIREMENTS.
3. CONTRACTOR IS TO SUPPLY ALL CONCRETE STRUCTURES AND PERFORM INSTALLATION.
4. SURROUND ENTIRE BIOCLERE UNIT (BELOW GRADE) WITH CLEAN SAND OR 3/8" PEA STONE.
5. BIOCLERE AND OTHER PLANT, ELECTRICAL CABLES, NOT SHOWN FOR CLARITY.

(General Parallel 12' Bioclere STEP_N.dwg)

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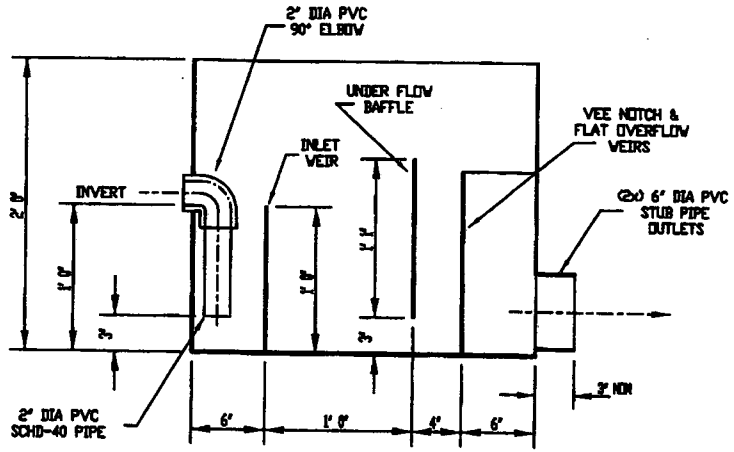
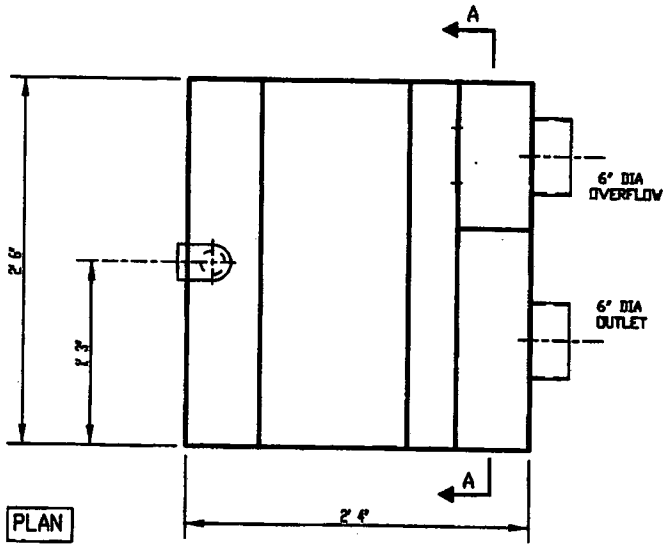
241 DUCHAINE BLVD.
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	BIOCLERE GENERAL 12' PARALLEL ARRANGEMENT LAYOUT (STEP_N)
DRAWING NO:	1264-20
REVISION:	--
DATE:	25 July 2006
DWN BY:	P.VILLEY
SCALE:	1 : 80 SIZE: B / A3
SHEET #:	

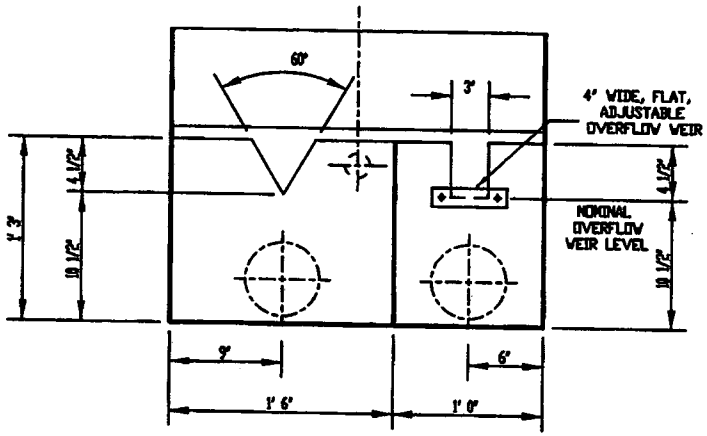
SECTION THROUGH BOX





PLAN

SECTION A - A



NOTES.
INTERNAL WALLS & WEIR PLATES TO BE 1/4" THICK FIBERGLASS.
EXTERNAL WALLS TO BE 1/4" MIN THICK FIBERGLASS.

FLOW (gpm) = 647.6 x (H^2.5)
H = HEIGHT OF FLOW ABOVE VEE NOTCH (Ft)

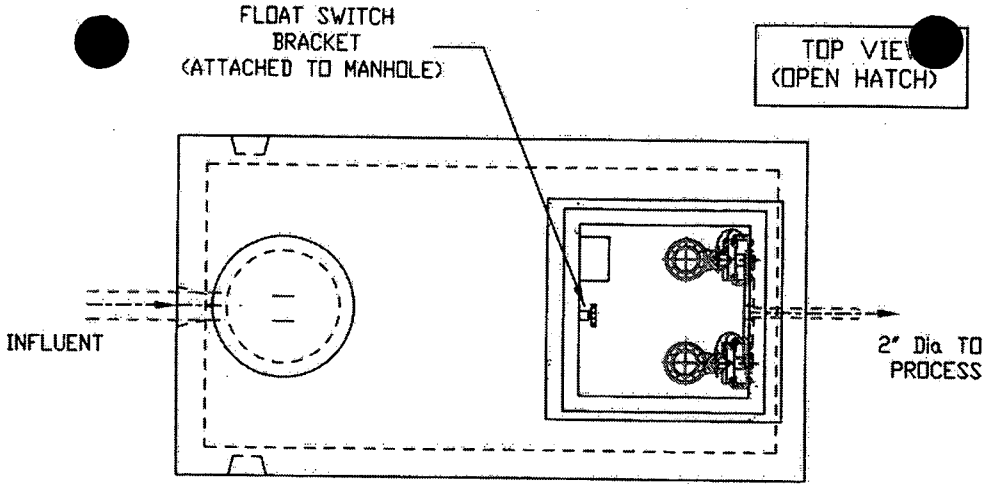
SPLITTER BOX TO BE INSTALLED IN A 4' DIA MANHOLE
WITH ACCESS TO GRADE.

FIBERGLASS SPLITTER BOX MANUFACTURING DETAILS

2 Way_Flow proportional splitter box

AquaPoint
Holding Alliance in Water Resource Technology
241 DUCHAINE BLVD.
P.O. BOX 50120
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	SPLITTER BOX DETAILS
DRAWING NO:	BS.1279/14
REVISION:	F
DATE:	11 February 2005
DWN BY:	P.WILLEY
SCALE:	1 : 10 SIZE: B
SHEET #:	1 of 1



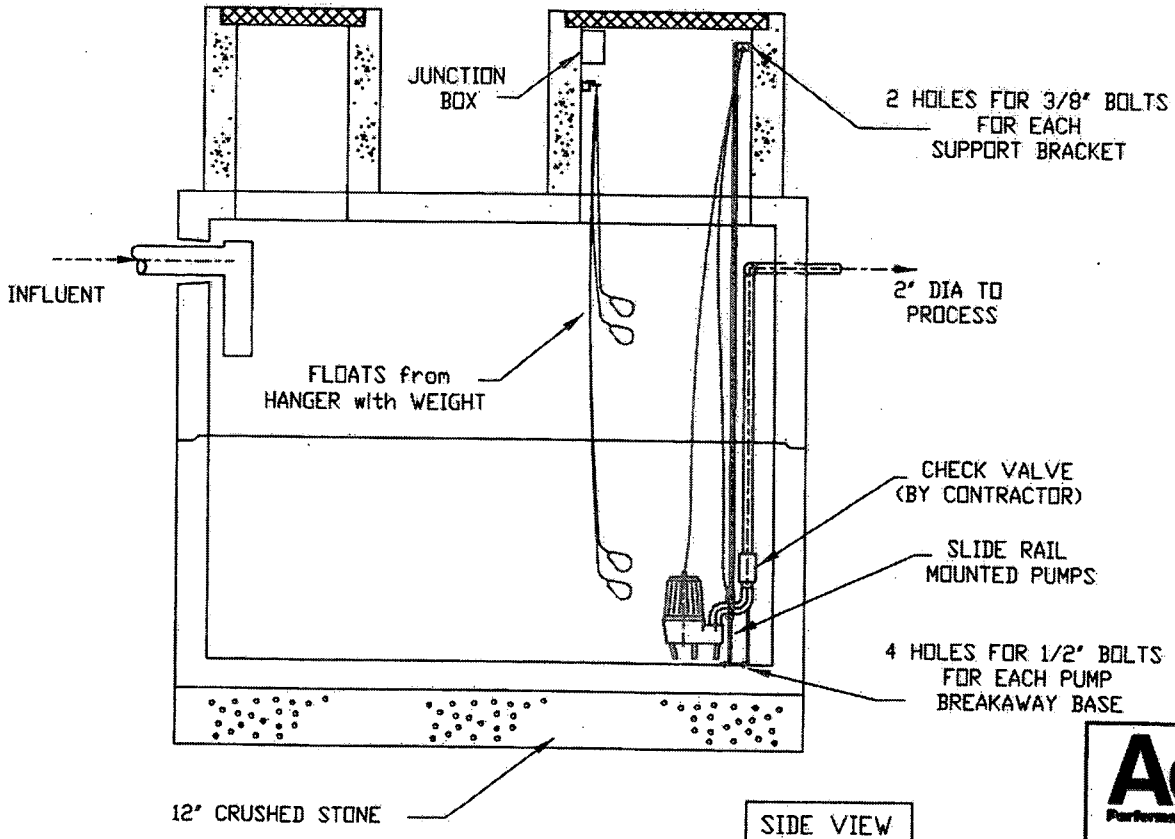
NOTES FOR CONTRACTOR:

1. PUMPS, FLOATS, SLIDE RAIL ASSEMBLIES AND CONTROLS BY AQUAPOINT, HARDWARE BY CONTRACTOR.
2. TO BE INSTALLED BY GENERAL CONTRACTOR.
3. PROVIDE 3' x 3' (min) ALUMINIUM HATCH OVER PUMP ASSEMBLIES.
4. INSTALL JUNCTION BOX AND FLOAT HANGER AT TOP OF CONCRETE RISER.

FLOAT SWITCH ELEVATION SETTINGS

1) LOW LEVEL ALARM FLOAT SWITCH (OPEN)
   6 INCHES BELOW THE LOW FLOAT
2) LOW FLOAT SWITCH (OPEN):
   3 TO 6 INCHES ABOVE TOP OF FEED PUMPS,
3) MID LEVEL FLOAT SWITCH (CLOSED) :
   12 INCHES BELOW INLET TEE INVERT,
4) HIGH LEVEL FLOAT SWITCH (CLOSED):
   6 INCHES BELOW INLET TEE INVERT.

(UNLESS SPECIFIED ON THE SITE PLANS)



Equalization Feed Assembly

Prev= 1256-18
EqualFeed+Rail_4F.dwg

AquaPoint
Performance Based Wastewater Treatment Systems
241 DUCHAINE BLVD.
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE	Equalization Feed with slide rail pumps.
DRAWING NO.	1287-6
REVISION	--
DATE	March 1, 2006
DWN BY	P.WILLEY
SCALE	1 : 40
SIZE	A / A4
SHEET #	1 of 1

4.1 START-UP (BOCLERES WITH PLC CONTROLS)

NOTES: 1. During installation the Bioclere sump(s) should have been filled with potable water. Care should be taken to prevent foreign matter/debris from entering the unit(s).
2. Bioclere Plant needs to be commissioned prior to start-up.
3. If the Bioclere Plant was shut down, reinstall the fan into fan module prior to start-up. Remember to verify power is locked/tagged out prior to plugging fan in.
4. Verify the Fan Module Toggle Switch is in the "ON" position.

A. Check that the Bioclere sump is full of water to the outlet invert and verify all plumbing unions are connected.

B. See Appendix B for PLC (programmable logic controller) Operating Instructions prior to turning on the system.

C. Turn Bioclere control main power disconnect switch to "ON". The green power light should be "ON".

D. At the Bioclere HMI PLC screen set the timers to a **"test cycle"** as follows:

TEST CYCLE SETTINGS	ON	OFF
Dosing Pump(s)	1 min	1 min
Recycle Pump	1 min	2 min

After the test cycle is complete refer to Section 2.0 of the Bioclere Technical Manual for Timer Settings.

E. Verify the Tank(s) are set to **ON** using the control screen (HMI), then set the dosing pump(s) to **AUTO** in the Tank Control Screen. Each dosing pump should be set to pump for a minute and rest for a minute. Leave both dosing pumps in **AUTO**.

F. Turn recycle pump to **AUTO**. The recycle pump should be set to pump for 1 minute and rest for 2 minutes. Leave the recycle pump in **AUTO**.

G. Turn the alarm to **TEST**. The alarm should sound. Press the alarm silence, audio alarm should silence, the red alarm light should remain illuminated. Turn alarm to OFF, red alarm light should turn off. Set the alarm to **AUTO** and unsilence the alarm.

H. Proceed to the Bioclere, the fan should be on continuously. Remove the Bioclere lid. Dosing pump(s) should alternate on 1 minute, off 1 minute. Verify a uniform spray pattern. The recycle pump should be on 1 minute, off 2 minutes. Verify the recycle pump operation by observing the spray out of the telltale hole near the recycle pipe union at the top of the central shaft. Leave fan module switch "ON".

I. At the Bioclere, now turn the fan module switch to "OFF". This disconnects the pumps and fan which should active the audio/visual alarm. Return the fan module switch to the "ON" position and alarm should stop.

J. Close and secure the fan module box and Bioclere lid.

K. Return to the control panel to set the dosing pump(s) and recycle pump timers to the settings specified in Section 2.4 "PUMP TIMER SETTINGS".

L. Close/secure control panel.

4.2 START-UP (EQUALIZATION SYSTEM WITH PLC CONTROLS)

NOTES: 1.During tank installation care should be taken to prevent foreign matter/debris from entering the tank.
2. Equalizaion system needs to be commissioned prior to start-up.

A. Check that the electrical connections have been made inside the control panel and that there is power to the panel.

B. See Appendix B for PLC (programmable logic controller) Operating Instructions prior to turning on the system.

C. Turn Equalization control main power disconnect switch to "ON". The green power light should be "ON".

D. At the Equalization control panel use the control screen (HMI) to set the PLC timers to a **"test cycle"** as follows:

TEST CYCLE SETTINGS	ON	OFF
Pump(s) 1 & 2	1 min	1 min

After the test cycle is complete refer to Section 2.0 of the Bioclere Technical Manual for Timer Settings.

E. Verify the Tank(s) are set to **ON** using the control screen (HMI), then set the pump(s) to **AUTO** in the Tank Control Screen. Each pump should be set to pump for a minute and rest for a minute. Leave both pumps in **AUTO**.

F Four control float switches located in the tank govern the following functions:

4. Low level Alarm float: The low level alarm float will act as a redundant pump shut off and will activate an audio/visual alarm signal when the float switch is in the extended position (open circuit).

5. Low level float: In the extended position this float switch shall create an open circuit and prevent operation of the pumps. When the circuit is closed the float switch shall allow activation of the timer and the pumps shall alternate between cycles, transferring wastewater to the downstream treatment reactor(s).

6. Mid level float: Upon closure the mid level float switch shall activate the lag pump and the two pumps shall draw down the liquid in the equalization tank until the mid level float is open. Upon this occurrence, a counter shall be triggered to alert the operator of a high level condition has occurred and the timer "on" setting for the pumps may need adjusting.

7. High level float: The high level float switch shall activate the audio/visual alarm when the circuit is closed.

G. Test each float for proper function. Make sure each float is producing the correct given response

H. Check to make sure that the junction box and Float switch hanger are within 18" of finished grade.

I. Check that the slide rails have been installed properly. Pull up each pump to ensure the rails have been installed properly and that the pumps seal seats back on the slide rail assembly piping.

J. Check that the effluent piping was piped correctly.

K. At the panel turn the alarm to **TEST**. The alarm should sound. Press the alarm silence, audio alarm should silence, the red alarm light should remain illuminated. Turn alarm to OFF, red alarm light should turn off. Set the alarm to **AUTO** and unsilence the alarm.

L. Close and secure the lid.

M. Return to the control panel to set the pump(s) and timers to the settings specified in Section 2.4 "PUMP TIMER SETTINGS".

N. Close/secure control panel.

5.1 PLANT SHUTDOWN

A. No action need be taken if flow is not discharged to the system for up to 12 weeks. Leave the plant in operation with power "ON".

B. If no flow is anticipated to be discharged to the plant for more than 12 weeks, the following shut down procedure will apply.

   A. On Bioclere PLC control panel turn the recycle pump to the **ON** position for 2 minutes. Return recycle pump to **AUTO** mode.
   B. Measure sludge level in each Bioclere unit using a sludge judge. If the sludge level is > 18" repeat step A.
   C. Turn the main power disconnect switch off.
   D. At the unit, verifying the power is off, remove the fan from the fan module and store in a safe dry location.

C. Upon resumption of wastewater flow to the plant the Bioclere should be re-started as described in Section 4.

5.2 SHUTDOWN (EQUALIZATION SYSTEM WITH PLC CONTROLS)

A. The following shut down procedure will apply.

   A. On PLC control panel turn both pumps to the **ON** position and pump manually until the tank has been pumped down to the low float. Return pumps to **AUTO** mode.
   B. Fill out an equalization field report and document the timer settings and pump amperages at the time of shut down.
   C. Turn the equalization control panel main power disconnect switch off.
   D. At the junction box, verifying the power is off.

C. Upon resumption of wastewater flow to the plant the equalization tank should be re-started as described in Section 4.2

6.0 MAINTENANCE PROCEDURES

6.1 BIOCLERE MAINTENANCE

NOTE: Turn the main power switch to "OFF" before servicing the pump, fan or electrical panel box. The Aquapoint Field Service Report is provided to facilitate Bioclere maintenance and to provide a thorough check of Bioclere components.

Standard Quarterly Maintenance:

1. Check general condition/appearance of unit.
2. Check vent flow, odor.
3. Check general condition of fan box including internal and external wiring, lock, latch, gaskets, etc.
4. Check quiet fan operation.
5. Check condition of cover locks, latches, gaskets.
6. Check and characterize biomass.
7. Check recycle pump operation, timing, effluent clarity and spray pattern.
8. Check dosing pumps operation, timing, effluent clarity and spray pattern.
9. Check general condition of dosing assembly.
10. Check general condition of control box including locks, gaskets, etc.
11. Check control box switches, alarms, timers, etc.
12. Complete and maintain service report file.

6.2 Pre Equalization Tank:

1. Check general condition/appearance of components.
2. Check and record high level counter in control panel.
3. Measure flow rate discharged by the pumps and adjust as necessary.
4. Check condition of junction box in the tank.
5. Check pumps, operation and timing.
6. Check condition of piping assembly in the tank.
7. Check condition and function of control panel.

See attached Equalization field report for complete O&M procedures

6.3 PROCESS CONTROL for CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND ($CBOD_5$) REMOVAL with the BIOCLERE SYSTEM:

Wastewater flows from the primary settling tank into a baffled chamber in the clarifier of the Bioclere. Dosing pumps located in this clarifier intermittently dose the PVC filter media bed with the wastewater.

In the Bioclere trickling filter the organic material in the wastewater is reduced by a population of microorganisms, which attach to the filter media and form a biological slime layer. Aerobic microorganisms accomplish treatment in the outer portion of the slime layer. As the microorganisms multiply the biological film thickens and diffused oxygen and organic substrate are consumed before penetrating the full depth of the slime layer. Consequently the biological film develops aerobic, anoxic and anaerobic zones.

Absent oxygen and a sufficient organic carbon source (CBOD5) the microorganisms near the media surface lose their ability to cling to the media. The wastewater flowing over the media washes the slime layer off the media and a new slime layer begins to form. This process of losing the slime layer is called "sloughing" and it is primarily a function of organic and hydraulic loading on the filter. This natural process allows a properly designed media bed to be self-purging and maintenance free.

The sloughed biomass settles to the bottom of the clarifier as sludge. This secondary sludge is periodically pumped back to the primary tank to enhance the digestion and denitrification processes, which is further discussed in ***Section 6.3.2 below.***

6.3.1 *Bioclere Trickling Filter Dosing Rates:*

The Bioclere uses two alternating dosing pumps to distribute wastewater over the trickling filter. It is critical to periodically clean the nozzles of excess biomass using a bottlebrush to ensure uniform distribution. The Bioclere dosing rates that were set at the time of commissioning are listed in ***Section 2.0*** of this manual. The dosing rates are set so that the flow of water and pollutants (CBOD5 and ammonium) over the biofilm are maximized. This in turn, will maximize the pollutant removal efficiencies and facilitate biomass sloughing through the filter. Therefore, it is **not necessary** to adjust the dosing timers. In fact, the dosing timers should only be adjusted if the Bioclere receives little or no flow for extended periods.

6.3.2 *Bioclere Recirculation Rates:*

Recirculation of sludge and treated effluent is accomplished in each unit using a submersible stainless steel pump controlled by a fully adjustable timer. The biological solids generated in the filter are returned to the sludge storage facility at regular intervals, typically every hour. Therefore, the sludge will not collect in the secondary settling tank and a sludge blanket will not form.

The benefits of sludge and treated effluent re-circulation are numerous and include: 1) removal of biological sludge from the Bioclere so that only the primary tank(s) need periodic pumping, 2) dilution of the influent pollutant concentrations, which results in a thinner and more effective biofilm on the media bed, 3) reduction or near elimination of odors in the primary tanks and the treatment components, 4) dilution of biological inhibitors (cleaning agent, sanitizers, etc.) that may exist in the wastewater, 5) attainment of nitrogen removal through denitrification due to the recirculation of nitrate to the primary tank.

The recirculation rates that were set at the time of commissioning are listed in ***Section 2.0*** of this manual. These rates may need adjusting depending on the 1) actual average daily flow, and 2) actual measured strength of the wastewater (concentrations of influent BOD5, TKN etc.). Please contact AQUAPOINT prior to adjusting the recirculation rates.

In a two stage Bioclere system the first unit is typically set to return only the biological sludge generated in the reduction of CBOD5. The second stage unit is set to run several minutes each hour to return biological sludge and treated effluent in order to maximize treatment efficiency.

6.4 PROCESS CONTROL for NITROGEN REMOVAL with the BIOCLERE SYSTEM (if applicable):

Below is a brief description of how nitrogen removal is accomplished in the Bioclere units. Generally BOD removal occurs in the first stage Bioclere unit and a majority of nitrification in the second stage Bioclere. However, if the actual wastewater flow is less than the design flow, signifigant nitrification will occur in the first stage Bioclere unit.

6.4.1 *Nitrification:*

Nitrification is the sequential biological oxidation of NH_4-N, first to nitrite (NO_2^--N) by *Nitrosomonas* bacteria then to nitrate (NO_3^--N) by *Nitrobacter* bacteria according to the following overall equation: $\mathbf{2NH_4^+ + 2O_2 \rightarrow NO_3^- + 2H^+ + H_2O}$

Oxidation of 1 mg/l of NH_4-N requires approximately 4.6 mg/l of dissolved oxygen and produces acid resulting in the consumption of approximately 7.1 mg alkalinity as $CaCO_3$/mg NH_4-N oxidized. Alkalinity is the inorganic carbon source nitrifying bacteria required to oxidize ammonia. ***Therefore it is critical that alkalinity is monitored on a regular basis to ensure complete nitrification.*** Alkalinity concentrations in the Bioclere effluent must remain above 75 mg/l as CaCO3 to allow nitrification to proceed. If the alkalinity drops below this value, it is likely that nitrification will be inhibited and the effluent will not meet permit requirements. It is best to measure the alkalinity in the Bioclere effluent using a field test kit each time you are onsite to inspect the treatment system. Bioclere effluent can be collected from the final pump chamber or the sampling port that is located on top of the Bioclere unit (see the Bioclere general arrangement drawing located in Appendix A for the sampling port location). The sampling port is a 4" diameter PVC pipe that extends approximately 10' through the trickling filter to the effluent in the clarifier. Effluent can be collected with a bailer.

Alkalinity is generally added in the form of baking soda (sodium bicarbonate). It can be purchased as a powder in 50-pound bags. A solution can be mixed using the alkalinity mixing setup that has been included with the treatment equipment. Solution dosing is accomplished using a variable speed Masterflex chemical feed pump, which is controlled with a timer in the Bioclere control panel. Dosing should be set to run several minutes each hour. For a detailed description of the chemical feed installation and operational requirements refer to the site plans and ***Appendix E*** of this manual. Contact Aquapoint if assistance is required to determine the alkalinity-dosing rate.

Please note that nitrifying bacteria require a stable and consistent environment because of their sensitivity to numerous inhibitory and toxic substances and an array of environmental factors including temperature, pH, dissolved oxygen, and alkalinity. If nitrification is not being achieved then it will be necessary to verify the influent average daily flow, pH, BOD5, TSS, TKN. It may also be necessary to conduct an inventory of the type and quantity of any and all cleaning and process solutions that are used that may impact the microorganisms in the Bioclere units.

6.4.2 *Denitrification:*

Dissimilating denitrification, the biological reduction of nitrate (NO_3^--N) to nitrite (NO_2^--N) and ultimately nitrogen gas in an anoxic environment (dissolved oxygen <0.5 mg/l), involves the transfer of electrons from a reduced electron donor (organic carbon substrate) to an oxidized electron acceptor (NO_3^--N). It is an important reaction as it restores approximately 3.57 mg alkalinity/mg of NO_3^--N reduced, and partially offsets the effects of nitrification in a combined nitrification/denitrification process. The microorganisms responsible for completing the reaction are facultative heterotrophic aerobes contained in the wastewater that are also responsible for $CBOD_5$ oxidation in the Bioclere.

Denitrification in the Bioclere system is accomplished by periodically recirculating secondary sludge and treated nitrified effluent to the septic tank which provides an anoxic environment. Recirculation typically occurs several minutes every hour via a timer in the control panel. See ***Section 2*** of this manual for Bioclere recycle and dosing rates. For typical residential strength wastewater, recirculation of treated effluent from the Bioclere to the septic tank will achieve <12 mg/l of total nitrogen. This is due to the fact that weight ratios of carbon to

nitrate, measured as **BOD:NO_3-N** in the influent wastewater are usually greater than the generally accepted ratio of **2:4** in which denitrification has been proven to proceed without an external carbon source such as methanol.

However, many commercial applications will require a carbon source such as methanol. If required, a carbon dosing rate of approximately 3:1 (COD carbon source: NO3 in wastewater) is required to complete denitrification.

Carbon is often added in the form of methanol or a 20% methanol solution. However many other organic carbon sources can be used including glucose (sugar), sodium acetate, soda syrup etc. If the carbon source is not purchased in pre-mixed drums, a solution can be made-up using the mixing setup that has been included with the treatment equipment. Carbon dosing is accomplished using a variable speed Masterflex chemical feed pump, which is controlled with a timer in the Bioclere control panel. Dosing should be set to run several minutes each hour. For a detailed description of the chemical feed installation and equipment operational requirements refer to the site plans and ***Appendix E*** of this manual. Contact Aquapoint if assistance is required to determine the carbon-dosing rate.

If the effluent dissolved oxygen concentrations from the anoxic reactor exceed 0.5 mg/l, denitrification may be inhibited. In isolated instances, this has been documented to occur during extreme cold weather periods. If this occurs, the Bioclere fan size can be reduced to compensate for the increased dissolved oxygen levels. If the condition persists, an oxygen scavenging agent can be dosed into the Post Equalization tank to uptake the residual dissolved oxygen. Please contact Aquapoint if this condition is experienced.

How do I know when a carbon source is needed?
You must monitor the nitrate in the septic tank effluent tee with a nitrate field test kit. When nitrate is consistently >3 mg/l in the septic tank effluent, it is necessary to add an organic carbon source to the influent side of the septic tank to achieve denitrification. You should also measure the dissolved oxygen. For denitrification to proceed a dissolved oxygen level of <0.5 mg/l is required in the septic tank effluent.

AQUAPOINT		
[redacted] DUCHAINE BLVD.		
NEW BEDFORD, MA 02745		
TEL. 508 998-7577 / FAX. 508 998-7177		
BIOCLERE FIELD REPORT		
Date:	Installation:	Tested:
Client:	Service:	Commissioned:
Address:	Other:	Scheduled Maint.
Inspector:		
Bioclere Model Number(s)		
1) Odor around site? Y / N, Source of odor?		
Check all that apply:	Mild: Med:	Strong:
	Musty:	Septic:
2) Take influent/effluent samples as required.		
Please fax analytical resutls to Aquapoint for review.		
3) a) Measure sludge in primary tanks and grease traps as required:		
b) Sludge depth in primary tank:	scum depth:	sludge depth:
c) Does grease trap need pumping?	Y / N	
	UNIT 1	**UNIT 2**
4) BIOCLERE VENTS		
[redacted]s air passing through the vent?	Y / N	Y / N
[redacted]f in doubt put a small plastic bag around vent and allow to fill		
b) Is the fan operating and in good condition?	Y / N	Y / N
5) GENERAL		
a) Any external damage to the unit(s)? If yes, then provide details on back	Y / N	Y / N
b) Are cover, fan box and control panel securely locked?	Y / N	Y / N
c) Any filter flies in the unit?	Y / N few / many	Y / N few / many
Location of flies:		
d) Locks / Latches / Handles, OK?	Y / N	Y / N
e) Lid Gasket, OK?	Y / N	Y / N
f) Does the fan box contain standing water?	Y / N	Y / N
If yes, then remove water and clean drain holes if necessary.		
6) BIOMASS CHARACTERIZATION		
a) Color of biomass?		
1)white 2)white/grey 3)grey 4)grey/brown 5)brown 6)red/brown 7)black 8)other		
b) Thickness of biomass 6 - 12 inches below media surface		
1) light 2) medium 3) heavy		
7) NOZZLE SPRAY PATTERN		
a) Does spray cover the entire surface area of media?	Y / N	Y / N
If not then clean each nozzle with a bottle brush		
Does the spray now cover the entire surface area?	Y / N	Y / N
If not then:		
1) remove nozzles and soak them in a bleach solution		
[redacted] 2) manually engage both dosing pumps for 2 minutes		
3) replace nozzles		
Does the spray now cover the entire surface area?	Y / N	Y / N
If not then consult AQUAPOINT		

8) PUMPS AND CONTROL PANEL		
a) Record dosing and recycle pump timer settings from control panel		
Dosing pump 1 and 2:	min on/ min off	min on/ min off
Recycle pump:	min on/ hrs off	min on/ hrs off
In Bioclere control panel set dosing and recycle timers to a test cycle:		
a) Measure amperage of dosing pump 1:	amps	amps
b) Measure amperage of dosing pump 2:	amps	amps
c) Measure amperage of recycle pump:	amps	amps
Are the dosing pumps alternating?	Y / N	Y / N
Are the timers operating properly?	Y / N	Y / N
Visually inspect relays for wear and record problems below.		
*If spare components are needed contact Aquapoint		
If an ammeter is not available, set the timers to a test cycle as above and		
physically at the Bioclere, check the pumps operation as follows:		
Dosing pumps: check that pump(s) are operating, alternating and the	pump 1: OK? Y / N	pump 1: OK? Y / N
designated rest cycle is occurring.	pump 2: OK? Y / N	pump 2: OK? Y / N
Recycle pump(s):check that pump(s) are operating and the designated		
rest cycle is occurring.	OK? Y / N	OK? Y / N
*If pumps or control components are not operating properly record below		
and consult AWT Environmental, Inc.		
RESET TIMERS TO ABOVE SETTINGS: Note any changes here:	min on/ min off	min on/ min off
***Do not change timers without consulting Aquapoint**	min on/ hrs off	min on/ hrs off
9) PLUMBING		
a) Are the unions in the Bioclere leaking?	Y / N	Y / N
If yes then tighten with pipe wrench		
10) FINAL CHECK		
a) Main power "on" and toggle for all pumps set to "normal" position	Y / N	Y / N
b) Alarm toggle set to the "on" position	Y / N	Y / N
c) Lock control panel, Bioclere cover and fan box		
d) If possible, record the water meter reading:		
11) REPORT SUMMARY:		
SIGNATURE:		

AQUAPOINT
[redacted] DUCHAINE BLVD.
NEW BEDFORD, MA 02745
TEL. 508 998-7577 / FAX. 508 998-7177

PRE-EQUALIZATION TANK FIELD REPORT

Site:

Date:

Client:

Inspector:

Installation: Tested:

Service: Commissioned:

Scheduled Maint: Other:

PRE-EQUALIZATION CONTROL PANEL

1) PUMPS AND CONTROL PANEL

a) Record dosing pump timer setting from control panel.

Dosing pump 1 and 2: minutes on / minutes off

b) Record high float counter in control panel:

In the Bioclere control panel set dosing timer to a test cycle (i.e. 0.5 min on 0.5 min off:)

a) Measure amperage of dosing pump 1: amps

b) Measure amperage of dosing pump 2: amps

c) Measure amperage of mixing pump (if applicable): amps

A[redacted]e dosing pumps alternating? Y N

Are the timers operating properly? Y N

Visually inspect relays for wear and record problems below.

*If spare components are needed contact Aquapoint, Inc.

If an ammeter is not available, set the timers to a test cycle as above and physically check the pumps operation as follows:

Dosing pumps: check that pump(s) are operating, alternating and the designated rest cycle is occurring.

pump 1: OK? Y / N

pump 2: OK? Y / N

*If pumps or control components are not operating properly record below and consult Aquapoint, Inc.

RESET TIMERS TO ORIGINAL SETTINGS: Note any changes here: min on / min off

*Do not change timers without consulting Aquapoint, Inc.

2) PLUMBING

a) Are the unions in the Equalization tank leaking? Y N

If yes then tighten with pipe wrench

3) FLOAT SWITCH OPERATION

a) **LOW FLOAT** - In extended position (open circuit) float is a low level pump shut off
- In closed position float activates Serlac timer and dosing cycle

b) **MIDDLE FLOAT** - In extended position (open circuit) float allows normal operation
- In closed position float trips the counter and activates lag pump until tank is empty

c) **HIGH FLOAT** - In extended position (open circuit) float allows normal operation
- In closed position float will activate the audio/visual alarm

4) FLOW RATE MEASUREMENT (gpm)

- Measure flow rate in (gpm) from tank by measuring the draw down volume over a specified time (i.e. 5 minutes)
- Refer to Bioclere Technical Manual for process description and maximum flow rate (gpm)
- Flow rate may be adjusted using the 2" brass ball valves in the tank

5) FINAL CHECK

a) Main power "on" and toggle for pumps set to "normal" position Y / N
b) Alarm toggle set to the "on" position Y / N
c) Lock control panel
d) If possible, record the water meter reading:

6) REPORT SUMMARY

SIGNATURE:

7.0 TROUBLE SHOOTING

7.1 Before conducting any repair work on the fan or pump, replacing fuses, or doing any work on the panel or fan module:

SWITCH THE MAIN POWER PANEL SWITCH TO "OFF"- and follow applicable "lock out", "tag out" procedures.

FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
Fan not working	Power failure	Check fuse and replace if necessary.
	Fan motor failure	Check wiring and terminal connections. Replace fan if necessary.
Dosing pump not working	Power failure	Check circuit breaker.
	Pump not submerged	Check that pump is fully submerged.
	Timer control failure.	Check that power switch is "ON". Replace timer if necessary.
	Pump failure.	Replace pump.
Excessive build-up of biomass	Plant overload	Check that hydraulic and organic load are within design limits. Contact Aquapoint Inc. if capacity is to be increased.
	High sludge or grease levels in primary tanks.	Check sludge levels in each unit and de-sludge as necessary.
Elevated solids concentration in final effluent.	High sludge level in Bioclere sump.	Check pump and timer control. De-sludge by pumper if necessary.
	Excess shedding of biomass.	investigate and eliminate any source of biofilm poisoning such as disinfectant, household bleach, acids, etc. showing up in waste.
Odorous	Inefficient treatment.	Check that dosing assembly sprinkles evenly over media surface. Clean dosing assembly.
	Inadequate air supply	Check fan and air intake. See "fan not working" above.

ALARM CONDITIONS/TROUBLESHOOTING

NOTE: This is not intended to be an exhaustive list, rather, an aid to solving problems that may occur.

Causes of alarms may be isolated by determining if a breaker has tripped, a fuse has blown, and if any AR contact is opened under power. Below is a list of alarm relays with the components that are effected.

ALARM RELAY	DEVICES AFFECTED	ACTION/REMEDY
AR1*	"POWER ON" light fan in tank F1 C.B.	Check fan for overload/blockage. Replace C.B.
AR2	Dosing pump timer ALT, 1C, 2C	Determine cause of overload. Replace C.B.
AR3	#1 dosing pump, #1 dosing pump light breaker tripped	Check pump, determine cause of overload, reset breaker.
AR4	#2 dosing pump, #2 dosing pump light breaker tripped	Check pump, determine cause of overload, reset breaker.
AR5	Recycle pump, recycle pump light breaker tripped	Check pump, determine cause of overload, reset breaker.
CR1*	#1 dosing pump	Check pump/wiring.
CR2*	#2 dosing pump	Check pump/wiring.
CR3*	Recycle pump	Check pump/wiring.

NOTE:

1. AR1 operate (drop out) when power is interrupted or when fuse/CB is tripped.
   CR1-CR3 operate (drop out) when CSR relays do not sense proper motor load when motor should be running.
2. All pertain to Model 22, 24 and 30 series Bioclere units.
3. * pertain to Model 36 series Bioclere units only.

FAULT	POSSIBLE CAUSE	REMEDIAL ACTION
	Primary tank clogged.	Check inlet and outlet pipes and sludge level. De-sludge as necessary.

8.0 FINAL EFFLUENT QUALITY PROBLEMS

8.1 HIGH SUSPENDED SOLIDS.

If effluent solids concentrations are exceeded, carry out the following checks:

1. Check operation of recycle pump from telltale near the top of the central shaft.
2. Examine primary settlement tank. If excessive sludge or floating matter in the chamber is discharging to the Bioclere arrange for the primary tank to be de-sludged. (See Section 2.6, 2.7)
3. If the sludge recycle pump has been out of operation for more than 8 weeks, the Bioclere sump should be de-sludged.

8.2 HIGH B.O.D. (BIOCHEMICAL OXYGEN DEMAND)

If effluent levels are exceeded carry out the following checks:

1. Check for signs of excessive sludge in the primary tanks. (See Section 2.6, 2.7)
2. Check that the fan is operating continuously and that the air inlet to the fan is unobstructed. Clean and replace as necessary.
3. Check that the dosing assembly is clean and that the effluent is being distributed evenly to the filter media.
4. Check whether the loading to the plant has increased beyond the design basis. Consult Aquapoint Inc. if loading has increased.
5. Ensure that there are no toxic or concentrated cleansing chemicals being discharged to the plant.

8.3 HIGH NH_3N (AMMONIA-NITROGEN)

Carry out check procedure as for Item 8.2 B.O.D.

For additional assistance contact:

AQUAPOINT
241 Duchaine Blvd.
New Bedford, MA 02745
Tel. 508-998-7577
Fax 508-998-7177

E-mail: aquapoint@aquapoint.com

WASTEWATER TREATMENT SYSTEM

TOXICITY WARNING

The wastewater treatment system at this facility has been designed to treat the waste stream generated by the facility and maintain compliance with the facilities discharge permit. Its biological treatment process is very stable.

HOWEVER, TOXIC SHOCK LOADING WILL ADVERSLY IMPACT THE EFFLUENT QUALITY FROM THE SYSTEM.

Therefore, none of the following biologically toxic substances should be introduced into the system:

1. Gasoline, kerosene, benzene, naphtha, fuel oil or other flammable or explosive liquid, solid or gas.
2. Oil based latex paints, paint thinners, paint removers or strippers.
3. Organic solvents or any liquid containing organic solvents.
4. **Quaternary ammonium compounds**, sanitizers or chemical solutions containing Dimethyl Benzyl Ammonium Chloride.
5. Photographic fluids including waste developer, fixer and rinse water.
6. Pesticides including insecticides, fungicides, rodenticides, and herbicides of any sort.
7. Water or waste containing toxic poisonous solids, liquids or gases in sufficient quantity to interfere with the sewage treatment process, constitute a hazard to humans or animals, create a public nuisance or create any hazard in the ground water.
8. Water or waste having a pH higher than 8.5 or lower than 6.5
9. Solid or viscous substances in quantities capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewage works such as but not limited to, ash, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, un-ground garbage, whole blood, manure, hair, fleshing, entrails, paper dishes, cups, milk cartons, etc... either whole or in parts.
10. Water or waste containing fats, wax, grease or oils whether emulsified or not, in excess of 100 mg/l or containing substances which may solidify or become viscous at temperatures between 32 and 150 degrees Fahrenheit (0-65 degrees Celsius).
11. Garbage that has not been properly shredded.
12. Storm water, surface water, roof runoff or subsurface drainage.
13. Rubber gloves, gauze pads, etc... which are typically from medical facilities.

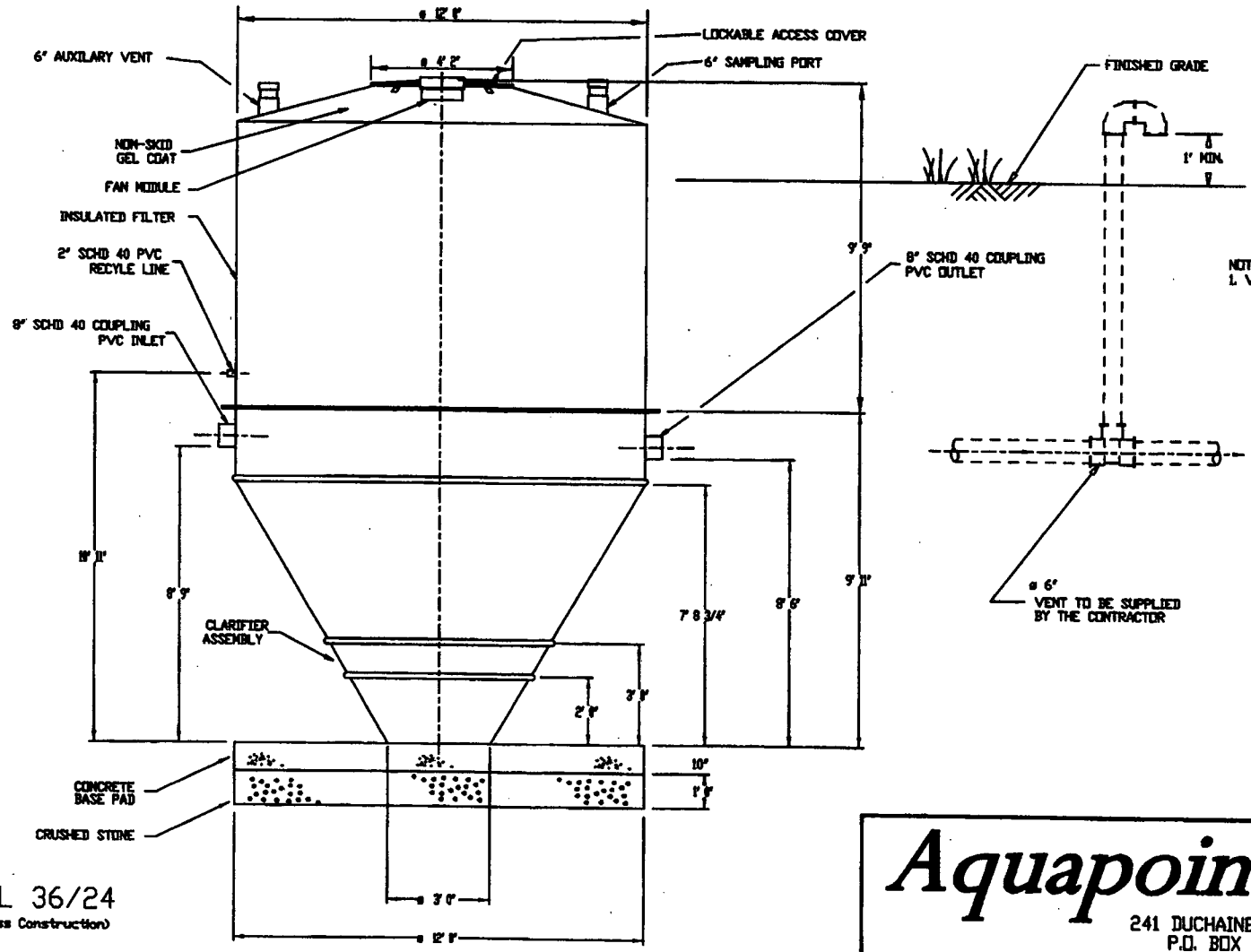
IN THE EVENT THAT THESE OR OTHER INHIBITIVE SUBSTANCES INADVERTENTLY ENTER THE WASTE STREAM, CONTACT AQUAPOINT IMMEDIATELY (508)998-7577 ext.20

APPENDIX TABLE OF CONTENTS

APPENDIX A

DRAWINGS

SHIPPING WEIGHTS
WEIGHT DRY WITH MEDIA = 5200 lbs (FRP) or 12800 lbs (Steel)
WEIGHT DRY WITH NO MEDIA = 3400 lbs (FRP) or 9000 lbs (Steel)

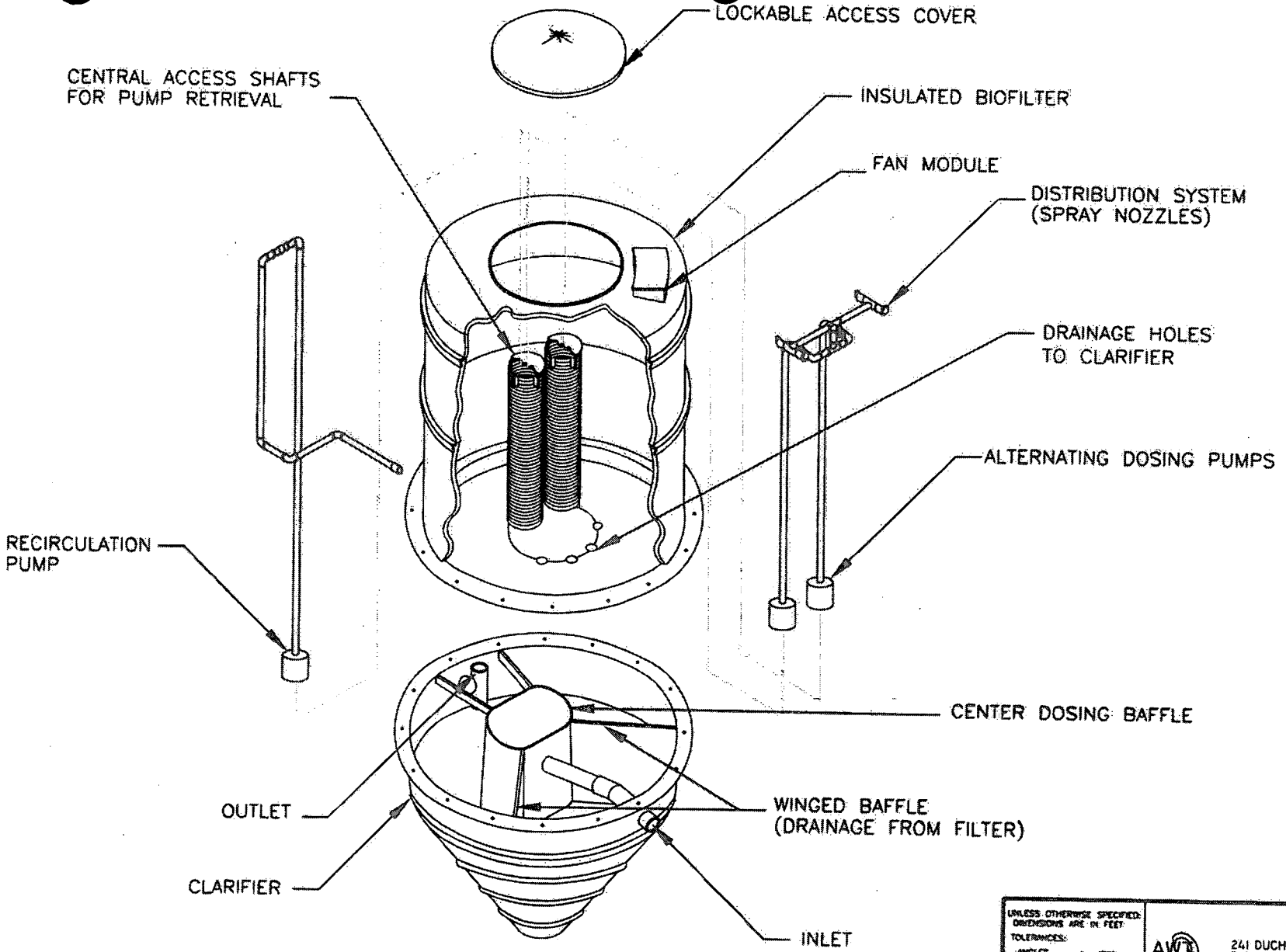


NOTES:
1. VENT MAY BE RUN UP THE SIDE OF BUILDING.

MODEL 36/24
(Fiberglass Construction)

Aquapoint
241 DUCHAINE BLVD.
P.O. BOX 50120
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	BIODISC 12' BIA BIOFILTER GENERAL ARRANGEMENT
DRAWING NO:	UK.1263-13
REVISION	A
DATE	04/3/02
DWN BY:	P.Wiley
SCALE	1 : 40 SIZE B
SHEET #	1 of 1



ISOMETRIC VIEW OF BIOCLERE

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN FEET
TOLERANCES:
ANGLES: ± XXX
FRACTIONS ± --
2 PLACE DIM ± XXX
3 PLACE DIM ± XXX
DATE: 12/03/96
DWN: PGA
CHKR:
APPVD:

AWT
241 DUCHAINE BLVD.
P.O. BOX 50120
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE: BIOCLERE – ISOMETRIC
SIZE: REVISION: DRAWING NO.:
SCALE: NONE
SHEET #: 1 OF 1

APPENDIX B

CONTROL PANEL FOR OPERATION

OF

BIOCLERE

Wastewater Treatment System

BIOCLERE ELECTRICAL INFORMATION

1. **ELECTRICAL SUPPLY REQUIREMENTS:**

   A. Aquapoint recommends that the Bioclere control panel receive a separate 220/1/60 supply rated for 45 amps. And a 115/1/60 supply rated for 15 amps.

   B. The pre-equalization control panel requires a separate 115/1/60 supply rated for 45 amps.

2. **WIRING:**

   A licensed electrical contractor is responsible for wiring to meet local, state and federal codes as applicable.

   Grounds are provided in both the Bioclere main control panel and fan module which must be wired to earth ground.

   All fittings, connections, etc. are to be weatherproof, watertight construction.

   #12 wire is sufficient for all motor connections.

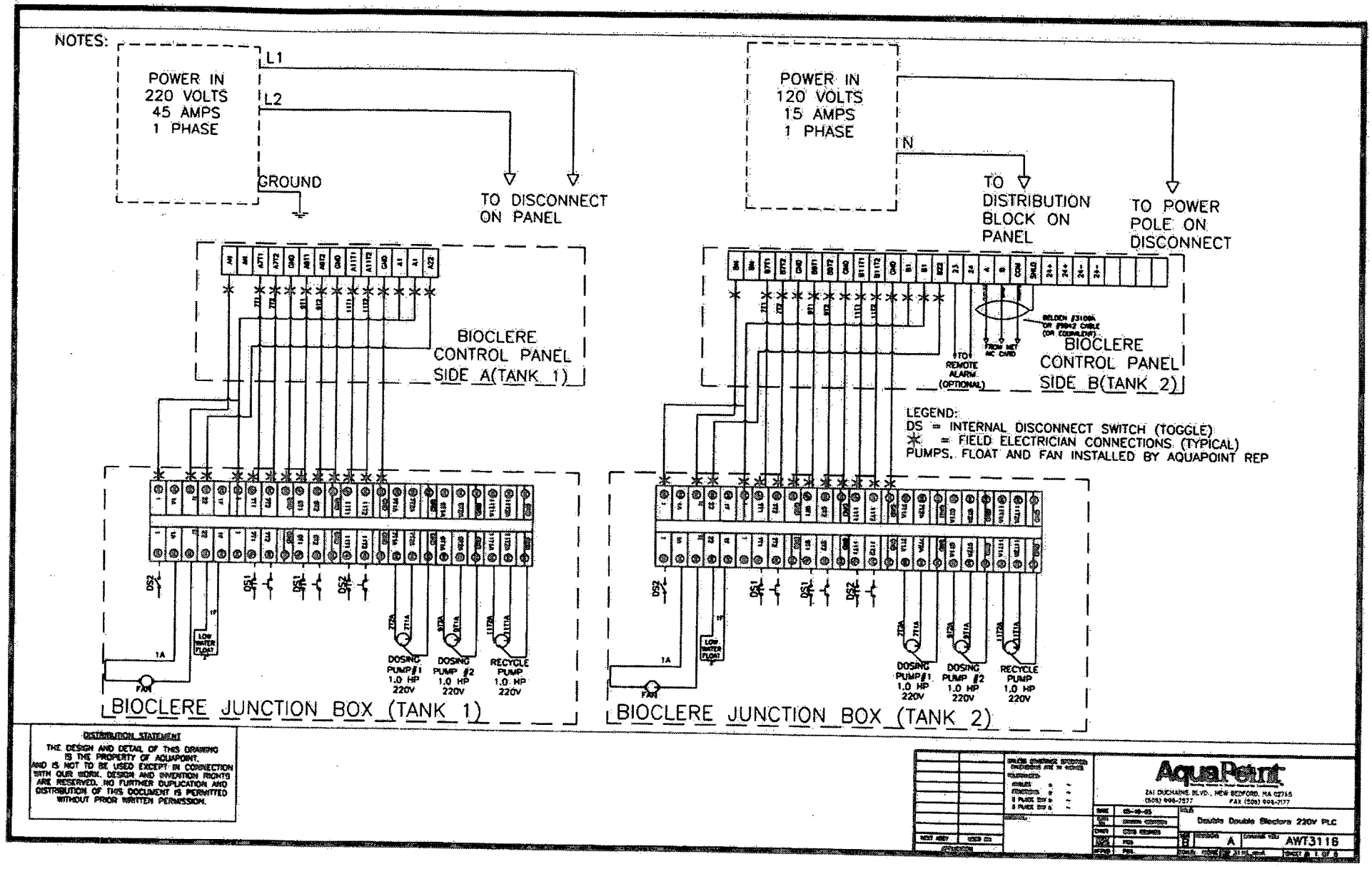
   In the event more than one system is located in an enclosure, wire numbers are prefixed by AA≅ on the first system, "B" on the second, etc. Aquapoint would recommend care be taken not to mix wires between systems.

3. **OPERATION:**

   A. Normal Operation: The Bioclere unit will normally operate without any need for supervision. However, from time to time conditions may occur which activate the audible/visual alarms and require correction.

   B. Alarms provided: Each Bioclere system has a separate set of alarms which consist of a flasher light on top, and an "ON/OFF/TEST" switch on the front panel. The "ON/OFF/TEST" switch should always be in the "ON" position, otherwise the alarms are disabled. The "TEST" position is for test of the visual/audible alarms. The "OFF" position should only be used during servicing by authorized personnel.

BIOCLERE CONTROL PANEL

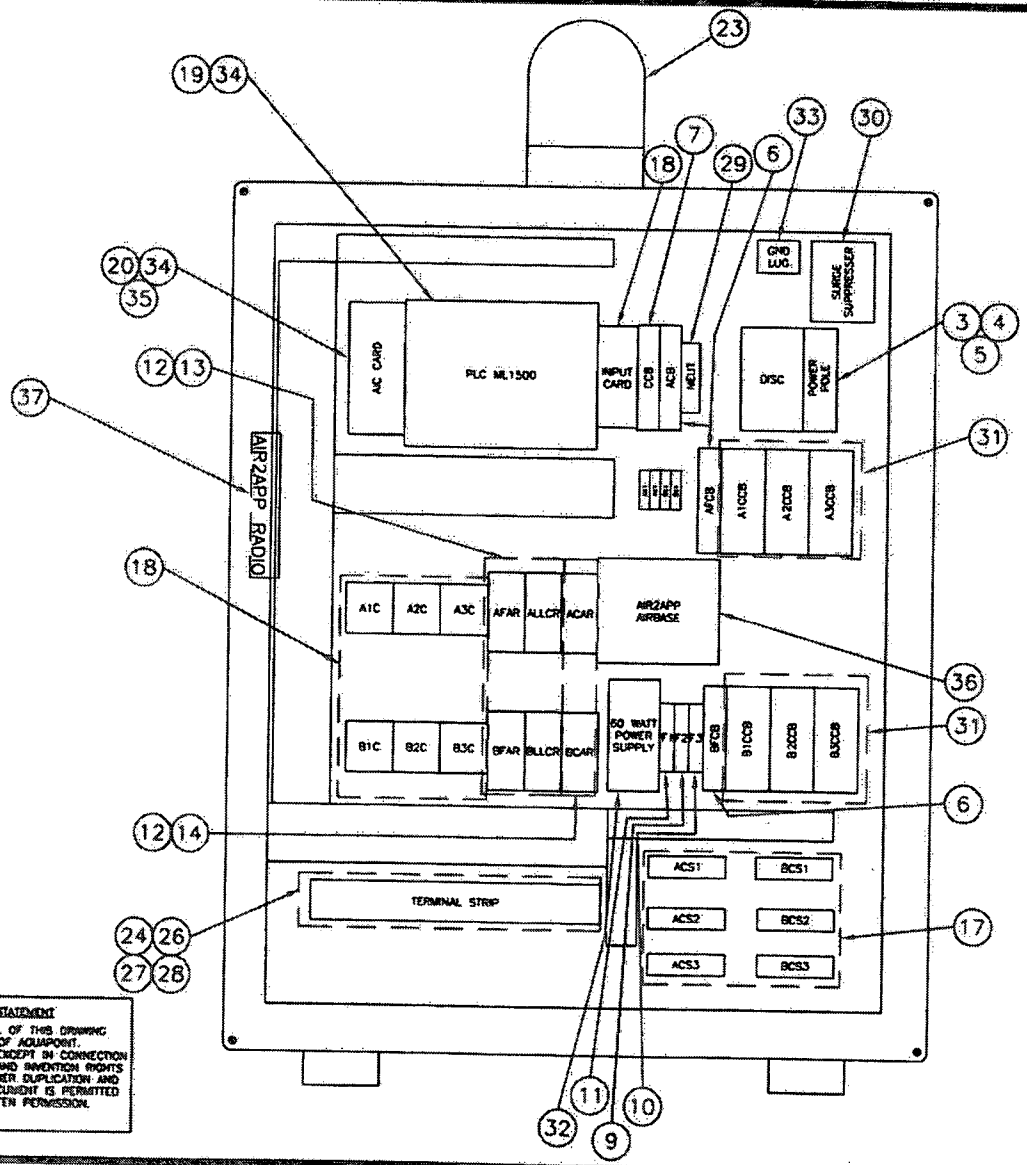


AquaPoint
241 DUCHAINE BLVD., NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7777

Double Double Bioclere 220V PLC

AWT3116

NOTES:

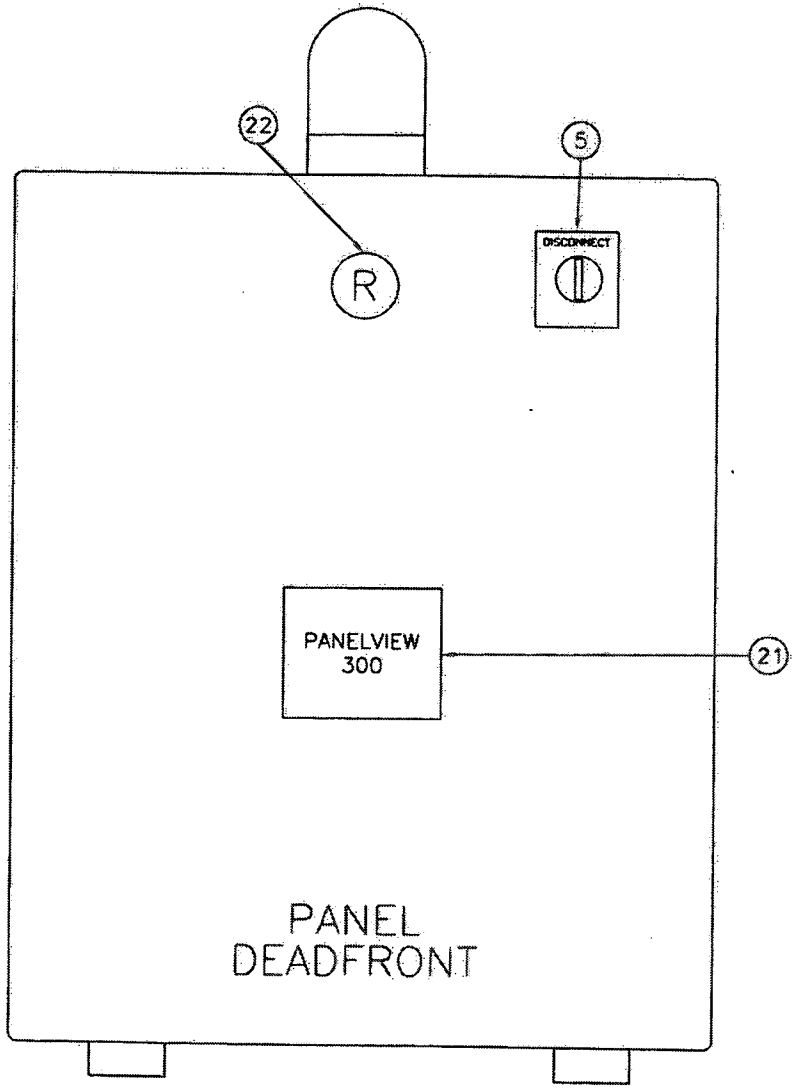


ITEM NO.	QTY	MANUFACTURE	DESCRIPTION	PART NO.
37	1	AIR2APP	RADIO TELEMETRY UNIT	
36	1	AIR2APP	MOBILE AIRBASE UNIT	AS9003
35	1	ABB	PC TO MICROLOGIX CABLE	1761CBL-PM02
34	1	ABB	COMMUNICATION CABLE	2707-NC11
33	1	ILSCO	GROUND LUG	AU-0
32	1	IDEC	60W 24V POWER SUPPLY	PS5R-SD24
31	6	ABB	6A 2 POLE BREAKERS	S272K6A
30	1	SQUARE D	SURGE SUPPRESSOR	SDA1175
29	1	ENTRELEC	NEUT TERMINAL	115120.17
28	4	ENTRELEC	GROUND TERMINALS	16511316
27	6	ENTRELEC	TERMINAL END BLOCKS	10300209
26	5	ENTRELEC	TERMINAL BARRIERS	211831618
25	4	ENTRELEC	TERMINALS 50A/#8 AWG	011511811
24	31	ENTRELEC	TERMINALS 30A/#10 AWG	11511607
23	1	PATLITE	120V RED BEACON W/ HORN	RHB120 AULR
22	1	IDEC	24V AMBER LIGHT	APW199A24
21	1	ALLEN BRADLEY	MICRO 300 PANELVIEW DISPLAY	2711M3A19L1
20	1	ALLEN BRADLEY	INTERFACE CONVERTER	1761-NET-AIC
19	1	ALLEN BRADLEY	MICROLOGIX 1500 BASE UNIT	1764-28BXB
18	1	ALLEN BRADLEY	INPUT CARD	1769-IQ16
17	6	DIVERSIFIED	CURRENT SENSING RELAYS	CMG D10020
16	6	AEG	CONTACTORS 24VDC 16A 1 NO	LS07.10.M5W
15	3	ABB	1 POLE CIRCUIT BREAKERS	TS272K8
14	2	IDEC	2 POLE RELAY LIGHTED 24VDC	RH2BULAC24
13	4	IDEC	2 POLE RELAYS LIGHTED 120V	RH2BULAC120
12	6	IDEC	2 POLE RELAY SOCKETS	SH2B-05
11	1	BUSSMAN	TIME DELAY FUSE	MDL5
10	1	BUSSMAN	TIME DELAY FUSE	MDL3
9	1	BUSSMAN	TIME DELAY FUSE	MDL1
8	3	ALTECH	DIN RAIL MOUNTED FUSEHOLDER	11022
7	1	ABB	5A 1 POLE CIRCUIT BREAKER	S271K5A
6	2	ABB	.5A 1 POLE CIRCUIT BREAKER	S271K0.5A
5	1	ABB	HANDLE	OHBZX102
4	1	ABB	SHAFT	OXZS49
3	1	ABB	63 AMP DISCONNECT SWITCH	OT63E3
2	1	MCKINSTRY	27 X 21 BACKPANEL	42/3024
1	1	ROBROY	30 X 24 X 10 ENCLOSURE	N302410HWT-DF

Double Double Stacker 220V PLC

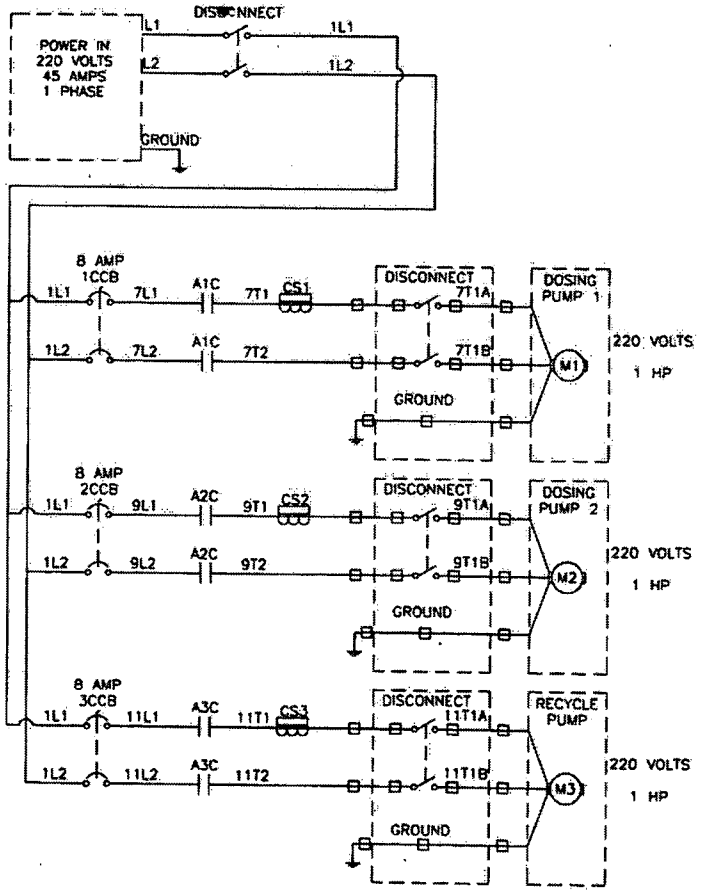
B | A | AWT3116

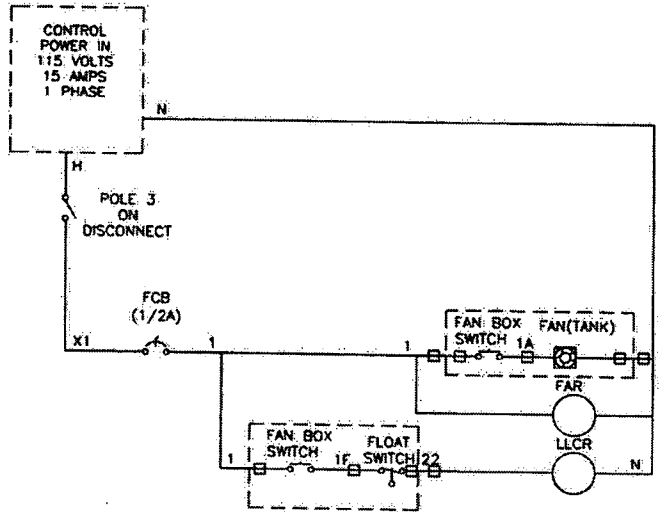
NOTES:



Double Double Shelters 220V PLC
H A AWT3116

NOTES: WIRE FOR BOTH TANKS (PREFIX WIRE NUMBERS A FOR TANK 1, B FOR TANK 2

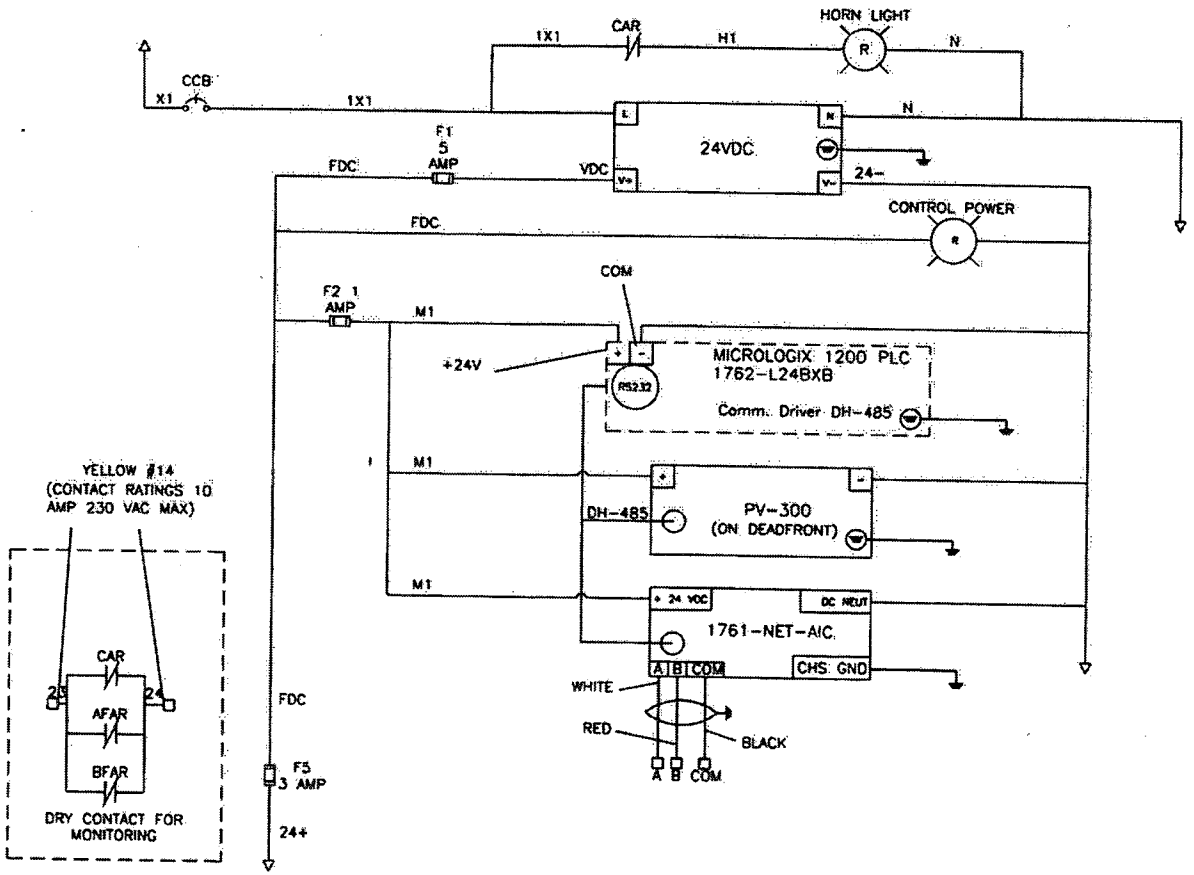




Double Double Stacker 220V PLC

B A AWT3116

NOTES:

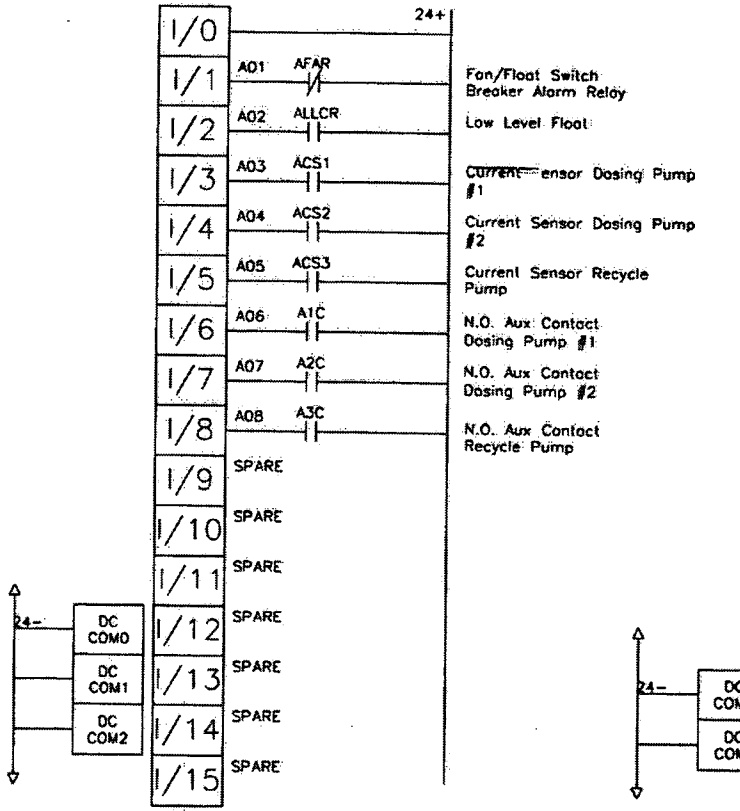


Double Double Stacker 220V PLC

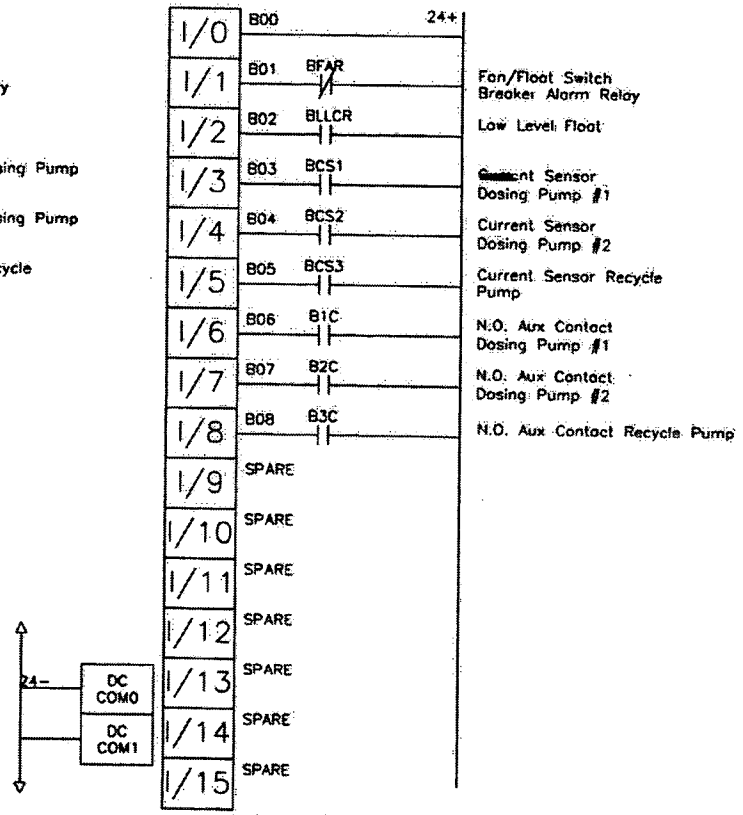
A

AWT3116

NOTES:



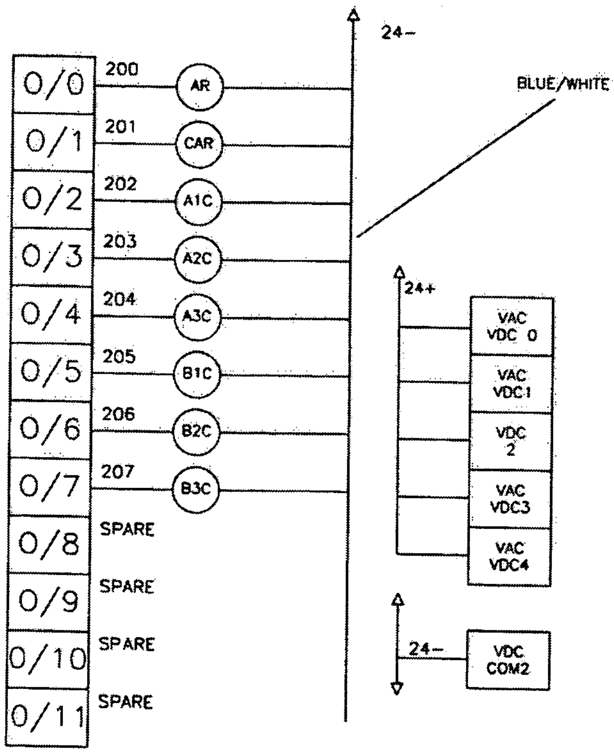
AB-1764-28BXB
INPUT - BASE UNIT



AB-1769-1Q16
INPUT CARD 1

Double Double Stackers 220V PLC
B A AWT3116

NOTES:



AB−1764−28BXB
OUTPUT − BASE UNIT

Double Double Bioclere 220V PLC

B | A | AWT3116

Aquapoint Control Systems
Double Bioclere PLC Operating Instructions

System Description

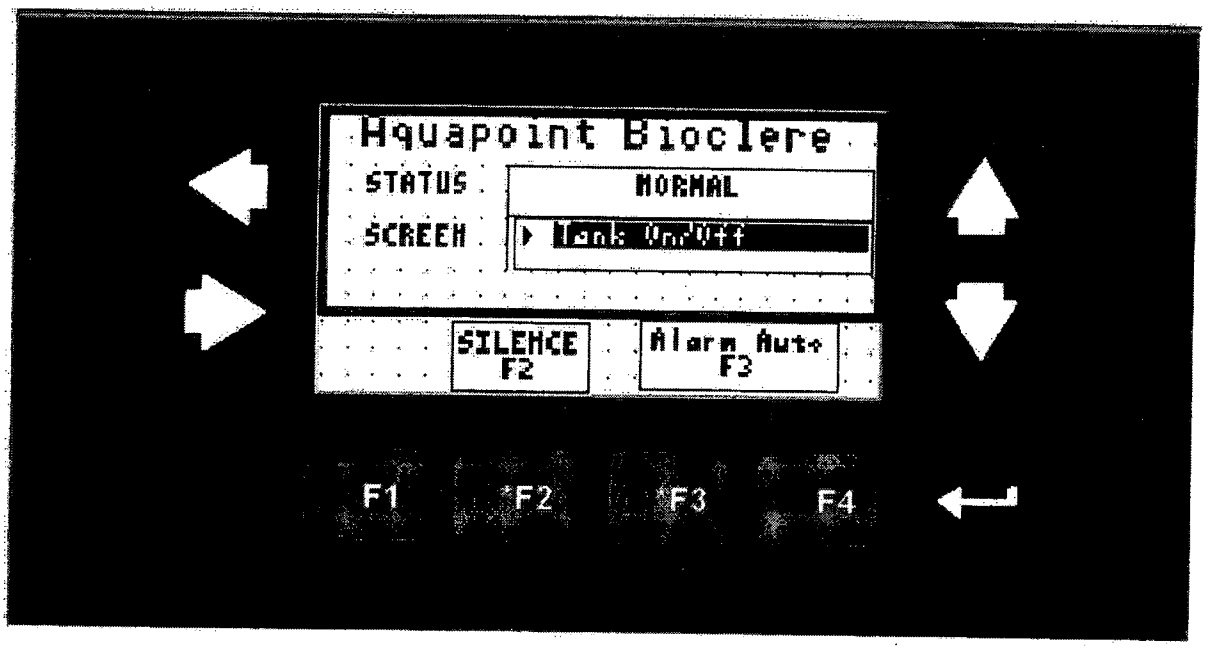
The Double Bioclere Wastewater Treatment Plant PLC System controls the operations of the pumps and alarms in a Double Bioclere Treatment System. A MicroLogix 1500 Programmable Logic Controller (PLC) is used to control all system functions if the system includes remote wireless telemetry. Non-telemetry systems use a Micrologix 1200 PLC. A Panel View 500 Human Machine Interface (HMI) is provided to allow access to timer values and to manually control the pump operation. The HMI also provides the operator access to pump cumulative run times, as well as system and alarm status.

Operating Instructions

Before starting the System, it must be installed according to the installation instructions provided, and by a qualified person.

The System is controlled entirely from the HMI. Upon power up, the Main HMI screen will automatically appear.

Main Screen



The system status indicator will inform the operator whether the system is running

normally or not.

Control screens for different system functions are accessed from the main screen. To select a screen use the UP/DOWN arrow keys until the desired screen appears in the list box, then use the enter key (left pointing arrow at lower right of HMI).

REVISION DATE: 04/18/06

Main Screen (cont.)

The **F2** key will silence the alarm horn, but will not clear the fault causing the alarm.
The **F3** key allows the operator to choose between the following alarm modes:
Alarm Auto: The alarm will sound normally in any alarm condition.
Alarm Off: The alarm will not sound, regardless of whether an alarm condition occurs.
Alarm Test: The alarm will sound for as long as the alarm is left in test mode.

Under normal operation the alarm should be set in Alarm Auto.

Tanks On/Off Screen

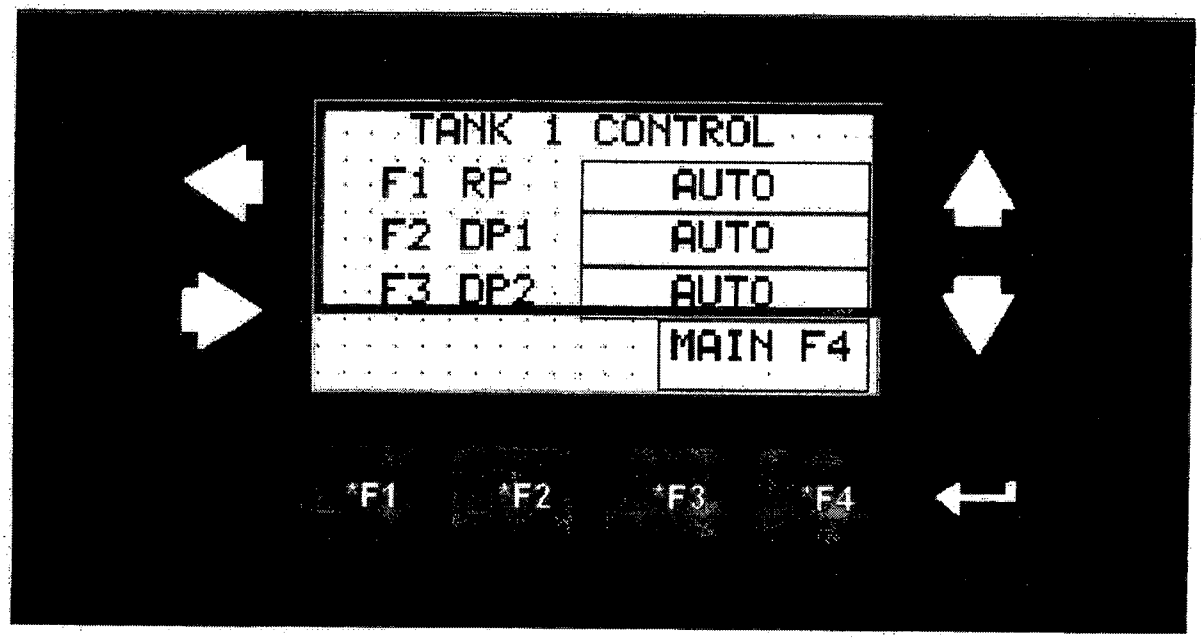
The Tanks On/Off Screen allows the operator to turn all pumps in a tank on or off. If the tank is off, all pumps in the tank will stay off regardless of individual pump settings and float conditions. Note: the pumps will be turned off, but the power is still on and the fan should be running.

If a tank is on, all pumps in that tank will operate according to their individual settings and float conditions.

The **F1** key will turn all pumps in tank 1 on or off.
The **F2** key will turn all pumps in tank 2 on or off.
The **F4** key will return the operator to the Main Screen.

REVISION DATE: 04/18/06

Tank # Control Screen (# = tank number)

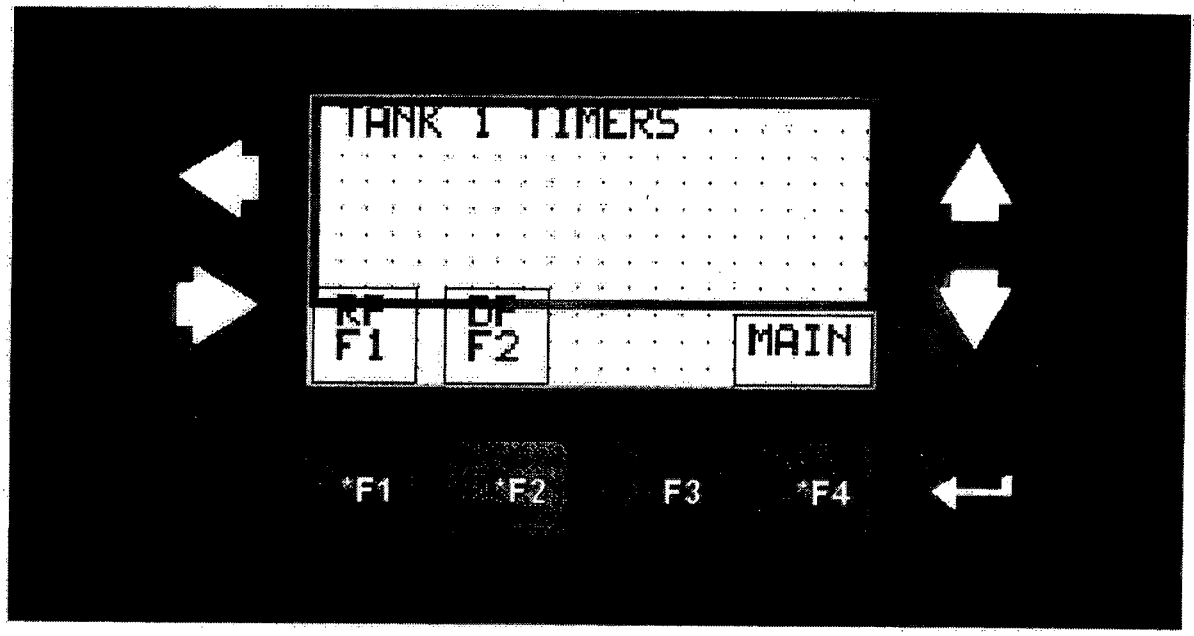


The Tank Control Screen allows the operator to control the recycle pump (RP), dosing pump #1 (DP1) and dosing pump #2 (DP2). Each pump may be placed in **AUTO, OFF**, or **ON** mode. In **AUTO** mode the pump will be controlled by the control system logic using the timer settings made in the TIMER screen. When placed in **OFF** the pump will be off and unaffected by the control system logic. When placed in **ON**, the pump is on continuously and is unaffected by the control system logic.

The **F1** key switches the Recycle Pump from **AUTO, OFF**, or **ON** mode.
The **F2** key switches the Dosing Pump #1 from **AUTO, OFF** or **ON** mode.
The **F3** key switches the Dosing Pump #2 from **AUTO, OFF** or **ON** mode.
The **F4** key changes to the main screen.

Note: If a pump in tank # is set to **OFF**, the alarm will sound, notifying the operator the pump is not set in **AUTO**.

Tank # Timer Screen (# = tank number)



The Tank # Timer screen allows the operator to select a timer screen for the Recycle Pump or Dosing Pump #1 and #2.

The **F1** key selects the Recycle Pump timer screen. Tank # RP
The **F2** key selects the Dosing Pump timer screen. Tank # DP
The **F4** key returns to the main screen.

REVISION DATE: 04/18/06

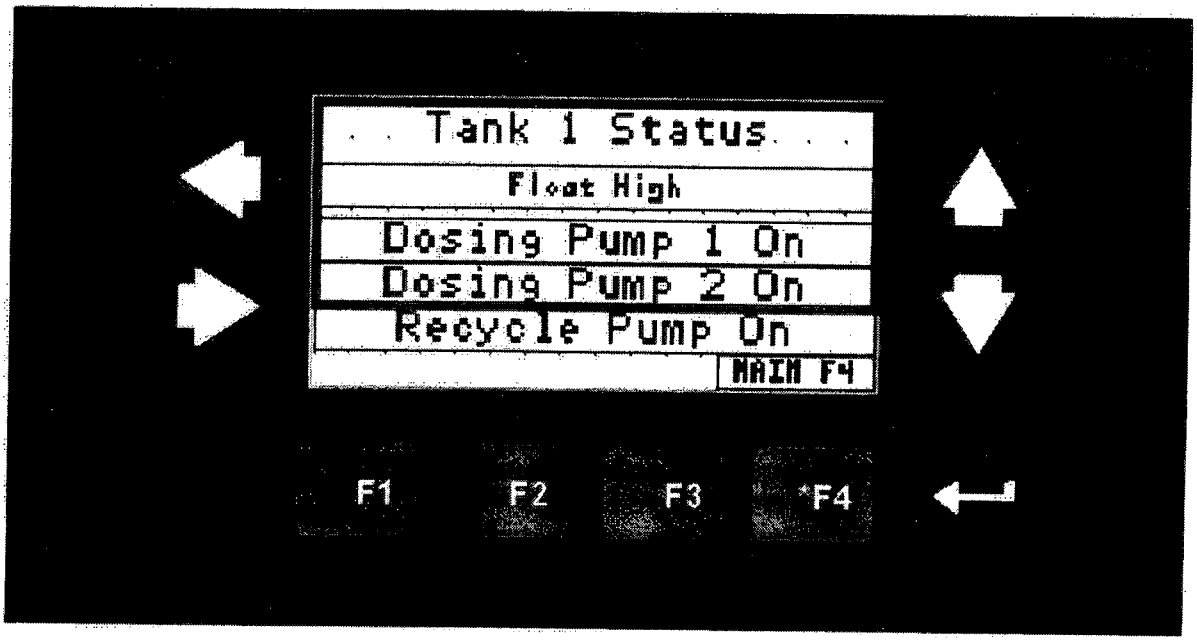
Tank # RP, Tank # DP Timer Screens

These screens allow the operator to adjust the pump timer values. There is a separate screen for each timer in each tank.

The **F1** key allows the operator to adjust the pump **ON** time. Time set in minutes.
The **F2** key allows the operator to adjust the pump **OFF** time. Time set in minutes.
Use the left and right arrows to select the digit to change.
Use the Up/Down keys to change the digit from 0 to 9.
The **F4** key returns to the main screen.

Tank # Status

(added 6/07/05)

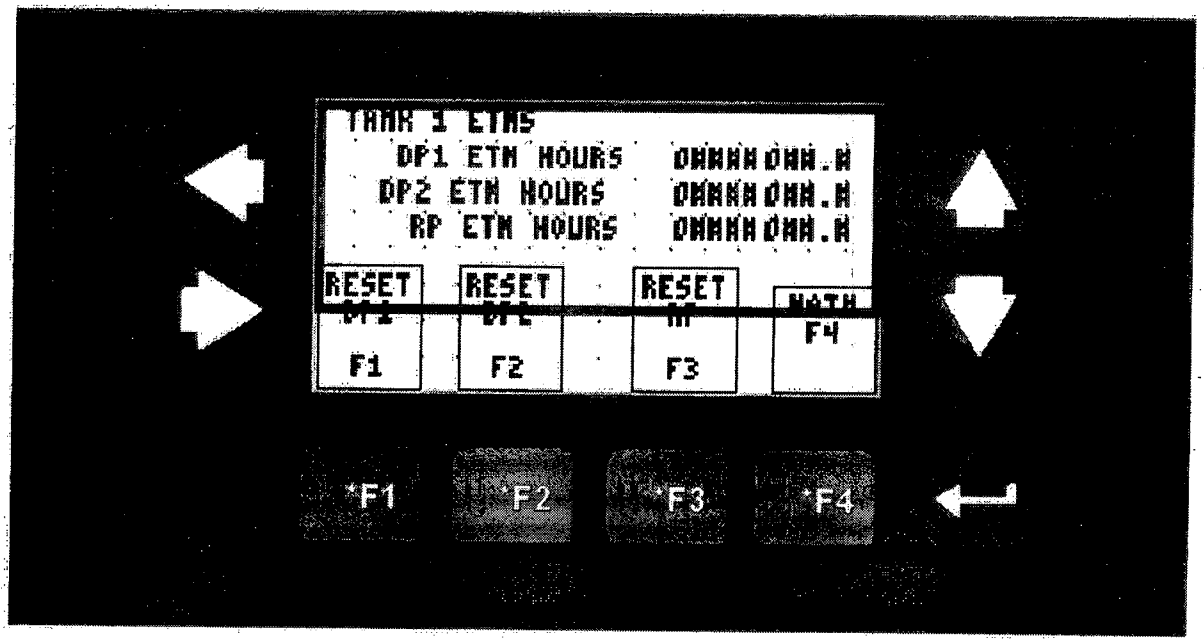


These screens show the status of all pumps and floats in the tank.

The **F4** key returns to the main screen.

REVISION DATE: 04/18/06

Tank # Elapsed Time Meters (ETMS)

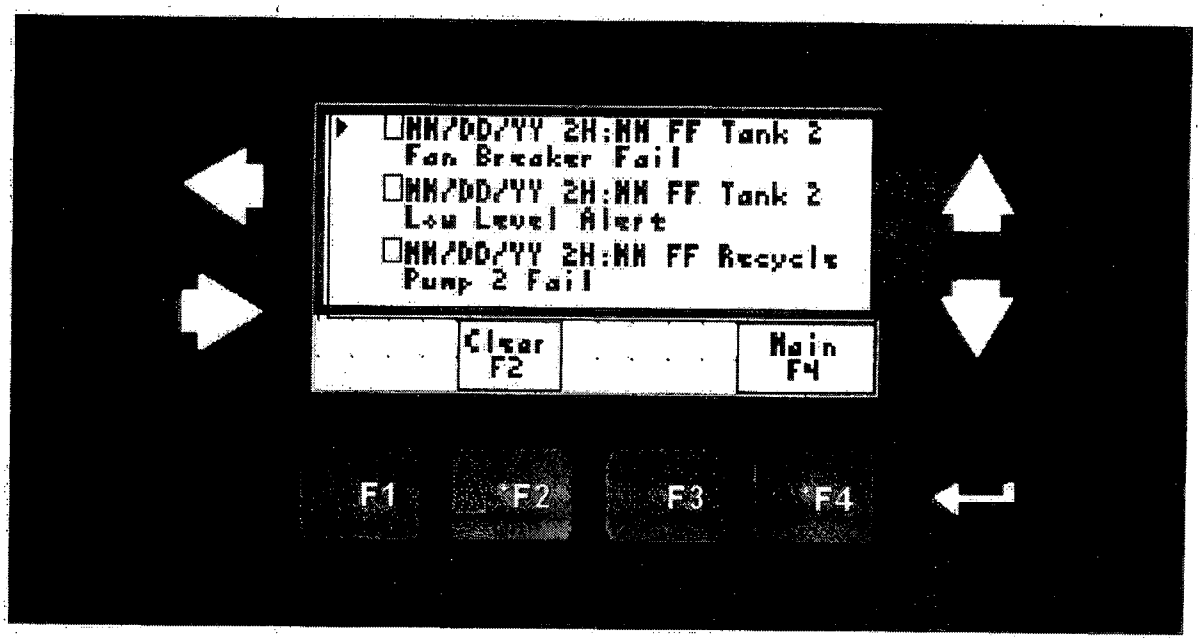


These screens show each tank's pump cumulative run time (in hours).

The **F1** key resets the DP1 ETM
The **F2** key resets the DP2 ETM
The **F3** key resets the RP ETM
The **F4** key returns to the main screen.
Remember to record and reset all pump ETMS when replacing a pump.

Alarm Log

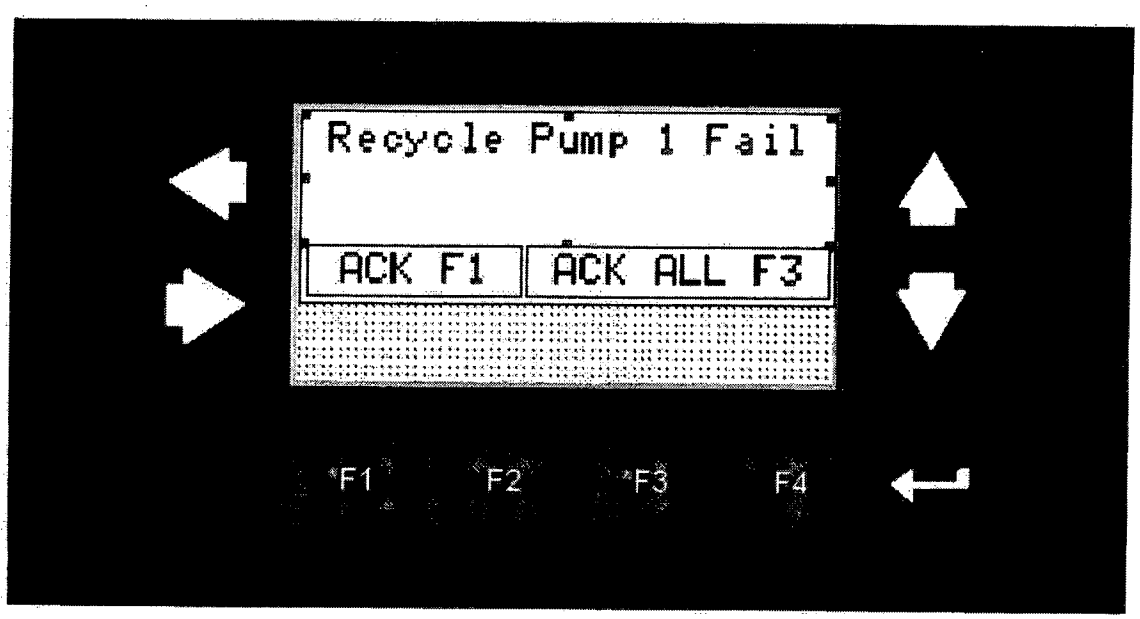
(added 6/07/05)



This screen is a record of all alarms that have occurred, with the time and date when the alarm was triggered.
Up and down arrows will scroll through the alarm list.
The **F2** key will view the alarm list clear confirmation window, press F1 to abort, **F2** to confirm clearing the alarm list.
The **F4** key returns to the main screen.

REVISION DATE: 04/18/06

Alarm Screen



The alarm screen is not a normal screen, and is not selectable from the main menu. It will only appear if an alarm condition occurs.
The alarm screen will show the alarm conditions that have occurred one at a time.
The **F1** key acknowledges the current alarm. The **F1** key must be pressed once for each alarm, and for each instance of the same alarm.
The **F2** key acknowledges all alarms, and all instances of the same alarm. (Added 6/07/05)

ALARM CONDITIONS/TROUBLESHOOTING

Caution: Turn off disconnect switch, lock out and tag out power, and verify prior to servicing!

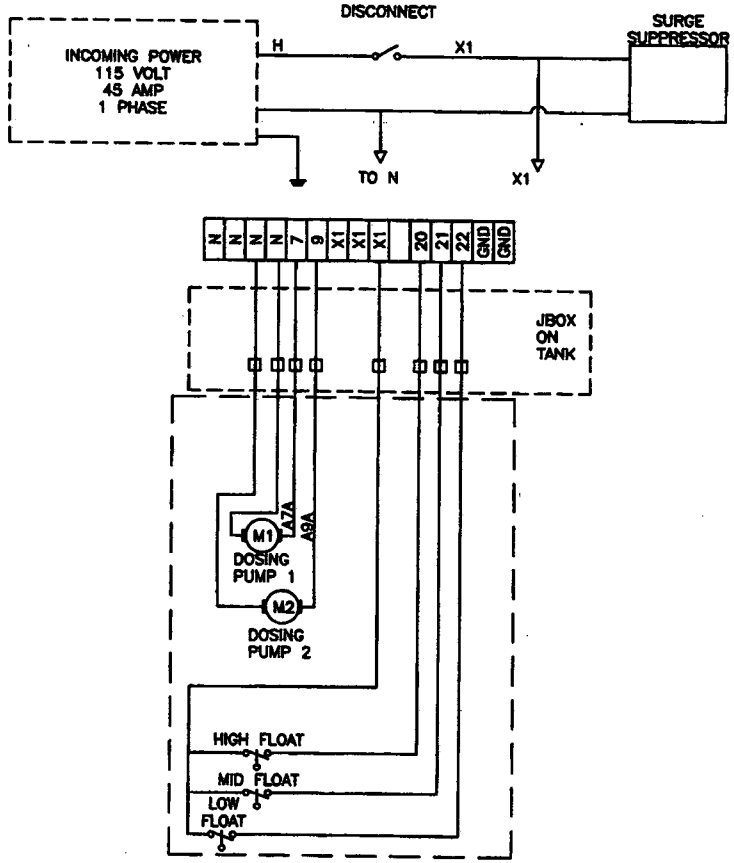
Tank # Fan/Float Circuit Breaker Fail: The fan/float switch circuit breaker has tripped.
Solution: Reset fan/float circuit breaker. Check float and fan for proper operation.

Tank # Pump # Fail: Pump # in Tank # is not running when it should be.
Solution: Possible problems or failure conditions consists of the following: pump clogged, pump internal thermal switch tripped or faulty current sensor, wire malfunction or loose connection, switch at junction box off or malfunctioning, contactor malfunction, or breaker tripped/malfunction.

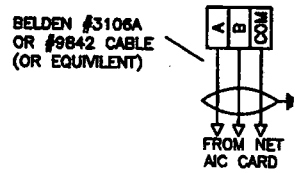
Tank # Low Level Alert: The tank # level has fallen below the Low Level Float Switch. **This is not an alarm condition!** In this condition the recycle pump will not run until the clarifier level in the Bioclere returns to normal.

REVISION DATE: 04/18/06

NOTES:



CONTRACTOR FIELD WIRING

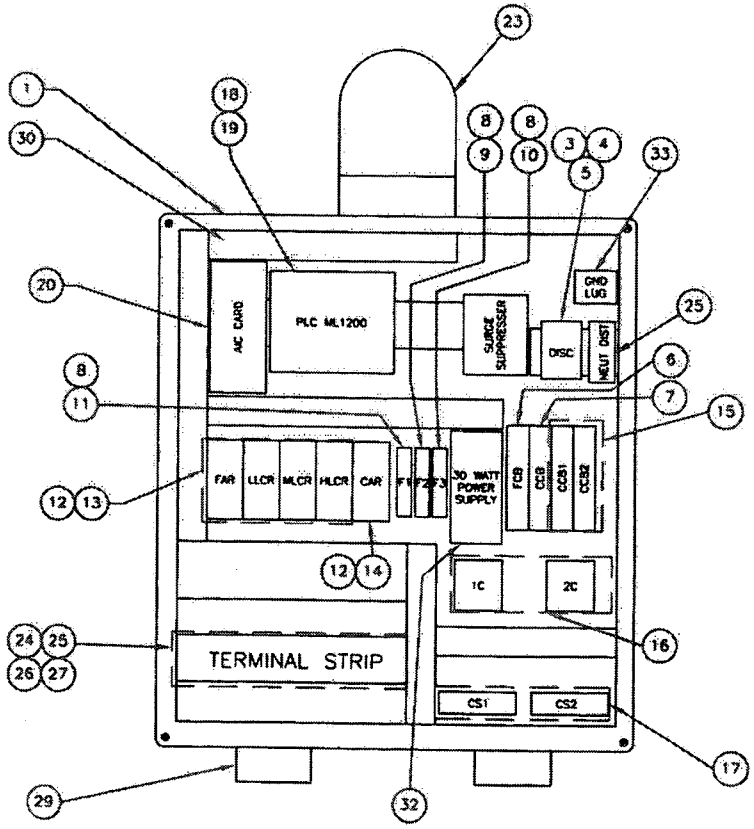


AquaPoint
241 DUCHAINE BLVD., NEW BEDFORD, MA 02745
(508) 995-7577 FAX (508) 995-7177

Pre EQ PLC

AWT3115

NOTES: ITEM 21 MOUNTED ON BACK OF DOOR

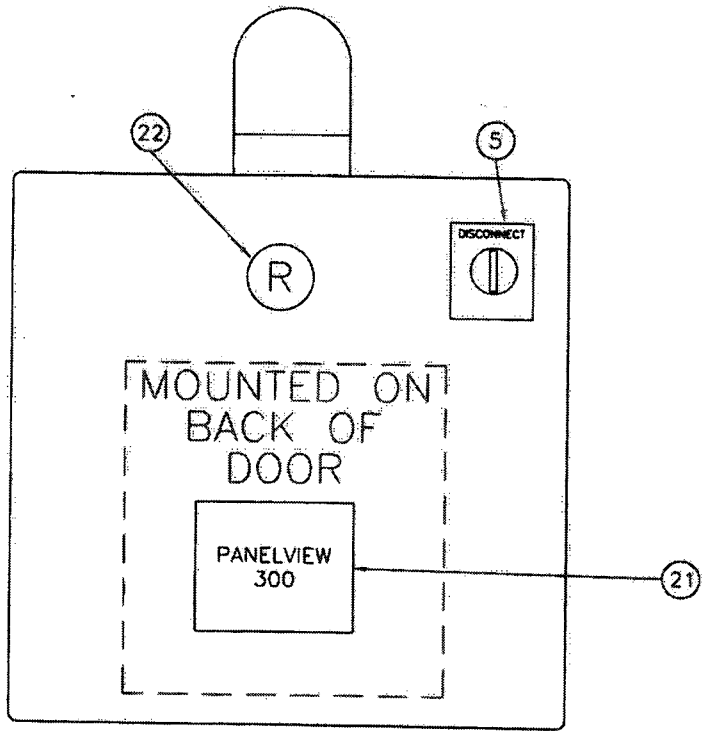


ITEM NO.	QTY	MANUFACTURE	DESCRIPTION	PART NO.
33	1	ILSCO	GROUND LUG	AU-0
32	1	IDEC	25W 24V POWER SUPPLY	PS5R-E24
31	3	ARVIN	NAMEPLATES	
30	6	VARIOUS	PANEL DUCT	
29	2	VARIOUS	LEGS	
28	6	VARIOUS	DIN RAIL	
27	3	ENTRELEC	TERMINAL END BLOCKS	10300206
26	2	ENTRELEC	TERMINAL BARRIERS	21183161B
25	6	ENTRELEC	TERMINALS 50A/#8 AWG	01151181
24	20	ENTRELEC	TERMINALS 30A/#10 AWG	11511607
23	1	PATLITE	120V RED BEACON W/ HORN	RHB120 AULR
22	1	IDEC	120V AMBER LIGHT	APW199A120
21	1	ALLEN BRADLEY	MICRO 300 PANELVIEW DISPLAY	2711M3A19L1
20	1	ALLEN BRADLEY	INTERFACE CONVERTER	1761-NET-AIC
19	1	ALLEN BRADLEY	MICROLOGIX 1200 BASE UNIT	1764-L24BXB
18	1	ALLEN BRADLEY	PROCESSOR	1764 LRP
17	2	DIVERSIFIED	CURRENT SENSING RELAYS	CMG 010020
16	2	AEG	CONTACTORS 24VDC 16A 1 NO	LS07.10.NSW
15	2	ABB	1 POLE CIRCUIT BREAKERS	TS272K8
14	1	IDEC	2 POLE RELAY LIGHTED 24VDC	RH2BULAC24
13	5	IDEC	2 POLE RELAYS LIGHTED 120V	RH2BULAC120
12	6	IDEC	2 POLE RELAY SOCKETS	SH2B-05
11	1	BUSSMAN	TIME DELAY FUSE	MDL5
10	2	BUSSMAN	TIME DELAY FUSES	MDL3
9	3	BUSSMAN	TIME DELAY FUSES	MDL1
8	6	ALTECH	DIN RAIL MOUNTED FUSEHOLDER	11022
7	1	ABB	3A 1 POLE CIRCUIT BREAKER	S271K3A
6	1	ABB	.5A 1 POLE CIRCUIT BREAKER	S271K0.5A
5	1	ABB	HANDLE	OHB2AJ1
4	1	ABB	SHAFT	OX55X180
3	1	ABB	45 AMP DISCONNECT SWITCH	OT45E3
2	1	MCKINSTRY	17 x 15 SUBPANEL	42/3024
1	1	ROBROY	30 X 24 X 10 ENCLOSURE	N302410HWT

Pro SD PLC

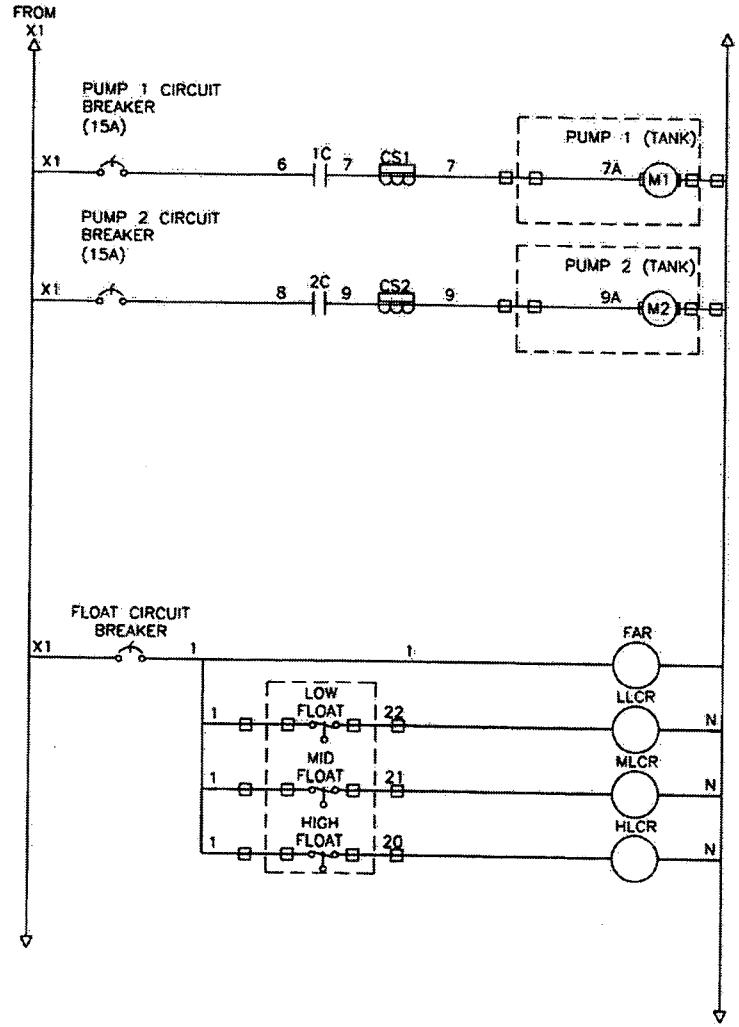
AWT3115

NOTES:



Prg ED PLC
A
AWT3115

NOTES:

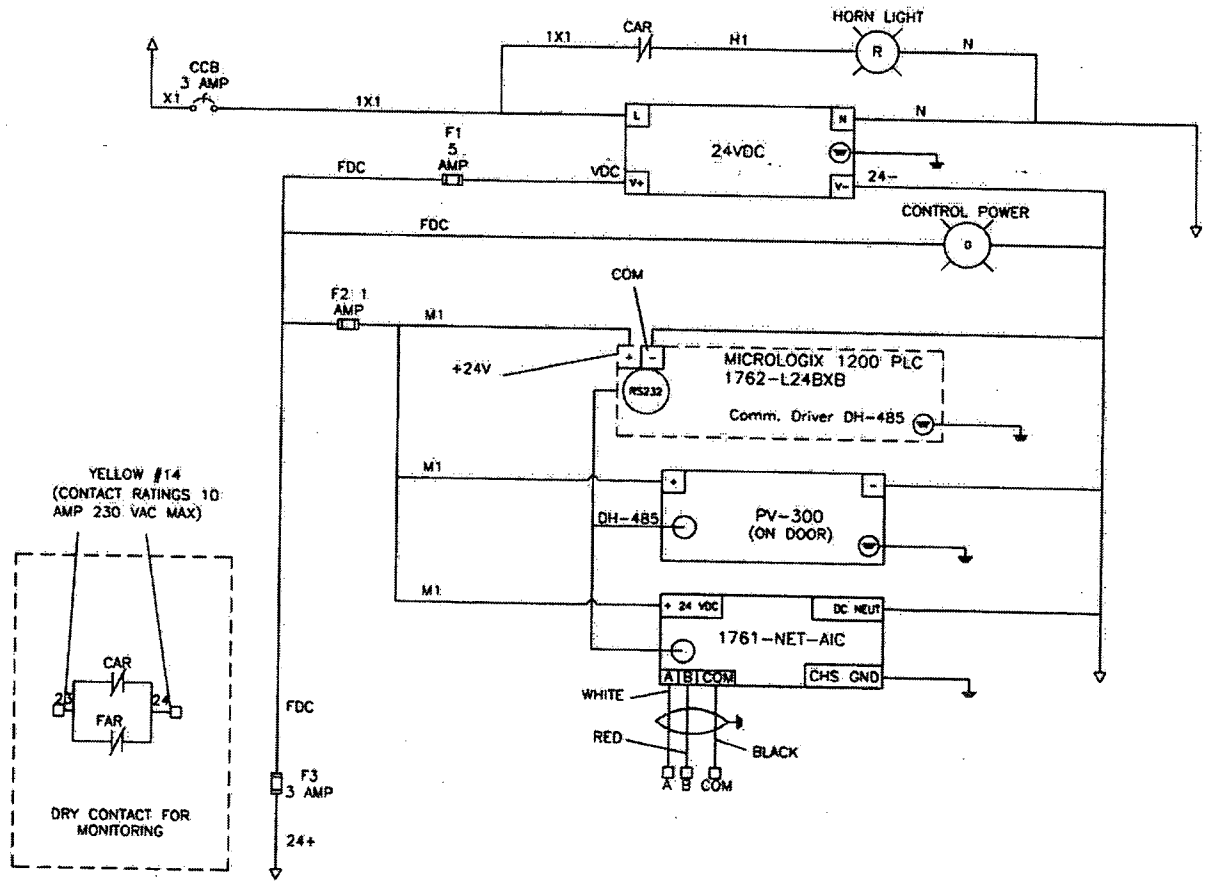


Pro ED PLC

A

AWT3115

NOTES:

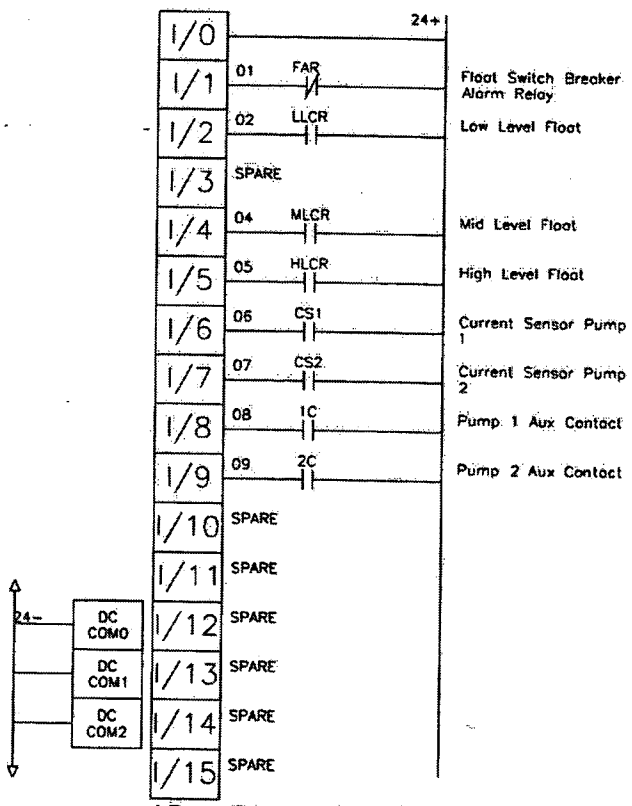


Pro ED PLC

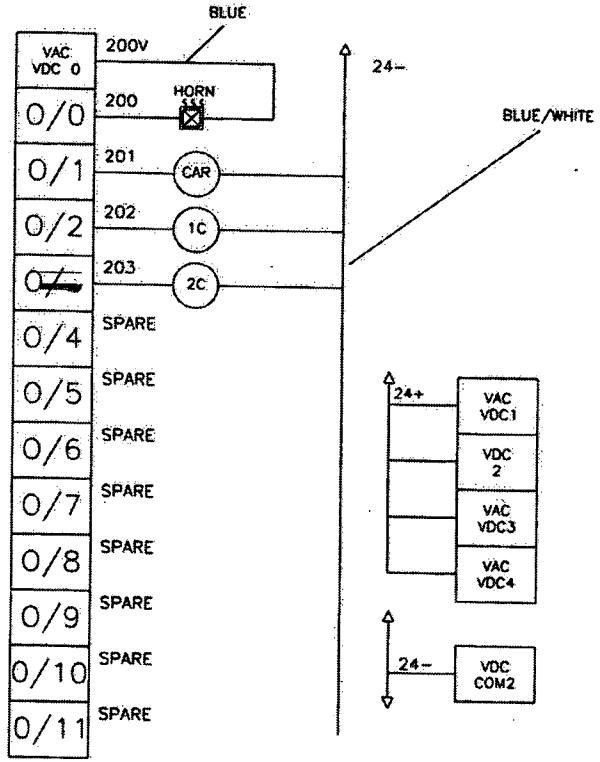
A

AWT3115

NOTES:



AB-1764-28BXB
INPUT - BASE UNIT



AB-1764-28BXB
OUTPUT - BASE UNIT

Pre EO PLC
A
AWT3115

Aquapoint Control Systems
Equalization Programmable Logic Control (PLC) System

System Description

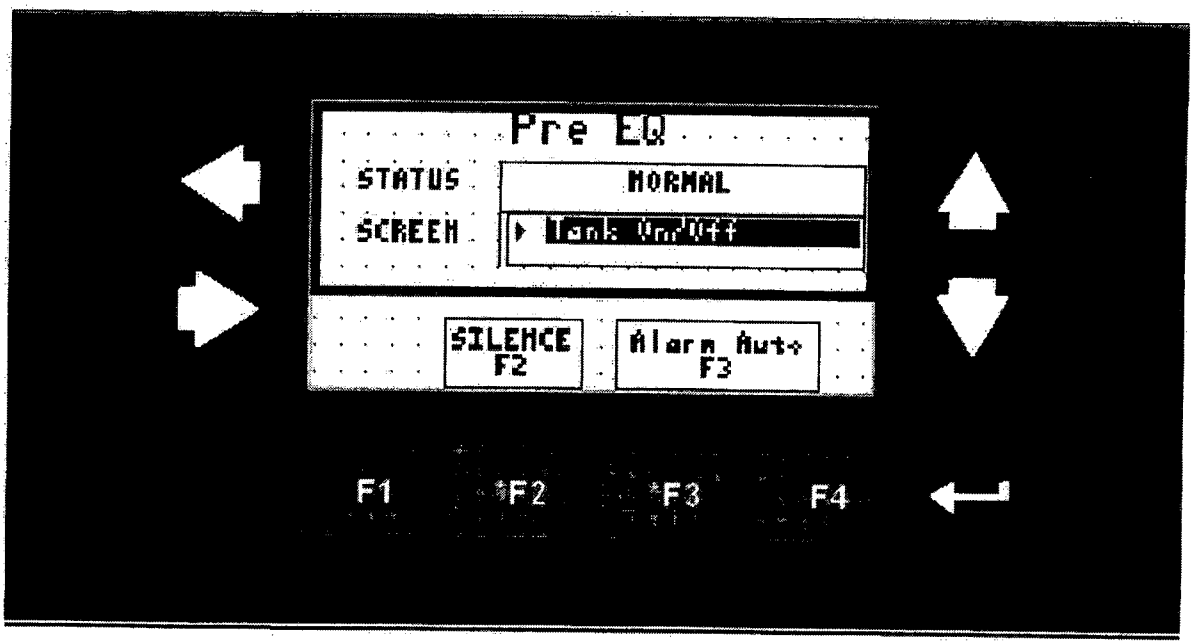
The Equalization Tank PLC System controls the operations of the pumps and alarms in an equalization tank. A MicroLogix 1500 Programmable Logic Controller (PLC) is used to control all system functions if the system includes remote wireless telemetry. Non-telemetry systems use a Micrologix 1200 PLC. A PanelView 500 Human Machine Interface (HMI) is provided to allow access to timer values and to manually control the pump operation. The HMI also provides the operator access to pump cumulative run times, as well as system and alarm status.

Operating Instructions

Before starting the system, it must be installed according to the installation instructions provided, and by a qualified person.

The system is controlled entirely from the HMI. Upon power up the Main HMI screen will automatically appear.

Main Screen



The system status indicator will inform the operator whether the system is running normally or not.

Screens to view different system functions are accessed from the main screen. To select a screen, use the UP/DOWN arrow keys until the desired screen appears in the list box, then press the enter key (left pointing arrow at lower right of HMI).

Revision Date 04/24/06

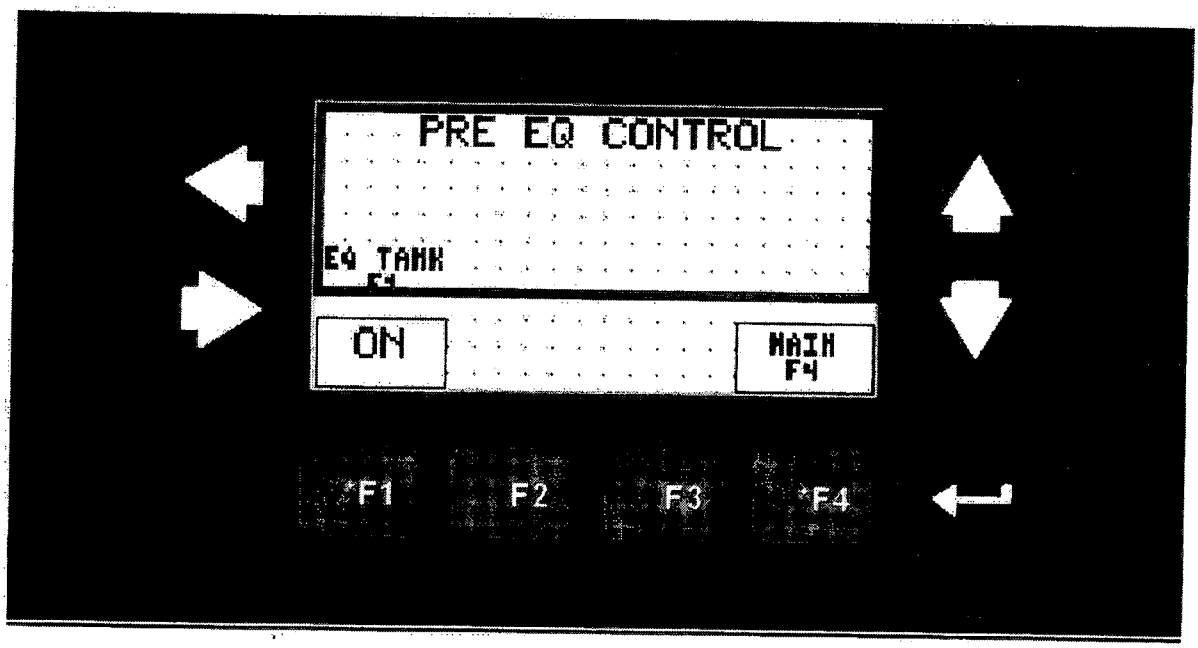
Main Screen (cont.)

The **F2** key will silence the alarm horn, but will not clear the fault causing the alarm.
The **F3** key will let the operator switch between the following alarm modes:

Alarm Auto: The alarm will sound normally in any alarm condition.
Alarm Off: The alarm will not sound, regardless of whether an alarm condition occurs.
Alarm Test: The alarm will sound for as long as the alarm is left in the test mode.

Under normal operation the alarm should be set to **Alarm Auto**.

Tank On/Off Screen



The Tank On/Off Screen allows the operator to turn an equalization tank control on or off. If a tank is **OFF**, all the pumps in that tank will stay off regardless of individual pump settings

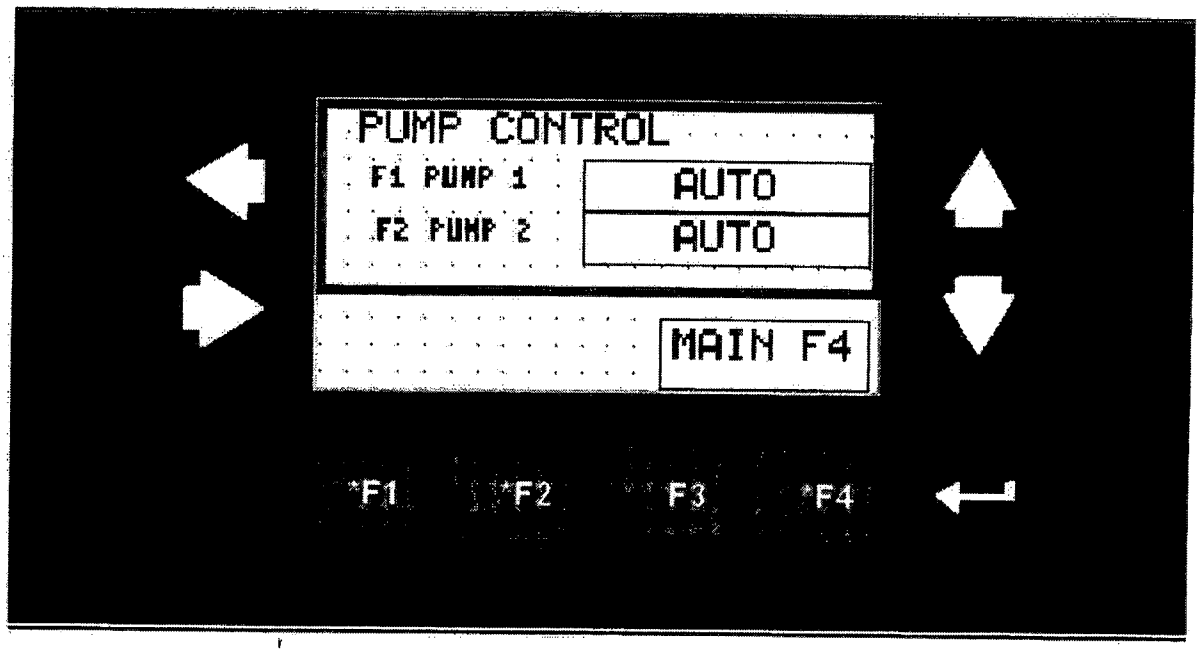
and float conditions.
If a tank is **ON,** all the pumps in that tank will operate according to their individual settings and float conditions.

The **F1** key will turn an equalization tank control on or off.

The **F4** key will return the operator to the Main Screen.

Revision Date 04/24/06

Pump Control Screen



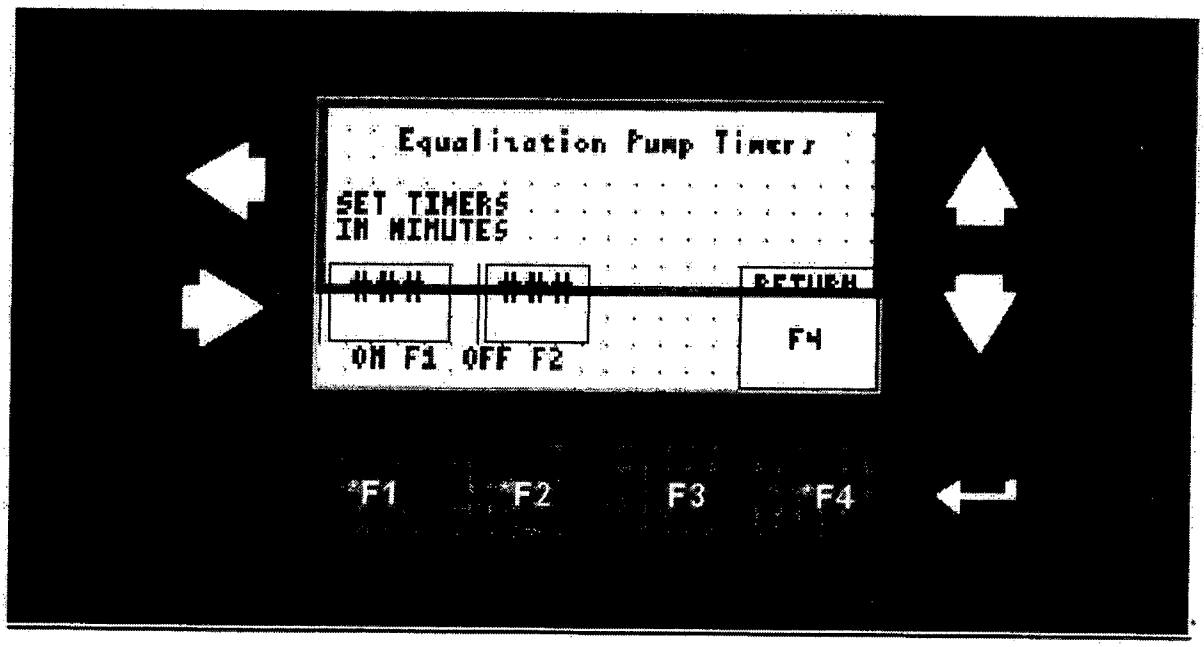
The Pump Control Screen allows the operator to change the operation of the equalization pumps. Each pump may be placed in **AUTO, OFF**, or **ON** mode.
In **AUTO** mode the pump will be controlled by the floats and the control system logic using the timer settings made in the TIMER screen.
When placed in **OFF** the pump will be off and unaffected by the control system logic. When placed in **ON**, the pump is on continuously and is unaffected by the control system logic.

The **F1** key changes Pump #1 from **AUTO, OFF** or **ON** mode.
The **F2** key changes the Pump #2 from **AUTO, OFF** or **ON** mode.

Note: If a tank is set to **ON** and a pump is set to **OFF**, the alarm may sound to notify the operator all pumps are not set to **AUTO**.

The **F4** key returns to the main screen.

Pump Timer Screen



The Pump Timer screen allows the operator to adjust the timers for the Equalization pumps.

The **F1** key allows the operator to adjust the pump **ON TIME**. After pressing F1 press enter to set **ON TIME**. Enter an **ON TIME** value by using the up/down arrows. Enter a value between 1 and 999 then press the enter key. Press the F1 key to Escape (ESC).

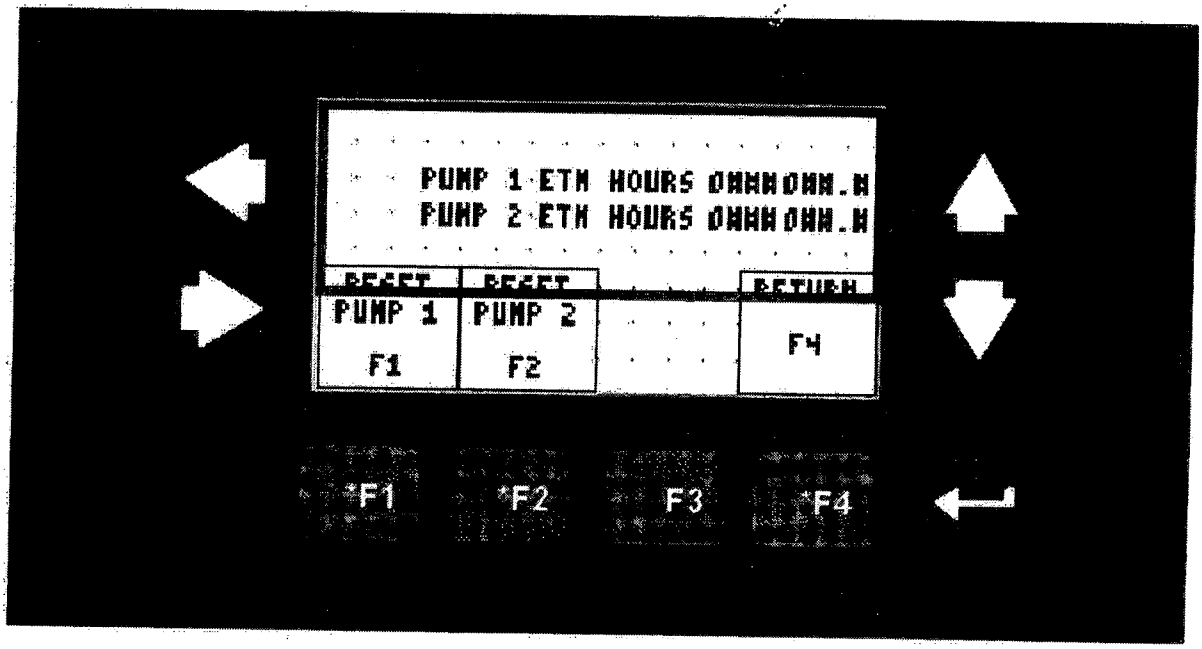
Revision Date: 04/24/06

Pump Timer Screen (cont.)

The **F2** key allows the operator to adjust the pump **OFF TIME**. After pressing F2 press enter to set the **OFF TIME**. Enter an **OFF TIME** value between 1 and 999 then press the enter key. Press the F1 key to Escape (ESC).

The **F4** key returns to the main screen.

Elapsed Time Meters (ETMS) Screen

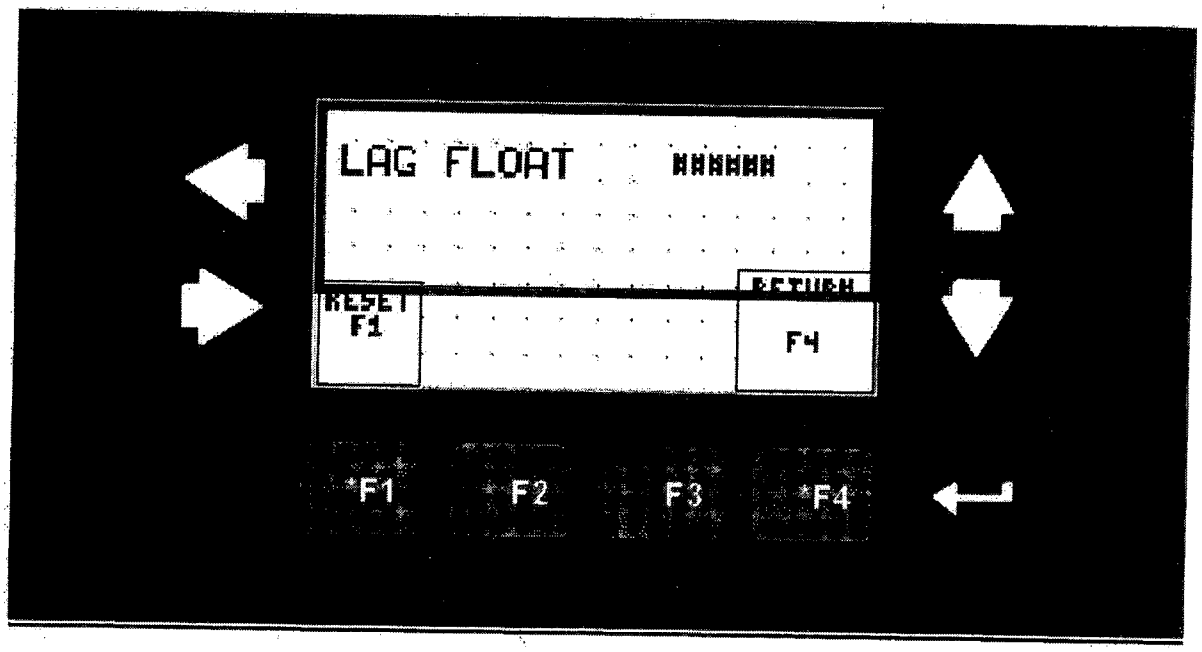


These screens show the cumulative run time (in hours) for each pump.
The **F1** key resets the Pump 1 ETM
The **F2** key resets the Pump 2 ETM

The **F4** key returns to the main screen.

If a pump is replaced record ETM readings and reset **ALL** ETMS to zero.

Lag Float Count Screen



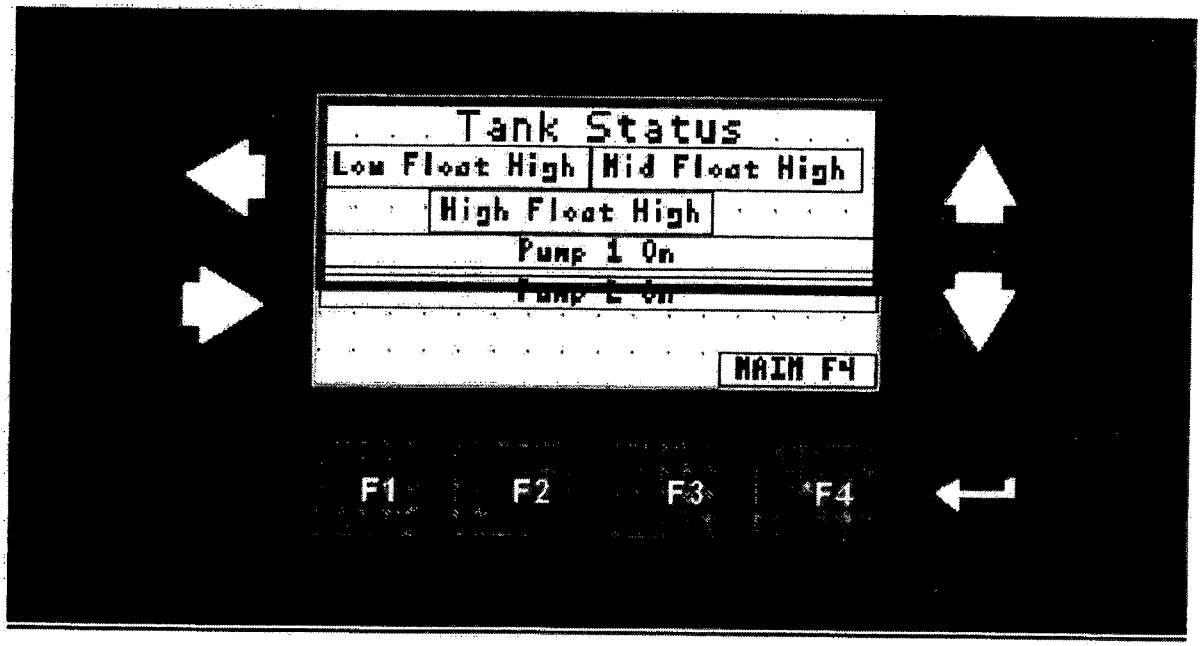
This screen displays the amount of times the water level rose above the lag float.

The **F1** key resets the Lag Float Counter.

The **F4** key returns the operator to the main screen.

Revision Date 04/24/06

Tank # Status Screen

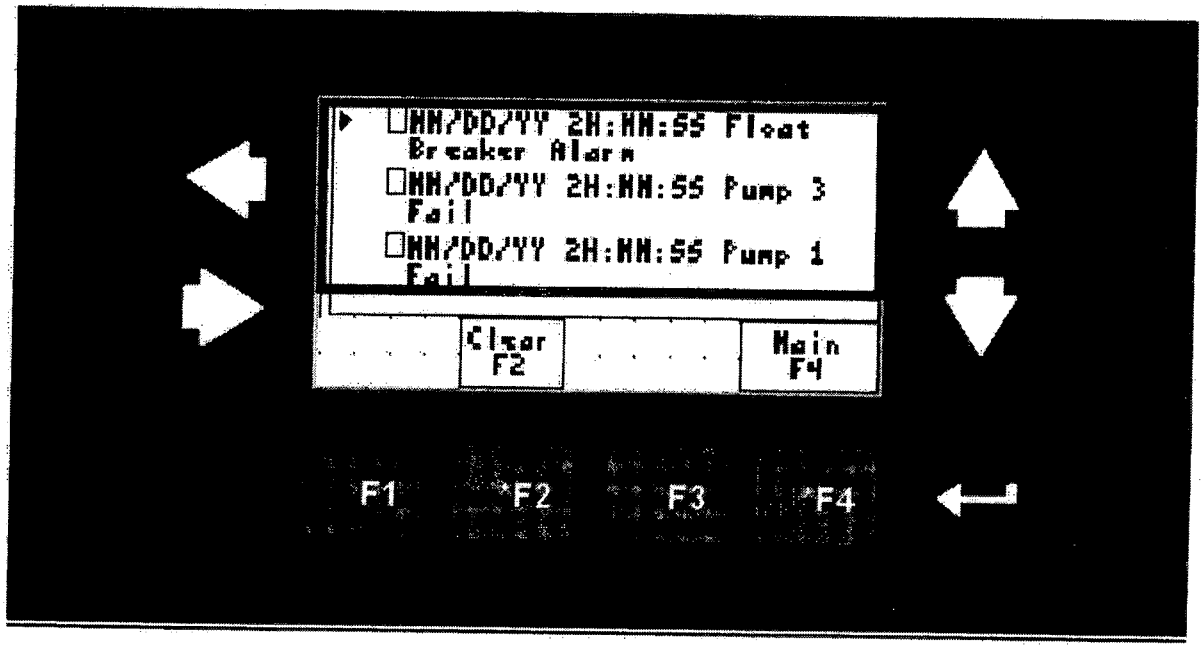


This screen displays the status of the pumps and floats at the present time.

Note: These are not records of pump settings but actual present pump conditions. The status of a float is either high or low. High means the float switch is closed and low means the float switch is open.

The **F4** key returns the operator to the main screen.

Alarm Log



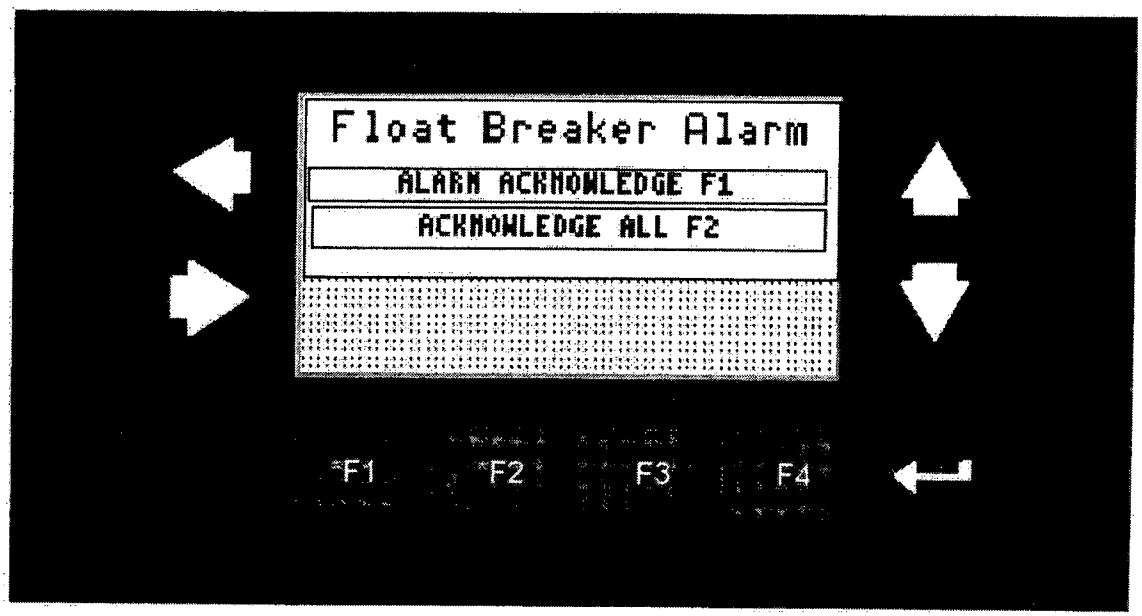
The alarm log is a list of up to the last 40 alarms which occurred, with the time and date they occurred. Use the up and down arrow keys to scroll through the list.

The **F2** key clears the alarm list. (You will be prompted to verify that you want to clear the list, press the **F2** key to confirm, press the **F1** key if you do not want to clear the list.)
The **F4** key returns the operator to the main screen.

(For details regarding each individual alarm see alarm section below.)

Revision Date: 04/24/06

Alarm Screen



The alarm screen is not a normal screen, and is not selectable from the main menu. It will only appear if an alarm condition occurs.
The alarm screen will show the alarm conditions that have occurred one at a time.

The **F1** key acknowledges the current alarm. The **F1** key **must** be pressed once for each alarm, and for each instance of the same alarm.
The **F2** key acknowledges all alarms, and all instances of the same alarm. (Added 6/07/05)

ALARM CONDITIONS/TROUBLESHOOTING:

Caution: Turn off Disconnect Switch, lock out and tag out power, and verify prior to Servicing!

Float Circuit Breaker Fail: The float switch circuit breaker has tripped.
Solution: Reset float switch circuit breaker. Possible problems consist of the following: faulty float, incorrect wiring, or loose wire connection.

Pump # Fail: Pump # is not running when it should be.
Solution: Determine the cause of failure. Possible problems or failure conditions consist of the following: pump clogged, pump internal thermal switch tripped, faulty current sensor, wire malfunction or loose connection, contactor malfunction, or circuit breaker tripped or failed.

Low Level Alert: The tank level has fallen below the Low Level Float Switch. **This is not an alarm condition!** Depending on the PLC, pumps set to manual may or may not run when the water level in the tank is below the low level float.

High Level Alarm: The tank level has risen above the High Level Float Switch.
Solution: Verify all pumps are working correctly and in **AUTO** mode. Verify all float switches are functioning correctly and represent existing conditions. If all pumps and floats are working correctly then the pump timer **ON** setting might need adjustment.

Revision Date 04/24/06

APPENDIX C

PURCHASERS WARRANTY

PURCHASERS WARRANTY

Re: Commissioned date:

Aquapoint Inc., a Massachusetts Corporation, warrants to the purchaser that the Bioclere wastewater treatment plant is free from defects in material and workmanship for a period of one (1) year from the date of installation. Date of warranty shall mean the day specified on Installation Report.

Aquapoint Inc. shall fulfill this warranty by repairing or exchanging any component part that in Aquapoint's judgment shows evidence of defect during the warranty period.

This warranty does not cover treatment processes, or Bioclere units which have been flooded by external means, which have been disassembled by unauthorized persons, which have been improperly installed, which have been subjected to external damage or which have not been operated and maintained in accordance with the manufacturers recommended procedures.

This warranty applies only to the Bioclere wastewater treatment plant and does not include any of the building wiring, plumbing, drainage, or disposal systems. Aquapoint Inc. is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale or use of this treatment plant.

Aquapoint Inc. reserves the right to revise, change or modify the construction or design of the Bioclere wastewater treatment plant or any component part thereof without incurring any obligation to make such changes or modification in previously sold equipment. Aquapoint Inc. also reserves the right to make replacements of component parts under this warranty, to furnish component parts, which, in its judgment, are equivalent to the component part, replaced.

Under no circumstances will Aquapoint Inc. be responsible for any other direct or consequential damages, including but not limited to lost profits, lost income, labor charges, delays in production and/or idle production, which damages are caused by a defect in material and/or workmanship in parts.

This warranty is expressly in lieu to any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of Aquapoint Inc.

Please fill out and return no later than ten (10) days after installation to:

AQUAPOINT
241 Duchaine Blvd.
New Bedford, MA 02745

Tel. 508-998-7577 / Fax 508-998-7177

Signed: _____
Aquapoint Inc. / Date

Signed: _____
Property Owner / Date

APPENDIX D

RECOMMENDED SPARE PARTS

Bioclere PLC CONTROL PANELS:

Recommended Spare Parts

Quantity	Description	Part No.
One (1)	AEG Contactor 24 VDC Coil	LS07.10NSW
One (1)	Diversified current sensor	CMG-0100-20
One (1)	Bussman Time Delay fuse 1A	MDL1
One (1)	Bussman Time Delay fuse 3A	MDL3
One (1)	Bussman Time Delay fuse 5A	MDL5
One (1)	ABB 3A 1 Pole Circuit Breaker/Control	S271K3A
One (1)	60W 24VDC Power Supply	PS5RSD24
One (1)	2 Pole 120V Relay	RH2BULAC120
One (1)	2 Pole 24V Relay	RH2BULDC24V
Four (4)	Entrelec terminals	0115 116 07
One (1)	ABB ½ A 1 Pole Fan Circuit Breaker	S271K0.5A
One (1)	16A 1 Pole Pump Circuit Breaker	S271K16A

BIOCLERE UNITS:

Quantity	Description	Part No.	Model
One (1)	Grainger fan	4C720	36
One (1)	Grundfos1hp pump (Dosing and Recycle)	AP12.40.08.01	36
One (1)	Barnes SE 411 (5.12 impeller)		Pre-Equalization

APPENDIX E

PUMP CURVES

12 mm Free Passage 60 Hz AP12.40.08.1

General Description

The GRUNDFOS AP12 pump is a single-stage submersible pump designed for the pumping of drainage water.

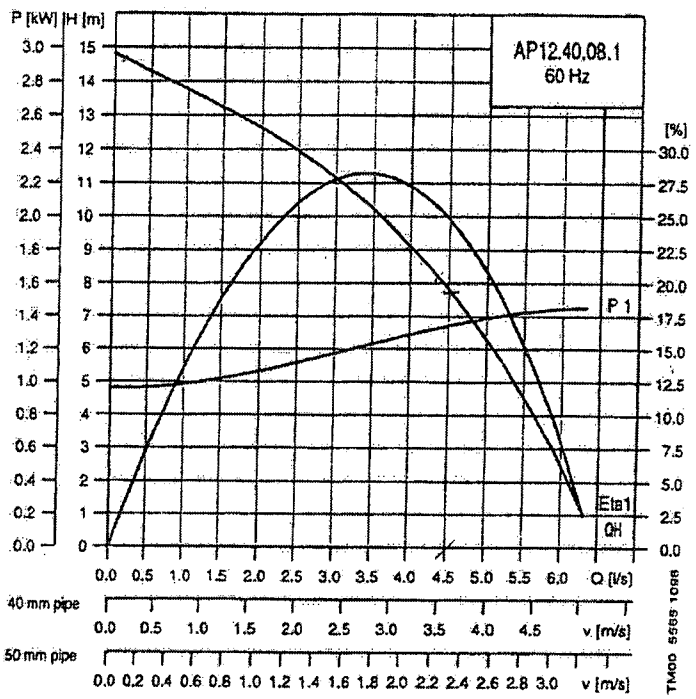
GRUNDFOS AP12 is suitable for the following applications:

- Groundwater lowering
- Pumping in drainage pits
- Pumping in surface water pits with inflow from roof gutters, shafts, tunnels, etc.
- Emptying of ponds, tanks, etc.

The pump is available with built-in thermal motor protection, and with 3 or 10 m cable.

The pump is available with or without level switch.

The use of an earth leakage circuit breaker (ELCB) with a nominal trip current < 30 mA is mandatory.



Unit Data

Voltage [V]	P_1/P_2 [kW]	I_n/I_{start} [A]	Cos φ
1 x 220 - 230	1,3/0,8	5,9/22,3	0,99

Mains	: 60 Hz, 1-phase
Enclosure class	: IP 58
Insulation class	: F (155°C)
Speed	: 3400 min^{-1}
Solids passage	: 12 mm
Efficiency (η_{max})	: 28 %
pH-range	: 4-10
Temperature range	: 0-55°C
Max. install. depth	: 10 m
Starts per hour	: Max. 20
Max. density of liquid	: 1100 kg/m^3
Weight[1]	: 12.4 - 13.2 kg

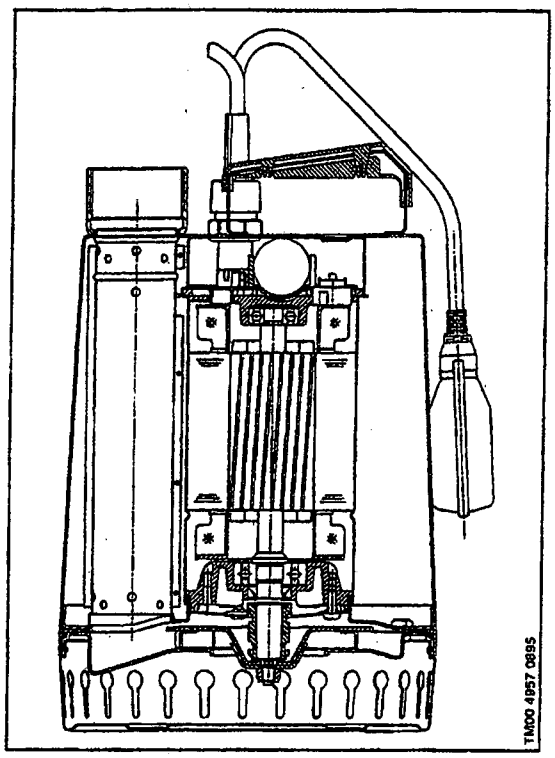
Material Specification

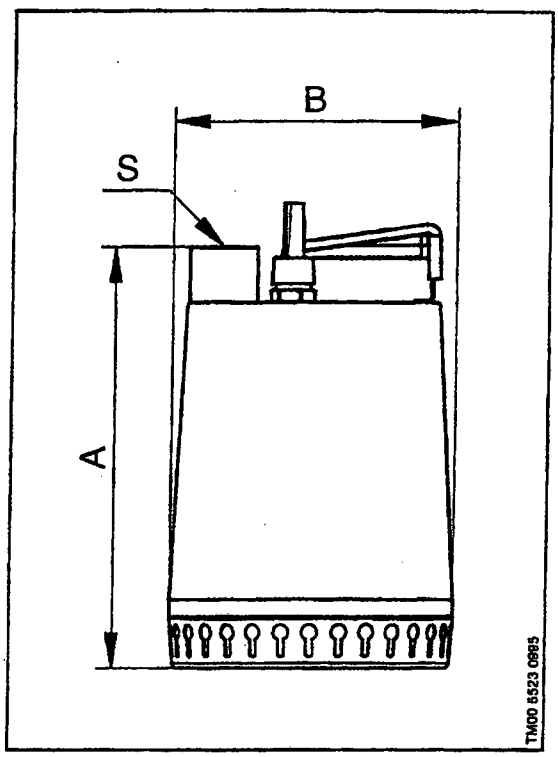
Description	Material	DIN W.-No.	AISI/ASTM
Pump housing	Stainless steel	1.4301	304
Riser pipe	Stainless steel	1.4301	304
Impeller	Stainless steel	1.4301	304
Pump sleeve	Stainless steel	1.4401	316
Lock nut and washer	Stainless steel	1.4301	304
Suction strainer	Stainless steel	1.4301	304
Mechanical shaft seal	Silicon carbide/silicon carbide NBR rubber, Stainless steel 1.4301/304		
Motor unit complete	Parts in contact with liquid: Stainless steel	1.4401	316
Shaft with rotor	Stainless steel/Silumin	1.4305	
Motor cable	Neoprene		
Cable/level switch	Neoprene/Polypropylene		
Screws	Stainless steel	1.4301	304
O-rings	NBR rubber		
Handle complete	Luranyl		
Nuts for cable entries	Nickel plated brass (CuZn36Pb2As)		
Oil	60 ml Cassida fluid 68		

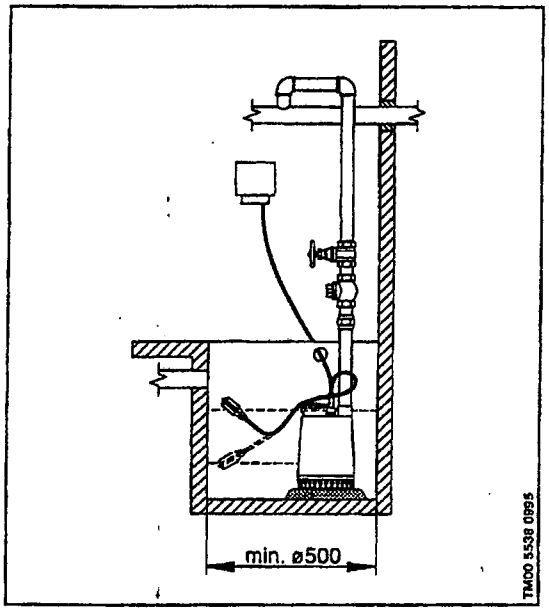
1. Dependent on pump version, incl. of cable.

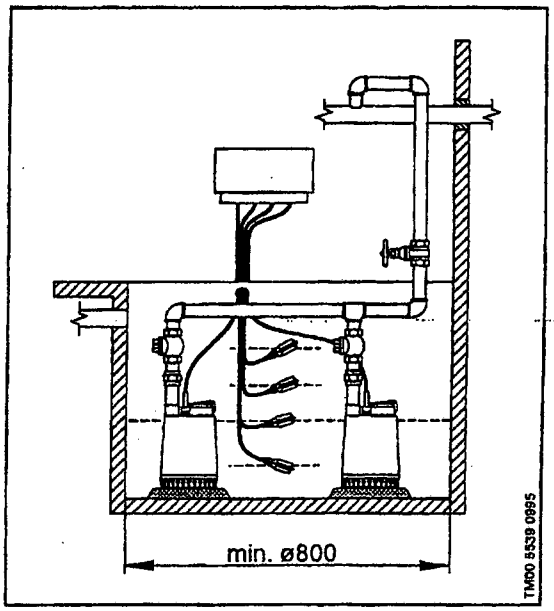
GRUNDFOS®

12 mm Free Passage 60 Hz AP12.40.08.1









Dimensions [mm]

A	B	S
346	216	Rp 1½

GRUNDFOS®

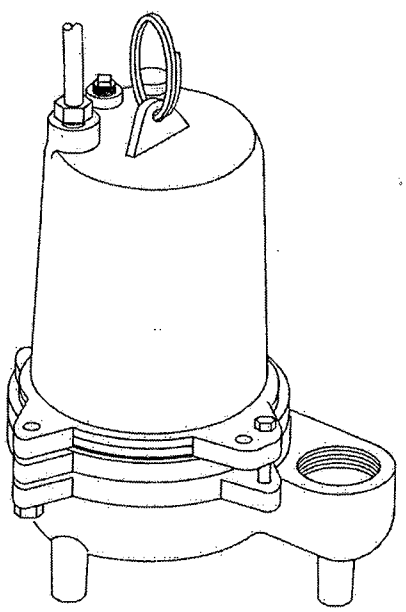
D.05 / 01.03.1996

Series SE

2" Spherical Solids Handling Manual & Automatic

1½", 2" & 3" Discharge

DISCHARGE	2" NPT, Female, Vertical
LIQUID TEMPERATURE	
SE411	77°F (25°C) Continuous
SE421	104°F (40°C) Continuous
VOLUTE	Cast Iron ASTM A-48, Class 30
MOTOR HOUSING	Cast Iron ASTM A-48, Class 30
SEAL PLATE	Cast Iron ASTM A-48, Class 30
IMPELLER:	
Design	2 Vane, Open with pump out vanes on back side, Dynamically Balanced, ISO G6.3
Material	Cast Iron ASTM A-48, Class 30
SHAFT	416 Stainless Steel
SQUARE RINGS	Buna-N
HARDWARE	300 Series Stainless Steel
PAINT	Air Dry Enamel
SEAL: *Design*	Single Mechanical, Oil Filled Reservoir, Secondary Exclusion Seal
Material	Carbon/Ceramic/Buna-N Hardware - 300 Series Stainless
CORD ENTRY	15 ft. (5m) Quick Disconnect Cord with plug On 115Volt, Pressure Grommet for sealing and strain relief
SPEED	1750 RPM (Nominal)
UPPER BEARING	Single Row, Ball, Oil Lubricated
Load	Radial
LOWER BEARING	Single Row, Ball, Oil Lubricated
Load	Radial & Thrust
MOTOR: *Design*	NEMA L Torque Curve, Oil Filled, Squirrel Cage Induction
Insulation	Class B
SINGLE PHASE	Permanent Split Capacitor (PSC) Includes Overload Protection in Motor
LEVEL CONTROL	**"A"** - Wide Angle, PVC, Mechanical, 15 ft (5m) cord with Piggy-Back Plug, N/O **"AU"**- Wide Angle, Polypropylene, Mechanical, N/O, Integral to pump. ON and OFF Points are adjustable **"VF"** - Vertical Float, PVC, Snap Action, 15 ft (5m) cord, with Piggy-Back plug. OFF point ONLY is adjustable
OPTIONAL EQUIPMENT	Seal Material, Additional Cord



Series: SE (SE411 & SE421)
.4HP, 1750RPM, 60Hz

Submersible Wastewater Pump Association
SWPA MEMBER

C SP® US
CSA 108
UL 778
LR16567

Sample Specifications: Section 1 Page 3.

DESCRIPTION:

SUBMERSIBLE NON-CLOG SEWAGE PUMP DESIGNED FOR TYPICAL RAW SEWAGE APPLICATIONS

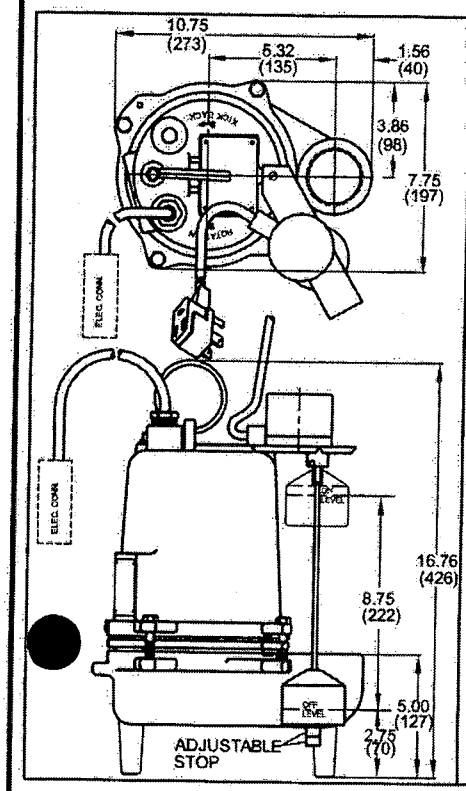
Series SE

2" Spherical Solids Handling
Manual & Automatic

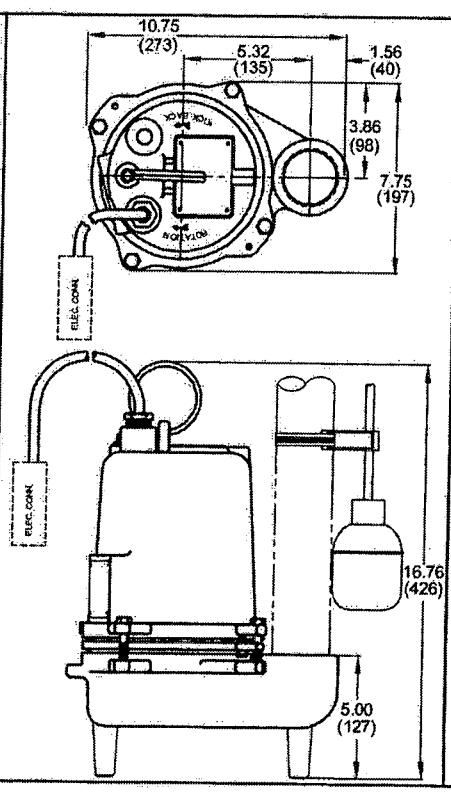
BARNES®
www.cranepumps.com

1½", 2" & 3" Discharge

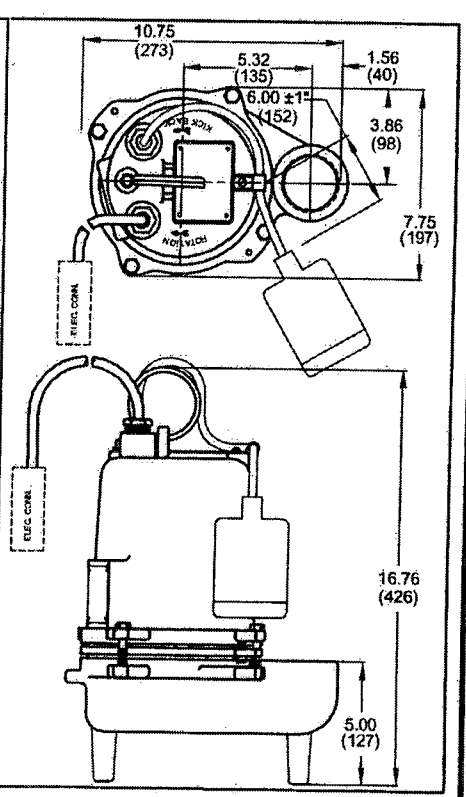
SE411VF



SE411 & SE421 (Less Float)
SE411A



SE411AU, SE421AU



inches
(mm)

MODEL NO	PART NO	HP	VOLT/PH	Hz	RPM (Nom)	NEMA START CODE	FULL LOAD AMPS	LOCKED ROTOR AMPS	CORD SIZE	CORD TYPE	CORD O.D inch (mm)
SE411	096747	0.4	115/1	60	1750	C	12.0	19.0	14/3	SJTOW	0.375 (9.5)
SE411A	096748	0.4	115/1	60	1750	C	12.0	19.0	14/3	SJTOW	0.375 (9.5)
SE411AU	096749	0.4	115/1	60	1750	C	12.0	19.0	14/3	SJTOW	0.375 (9.5)
SE411VF	100836	0.4	115/1	60	1750	C	12.0	19.0	14/3	SJTOW	0.375 (9.5)
SE421	096750	0.4	230/1	60	1750	C	6.2	13.0	14/3	SJTOW	0.375 (9.5)
SE421AU	096751	0.4	230/1	60	1750	C	6.2	13.0	14/3	SJTOW	0.375 (9.5)

Mechanical Switch on SE-A, cord 16/2, SJOW, Piggy-Back Plug
Mechanical Switch on SE-AU, cord 14/2, SJOW, 0.370 (9.4mm) O.D.
Vertical Switch on SE-VF, cord 16/2, SJOW, 0.320 (8.1mm) O.D. Piggy-Back Plug

IMPORTANT !

1.) PUMP MAY BE OPERATED "DRY" FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
2.) THIS PUMP IS APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION II HAZARDOUS LOCATIONS.
3.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
4.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.

CRANE®
A Crane Co. Company

PUMPS & SYSTEMS

USA: (937) 778-8947 • Canada: (905) 457-6223 • International: (937) 615-3598

BARNES®

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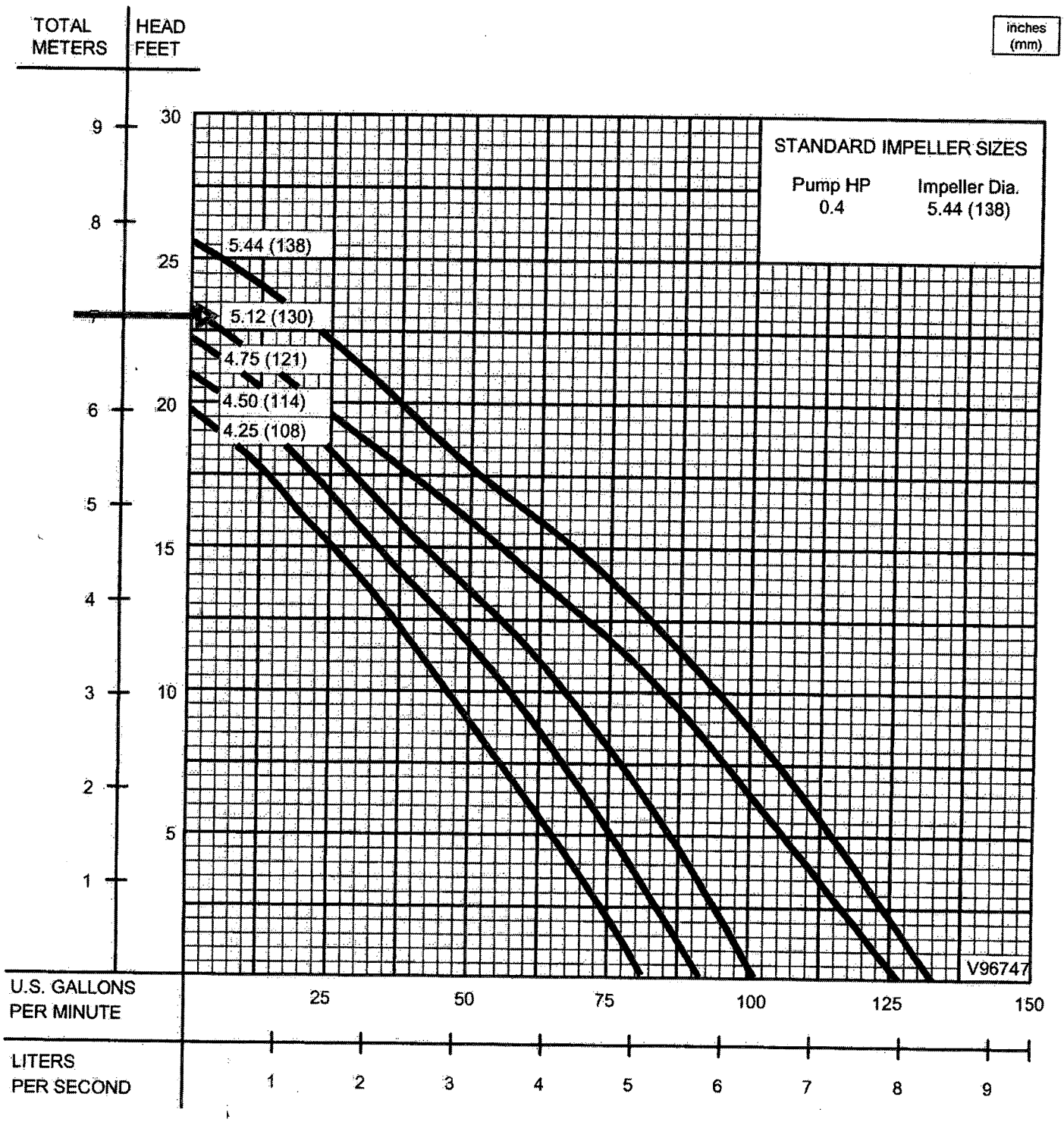
Series SE

Performance Curve
.4HP, 1750RPM, 60Hz

1½", 2" & 3" Discharge

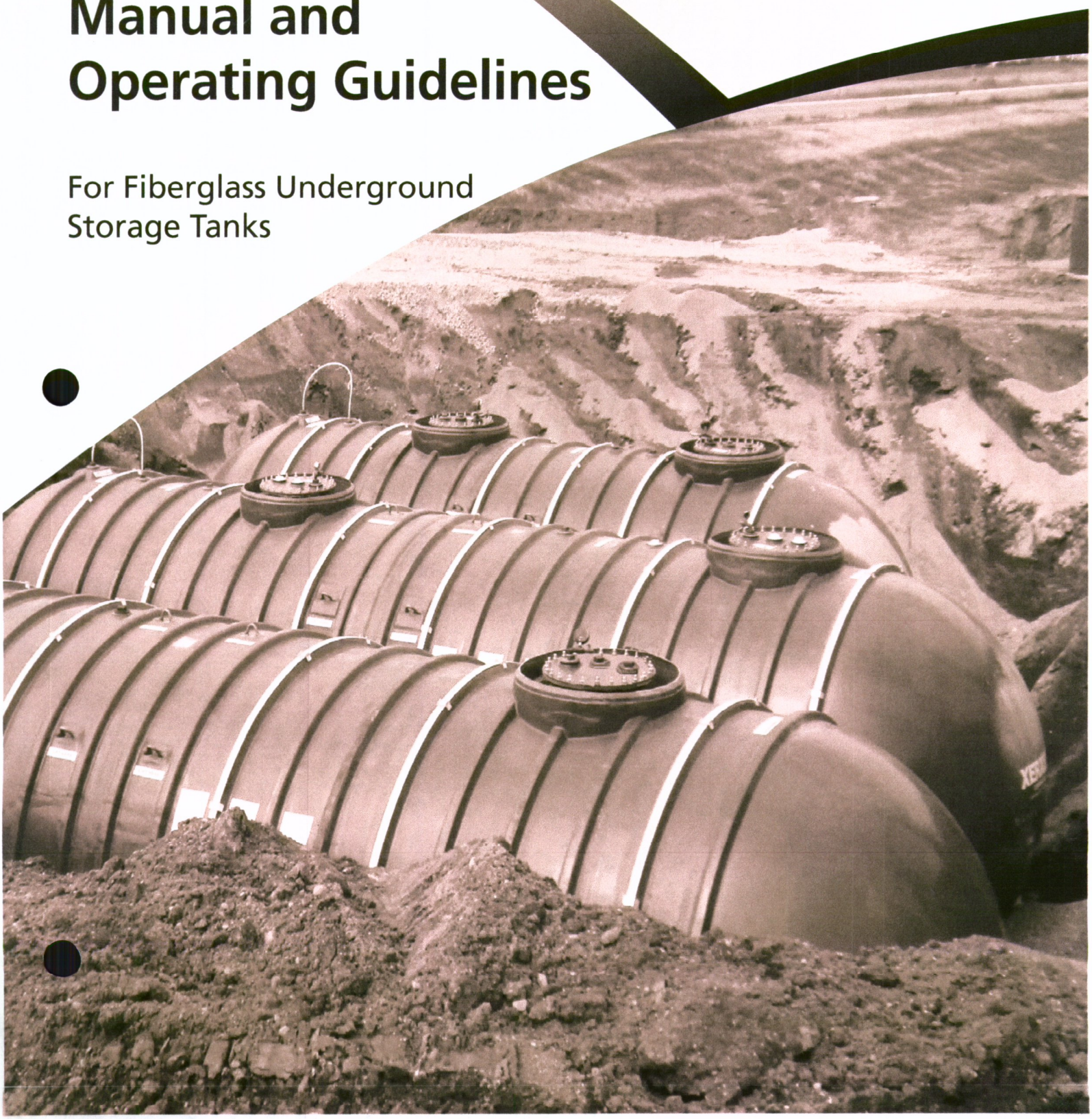


Testing is performed with water, specific gravity 1.0 @ 68° F @ (20°C), other fluids may vary performance

XERXES®
a ZCL company

Installation Manual and Operating Guidelines

For Fiberglass Underground Storage Tanks



XERXES INSTALLATION MANUAL AND OPERATING GUIDELINES

TABLE OF CONTENTS

SECTIONS

APPENDICES

XERXES INSTALLATION MANUAL AND OPERATING GUIDELINES

Read all instructions and operating guidelines before installation.

These instructions, which are based on successful experiences in a wide variety of situations, are issued as a guide for the installation of Xerxes underground storage tanks. Compliance with the procedures and instructions contained in this Installation Manual are necessary for the proper installation of Xerxes tanks. Failure to comply will void the limited warranty for the tank(s) and may cause tank failure.

To Installer: Before installation, read and understand the Installation Manual and Operating Guidelines (subsequently referred to as Installation Manual). After installation, give the Installation Manual with the completed Tank Installation Checklist (back of manual) to the tank owner.

To Owner: After installation, retain the Installation Manual for future reference to operating guidelines and checklist.

1. INTRODUCTION

1.1. SAFETY

1.1.1. Before beginning the tank installation, read through the entire Installation Manual and Operating Guidelines (subsequently referred to as Installation Manual). It is the responsibility of the owner, installer and operator to understand and follow all requirements contained in this Installation Manual.

1.1.2. Work must be performed according to standard industry practices that may apply to all aspects of tank installations and operations.

1.1.3. Comply with all applicable federal, state and local regulations and standards, such as:

- federal, state and local construction, health, safety and environmental codes
- National Fire Protection Association standards (for example, NFPA 30, 30A and 31)
- industry standard practices (for example, PEI RP100, API RP1615)
- EPA reference materials (for example, "Doing It Right").

NOTE: A U.S. federal law (the Resource Conservation and Recovery Act (RCRA), as amended (Pub. L. 98–616)) requires owners of certain underground storage tanks to notify designated state or local agencies by May 8, 1986, of the existence of their tanks. Notifications for tanks brought into use after May 8, 1986, must be made within 30 days. Consult EPA's latest regulations to determine if you are affected by this law.

1.1.4. For additional information, contact relevant state, county and city storage-tank authorities, including health, fire or building departments, and environmental agencies.

1.1.5. The following definitions will serve as a guide when reading the Installation Manual:

⚠ WARNING

Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

CAUTION

A Caution without the safety alert symbol indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

1.1.6. Keep this Installation Manual available at the installation site to refer to safety procedures as needed.

⚠ WARNING

Follow OSHA regulations for tank excavations. Collapse of excavation walls could result in death or serious injury.

1.1.7. Working in and around excavations is dangerous.The Occupational Safety and Health Administration (OSHA) has specific requirements that must be followed. Prior to beginning work at the site, the installer must read and understand OSHA's Standard, Part 1926, Subpart P (Excavations), 650-652. A copy of this standard is available free of charge at www.osha.gov.

1.1.8. Careless activity or reckless operation of equipment can cause death, serious injury or property damage.

1.1.9. Federal, state and local codes and regulations always take precedence over a Xerxes requirement.

1.1.10. No instructions or procedures presented in this Installation Manual should be interpreted so as to put at risk any person's health or safety, or to harm any property or the environment.

1.2. GENERAL

1.2.1. It is important to follow the procedures and instructions in this manual in order to safely and properly install a Xerxes underground storage tank and accessories. Failure to follow these instructions will void Xerxes' obligations under the limited warranty, may result in tank failure or property damage, and could cause serious personal injury or death.

1.2.1.1. The presence of a Xerxes representative does not relieve the installer of responsibility for proper installation of the tank.

1.2.2. The Xerxes limited warranty applies only to a tank installed according to these instructions. Since Xerxes does not control the parameters of any installation, Xerxes' sole responsibility in any installation is that presented in the limited warranty.

1.2.3. It is the responsibility of the owner and operator to always follow the operating guidelines *set forth in Xerxes' applicable limited warranty and SECTION 18* of this Installation Manual. It is the responsibility of the owner to retain this Installation Manual for future reference to operating guidelines.

1.2.3.1. A copy of the applicable Xerxes limited warranty is found in the shipping documents that accompany each tank when delivered.

1.2.3.2. A copy of the applicable Xerxes limited warranty is also found in some of the applicable product brochures, at www.xerxes.com and upon request from the Xerxes customer service coordinator.

1.2.4. Use the Tank Installation Checklist (back of manual) for all single-wall tanks (SW), double-wall tanks (DW), oil/water separators (OWS) and multicompartment tanks (MC) as the installation proceeds.

1.2.5. Relevant information for each tank installed must be recorded on the Tank Installation Checklist found at the back of this manual. Consult the Xerxes customer service coordinator if additional checklist forms are needed.

1.2.6. The tank owner should retain a copy of the completed Tank Installation Checklist in order to facilitate any warranty claim.

1.2.7. Xerxes recommends that the installing contractor also keep a copy of the completed Tank Installation Checklist.

1.2.8. Xerxes must authorize—in writing and prior to tank installation—any variation to, or deviation from, the instructions in the Installation Manual.

1.2.8.1. All correspondence regarding variations must be retained for any warranty claim to be valid.

1.2.9. For any questions regarding the interpretation of these instructions or for any other technical inquiries, contact technical support at Xerxes Minneapolis, MN.

1.2.10. All contact information applicable to installation is found on the back cover of this manual.

1.3. EQUIPMENT

1.3.1. The following list is to be used as a guide for the equipment recommended for installing Xerxes tanks:

1.3.1.1. excavation equipment capable of producing a level bottom hole and placing backfill material at any point in the excavation

1.3.1.2. suitable lifting equipment capable of lifting and placing the tanks and associated tank anchors

1.3.1.3. spirit level or transit

1.3.1.4. 50-foot tape measure

1.3.1.5. tamping rod(s)

NOTE: A long wooden shovel handle is satisfactory.

1.3.1.6. pipe wrenches and appropriate pipe joint compound

1.3.1.7. a test manifold for each air-testable tank or compartment—*see FIGURE 3-2*

1.3.1.8. source of pressurized air capable of 6 psig

1.3.1.9. soap and water solution (during freezing conditions, a suitable solution such as windshield wiper fluid may be added to the soap and water mixture)

1.3.1.10. soft cloth, brush or hand-held pneumatic sprayer

1.3.1.11. hand shovel

1.3.1.12. lifting sling(s)

1.3.1.13. soil compacting equipment (if necessary).

2. HANDLING AND STORING TANKS

2.1. GENERAL

2.1.1. Although Xerxes tanks are rugged, the tank owner and/or tank owner's representative must take care so that the tank is not dropped or damaged during loading, unloading, handling and storage at the jobsite.

2.1.2. Move tanks by lifting and setting only. Do not move tanks by rolling or dragging.

2.1.3. Always lift tanks by using the lifting lugs provided with the tank. Distribute the lifting load evenly between the lifting lugs. Use spreader bars and equal length slings as required.

NOTE: Larger tanks may be provided with guide lugs for attachment of guide ropes during lifting and positioning operations. Do not use guide lugs for lifting.

CAUTION

Never roll, drag or drop the tank. This may result in damage to the tank.

2.2. UNLOADING AND HOISTING TANKS

2.2.1. Before the tank is unloaded or relocated on the job site (and before preinstallation testing at the jobsite), tank owner and/or tank owner's representative must complete the following steps:

2.2.1.1. Visually inspect the entire exterior surface of the tank to make sure that no shipping or handling damage has occurred. Look particularly for visible damage, cracks or deep scrapes.

2.2.1.2. Sign the shipping papers accepting the tank as delivered. Any damage observed must be noted in these papers.

2.2.1.3. Be sure that all equipment used to lift the tank is rated to handle the load.

2.2.1.4. Select a smooth, solid, level area on which to place the tank, and clear that area of all large rocks, trash and debris.

2.2.1.5. Make sure that all tools and other items that may damage the tank during unloading are removed from the trailer bed.

2.2.2. When unloading the tank from the truck, tank owner and/or tank owner's representative must make sure that the tank is secured in such a way that it does not roll off the truck.

⚠ WARNING

Do not release straps securing the tank to the truck until lifting equipment (such as a crane) is secured to the tank's lifting lug(s) and until anyone in a position to be injured by the tank's movement is in a safe location. Failure to do so could result in death, serious injury or property damage.

2.2.3. When hoisting the tank, follow these instructions—*see FIGURE 2-1 and FIGURE 2-2:*

2.2.3.1. Choose suitable lifting sling(s) for the tank being installed.

2.2.3.2. When using multiple lifting lugs, the angle of the lifting sling should never exceed 30 degrees—*see FIGURE 2-1.*

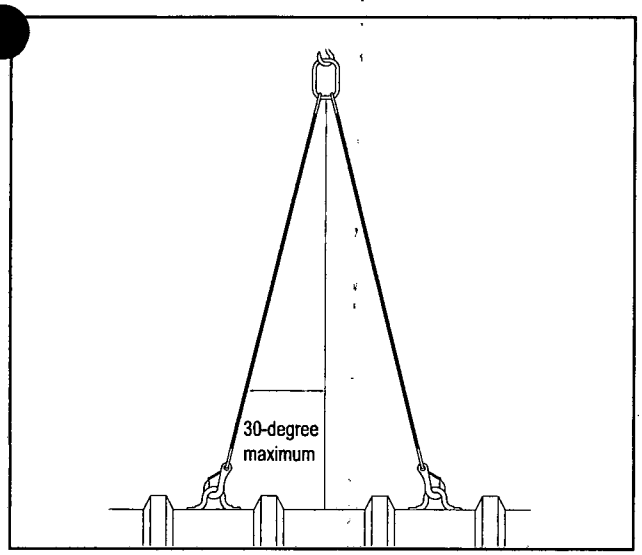


FIGURE 2-1

2.2.3.3. When the tank is not rotated (the tank is upright), use all lifting lugs to unload and install the tank. *See FIGURE 2-2.*

2.2.3.4. Some tanks are rotated on the truck for shipping purposes. These tanks have extra lifting lug(s) to aid in the loading/unloading process. *See FIGURE 2-2.*

2.2.3.4.1. To unload these tanks, use the lifting lugs that are situated on top of the tank in its rotated position.

2.2.3.4.2. To install the tank, carefully rotate the tank to its upright position and then use all lifting lugs situated on top of the tank in its upright position. *See FIGURE 2-2.*

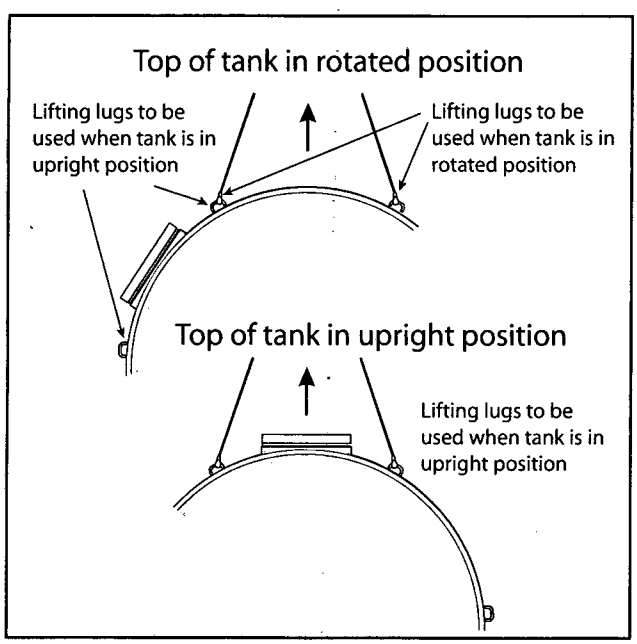


FIGURE 2-2

2.2.4. Do not wrap chain or cable around the tank at any time, including when securing the tank on the ground.

2.2.5. Use guide ropes to guide the tank when needed.

2.2.6. When handling a tank with a bottom sump or fitting, always take extra care so that the bottom sump or fitting is not damaged by contact with any other object, such as the truck bed or the ground.

2.3. STORING TANKS

2.3.1. Whenever a tank is temporarily placed above the ground at the site, place it on a smooth, solid, level area that is clear of large rocks, trash and debris, and then chock it in place to prevent rolling. *See FIGURE 2-3.*

⚠ WARNING

Always chock the tank. The tank is heavy and has a large surface area. The tank will roll on sloped surfaces and could be blown about by the wind. Movement of the tank could result in death or serious injury.

2.3.2. Tie the tank down if high winds are expected. **Do not use wire rope or chains.** *See FIGURE 2-3.*

2.3.2.1. Never place tie-down straps over collars or reservoirs.

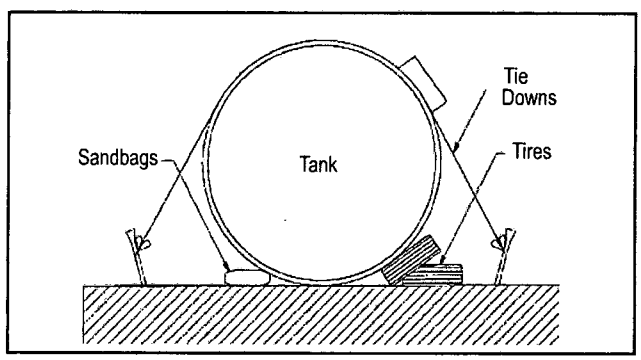


FIGURE 2-3

2.3.3. Whenever a tank is temporarily placed above the ground at the site, always take extra care so water does not enter the collar. Xerxes recommends that the tank be rotated and/or the collar covered.

CAUTION

If water enters the collar, it could freeze and may result in damage to the tank and/or collar.

2.3.4. Ensure that the tank is UV-protected if it will be stored above the ground for an extended period of time, typically 12 months depending on the geographic location of installation.

3. PREINSTALLATION INSPECTION AND TESTING

3.1. GENERAL

⚠ WARNING

Do not conduct preinstallation testing while the tank is on a trailer. Failure to follow this warning could result in death or serious injury.

CAUTION

Do not put product in the tank until all necessary preinstallation inspection and testing is completed. Failure to follow this caution may result in property damage.

3.1.1. The applicable inspection and testing procedures *set forth in SECTIONS 3 and 4* must be performed to validate the limited warranty.

3.1.2. All tanks are tested and inspected at the factory prior to shipment. However, in order to verify the absence of any damage resulting from shipping or handling, prior to installation all tanks must also be inspected at the site. Some tanks must also be tested at the site prior to installation according to the applicable procedures.

⚠ WARNING

Always secure the tank before moving, rotating or lifting it. This is commonly done by connecting a crane or backhoe to the lifting lugs. Failure to follow this warning could result in death or serious injury.

⚠ WARNING

While moving or lifting the tank, do not position any part of your body underneath the tank. Failure to follow this warning could result in death or serious injury.

⚠ WARNING

Do not lift or hoist a tank under pressure. Failure to follow this warning could result in death or serious injury.

3.1.3. Not all tanks are air-testable in the field. If a tank needs to be hydrostatically tested, *see SECTION 13.3.*

3.1.4. If the tank is a water/wastewater tank equipped for optional preinstallation testing, after inspecting the tank *(see SECTION 3.2.), follow procedures in the Xerxes supplement, Preinstallation Testing Instructions for Water/Wastewater Tanks Factory-Equipped for Pressure Testing. See SECTION 20* for information on how to obtain this supplement.

3.1.5. If damage of any kind is detected, contact the plant from which the tank was shipped before installing the tank.

NOTE: Do not attempt unauthorized repairs.

3.2. INSPECTING THE TANK

3.2.1. Thoroughly inspect the entire outside surface of the tank for signs of shipping or handling damage. Rotate or lift the tank to inspect the bottom of the tank.

3.2.2. If damage of any kind is detected, contact the plant from which the tank was shipped before installing the tank.

NOTE: Do not attempt unauthorized repairs.

3.3. PRETESTING PROCEDURES

CAUTION

Do not install any piping or fittings other than test fittings until all preinstallation testing has been completed. Failure to follow this caution may result in property damage.

CAUTION

Never pressurize a wet interstitial space. Doing so may result in damage to the primary tank and/or tank failure.

3.3.1. All UL-labeled tanks, chemical tanks and potable water tanks must be air tested after backfill is brought close to the top of the tank.

3.3.2. If the tank being installed is not an air-testable tank, *proceed to SECTION 5.*

3.3.3. *See SECTIONS 3.4. through 3.9.* for specific instructions for preinstallation testing procedures.

3.3.4. *See SECTION 4* for preinstallation testing instructions for specific types of air-testable tanks.

3.3.5. Someone must be with the tank at all times during air testing.

3.3.6. Prior to the pressure test, remove all plugs, apply sealant, and replace and tighten plugs.

⚠ WARNING

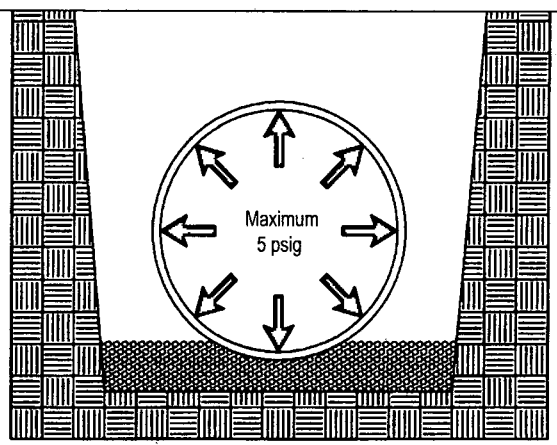
When the tank is under pressure, the manways, access openings and/or fittings may dislodge, or the tank could rupture, and this could result in death or serious injury. Before beginning the air test, notify all people on the test site to remain in a safe location. NEVER LEAVE A TANK UNDER PRESSURE UNATTENDED. Stand clear of manways, fittings and tank ends during the test.

3.4. PREPARING THE TANK FOR AIR TESTING

3.4.1. The air test pressure is 5 psig (3 psig for 12-foot-diameter tanks). *See FIGURE 3-1.*

⚠ WARNING

Do not overpressurize the tank. Position the pressure gauges so that the pressure readings can be clearly read at all times. The pressure gauge must have a pressure-relief valve that is used and set at 6 psig (4 psig for 12-foot-diameter tanks). Failure to follow this warning could result in death or serious injury.



Note: Maximum is 3 psig for 12-foot-diameter tanks.

FIGURE 3-1

3.4.2. The tester is responsible for verifying that all of the test equipment is in good working condition, and is properly configured and calibrated.

3.4.3. Construct a test manifold with two pressure gauges *as shown in FIGURE 3-2.* Each pressure gauge must have a maximum full-scale reading of 15 psig with graduations in 1/2 psig increments, and a pressure-relief valve set at 6 psig (4 psig for 12-foot-diameter tanks).

3.4.3.1. When air testing multicompartment tanks, a test manifold is needed for each compartment. *See FIGURE 3-2.*

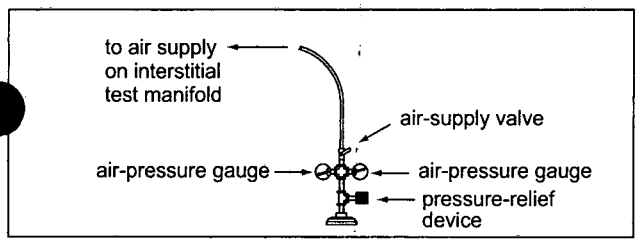


FIGURE 3-2

NOTE: All compartments on a double-wall tank may be manifolded together and tested simultaneously, or each compartment may be tested separately.

3.4.3.2. A test manifold is needed for testing the dry interstitial space of an air-testable, double-wall tank. *See FIGURE 3-2.*

NOTE: A test manifold is not required for a tank with an interstice filled with monitoring fluid.

3.4.4. During air tests, ambient air temperature can affect pressure-gauge readings.

⚠ CAUTION

Allow for pressure variations when tanks are subject to abrupt temperature changes. Failure to follow this caution may result in minor or moderate injury.

3.4.5. When testing tanks with wet monitoring, remove the reservoir-fitting plug.

3.4.6. If the tank has threaded fittings, it is the installer's responsibility to select a thread sealant that is compatible with the product being stored. Some sealants cannot be used with some stored products.

3.4.7. Install permanent plugs in all openings where piping will not be installed.

3.4.8. Make sure all manway bolts are tightened, and fitting plugs are properly doped and sealed.

3.4.8.1. The tank may be air tested with the factory-supplied temporary plugs. Redope and tighten temporary plugs if needed.

3.4.9. Keep one service fitting open in each compartment for the test manifold.

3.4.10. Tanks equipped with flanged nozzles may require contractor-supplied blind flanges for preinstallation air testing.

3.5. PRESSURIZING THE PRIMARY TANK

3.5.1. Install the test manifold in the open service fitting and connect the pressure source to the test manifold. *See FIGURE 3-3.*

3.5.2. If the interstitial space is dry, install the test manifold and close the valve before pressurizing the primary tank.

3.5.3. Open the air-supply valve and pressurize the primary tank to 5 psig (3 psig for 12-foot-diameter tanks). Allow a few minutes for the air temperature in the tank to stabilize, then allow the pressure to stabilize by adding or removing air as necessary.

3.5.4. Hold and monitor the pressure for a minimum of 1 hour.

3.5.4.1. If the test manifold shows a pressure build-up in the interstitial space of a dry-monitor, double-wall tank, contact the plant from which the tank was shipped.

NOTE: Do not attempt unauthorized repairs.

3.6. PRESSURIZING THE INTERSTITIAL SPACE IN A DRY TANK

⚠ WARNING

Never lift or hoist a tank under pressure. Failure to follow this warning could result in death or serious injury.

NOTE: Do not attempt unauthorized repairs.

3.6.1. Tanks with a dry interstitial space not shipped under vacuum come with a quick-disconnect assembly. *See FIGURE 3-3.*

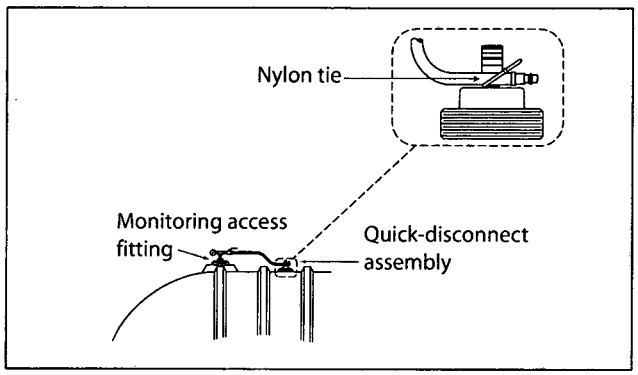


FIGURE 3-3

3.6.2. If the tank is not configured *as shown in FIGURE 3-3* prior to preinstallation testing, contact the plant from which the tank was shipped.

3.6.3. The quick-disconnect assembly must not be connected to the service fitting when air testing the primary tank. Keep the nylon tie in place.

3.6.4. Maintain the pressure in the primary tank.

CAUTION

Do not connect the air supply directly to the interstitial-space monitoring access fitting. Pressurizing the secondary tank (interstitial space) by itself may damage the primary tank or cause tank failure.

3.6.5. Free the hose from the service fitting by cutting the nylon tie.

3.6.6. Insert the hose into the quick-disconnect fitting. This will allow air to transfer from the primary tank to the interstitial space.

3.6.7. Reconnect the air-supply line. Allow the pressure to stabilize at 5 psig (3 psig for 12-foot-diameter tanks) by adding or removing air as necessary.

3.6.8. Close the air-supply valve on the test manifold and disconnect the air-supply line.

3.7. SOAPING THE TANK

3.7.1. After pressurizing the tank, soap the tank to check the tank's integrity.

3.7.1.1. Soap either the fittings, manways and covers or the entire exterior of the tank, depending on what part of the testing process the tester is at and what kind of tank is being air tested. *See SECTION 4 instructions* for specific types of tanks.

3.7.1.2. Watch for active air bubbles. **There should not be any.**

NOTE: During freezing conditions, a suitable solution such as windshield washer fluid may be added to the soap and water mixture.

3.7.2. When doing a soap test, rotate the tank to check the bottom. **Do not rotate a tank filled with monitoring fluid.**

3.7.2.1. Before rotating the tank, place protective material on the area on which the tank will be rotated. Make sure the area is flat and free of large or sharp objects, such as rocks, which may damage the tank.

3.7.2.2. Rotate the tank slowly and carefully to avoid developing too much momentum. Momentum can grow because manways and fittings on top of the tank make it top heavy. Make sure the tank's fittings and manways never touch the ground. Do not rotate the tank more than 120 degrees from the initial starting point.

3.7.3. If damage is detected, contact the plant from which the tank was shipped.

NOTE: Do not attempt unauthorized repairs.

3.8. PERFORMING VISUAL CHECKS ON A TANK WITH A WET INTERSTITIAL SPACE

CAUTION

Never pressurize a wet interstitial space. Doing so may damage the primary tank or cause tank failure.

CAUTION

Never rotate a tank filled with monitoring fluid. Doing so may result in damage to the tank and/or tank failure.

3.8.1. Check that the tank has monitoring fluid in the reservoir. Measure the level of the monitoring fluid in the reservoir.

NOTE: If the reservoir is less than a third full, contact the plant from which the tank was shipped. See the back cover of the Installation Manual for contact numbers.

3.8.2. Visually check the interior of the tank for monitoring fluid. **There should not be any.**

3.8.2.1. When checking a multicompartment tank, inspect the interior of each compartment for monitoring fluid.

3.8.3. Visually check the exterior of the tank for monitoring fluid. (The monitoring fluid is dyed blue to distinguish between moisture and monitoring fluid.) If monitoring fluid is found, wipe the tank dry and verify that the monitoring fluid does not reappear. Lift the tank to check the bottom. **Do not roll the tank.**

3.8.3.1. When checking a multicompartment tank, inspect the exterior of each compartment for monitoring fluid.

3.9. RELEASING PRESSURE FROM THE TANK

3.9.1. If there is an interstitial space to pressurize, open the valve of the test manifold and carefully release the air pressure in the interstitial space first.

3.9.2. If the tank is a multicompartment tank, carefully release the air pressure in the end compartments first.

3.9.3. Then carefully release the air pressure from the base tank.

CAUTION

Never allow the pressure in the interstitial space to be greater than the pressure in a primary tank. Failure to follow this caution may result in damage to a primary tank and/or tank failure.

⚠ WARNING

Never remove the service-fitting plugs when there is pressure in the tank. Failure to follow this warning could result in death or serious injury.

3.9.4. Remove the test manifolds and replace the protective covers in the service fittings.

4. PREINSTALLATION TESTING FOR SPECIFIC TYPES OF AIR-TESTABLE TANKS

NOTE: When air testing a tank, follow the procedures outlined here for the specific type of tank being installed. For more specific details on these procedures, *see the SECTION 3 SECTIONS and SUBSECTIONS to which you are referred.*

4.1. AIR TESTING A SINGLE-WALL TANK

4.1.1. Prepare the tank for air testing. *See SECTION 3.4.*

4.1.2. Pressurize the tank. *See SECTION 3.5.*

4.1.3. Soap the entire exterior of the tank. *See SECTION 3.7.*

4.1.4. Hold and monitor the pressure for a minimum of 1 hour.

4.1.5. Carefully release the air pressure from the tank. *See SECTION 3.9.*

4.1.6. Remove the test manifold and replace the protective covers in the service fittings.

4.2. TESTING A WET DOUBLE-WALL TANK

CAUTION

Never pressurize a wet interstitial space. Doing so may result in damage to the primary tank and/or tank failure.

4.2.1. Check the level of the monitoring fluid in the reservoir. *See SECTION 3.8.* for instructions.

4.2.2. Visually check the interior and the exterior of each compartment for the presence of monitoring fluid. *See SECTION 3.8.* for instructions.

4.2.3. If the monitoring fluid is not at the proper level, and/or monitoring fluid is found on either the interior or the exterior of any compartment, contact the plant from which the tank was shipped.

4.2.4. If there is no monitoring fluid on either the interior or the exterior of any compartment, proceed to backfill the tank to the top of the tank.

4.2.5. After the tank is backfilled to the top of the tank, it must be air tested. *See SECTION 13* for instructions.

4.3. TESTING A DRY-MONITOR, DOUBLE-WALL TANK WITH THE INTERSTITIAL SPACE UNDER VACUUM

4.3.1. A dry-monitor, double-wall tank may be shipped from the factory with the interstitial space under vacuum. This option allows for monitoring the tank during shipping and handling, and may expedite tank installation by shortening

preinstallation testing procedures. The date that the vacuum was applied is on a label by the monitor or on the shipping documentation delivered with the tank.

4.3.1.1. This date may be used as a reference under this procedure to evaluate the tank's integrity prior to installation, and to validate Xerxes' obligations under the limited warranty.

4.3.1.2. Xerxes tanks shipped under vacuum must be under vacuum for a minimum of 7 days. If this requirement is not met, an air/soap test is required. *See SECTION 4* for instructions.

4.3.1.3. The tank shipped under vacuum should be installed and backfilled with the vacuum intact if both of the following two conditions are met:

4.3.1.3.1. installation of the tank is to begin 7 days or more after the factory application of vacuum (as indicated on the shipping documents and/or tank labels)

4.3.1.3.2. the vacuum gauge shipped with the tank reads 12 inches of mercury or more.

NOTE: The vacuum-monitoring method is less sensitive and less reliable than the soap test *described in SECTION 3.7.* Under certain field conditions (such as major changes in temperature, barometric pressure and/or altitude) and/or with certain equipment failure (such as freezing or sticking of gauge mechanism), the vacuum-monitoring method may not be an accurate enough test. When in doubt, or when such conditions occur, Xerxes recommends *SECTION 4.4. or 4.5. (whichever is applicable)* as the preferred preinstallation test procedure.

4.3.1.4. After the tank is backfilled to the top of the tank, the tank must be air tested. *See SECTION 13* for instructions.

4.3.1.5. If either or both of the conditions *stated in POINTS 4.3.1.3.1. and 4.3.1.3.2.* are not met, *follow the procedures of SECTION 4.4. or 4.5. (whichever is applicable)* for the preinstallation test.

4.3.1.5.1. If the gauge reads less than 12 inches of mercury, perform a visual inspection of the exterior of the tank and the vacuum gauge fittings to evaluate the tank's integrity, and contact the plant from which the tank was shipped.

NOTE: Do not attempt unauthorized repairs.

4.3.1.6. Record the vacuum gauge reading at the time of installation *on the Tank Installation Checklist.*

4.4. AIR TESTING A DRY-MONITOR, DOUBLE-WALL TANK

4.4.1. Prepare the tank for air testing. *See SECTION 3.4.*

4.4.2. Pressurize the primary tank. *See SECTION 3.5.*

4.4.3. Soap all service fittings and manways. *See SECTION 3.7.*

4.4.4. Hold and monitor the pressure in the primary tank for a minimum of 1 hour.

4.4.5. Use the quick disconnect assembly to pressurize the interstitial space. *See SECTION 3.6.*

4.4.6. Soap the entire exterior of the tank. *See SECTION 3.7.*

4.4.7. Hold and monitor the pressure in the interstitial space for a minimum of 1 hour.

4.4.8. Carefully release the air pressure from the tank. *See SECTION 3.9.*

4.4.9. Remove the test manifold and replace the protective covers in the service fittings.

4.5. AIR TESTING A DRY-MONITOR, DOUBLE-WALL MULTICOMPARTMENT TANK NOT UNDER VACUUM

CAUTION

Do not connect air supply directly to the interstitial-space monitoring access fitting. Pressurizing the interstitial space by itself may result in damage to the primary tank and/or tank failure.

4.5.1. Prepare the tank for air testing. *See SECTION 3.4.*

4.5.1.1. Install a test manifold in each compartment, that is, in the base tank and each end compartment. *See FIGURE 4-1.*

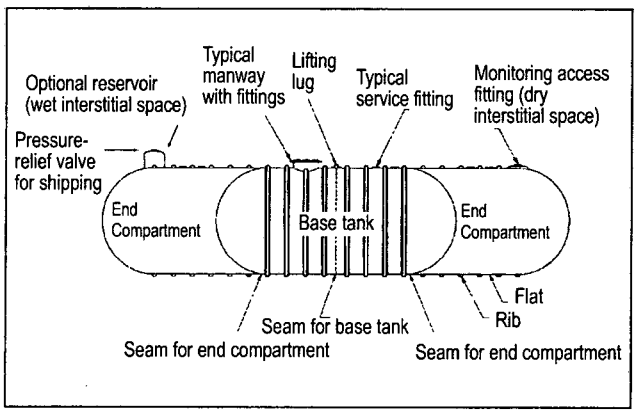


FIGURE 4-1

4.5.2. Pressurize the primary tank. *See SECTION 3.5 and FIGURE 4-2.*

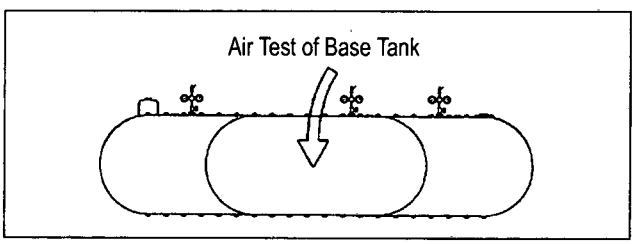


FIGURE 4-2

4.5.3. Pressurize the end compartment(s). *See SECTION 3.5. and FIGURE 4-3.*

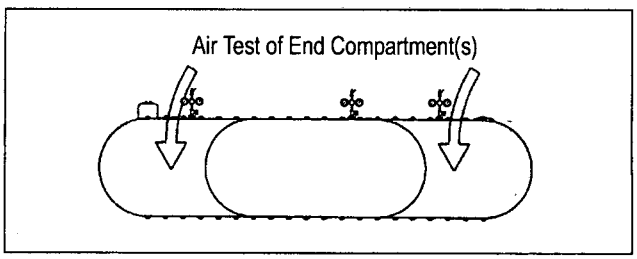


FIGURE 4-3

4.5.4. Soap all service fittings, manways and covers. *See SECTION 3.7.*

4.5.5. Hold and monitor the pressure for a minimum of 1 hour.

4.5.6. Use the quick-disconnect assembly to pressurize the interstitial space. *See SECTION 3.6. and FIGURE 4-4.*

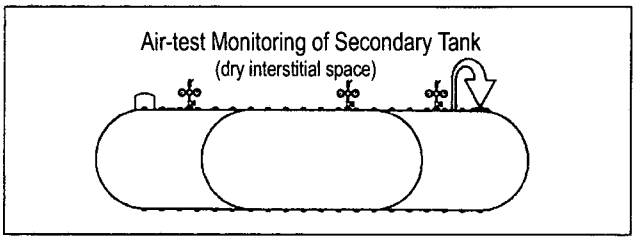


FIGURE 4-4

4.5.7. Soap the entire exterior of the tank. *See SECTION 3.7.*

4.5.8. Hold and monitor the pressure for a minimum of 1 hour.

4.5.9. Carefully release the air pressure from the tank. *See SECTION 3.9.*

4.5.10. Remove the test manifolds and replace the protective covers in the service fittings.

5. INSTALLING TANKS

⚠ WARNING

If product is used as ballast, exercise special care in handling. Safeguard against sparks, fire or product spills. Improper handling of product could cause a fire or explosion and could result in death or serious injury.

⚠ WARNING

Do not use air pressure to test tanks that contain or have contained flammable or combustible liquids or vapors. The fuel and air mixture could explode and could result in death or serious injury. Tanks should be air tested before ballasting. *See SECTION 12.*

CAUTION

Adequately ballast the tank (add liquid) in a wet hole or in a dry hole that may become wet (for example, from site runoff) until the installation is totally completed. Failure to do this may result in damage to the tank and/or surrounding property.

5.1. GENERAL

5.1.1. Take safety precautions throughout the entire installation process. *See SECTIONS 1.1. and 7.1.*

5.1.2. Use only approved backfill material. *See SECTION 6.*

5.1.3. Do not mix approved material together with sand or in situ soil.

5.1.4. Do not use in situ soil as primary backfill material.

5.1.5. Typically, all excavated in situ soil must be replaced with primary backfill material.

5.2. DRY-HOLE INSTALLATION

5.2.1. Before beginning tank installation, take a tank diameter measurement. *See SECTION 11* for instructions.

5.2.2. Record this measurement as Measurement #1 on the Tank Installation Checklist.

5.2.3. Locate the excavation site *according to instructions in SECTIONS 7.1. and 7.2.*

5.2.4. Prepare the excavation *according to instructions in SECTION 7.*

5.2.4.1. When preparing the excavation, allow for an anchoring system (if used) and geotextile fabric (if used). *See SECTIONS 7.2., 7.3. and 7.4.*

5.2.4.2. When preparing the excavation, allow for the appropriate depth of cover *as specified in SECTION 7.4.*

5.2.4.3. If two or more tanks are to be installed in the same excavation hole, *follow instructions in SECTION 7.5.*

5.2.4.4. If the tank has a bottom sump or fitting, prepare the excavation hole *according to instructions in SECTION 10.*

5.2.5. Remove all loose material from the excavation.

5.2.6. Where necessary, level the bottom of the excavation using primary backfill material, filling in any low areas. *See SECTION 6* for backfill requirements.

5.2.7. If an anchor slab is needed, install it now. *See POINT 7.5.3.3. and SECTION 8.6.*

5.2.8. If geotextile fabric is to be used, place it in the excavation hole at this time. *See SECTION 9.*

5.2.8.1. Geotextile must be placed to separate the primary backfill material from all other in situ soil and/or secondary backfill material.

5.2.9. If deadmen are used, *see SECTION 8* for information on deadmen placement and place them now.

5.2.9.1. If deadmen are used and they are to be placed so that they are in the bedding or below the bottom of the tank, place the deadmen before preparing the backfill bedding.

5.2.10. Prepare a 12-inch-thick smooth, level bed of approved primary backfill material on the bottom of the excavation. *See SECTION 6* for backfill requirements.

CAUTION

If anchor straps are used, bedding must be carefully leveled. Failure to follow this caution may result in straps being too short or too long, and may result in property damage.

5.2.10.1. If the excavation has soft soil conditions or if there might be difficulties controlling water accumulation, it is acceptable to increase the bedding thickness to 18 inches and set the tank anchors 6 inches off the bottom of the excavation (9 inches for 10-foot-diameter tank deadmen).

5.2.11. *See SECTION 2* regarding the use of lifting lugs to hoist the tank when unloading and installing it.

5.2.12. Place the tank or tanks onto the bed.

5.2.12.1. If deadmen are in place, center the tanks between them.

CAUTION

Do not set tanks directly onto a concrete slab, timbers, cradles or in situ soil. Failure to follow this caution may result in damage to the tank.

5.2.12.2. Align the tanks with anchors for proper placement of anchor straps.

5.2.12.3. As the tank is being placed, slope the tank according to site specifications.

NOTE: Xerxes does not require that a tank be sloped. The slope is determined by the tank owner's specifications.

5.2.12.3.1. Sloping of tanks may affect accuracy of calibration charts.

5.2.12.3.2. If a double-wall tank is sloped, the monitor should be at the low end.

5.2.13. Use the tops of the ribs to establish longitudinal level. Establish lateral level by placing the level across the top of a fitting or a manway.

5.2.14. If anchor straps are to be used, install them at this time. *See SECTION 8.2.*

5.2.14.1. The locations for anchor straps are marked on tank ribs by the arrowhead symbol ▶◀ (on the tank itself on 4-foot-diameter tanks).

5.2.14.2. All marked anchor strap locations must have straps.

CAUTION

Do not place straps between ribs. Failure to properly place straps may result in damage to the tank.

5.2.14.3. Place a strap on each marked location and install anchoring hardware. *See SECTION 8.*

5.2.14.4. Tighten each anchor strap until it is snug over the rib (over the tank itself in 4-foot-diameter tanks) but causes no deflection of the tank. Straps must be uniformly tight.

5.2.14.5. The elevation of deadmen is critical. If a strap appears too short or there is not sufficient adjustment in the turnbuckle to make the strap snug, the tank and/or tank anchors must be repositioned by adding or removing backfill material until the straps are properly installed.

NOTE: Make sure that the minimum bedding thickness of 12 inches has been maintained.

5.2.14.6. After the straps have been installed and tightened, take a tank diameter measurement to check tank deflection, and record it as Measurement #2 on the Tank Installation Checklist.

CAUTION

Overdeflection of the tank may result in damage to the tank.

5.2.15. On water/wastewater tanks with bottom fittings, piping needs to be installed at this time.

5.2.16. Place approximately 12 inches of primary backfill around the bottom of the tanks between the ribs (if present) and under the end domes.

5.2.16.1. Use a nonmetal tamping rod long enough to reach beneath the tank to push material under the tank body and domes until solid resistance is felt, all voids are filled and the tank is fully supported. *See FIGURE 5-1.*

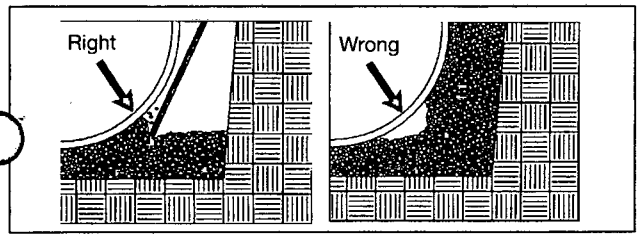


FIGURE 5-1

CAUTION

Do not use metal probes. Failure to follow this caution may result in damage to the tank.

NOTE: An object like a long wooden shovel handle is a practical choice as a tamping rod.

CAUTION

Do not strike the tank with the tamping rod. Failure to heed this caution may result in damage to the tank.

5.2.17. *Repeat POINTS 5.2.16. and 5.2.16.1.* with a second lift of approximately 12 inches of primary backfill.

5.2.18. After the second lift of material has been placed and worked under the tank, bring the backfill to the top of the tank.

5.2.18.1. Place backfill material evenly on opposite sides of the tank so that the tank does not shift.

5.2.19. If secondary backfill material is to be used on the perimeter of the installation, it must be placed and compacted at the same time as the primary backfill material.

5.2.20. During the backfilling process, it is good practice to continue to check tank deflection.

CAUTION

Thoroughly hand tamp backfill to eliminate all voids under the tank. Do not allow the tank to shift during the backfill procedure. If there are voids under the tank and/or the tank has shifted (and the backfill is above one-quarter (1/4) of the tank diameter), it may be necessary to remove and reinstall the tank. Failure to follow this caution may result in damage to the tank and/or property damage.

5.2.21. After backfill has been brought to the top of the tank, take another tank diameter measurement. Record it as Measurement #3 in the Tank Installation Checklist, and determine whether tank deflection is within the allowable limits *shown in TABLE 11-1.*

5.2.22. All UL-labeled tanks, chemical tanks and potable water tanks must be air tested after backfill is brought close to the top of the tank.

5.2.23. If additional testing (postinstallation testing for air-testable tanks or optional hydrostatic testing) is to be done, perform those tests now. *See SECTION 13* for instructions.

5.2.24. Typically, the tank should be ballasted at this time. *See SECTION 12* for instructions.

5.2.25. If piping and/or venting needs to be installed, complete this work now. *See SECTION 14* for instructions.

5.2.26. If containment sumps need to be installed, do that now. *See SECTION 16* for instructions.

5.2.27. Continue to backfill to grade, or to subgrade if reinforced concrete or asphalt is to be installed.

5.2.28. When the tank has been backfilled to subgrade (but before placement of reinforced concrete or asphalt), take the last required tank diameter measurement. Record it as Measurement #4 and determine whether tank deflection is within the allowable limits *shown in TABLE 11-1.*

5.2.28.1. Subtract Measurement #4 from Measurement #1 and record it as the Deflection Measurement on the Tank Installation Checklist.

5.2.29. Install reinforced concrete or asphalt, if used, at this time. *See SECTION 7.4.*

5.2.29.1. The cover depth must meet the appropriate minimum *specified in SECTION 7.4.*

5.2.29.2. For installations in traffic conditions, all secondary backfill used as subgrade backfill must be compacted with a hand-guided, vibrating-plate, mechanical compactor.

5.2.30. If the tank has a monitoring system, after backfilling is completed and after top slab is in place (if used), perform necessary monitoring checks. *See SECTION 15.*

5.2.31. Complete the Tank Installation Checklist.

5.3. WET-HOLE INSTALLATION

5.3.1. *Follow the dry-hole installation instructions (SECTION 5.2.)* with the modifications listed below.

5.3.2. *Perform POINTS 5.2.1. through 5.2.4.4.* of the dry-hole installation instructions.

5.3.3. *Before performing POINT 5.2.5.* of the dry-hole installation instructions, pump water from the excavation hole and continue pumping to maintain minimum water level during tank installation.

5.3.3.1. Attempt to maintain the water level below the top of the bedding materials until the tank can be fully backfilled and ballasted.

5.3.4. *Proceed with POINTS 5.2.5. through 5.2.9.1.* of the dry-hole installation instructions.

5.3.4.1. In high-water conditions, when Xerxes' preferred Man-Out-of-Hole (MOH) anchoring method is not available or possible, *see SECTION 8.8.* for an alternate method.

5.3.5. *Proceed with POINTS 5.2.10. through 5.2.12.3.2.* of the dry-hole installation instructions.

5.3.6. In high-water conditions, where it is not possible to maintain the water level below the top of the bedding material during the entire installation, partially ballast the tank to firmly seat the tank into the bedding material and to keep it from floating. *See SECTION 12* for instructions.

5.3.7. The ballast level in the tank must either be lower than the backfill material or less than 12 inches above the water level in the hole. *See FIGURE 5-2.*

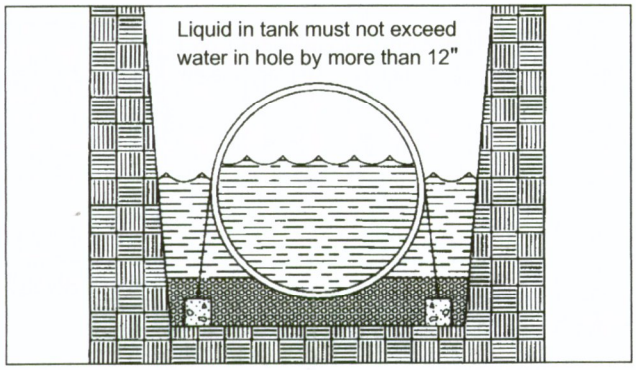


FIGURE 5-2

5.3.8. *Proceed with POINTS 5.2.13. through 5.2.23.* of the dry-hole installation instructions.

5.3.9. Ballast the tank once the backfill is even with the top of the tank. *See SECTION 12.*

5.3.10. *Proceed with POINTS 5.2.25. through 5.2.31.* of the dry-hole installation instructions.

6. BACKFILL MATERIAL

6.1. GENERAL

6.1.1. Xerxes tanks shall be installed using select rounded stones or crushed stones as primary backfill material. *See SECTION 6.2.* for definition of primary backfill material.

6.1.2. Alternatively, Xerxes tanks shall be installed using primary backfill vertically up to at least 75 percent of the tank diameter and secondary backfill above the primary backfill. *See SECTION 6.3.* for definition of secondary backfill and *Xerxes Split Backfill Instructions, APPENDIX C,* for more information regarding this alternative.

6.1.3. Using backfill material other than that *specified in POINTS 6.1.1. and 6.1.2.* without prior written authorization from Xerxes will void Xerxes' obligations under the limited warranty.

CAUTION

Using other than specified backfill material may cause tank failure, or may result in damage to the tank and/or surrounding property.

6.2. PRIMARY BACKFILL

6.2.1. Primary backfill material must meet the following specifications:

6.2.1.1. Material is to be clean, free-flowing, and free of dirt, sand, large rocks, roots, organic materials, debris, ice and snow. Backfill material shall not be frozen or contain lumps of frozen material at any time during placement.

6.2.1.2. An important characteristic of good backfill material is hardness or stability when exposed to water or loads. Most materials have no problem meeting the hardness requirement. Materials like soft limestone, sandstone, sea shells or shale should not be used as backfill because they may break down over time.

6.2.1.3. When using select rounded stones, they must conform to the specifications of ASTM C 33, size numbers 6, 67 or 7. *See FIGURE 6-1 and Xerxes Primary Backfill Requirements, APPENDIX B,* for additional information on backfill material specifications.

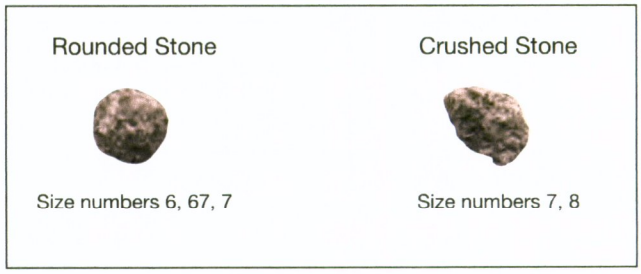


FIGURE 6-1

6.2.1.4. When using select crushed stones, they must conform to the specifications of ASTM C 33, size numbers 7 or 8. *See FIGURE 6-1 and Xerxes Primary Backfill Requirements, APPENDIX B,* for additional information on backfill material specifications.

6.2.2. Xerxes recommends that the supplier of backfill material provides written certification that the material conforms to ASTM C 33, ASTM D 448, AASHTO M 43, and any other applicable specifications.

6.2.3. If primary backfill material which meets these specifications is not available, contact technical support at Xerxes Minneapolis, MN, for information on alternate materials, installation instructions for alternate materials and the process for approval.

6.3. SECONDARY BACKFILL

6.3.1. Material is to be clean, free-flowing, and free of large rocks, roots, organic materials, debris, ice and snow. Backfill material shall not be frozen or contain lumps of frozen material at any time during installation.

6.3.2. Material must be compacted to achieve a minimum of 85 percent standard proctor density.

6.3.2.1. Do not use rammer-type compactors over the top of the tank.

6.3.3. Material must be installed in 12-inch to 24-inch lifts compatible with the compaction equipment used.

6.3.4. In some conditions, frost heave may be encountered when using secondary backfill. Therefore, consider any frost-related problems that may occur.

6.3.5. Specifications for secondary backfill material and compaction above the filter-fabric layer may be determined by the requirements of the piping, surface slab or roadway.

6.3.6. Refer to applicable codes or standards for base course and sub-base course material and compaction requirements.

6.3.7. The following are examples of acceptable secondary backfill material:

6.3.7.1. clean native backfill

6.3.7.2. coarse sand or gravel.

6.3.8. One hundred percent (100%) of all backfill material must pass through a 1-inch sieve.

6.3.9. Install a layer of geotextile filter fabric over the entire surface of primary backfill material before secondary backfill is placed. *See SECTION 9* for information regarding geotextile fabric.

6.3.9.1. All joints in the filter fabric must be overlapped a minimum of 12 inches.

6.3.9.2. Geotextile fabric must overlap onto the tank and excavation surface a minimum of 12 inches.

6.3.10. *See Xerxes Split Backfill Instructions, APPENDIX C,* for more information regarding this alternative.

7. EXCAVATION REQUIREMENTS

⚠ WARNING

Follow OSHA regulations for tank excavations. Collapse of excavation walls could result in death or serious injury.

7.1. GENERAL

7.1.1. The installing contractor must take all necessary precautions in or near a tank excavation. These precautions should include but are not limited to the following:

7.1.1.1. Locate and protect any utility installations near the excavation before opening the excavation.

7.1.1.2. Secure the walls of the excavation.

7.1.1.3. Prevent exposure to hazardous fumes from the excavation.

7.1.1.4. Avoid hazards associated with water accumulation in the excavation.

7.1.1.5. Erect barricades, etc., to prevent unauthorized vehicle or pedestrian traffic.

7.1.1.6. Inspect, a minimum of once a day, the excavation and surrounding area during the entire installation process.

7.1.2. For additional information on excavation, trenching and shoring safety practices, consult OSHA's Standard, Part 1926, Subpart P (Excavations), 650-652; and "Fall Protection Rules and Regulations."

7.1.3. The minimum clearance dimensions given in this section are important to the successful installation of a tank.

7.1.3.1. Additional clearances may be necessary due to federal, state or local regulations, safety requirements or operational requirements. Follow all applicable regulations and safety practices.

7.1.3.2. For additional requirements and specifications, consult all applicable federal, state and local codes and regulations. *See SECTION 1* for additional information.

7.2. EXCAVATION AND TANK LOCATION

7.2.1. Xerxes recommends that the tank owner seek the advice of a local foundation professional engineer to determine the proper placement of a tank excavation near any existing structure(s).

CAUTION

Improper placement of the excavation may result in damage to the tank and/or property damage.

7.2.2. The tank owner and/or the owner's technical representative is responsible for determining the proper placement of a tank excavation.

7.2.3. In general terms, the size of the excavation is determined by:

7.2.3.1. the number of tanks to be installed

7.2.3.2. the size of the tanks to be installed.

7.2.4. The location of a tank can be affected by the location of nearby structures. When selecting a tank site, care must be taken to avoid undermining the foundations of existing structures or new buildings to be constructed. *See FIGURE 7-1.*

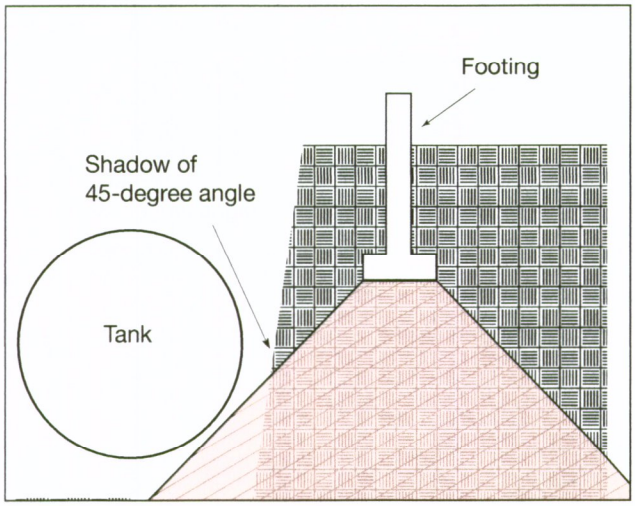


FIGURE 7-1

7.2.4.1. Ensure that downward forces from loads carried by the foundations and supports of nearby structures (constructed before or after tank installation) are not transmitted to the tanks.

7.2.5. Typically, the way to check the placement of the tank in relationship to a nearby structure is to do the following:

7.2.5.1. Determine the depth of burial needed for the tank.

7.2.5.2. Locate the footing of the structure to be considered.

7.2.5.3. Determine the line that would fall into the ground from a 45-degree angle drawn downward from the corner(s) of the footing of the foundation that is closest to the tank.

7.2.5.4. The tank must not fall within the "shadow" of the 45-degree-angle line drawn from the foundation's footing. *See FIGURE 7-1.*

7.2.5.5. If the tank would fall within this "shadow," do one of the following to ensure that the tank does not fall within the "shadow":

7.2.5.5.1. Move the tank away from the existing building.

7.2.5.5.2. Move the foundation of the building to be constructed away from the tank.

7.2.5.5.3. Deepen the footing of the planned building's foundation.

7.3. DEPTH OF EXCAVATION

7.3.1. Typically, the depth of the excavation is determined by:

7.3.1.1. groundwater conditions

7.3.1.2. traffic at the site

7.3.1.3. soft or uneven excavation base

7.3.1.4. codes and regulations.

7.3.2. Groundwater must be considered if the level of water in the ground may rise above the bottom of the tank at any time during the life of the tank.

7.3.3. Traffic loads are considered to be loadings for highway vehicles up to H-20 or HS-20 as defined in the AASHTO Standard Specifications for Highway Bridges.

7.3.4. Excavations must allow for 12 inches of backfill between the bottom of the tank and the bottom of the excavation or the top of the anchor slab (or any other stabilizing materials used). *See POINT 7.5.3.3. and SECTION 8.6.*

7.3.5. If either an anchor slab or other stabilizing material is used, allow additional depth in the excavation to accomodate their construction.

7.3.6. Typically, no additional depth of bedding is required for the use of a deadman anchoring system.

7.4. DEPTH OF COVER

⚠ CAUTION

In both traffic and nontraffic installations, no truck or equipment loads are allowed over the tank until the backfill is at the minimum specified requirements. Failure to follow this caution may result in minor or moderate injury, and/or damage to the tank.

7.4.1. Xerxes recommends that every site be thoroughly evaluated for the potential of a rise in the local water table or of trapped water (a wet-hole condition). Sufficient overburden and/or an appropriate anchoring system must be present to offset buoyancy of the tank in such conditions.

CAUTION

Failure to provide sufficient overburden and/or an appropriate anchoring system may cause tank failure, or may result in damage to the tank and/or surrounding property.

7.4.2. The tank owner or the owner's technical representative is responsible for determining sufficient overburden and/or appropriate anchoring system.

7.4.3. The minimum depths of cover dimensions given here are important to the successful installation of a tank. They may not be sufficient to counteract bouyancy in wet-hole conditions.

7.4.3.1. Additional depths of cover may be necessary due to federal, state or local regulations, safety requirements or operational requirements.

⚠ WARNING

In a nontraffic installation, ensure that the area above the tank is not subjected to traffic or other types of loads, which could cause damage to the tank, and could result in death or serious injury.

7.4.4. Tanks not subjected to traffic must have a cover depth of 12 inches of backfill. *See TABLE 7-1.*

7.4.5. Tanks subjected to traffic must have a cover depth of one of the following:

7.4.5.1. 36 inches of backfill

7.4.5.2. 18 inches of backfill and 6 inches of reinforced concrete

7.4.5.3. 18 inches of backfill and 8 inches of asphalt.

7.4.6. *See TABLE 7-1* for minimum requirements for tanks other than petroleum tanks.

Depth of Cover
Minimum Requirements for Tanks Other than Petroleum Tanks

No Traffic

- 12" backfill

Traffic Options

- 36" backfill
- 18" backfill + 6" reinforced concrete
- 18" backfill + 8" asphalt

NOTE: The maximum burial depth for standard tanks is 7 feet of cover over the top of the tank.

TABLE 7-1

7.4.7. Tank owner must follow NFPA 30 and 31, as a minimum, for petroleum tanks. See TABLE 7-2 for those requirements.

Depth of Cover
Minimum Requirements for Petroleum Tanks

No Traffic Options

- 24" backfill
- 12" backfill + 4" reinforced concrete
- 12" backfill + 6" asphalt

Traffic Options

- 36" backfill
- 18" backfill + 6" reinforced concrete
- 18" backfill + 8" asphalt

NOTE: These are NFPA 30 and 31 requirements.

TABLE 7-2

7.4.8. The maximum burial depth for standard tanks is 7 feet of cover over the top of the tank. However, tanks can be designed for a deeper burial.

7.4.8.1. Call your Xerxes representative for a special quotation prior to tank purchase if the burial depth is to be greater than 7 feet.

7.4.8.2. If you are installing a tank and need to consider a deeper burial than that given for the tank that was ordered, contact your Xerxes representative to discuss available options.

7.4.8.3. Prior written authorization from Xerxes is required to deviate from a standard tank's maximum burial depth.

7.4.9. Surface asphalt and concrete pads must extend a minimum of 12 inches beyond the tank in all directions.

7.4.10. If there is an unattached riser, it must not transmit load from the concrete slab to the tank. A minimum space of 6 inches must exist between the bottom of the riser and the top of the tank.

7.4.11. Traffic loads from the top slab must not be transmitted to a containment sump or a riser. A minimum space of 3 inches must exist between the riser or sump and the slab. *See SECTION 16.*

7.5. TANK SPACING

7.5.1. GENERAL

7.5.1.1. The following are minimum spacings and must be increased as needed to accommodate deadmen or anchor slabs. *See SECTION 8.*

7.5.1.2. Always provide sufficient clearance to allow the deadmen to be set outside of the tank "shadow." *See FIGURE 7-2.*

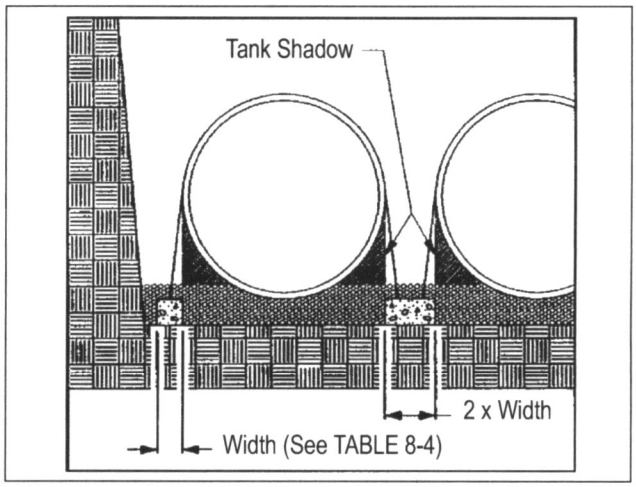


FIGURE 7-2

7.5.2. SPACING IN STABLE IN SITU (NATIVE) SOIL CONDITIONS

7.5.2.1. The minimum spacing between the sidewall or endcap of the tank and the side of the excavation must be 18 inches. *See FIGURE 7-3.*

NOTE: All measurements from the tank sidewalls are to be taken from the outside diameter of the tank ribs.

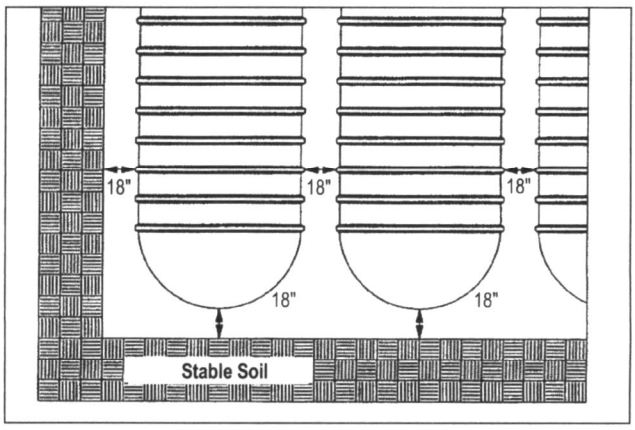


FIGURE 7-3

7.5.2.2. If two or more tanks are installed in the same hole, allow for at least 18 inches between the tanks. *See FIGURE 7-3.*

7.5.2.3. If two or more tanks are installed in the same hole and deadmen are used, the space between the tanks must be equal to or greater than two times the width of the deadman or deadmen required between the tanks. *See FIGURE 7-2 and TABLE 8-4.*

7.5.2.3.1. For instance, the space between tanks using deadmen is typically 24 inches for tanks up to and including 8-foot-diameter tanks, 36 inches for 10-foot-diameter tanks, and 72 inches for 12-foot-diameter tanks.

7.5.3. SPACING IN UNSTABLE IN SITU (NATIVE SOIL) CONDITIONS

7.5.3.1. Xerxes recommends that the tank owner seek the advice of a local foundation professional engineer if the in situ soil is extremely soft or inherently unstable (for example, peat, quicksand, muck, landfill, soft or highly expansive clay, underground stream, etc.).

7.5.3.2. If the soil has less than 750 lbs./sq. ft. cohesion as calculated from an unconfined compression test; or in soils having an ultimate bearing capacity of less than 3,500 lbs./sq. ft.; or where soil will not maintain a vertical wall, the excavation must allow a minimum space equal to one-half (1/2) the diameter of the tank between the excavation wall and both the side and the endcap of the tank to enhance lateral resistance. *See FIGURE 7-4.*

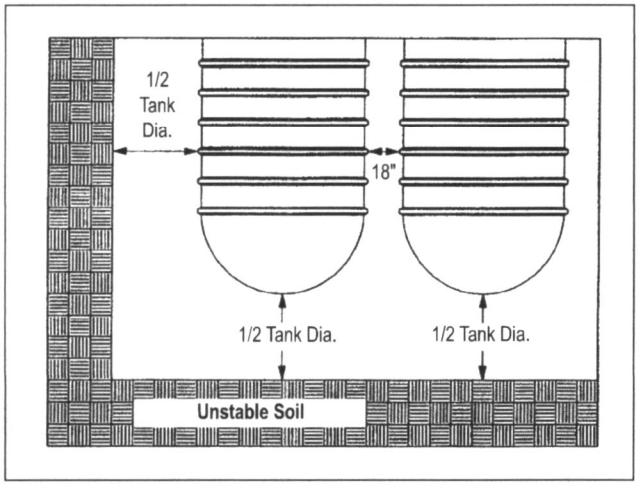


FIGURE 7-4

7.5.3.3. Stabilizing materials, such as a reinforced concrete slab, may be required under the tank as a foundation in addition to the required 12-inch bedding in an excavation where the bottom is unstable.

7.5.3.4. The spacing between adjacent tanks is to be at least 18 inches. *See FIGURE 7-4.*

7.5.3.5. If deadmen are used, follow the spacing requirements between the tanks *given in POINTS 7.5.2.3. and 7.5.2.3.1.*

8. ANCHORING SYSTEMS

8.1. GENERAL

8.1.1. The tank owner or the owner's technical representative is responsible for determining an appropriate anchoring system.

8.1.2. Xerxes recommends that every site be thoroughly evaluated for the potential of a rise in the local water table or of trapped water (a wet-hole condition). Sufficient overburden and/or an appropriate anchoring system must be present to offset buoyancy of the tank in such conditions.

CAUTION

Failure to provide sufficient overburden and/or an appropriate anchoring system may cause tank failure, or may result in damage to the tank and/or surrounding property.

8.2. ANCHOR STRAPS

8.2.1. GENERAL

8.2.1.1. Only Xerxes anchor straps may be used when anchoring a Xerxes tank.

8.2.1.2. Xerxes has two anchor strap models (not including man-out-of-hole straps)—D-ring/hook anchor straps and D-ring/D-ring anchor straps.

8.2.1.2.1. Depending on which type of anchor strap is being used, *see either SECTION 8.2.2. or 8.2.3.*

8.2.1.3. The locations for anchor straps on each tank are marked on the tank ribs by the arrowhead symbols ▶◀ (on the tank itself on 4-foot-diameter tanks).

8.2.2. D-RING/HOOK ANCHOR STRAPS

8.2.2.1. When installing any size tank, and when using Xerxes' D-ring/hook anchor straps and Xerxes' prefabricated deadmen, the deadmen are to be placed so that the top of the deadmen is even with the bottom of the tank. *See FIGURE 8-1 and TABLE 8-1* for anchor-point dimensions.

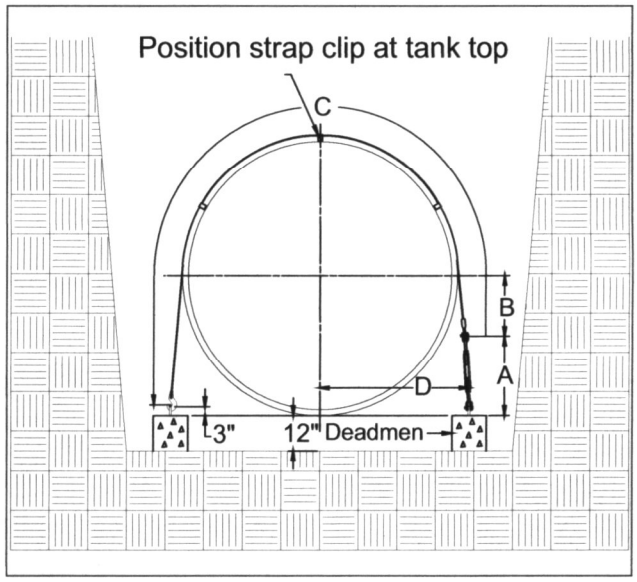


FIGURE 8-1

Anchoring Dimensions for FIGURE 8-1					
Tank Dia.	A	B	C	D min.	D max.
4'	18"	13"	9'-8"	27"	30"
6'	26"	10"	13'-5"	42"	48"
8'	26"	20"	17'-10"	52"	58"
10'	26"	34"	23'-9"	69"	75"
12'	26"	43"	27'-9"	87"	93"

TABLE 8-1

8.2.3. D-RING/D-RING ANCHOR STRAPS

8.2.3.1. When installing any size tank, and when using Xerxes' D-ring/D-ring anchor straps and Xerxes' prefabricated deadmen, the deadmen are to be placed so that the top of the deadmen is even with the bottom of the tank. *See FIGURE 8-2 and TABLE 8-2* for anchor-point dimensions.

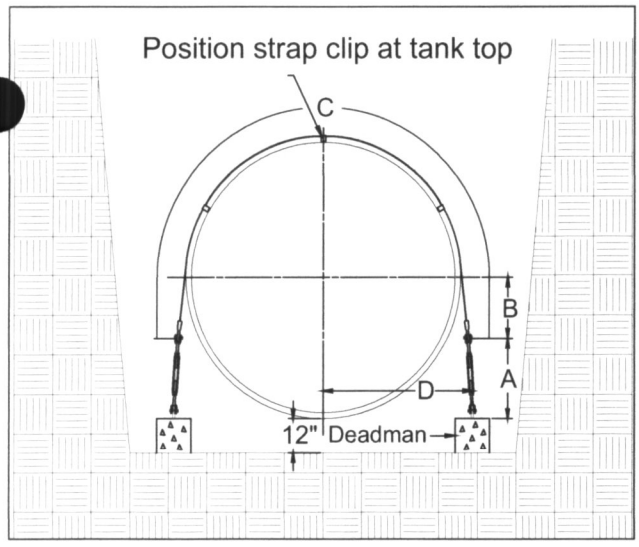


FIGURE 8-2

Anchoring Dimensions for FIGURE 8-2					
Tank Dia.	A	B	C	D min.	D max.
4'	18"	12"	8'-4 1/4"	27"	30"
6'	23"	13"	12'-1"	42"	48"
8'	31"	15"	15'-1"	52"	58"
10'	45"	15"	18'-8 3/4"	69"	75"
12'	50"	23"	22'-6 3/4"	87"	93"

TABLE 8-2

.3. HARDWARE AND ANCHOR POINTS

8.3.1. When Xerxes-supplied anchoring hardware is not being used, the installing contractor is responsible for providing hardware and anchor points of sufficient size and strength for the tank being installed.

8.3.2. Anchoring hardware must be manufactured to industry standards and dimensions, and sized *according to TABLE 8-3.*

Tank Diameter	Minimum Turnbuckle Diameter (by Type)			Minimum Wire-Rope Diameter
	Hook	Jaw	Eye	
4'	3/4"	1/2"	1/2"	3/8"
6'	3/4"	1/2"	1/2"	3/8"
8'	1 1/4"	3/4"	3/4"	1/2"
10'	1 1/4"	3/4"	3/4"	1/2"
12'	1 1/4"	3/4"	3/4"	1/2"

TABLE 8-3

8.3.2.1. All exposed metal on the anchoring system must be coated or galvanized to protect against corrosion.

8.3.3. The particular configuration of hardware will be determined by the contractor, the owner or the owner's representative.

8.3.4. If hardware being used is not provided by Xerxes, contact the hardware manufacturer or supplier for specific information on hardware and its use.

8.3.5. Locate the anchor points *as shown in FIGURE 8-1 or 8-2 (whichever is applicable) and TABLE 8-1 or 8-2 (whichever is applicable). Refer to dimension "D" in TABLE 8-1 or TABLE 8-2.* Align (within a tolerance of ±1 inch) all anchor points with the marked arrowhead symbols ▶◀ on the tanks.

8.3.6. Use only appropriately sized hardware with the strap eye. *See FIGURE 8-3 for dimensions of strap eye.*

⚠ CAUTION

Oversized hardware may damage the strap eye and may result in minor or moderate injury.

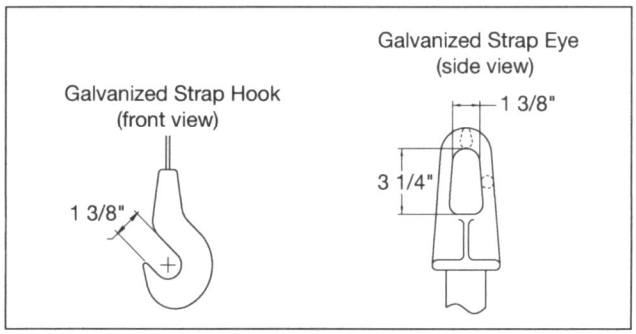


FIGURE 8-3

8.3.7. When connecting the end of an anchor strap to the anchor point, common methods are those *shown in FIGURE 8-4:* A) using a drop-forged turnbuckle, B) using a looped wire rope, C) using a combination of both A and B, and D) using the hook end of the strap.

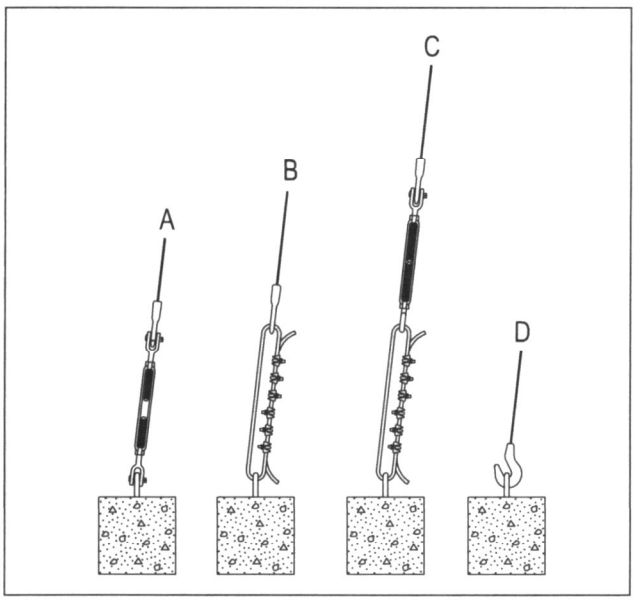


FIGURE 8-4

8.3.8. If using a wire rope, refer to recommendations of wire-rope manufacturer and supplier, and follow accepted industry standards when selecting, using, attaching or connecting wire rope. *See FIGURE 8-4, FIGURE 8-5 and FIGURE 8-6.*

8.3.8.1. The installer is responsible for using appropriate and approved engineering practices when fastening wire rope.

8.3.9. When fastening wire rope, use a minimum of 2 clips for a 3/8-inch wire rope and 3 clips for a 1/2-inch wire rope on each termination. *See TABLE 8-3 for minimum wire-rope diameter.*

8.3.10. Turn back from the thimble the exact amount of wire rope specified by the manufacturer of the clips used.

8.3.11. Apply the first clip at a distance from the dead end of the wire rope that is equal to the largest width of the clip used. *See FIGURE 8-5.*

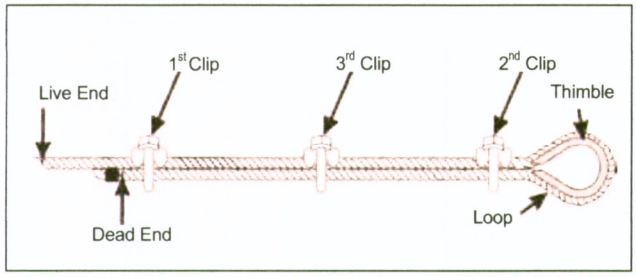


FIGURE 8-5

8.3.12. For each clip, apply a U-bolt over the dead end of the wire rope. *See FIGURE 8-5.*

NOTE: Live end rests in the saddle.

8.3.13. When only 2 clips are required, apply the second clip as close to the loop or thimble as possible. *See FIGURE 8-5.*

8.3.14. When more than 2 clips are required, apply the second clip as close to the loop or thimble as possible, turn nuts on the second clip firmly, but do not tighten initially. *See FIGURE 8-5.*

8.3.15. When more than 2 clips are required, space additional clips equally between the first 2, take up rope slack and tighten nuts on each U-bolt evenly.

8.3.16. Tighten all hardware uniformly and follow the manufacturer's torque specifications. Double-check the tightness once the anchoring system is complete.

8.3.17. If forming a loop in the wire rope, a splice is required for connecting the two ends together.

8.3.17.1. Standard rigging practice for splicing wire rope calls for using twice the number of clips recommended for a single-end termination.

8.3.17.2. Use a minimum of 4 clips for a 3/8-inch wire rope and a minimum of 6 clips for a 1/2-inch wire rope.

8.3.17.3. Place the rope ends parallel to each other and install the clips *as shown in FIGURE 8-6.*

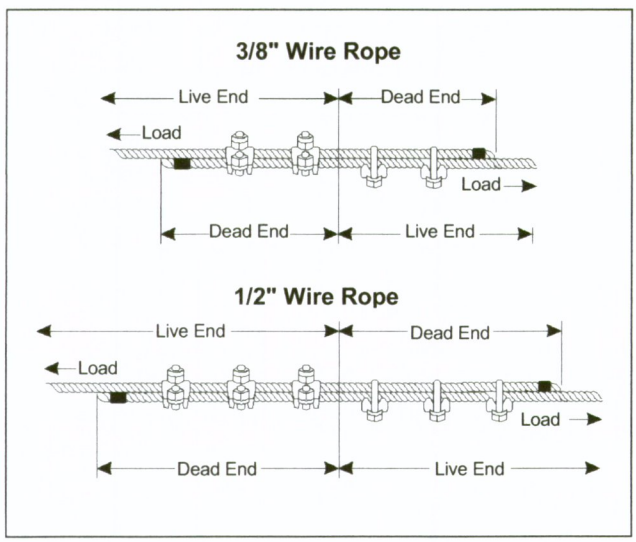


FIGURE 8-6

8.4. DEADMEN

8.4.1. A deadman is typically a reinforced concrete beam and should be designed according to the applicable American Concrete Institute code.

8.4.2. The length of a deadman is typically equal to the length of the tank.

8.4.3. Deadmen may be installed in multiple sections as long as the total length of the assembled deadman is appropriate for the installed tank, and as long as each section contains at least two balanced anchor points.

8.4.4. The width and thickness of a deadman depends on the tank diameter, water-table height, number of containment sumps and burial depth.

8.4.5. *See TABLE 8-4* for typical deadmen dimensions for Xerxes tanks (other than 10-foot-diameter tanks with a capacity greater than 25,000 gallons), given the following scenario: an empty tank, a 3-foot burial depth, groundwater to grade, and one containment sump.

Tank Diameter	Typical Deadman Dimensions (Width x Depth)
4'	12" x 12"
6'	12" x 12"
8'	12" x 12"
10'	18" x 9"
12'	36" x 8"

TABLE 8-4

8.4.5.1. If tanks are installed with any conditions different from *those identified in POINT 8.4.5*, and/or if tanks are 10-foot-diameter tanks with a capacity greater than 25,000 gallons, the installation may require either a deeper burial or deadmen larger than *those shown in TABLE 8-4.* Contact technical support at Xerxes Minneapolis, MN, for further information.

8.4.6. Lay the deadmen in the excavation parallel to the tank and outside of the tank "shadow." *See FIGURE 7-2.*

8.4.7. In installations where two or more tanks are installed using deadmen:

8.4.7.1. a separate anchor point must be provided for each anchor strap

8.4.7.2. the minimum spacing between the tanks must be equal to or greater than the width of the deadman used for the tanks

8.4.7.3. each tank will have its own set of deadmen, however, one deadman may be used between two tanks if the deadman is double the width of the single deadman *specified for tanks in SECTION 7.*

8.5. XERXES PREFABRICATED DEADMEN

8.5.1. Xerxes-supplied prefabricated deadmen are pre-engineered and sized to the tank ordered. As with any deadmen, water-table height, number of containment sumps and burial depth must be considered.

8.5.2. For placement of Xerxes prefabricated deadmen, *see FIGURE 8-1 or 8-2 (whichever is applicable) and the Xerxes supplement, Prefabricated Deadmen Installation Instructions.*

8.5.3. Xerxes prefabricated deadmen are supplied with 3/4-inch-diameter, galvanized, adjustable anchor points. These anchor points protrude up through the slots in the deadmen and are held up with temporary supports.

⚠ WARNING

Only use the anchor points when lifting and positioning the deadmen. A spreader bar may be required to lift longer sections of deadmen. Use guide ropes to guide the deadmen when lifting. Failure to do so could result in death or serious injury.

8.5.4. Use one anchor point per strap end and only one strap per anchor point.

8.5.5. The anchor points can be moved and positioned to match the anchor strap locations marked by arrowhead symbols ▶◀ on the tank rib (on the tank itself for 4-foot-diameter tanks).

8.5.6. When using these deadmen in man-out-of-hole strap applications, align the anchor points with the proper ribs before setting them in the hole.

8.5.7. Keep backfill from entering the anchor-point slot until final adjustment is made.

8.5.8. The deadmen are to be butted together when multiple sections are used.

8.6. ANCHOR SLABS

8.6.1. An anchor slab is a reinforced concrete base and should be designed according to the applicable American Concrete Institute.

8.6.2. The total length of the slab must be at least the same as the length of the tank.

8.6.3. The minimum slab thickness is 8 inches.

8.6.4. The width of the slab depends on the tank diameter. The slab must extend a minimum of 18 inches (12 inches for 4-foot-diameter tanks) beyond each side of the tank.

8.6.5. Provide a separate anchor point for each anchor strap.

8.6.6. All anchor points must be engineered to withstand the tank's buoyancy forces.

8.6.7. *Refer to FIGURE 8-7* for anchor-point height. *Refer to TABLE 8-1 or TABLE 8-2* for other anchor-point dimensions.

8.6.8. When using a concrete anchor slab, allow sufficient depth in the excavation for 12 inches of bedding material between the tank and the anchor slab. *See FIGURE 8-7.*

8.6.9. Anchor points must extend 3 inches above the bedding. With a 12-inch bedding, the anchor point is 15 inches above the slab.

NOTE: If a turnbuckle is used with a 4-foot-diameter tank, the anchor point must be 3 inches below the top of the bedding.

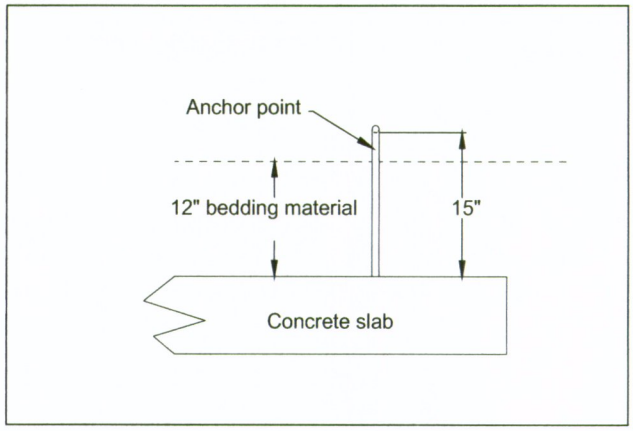


FIGURE 8-7

8.7. MAN-OUT-OF-HOLE (MOH) STRAPS

8.7.1. The Xerxes man-out-of-hole (MOH) strap system is designed for use in installations where water is in the excavation and/or where personnel may not enter the tank hole.

8.7.1.1. This strap system can be, but need not be, used in conjunction with Xerxes deadmen.

8.7.2. When using the MOH strap system, the placement of components is critical. *See the Xerxes supplement, Man-Out-of-Hole (MOH) Straps Instructions.*

8.8. ALTERNATE WET-HOLE ANCHORING METHOD

8.8.1. In wet-hole installations, when Xerxes' preferred man-out-of-hole anchoring method is not available or possible, the following method may be used:

8.8.1.1. Place the anchor strap between the wire rope and the tank so that the wire rope is never in direct contact with the tank.

8.8.1.1.1. The H-shaped positioning clips around the strap are designed to accommodate the wire rope on top of the strap *as shown in FIGURE 8-8.*

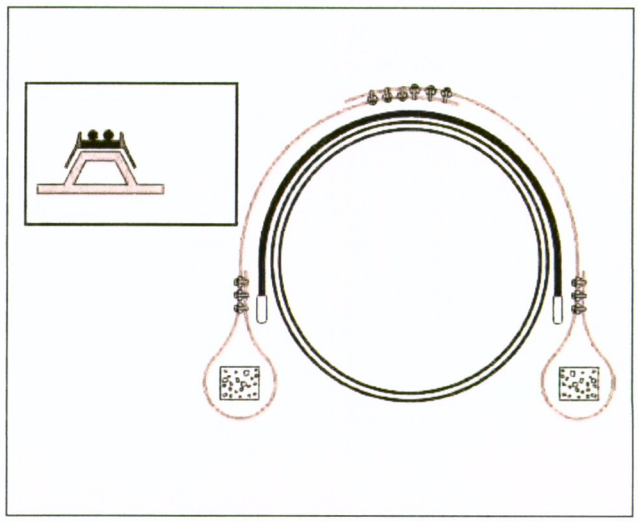


FIGURE 8-8

8.8.1.2. Loop a wire rope around the deadman at each rib marked with an arrowhead symbol ▶◀ (at each marked location on 4-foot-diameter tanks).

8.8.1.3. Secure the termination of the wire rope.

8.8.1.4. Lower each deadman to the bottom of the excavation using the wire rope.

8.8.1.5. Center each anchor strap on each location marked with an arrowhead symbol ▶◀.

8.8.1.6. Bring the live end of each wire rope up to the top of the tank at each marked location.

8.8.1.7. Take the slack out of each wire rope and splice the termination of the wire ropes on top of the tank.

9. GEOTEXTILE FABRIC

9.1. GENERAL

9.1.1. Geotextile fabric allows the passage of water in and out of the excavation but prevents the migration and mixing of in situ soil and the select backfill material. Geotextile helps preserve the integrity of the select backfill envelope that surrounds and supports the tank.

9.1.2. The tank owner or the owner's technical representative is responsible for determining whether a geotextile or an alternate filtering technique is appropriate for a specific installation.

9.1.3. Using geotextile fabric is considered good installation practice and Xerxes recommends using it in any installation, but especially when the tank is installed in the following conditions:

9.1.3.1. areas with frequently changing groundwater conditions or areas subject to tidal fluctuations

9.1.3.2. unstable soils, such as those *cited in SECTION 7.5.3.*

9.1.3.3. water conditions with silty in situ soil.

9.1.4. For further information concerning geotextile specifications and installation procedures, consult the geotextile supplier's installation guidelines or instructions.

9.1.5. Polyethylene film is not considered an effective geotextile material because it may tear or degrade while in service.

10. BOTTOM SUMPS AND FITTINGS

10.1. GENERAL

10.1.1. When handling a tank with a bottom sump or fitting, always take extra care so that the bottom sump or fitting is not damaged by contact with any other object, such as the truck bed or the ground.

10.1.2. When installing a large bottom sump in a water or wastewater tank, *see the Xerxes supplement, Large Bottom Sump Installation Instructions. See SECTION 20* for details on where to obtain this supplement.

CAUTION

All connections to the tank must be flexible. Provisions must be made to accommodate movement and misalignment between the piping and the tank. Failure to do this may result in damage to the tank and/or surrounding property.

10.1.3. While preparing the backfill bedding, dig a hole in the bottom of the excavation that is large enough to accommodate the sump or fitting. *See FIGURE 10-1.*

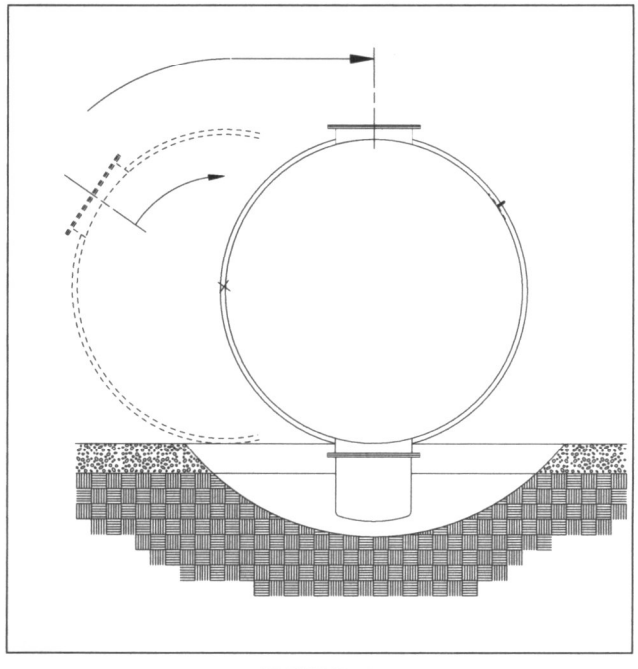


FIGURE 10-1

10.1.4. The required 12 inches of backfill bedding on the bottom of the excavation must also be present in the excavation hole in which the sump or fitting will be placed. *See FIGURE 10-2.*

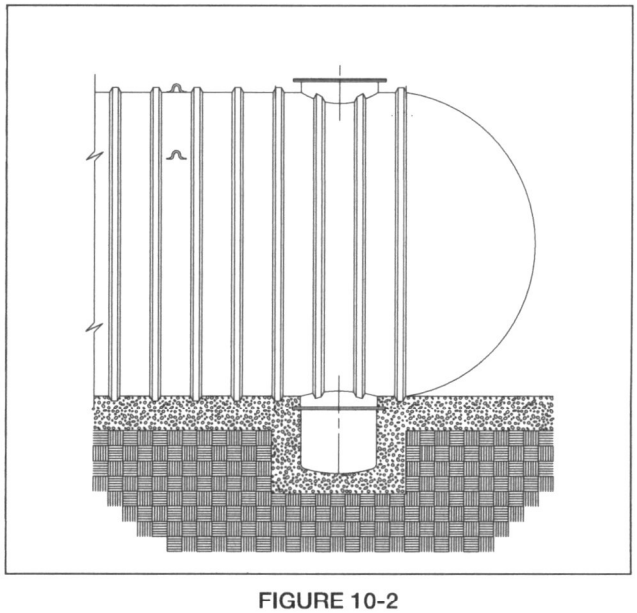


FIGURE 10-2

10.1.5. After setting the tank, fill and tamp the space around the sump or fitting by using hand tools before continuing the backfilling.

11. TAKING DIAMETER MEASUREMENTS

11.1. GENERAL

11.1.1. Diameter measurements must be taken at various stages of the installation process to verify that the process is proceeding correctly.

11.1.1.1. It is important that these measurements are taken and, if needed, appropriate action is taken so that tank deflection is within allowable limits.

11.1.2. Diameter measurements of the tank must be taken at one or more locations on each tank or tank compartment. It is preferable to take the deflection measurement near the center of a tank or compartment if possible.

11.1.3. An initial measurement must be taken before installation of the tank begins. This first measurement is used as a comparison reference for subsequent measurements in order to check proper backfill placement.

11.1.4. Additional measurements must be taken: a) after applying anchor straps (if used), b) after backfilling is brought to the top of the tank, c) after backfilling is brought to subgrade and before placement of reinforced concrete or asphalt (if used).

11.1.5. Measure the distance from the bottom edge of a tank fitting to the bottom of the tank immediately below that fitting.

11.1.6. Described here are two methods using a dipstick to measure the internal diameter of the tank—one not using a standpipe and one using a standpipe.

11.1.6.1. Similar methods can be used, such as using a tape measure, for example.

11.1.7. The deflection measurement can be obtained by using the same method twice or by using each method once.

11.1.8. For both methods, drive a small-headed, nonsparking nail (for example, brass) halfway into a wooden dipstick 1 inch above its base.

11.2. DIAMETER MEASUREMENT WITHOUT STANDPIPE

11.2.1. Place the dipstick into a service fitting.

11.2.2. Measure the distance from the tank bottom to the top of the fitting and record this measurement.

11.2.3. Pull the dipstick up until the exposed nail catches on the inside top of the tank.

11.2.4. Measure the distance from the tank top (inside) to the top of the fitting. Subtract the distance from the nail to the base of the dipstick (1 inch) and record this measurement.

11.2.5. Subtract the second measurement (inside tank top to top of fitting) from the first measurement (tank bottom to top of fitting).

11.2.6. Record the measurement at the appropriate place (as Measurement #1, #2, #3 or #4) *on the Tank Installation Checklist.*

11.3. DIAMETER MEASUREMENT WITH A STANDPIPE

11.3.1. Place the dipstick into a service fitting with a standpipe.

11.3.2. Measure the distance from the tank bottom to the top of the standpipe and record this measurement.

11.3.3. Pull the dipstick up until the nail catches on the inside top of the tank.

11.3.4. Measure the distance from the tank top (inside) to the top of the standpipe. Subtract the distance from the nail to the base of the dipstick (1 inch) and record this measurement.

11.3.5. Subtract the second measurement (inside tank top to top of standpipe) from the first measurement (tank bottom to top of standpipe).

11.3.6. Record the measurement at the appropriate place (as Measurement #1, #2, #3 or #4) *on the Tank Installation Checklist.*

11.4. CALCULATION AND COMPARISON

11.4.1. To get the deflection measurement at any time during installation, take a diameter measurement and subtract it from Measurement #1.

11.4.2. Compare this measurement to the applicable allowable deflection *shown in TABLE 11-1.*

Tank Diameter	Allowable Deflection
4'	1/2"
6'	3/4"
8'	1 1/8"
10'	1 1/2"
12'	1 3/4"

TABLE 11-1

11.4.3. Vertical deflection in excess of this measurement indicates improper installation.

12. BALLASTING TANKS (ADDING LIQUID)

⚠ WARNING

Inert the tank and use inert gases (not air) to pressure test a tank that contains or has contained flammable or combustible liquids or vapors. Failure to follow this warning could result in an explosion, and could result in death or serious injury.

⚠ WARNING

If flammable or combustible product is used as ballast, exercise special care in handling. Safeguard against sparks, fire or product spills. Failure to follow this warning could result in a fire or an explosion, and could result in death or serious injury.

⚠ WARNING

The tank must be adequately vented to prevent the development of vacuum or pressure when filling or emptying the tank. Failure to properly vent the tank could cause tank failure, and could result in death or serious injury.

12.1. GENERAL

12.1.1. In most anchoring systems, a tank is not adequately protected against flotation until the tank is fully backfilled and the top slab is in place. Therefore, during the installation process, the tank should be ballasted completely after the backfill is at least 75 percent of the way up the tank and after postinstallation testing has been successfully completed.

12.1.2. Only under wet-hole conditions should ballast be added before the backfill is 75 percent of the way up the tank. *See SECTION 5.3.*

12.1.3. Care must be taken so that the use of ballast does not contaminate the product being stored. This is especially important for potable water, chemical and diesel exhaust fluid (DEF) tanks.

12.1.3.1. Contamination can be avoided by doing one of the following:

12.1.3.1.1. ballast the tank with a liquid compatible with the product being stored, or

12.1.3.1.2. clean the tank after ballasting to eliminate any contaminating product.

13. POSTINSTALLATION TESTING

⚠ WARNING

Inert the tank and use inert gases (not air) to pressure test a tank that contains or has contained flammable or combustible liquids or vapors. Failure to follow this warning could result in an explosion, and could result in death or serious injury.

⚠ WARNING

If flammable or combustible product is used as ballast, exercise special care in handling. Safeguard against sparks, fire or product spills. Failure to follow this warning could result in a fire or an explosion, and could result in death or serious injury.

13.1. GENERAL

13.1.1. After backfill is brought close to the top of the tank, take a diameter measurement.

13.1.2. Typically, tanks should be air tested before ballasting.

13.1.2.1. Do not use atmospheric air when testing air-testable tanks that have held product. Use nitrogen or other inert gas when testing these tanks.

13.2. AIR TESTING TANKS

13.2.1. If the tank is a wastewater tank equipped for air testing, *follow the procedures in the Xerxes supplement, Preinstallation Testing Instructions for Water/Wastewater Tanks Factory-Equipped for Pressure Testing. See SECTION 20* for information on how to obtain this supplement.

13.2.2. All UL-labeled tanks, chemical tanks and potable water tanks must be air tested after backfill is brought close to the top of the tank.

13.2.3. To air test a tank, pressurize the primary tank to 5 psig (3 psig for 12-foot-diameter tanks) using a test manifold (see FIGURE 3-2).

13.2.3.1. Soap all service fittings and manways on the top of the tank.

13.2.4. If the interstitial space of the tank is filled with monitoring fluid, check the fluid level and check that there is no monitoring fluid in the interior of all tank compartments.

13.2.5. If the interstitial space of the tank was shipped under vacuum and the factory-supplied vacuum has not been released, check that the vacuum gauge shipped with the tank reads 12 inches of mercury or more.

13.2.5.1. If the vacuum gauge reads less than 12 inches of mercury, contact the plant from which the tank was shipped.

13.2.6. If the tank is a dry-monitor, double-wall tank with the interstice not under vacuum, bleed pressure from the primary tank to the interstice.

13.2.7. Hold and monitor the pressure in the interstitial space for a minimum of 1 hour. If pressure drops in the interstice more than 1 psig, contact the plant from which the tank was shipped.

13.2.8. Carefully release the air pressure from the tank.

13.2.9. Remove the test manifold and replace the protective covers in the service fittings.

13.2.10. If the air test was not successful, contact the plant from which the tank was shipped.

13.3. OPTIONAL HYDROSTATIC TESTING

13.3.1. This optional test is typically used for water or wastewater tanks that are not air-testable due to the accessories on the tank.

13.3.2. These instructions are for an optional hydrostatic test after backfilling is completed to the top of the tanks.

CAUTION

If the tank is to be hydrostatically tested, it must be supported by backfill on all sides to the top of the tank. Failure to follow this caution may result in damage to the tank and/or surrounding property.

13.3.3. Seal off the influent and effluent piping, and any fittings that are below the tank top with watertight caps or plugs.

13.3.4. Fill the tank with water to a level that is 3 inches into the access openings after the hole is backfilled at least 75 percent of the way up the tank.

13.3.5. Let the water stand in the tank for a minimum of 1 hour (or longer if required by applicable local codes).

13.3.6. If the water level drops, check to see that plugs or caps sealing off the piping are tight. Then add more water to fill air voids and return the water level back to the standard testing level. *See Point 13.3.3.*

13.3.7. If the water level does not stabilize, contact the plant from which the tank was shipped.

14. PIPING AND VENTING

14.1. INTERNAL PIPING

14.1.1. All piping must conform to all applicable codes and standards.

CAUTION

All internal piping must be at least 4 inches from the tank bottom. Failure to follow this caution may result in damage to the tank and/or surrounding property.

CAUTION

All metal fittings and other metal components must be coated to protect against corrosion. Failure to do this may result in damage to these parts, the tank and/or surrounding property.

14.1.2. For tanks equipped with manways, *refer to FIGURE 14-1 along with TABLE 14-1* to determine the correct dimensions for sizing internal piping.

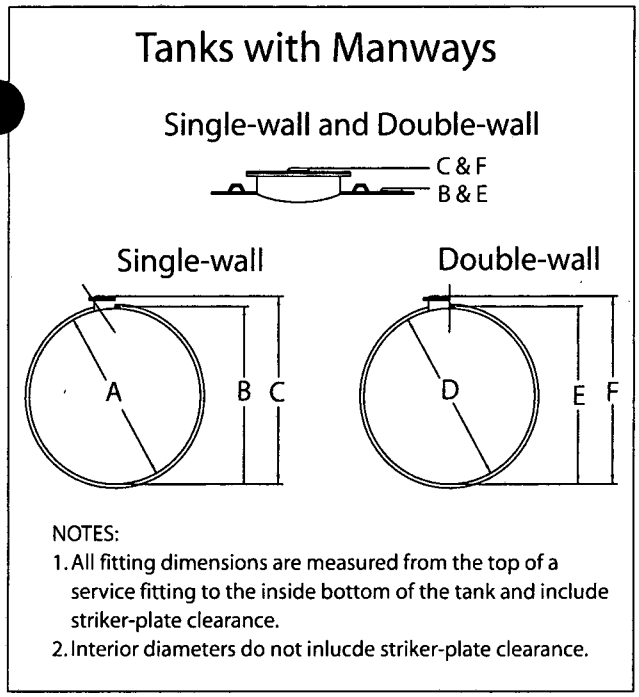


FIGURE 14-1

Dimensions for FIGURE 14-1						
Tank Dia.	A	B	C	D	E	F
4'	48"	49 1/2"	54 1/2"	48"	49 1/2"	54 1/2"
6'	71 3/8"	73"	78"	70 3/4"	72 1/2"	77 3/4"
8'	91 1/4"	93"	98"	90"	91 3/4"	97"
10'	119 1/4"	121"	126"	118"	119 3/4"	125"
12'	136 5/8"	138 1/4"	143 1/4"	---	---	---

TABLE 14-1

14.1.3. For tanks equipped with access openings, *refer to FIGURE 14-2 along with TABLE 14-2* to determine the correct dimensions for sizing internal piping.

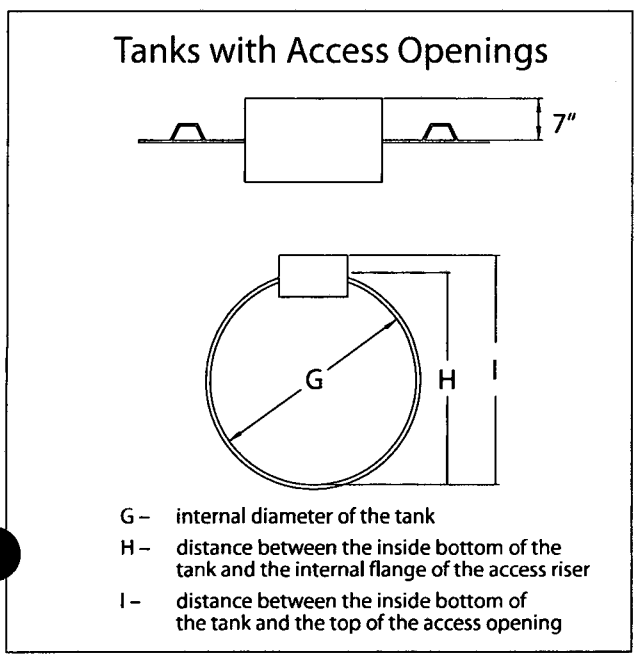


FIGURE 14-2

Dimensions for FIGURE 14-2			
Tank Dia.	G	H	I
4'	48"	51 1/4"	55 1/4"
6'	71 3/8"	74 3/4"	78 3/4"
8'	91 1/4"	94 1/2"	98 1/2"
10'	119 1/4"	122 1/2"	126 1/2"
12'	136 5/8"	140"	144"

TABLE 14-2

14.2. EXTERNAL PIPING

⚠ WARNING

The tank must be isolated from all piping when the external piping is being pressure tested. The test pressures for external piping could cause tank failure, and could result in death or serious injury.

CAUTION

When extending monitoring or vapor-recovery piping to the surface, make sure the at-grade fittings are different from any fill fittings and will not accept standard fill hoses. Failure to do this may result in damage to the tank and/or surrounding property.

CAUTION

All connections to the tank must be flexible. Provisions must be made to accommodate movement and misalignment between the piping and the tank. Failure to do this may result in damage to the tank and/or surrounding property.

14.3. VENTING TANKS

⚠ WARNING

All underground tanks/compartments shall be adequately vented to prevent the development of vacuum or pressure when filling or emptying the tank. Failure to properly vent a tank or compartment could cause tank failure, and could result in death or serious injury.

14.3.1. The single-wall tank is designed to operate at atmospheric pressure.

14.3.2. In the double-wall and triple-wall tanks, the primary tank is designed to operate at atmospheric pressure.

14.3.3. The tank's venting system must be adequately sized to ensure that atmospheric pressure is maintained at all times, including during filling and emptying of tank.

14.3.4. Whenever installing overfill protection, such as an alarm, an automatic shut-off device (flapper valve) or a vent-restriction device (ball-float valve), follow the instructions provided by the manufacturer of the overfill-protection device and consult the authority having jurisdiction to determine the level at which the overfill protection should operate.

14.3.4.1. Some jurisdictions do not allow ball-float valves. Consult applicable codes and regulations.

⚠ WARNING

Vent-restriction devices for overfill should not be installed if owner/operator will allow pump- or pressure-filling of tank. Failure to follow this warning could cause tank failure, and could result in death or serious injury.

14.4. VENTING INTERSTITIAL SPACES

CAUTION

All wet monitoring systems must be vented for proper operation. Failure to do this may result in damage to the tank and/or surrounding property.

14.4.1. When the tank's interstitial space is filled with a monitoring fluid, the space must be vented. It is sufficient to drill a 1/4-inch-diameter hole in the side or cap of the reservoir standpipe as supplied by the installer. If the groundwater level could be high enough to enter a drilled vent hole, install a vent line from the standpipe to above high-water level.

14.4.2. When the interstitial space is dry, it is not necessary to vent the space to atmosphere.

15. MONITORING TANKS

15.1. GENERAL

15.1.1. It is the responsibility of the tank owner and/or operator to determine the appropriate monitoring system and method if one is to be used.

15.2. SINGLE-WALL TANK

15.2.1. Single-wall tank installations may require release detection monitoring, which can include inventory control, automatic tank gauging, vapor monitoring or groundwater monitoring.

15.2.2. Check with federal, state and local officials for requirements in your area.

15.3. DOUBLE-WALL TANK

15.3.1. GENERAL

15.3.1.1. A double-wall tank has an interstitial space between the wall of the primary (internal) tank and the wall of the secondary (external) tank for the detection and containment of product from the primary tank.

15.3.1.2. A double-wall tank, as supplied, will have a minimum of one monitoring access fitting that provides access into the interstitial space.

15.3.1.3. Liquid and vapor sensors are installed through the monitoring access fitting.

15.3.1.3.1. Most sensors can be installed after the tank has been backfilled to grade. However, for ease of installation, the sensor may be inserted into the monitoring access fitting before installing the monitoring riser pipe to grade.

15.3.2. DOUBLE-WALL TANK WITH A DRY INTERSTITIAL SPACE

15.3.2.1. A safe electronic or mechanical monitoring system should be used to detect product and incoming water.

15.3.2.2. The monitoring system should detect product and water at the bottom of the tank.

15.3.2.3. If ordered as an accessory, use the factory-installed drawstring to facilitate positioning of the monitoring sensor at or near the bottom of the tank.

15.3.2.4. If a double-wall tank is sloped, the monitor should be at the low end.

15.3.2.5. For liquid or vapor sensors, the monitoring access fitting may be vented to atmosphere (independent from the primary tank) or sealed.

15.3.3. DOUBLE-WALL TANK WITH A WET INTERSTITIAL SPACE

15.3.3.1. A double-wall tank may be shipped with a factory-installed TRUCHEK® monitoring system.

15.3.3.1.1. The TRUCHEK system enables the owner to have continuous monitoring or to conduct a tank-tightness test. TRUCHEK meets the EPA criteria for tank-tightness testing. *See the Xerxes TRUCHEK brochure* for more information.

15.3.3.1.2. When a double-wall tank is shipped with the TRUCHEK monitoring system, the interstitial space is typically filled with monitoring fluid at the manufacturing facility.

15.3.3.1.3. Some tanks may be shipped with extra monitoring fluid so the monitoring-fluid level can be topped off.

15.3.3.2. When the tank is delivered and before it is installed, check the monitoring-fluid level and record it *on the shipping/receiving paperwork and Tank Installation Checklist. See FIGURE 15-1.*

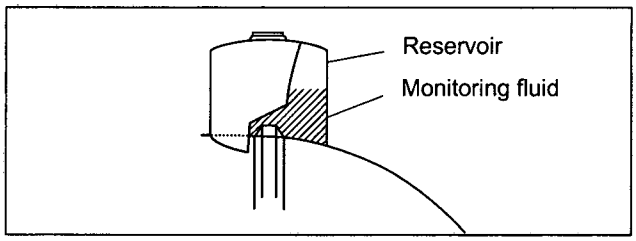


FIGURE 15-1

15.3.3.3. The required operating level for the monitoring fluid is approximately 1/2 full. If necessary, fill to the 1/2 full level with the Xerxes-supplied monitoring fluid shipped with the tank.

NOTE: Do not add monitoring fluid until after tank burial is completed and the monitoring system is set up.

CAUTION

All wet interstitial spaces must be vented to atmosphere. Failure to follow this caution may result in damage to the tank and/or surrounding property. *See SECTION 14.4.*

15.3.3.4. If monitoring fluid is not in the reservoir, contact the Xerxes customer service coordinator.

15.3.3.5. In a tank with the interstice filled with monitoring fluid, Xerxes recommends using a nonmetalic standpipe in the reservoir.

CAUTION

Monitoring fluid should not be present in the standpipe except during a TRUCHEK test. Monitoring fluid in the standpipe may create excessive pressure on the interstitial space and may result in damage to the tank. *See the Xerxes TRUCHEK brochure* for more information.

15.3.3.6. The monitoring-fluid level may fluctuate during shipping and installation.

15.3.3.7. If a tank is sloped, the reservoir should be at the high end.

15.3.3.8. During the installation process, the monitoring-fluid level in the reservoir will rise naturally under various conditions:

15.3.3.8.1. preinstallation air test

15.3.3.8.2. rise in groundwater level

15.3.3.8.3. backfill compaction

15.3.3.8.4. ballasting.

15.3.3.9. Check and record the monitoring-fluid level during the installation process. *See the Tank Installation Checklist.*

15.3.4. SETTING THE LEVEL OF THE MONITORING FLUID

15.3.4.1. After backfilling and top-slab placement is completed, check the level of the monitoring fluid in the reservoir and set the monitoring fluid to the proper level.

NOTE: Failure to set the monitoring-fluid level properly may lead to false alarms.

15.3.4.2. Once the tank is installed, the level of the monitoring fluid may fluctuate due to such things as:

15.3.4.2.1. product level

15.3.4.2.2. groundwater fluctuation

15.3.4.2.3. tank filling and emptying

15.3.4.2.4. product-temperature variation.

15.3.4.3. To establish the proper operating level for monitoring fluid, decide what type of monitoring probe will be used in order to determine the initial starting point for the level in the reservoir.

15.3.4.3.1. The typical probe has two sensors (a high-fluid level and a low-fluid level). When using a two-sensor probe, the starting point (the proper level for the monitoring fluid) is midway between the two sensors.

15.3.4.3.2. If using something other than a two-sensor probe, use 7 inches from the top of the tank as the starting point for the monitoring-fluid level.

NOTE: When using a probe, do not raise it off the tank to meet the monitoring-fluid level. The probe must remain upright and in contact with the top of the tank at all times. ***See FIGURE 15-2.***

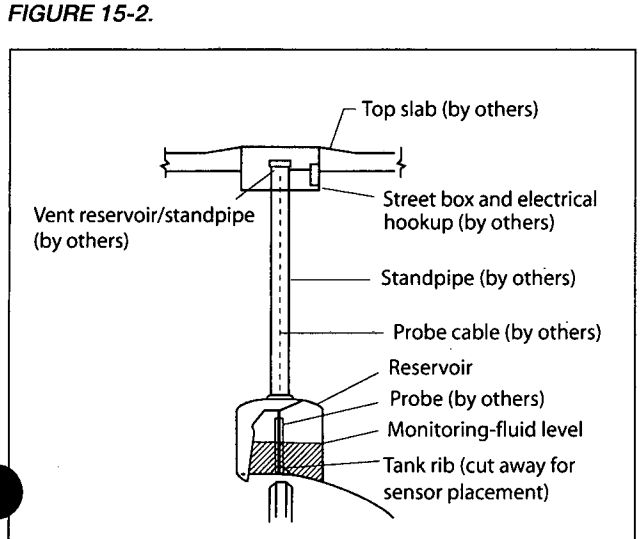


FIGURE 15-2

15.3.4.4. After determining the starting point, adjust the monitoring fluid based on the product level.

15.3.4.4.1. If the tank is between 1/4 and 1/2 full of product, the proper operating level for the monitoring fluid is **at** the starting point.

15.3.4.4.2. If the tank is between empty and 1/4 full, the proper operating level for the monitoring fluid is about 1 to 1-1/2 inches **below** the starting point.

15.3.4.4.3. If the tank is between 1/2 full and full, the proper operating level for the monitoring fluid is about 1 to 1-1/2 inches **above** the starting point.

15.3.4.5. Add or remove monitoring fluid to reach the proper operating level for the monitoring fluid.

15.3.4.6. If a TRUCHEK test is required after installation, *follow the procedures in the Xerxes TRUCHEK brochure.*

15.3.4.6.1. After this test, reset the monitoring-fluid level to a position based on the product level.

16. INSTALLING CONTAINMENT SUMPS

16.1. GENERAL

16.1.1. Xerxes containment sumps come in a variety of models and sizes, including single-wall and double-wall models, and round and flat-sided models.

16.1.1.1. Instructions for the different models are found in Xerxes' supplemental materials. *See SECTION 20* for information on where to obtain supplemental instructions.

16.1.2. The containment sump provides an enclosure for a submersible pump and a termination point for secondary piping systems.

16.1.2.1. It provides containment of product from the pump and/or piping connections.

16.1.2.2. It is designed to be monitored continuously using electronic sensors.

16.1.3. Consult federal, state and local codes and regulations to ensure proper monitoring compliance.

16.1.4. All Xerxes containment sumps must be isolated from traffic loads.

16.1.5. Before installing the containment sump, perform a visual inspection of the sump for potential shipping damage.

16.1.6. If damage is detected, contact the plant from which the tank was shipped.

⚠ CAUTION

Always wear eye protection and gloves when handling, grinding, cutting and attaching the containment sump unit. Failure to do so may result in minor or moderate injury.

CAUTION

Do not drop the containment sump assembly components or allow the sump body to roll. Since high winds could damage the sump components, protect and secure all pieces if windy conditions arise. Failure to follow this caution may result in damage to surrounding property.

16.1.7. Measure the sump to ensure it is the correct length for intended burial depth. For further instructions, *see the Xerxes supplement applicable for the specific containment sump being installed. See SECTION 20* for list of supplements.

16.2 FINAL CONTAINMENT SUMP INSTALLATION

CAUTION

Make sure that no heavy objects are allowed to distort the containment sump top after final assembly. This includes the street box and concrete pad. No weight should be transferred to the tank. Failure to follow this caution may result in property damage.

16.2.1. Backfill to the top of the containment sump system.

16.2.2. Backfill around the outside edge of the containment sump, making sure that no backfill is on top of the containment sump. *See FIGURE 16-1, Area A.*

16.2.3. Isolate the containment sump from all traffic loads.

16.2.3.1. The contractor must install a concrete form/barrier to allow a minimum 3-inch clearance between any load-bearing item (for example, the concrete pad/street-box frame) and the containment sump top.

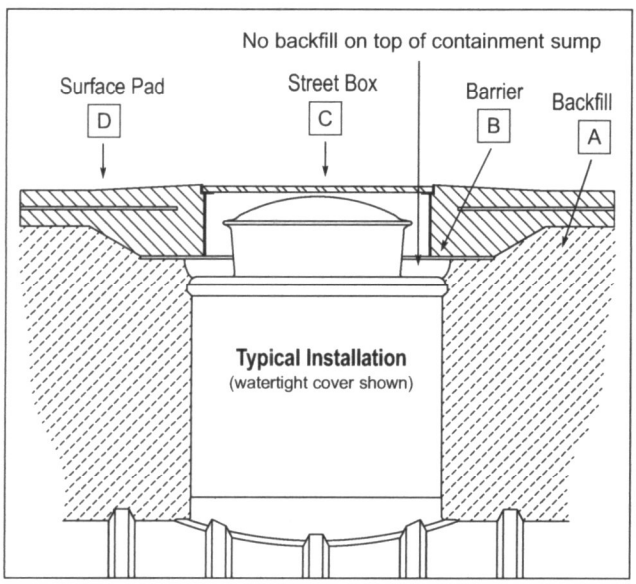


FIGURE 16-1

16.2.3.2. Typically, a sheet of plywood (or other material) is used as a barrier and is set on the backfill to ensure that there is at least a 3-inch clearance above the containment sump top. *See FIGURE 16-1, Area B.*

16.2.4. Choose a street-box size that allows enough clearance around the containment sump top opening for proper operation of the cover.

16.2.5. Set the street box, and check for clearance to allow access and space to remove the watertight cover. *See FIGURE 16-1, Area C.*

16.2.6. Continue with backfill, as required, to subgrade. *See FIGURE 16-1, Area A.*

16.2.7. Maintain good drainage of water away from the access opening of the containment sump top when installing the surface pad. *See FIGURE 16-1, Area D.*

17. ADDING TANKS AT EXISTING LOCATIONS

17.1. GENERAL

17.1.1. Additional Xerxes tanks may be installed at existing locations if proper foundation support exists.

17.1.2. Backfill support around the existing tanks must not be disturbed.

17.1.3. It is the responsibility of the tank owner to choose the method of installation.

17.1.4. Xerxes requires that one of the following methods be used.

17.2. PREFERRED METHOD

17.2.1. The preferred method is to install new tank(s) in a separate hole if space allows and/or if existing tank(s) must remain in service during installation of the new tank(s). The preferred method is described here. *See FIGURE 17-1.*

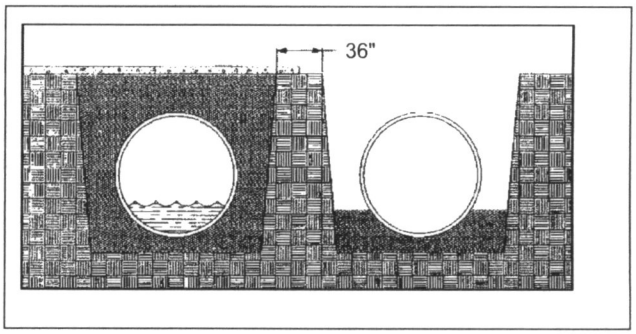


FIGURE 17-1

17.2.1.1. Install a new tank in a separate hole at least 3 feet from the original hole.

17.2.1.2. Follow procedures outlined in this Installation Manual.

17.2.1.3. Keep heavy and/or unusual surface loads off existing tanks when excavation hole is open.

17.2.1.4. Maintain the natural barrier of undisturbed soil between tanks.

17.2.1.5. *See SECTION 7.5.* for minimum spacing requirements between tanks.

NOTE: Sufficient soil must remain between the excavations so that the backfill in the original excavation does not shift.

17.3. ALTERNATE METHOD

17.3.1. If the preferred method outlined above is not possible or practical, an alternate method is described here. *See FIGURE 17-2.*

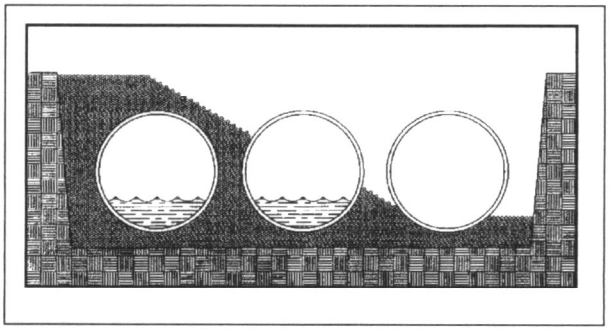


FIGURE 17-2

17.3.1.1. Bury additional tanks in the same installation hole.

17.3.1.2. Empty existing tanks to less than one-quarter (1/4) of capacity.

17.3.1.3. Remove the surface slab.

17.3.1.4. Enlarge the excavation for the new tanks, but leave as much backfill as possible around the existing tanks.

17.3.1.5. Install shoring, if necessary, to make sure that existing tanks do not move and that sufficient backfill remains around them.

⚠ WARNING

Failure to shore tanks if necessary to keep the existing tank(s) from moving could result in death or serious injury.

17.3.1.6. Follow the procedures and requirements for installing the tanks *as outlined in this Installation Manual.*

17.3.1.7. *See SECTION 6* for backfill requirements, *and SECTION 7* for excavation and spacing requirements.

⚠ CAUTION

If any existing tank(s) should move during the installation of new tanks, they must be removed and reinstalled according to tank manufacturer's instructions. Failure to follow this caution may result in minor or moderate injury.

18. OPERATING GUIDELINES

18.1. GENERAL

18.1.1. Owner must retain the Installation Manual and Operating Guidelines for future reference to operating guidelines.

18.1.2. In addition to these installation instructions and operating guidelines, follow all federal, state and local laws, regulations, codes and safety precautions that pertain to underground storage tanks and/or their associated systems.

18.1.3. Consult supplemental materials (*see SECTION 20*), tank brochures, separate product instructions (such as oil/water separators) and separate accessory instructions, which are available upon request from the Xerxes customer service coordinator. Most of these documents are also available at www.xerxes.com.

18.1.4. Consult the applicable limited warranty for further operating guidelines and limitations. A copy of the applicable Xerxes limited warranty is found in the printed material that accompanies each tank, in each applicable product brochure and at www.xerxes.com. It is also available upon request from the Xerxes customer service coordinator.

18.2. TEMPERATURE LIMITS FOR STORED PRODUCTS AND MATERIALS

18.2.1. Each Xerxes tank is designed to store materials identified in the manufacturer's applicable limited warranty.

CAUTION

Products and materials must be stored in the tank appropriate for the specific product or material. Failure to follow this caution may result in damage to the tank and/or surrounding property.

CAUTION

Storing products and materials other than those identified in the manufacturer's applicable limited warranty will void Xerxes' obligations under the limited warranty and may result in tank failure and/or damage to surrounding property.

18.2.2. All products and materials must be stored at ambient temperature except as follows:

18.2.2.1. The maximum temperature for storing fuel oils is 150°F.

18.2.2.2. The maximum temperature for storing nonpotable water is 150° F.

NOTE: Potable water is to be stored at ambient temperature.

18.2.2.3. The maximum temperature for storing wastewater products and materials is 150°F.

18.2.2.4. The maximum temperature for storing chemicals is 100°F.

CAUTION

Introducing or storing a product or material into a tank in excess of the allowable temperature may damage the tank. Failure to follow this caution may result in damage to the tank and/or surrounding property.

18.3. ENTERING TANKS

18.3.1. Do not allow anyone to enter the tank unless it has been properly emptied and vented, and unless the person entering the tank has been trained in confined-space entry procedures and applicable OSHA regulations.

⚠ WARNING

Improper tank entry could cause fire, explosion or asphyxiation, and could result in death or serious injury.

18.4. FILLING TANKS (IN GENERAL)

18.4.1. Never overfill the tank.

18.4.2. If pump- or pressure-filling a tank, owner/operator must take precautions to prevent overpressurization.

⚠ WARNING

Overpressurizing the tank could result in tank failure, and could result in death or serious injury.

⚠ WARNING

If a tank does not have overfill protection, the vent must be unrestricted and the vent size must be equal to or greater than the fill. Failure to follow this warning could result in death or serious injury.

18.5 FILLING UL-LABELED TANKS

⚠ WARNING

Xerxes does not recommend pump- or pressure-filling of the tank because an overfill or overpressurization could occur. Overfilling the tank while under pressure could cause tank failure even if the tank is vented properly. Failure to follow this warning could result in tank failure, and could result in death or serious injury.

18.5.1. Each time the tank is filled, the owner/operator must make sure the tank is properly vented. *See SECTION 14.*

18.5.2. Owner/operator must determine whether the tank has overfill protection, such as an automatic shut-off device (flapper valve) or vent-restriction device (ball-float valve), which will close off the internal piping and reduce the tank's capacity.

18.5.3. If a tank has a vent-restriction device (ball-float valve), Xerxes recommends that the tank be gravity-filled only.

18.5.4. Owner/operator must notify whoever fills the tank if the tank has overfill protection, which reduces the tank's capacity.

18.5.5. Before each tank filling, owner/operator or the delivery service must determine the tank's reduced capacity due to the overfill protection, then consult the instructions or guidelines provided by the installer and manufacturer of the overfill-protection device to determine how much additional product the tank can hold.

18.5.6. Owner/operator must ensure that the fill line and drop tube are adequately grounded to prevent static discharge during filling.

18.5.7. Initial fill rate should be controlled to limit the possibility of product sloshing.

19. LIMITED WARRANTIES

19.1. GENERAL

19.1.1. Each product is covered by a product-specific limited warranty, which contains operating guidelines and parameters that should be reviewed as applicable. A copy of the applicable Xerxes limited warranty is found in the printed material that accompanies each tank, in applicable product brochures and at www.xerxes.com. It is also available upon request from the Xerxes customer service coordinator.

20. SUPPLEMENTAL MATERIALS

20.1. GENERAL

20.1.1. Supplemental materials, which may apply to specific installations and/or conditions, are available upon request from the Xerxes customer service coordinator or from technical support at Xerxes Minneapolis, MN. Most supplemental materials are also available at www.xerxes.com.

20.1.1.1. Among those materials available from the Xerxes customer service coordinator and at www.xerxes.com are the following:

- Diesel Exhaust Fluid (DEF) Tank Installation Instructions
- Double-Wall Containment Sump Installation Instructions
- Field Fiberglass Lay-Up Instructions for Containment Sumps
- Flat-Bottom Containment Sump Installation Instructions
- Flexible Dipstick Monitoring Instructions
- Large Bottom Sump Installation Instructions
- Man-Out-of-Hole (MOH) Strap Instructions
- New York City Double-Wall Tank Installation/Testing Supplement
- Prefabricated Deadmen Installation Instructions
- Preinstallation Testing Instructions for Water/Wastewater Tanks Factory-Equipped for Pressure Testing
- Primary Backfill Requirements
- TRUCHEK® Brochure
- Single-Wall Containment Sump Installation Instructions for Flat-Sided Containment Sumps
- Single-Wall Containment Sump Installation Instructions for Round-Sided Containment Sumps
- Split Backfill Instructions
- Triple-Wall Tank Preinstallation Testing Instructions
- Two-Part Sealant Mixing/Handling Instructions
- Watertight Cover Gasket Replacement Instructions
- Wet Well Installation Instructions and Operating Guidelines.

20.1.1.2. Among those materials available from technical support at Xerxes Minneapolis, MN, are the following:

- Alternate Backfill (Sand) Installation Instructions
- Cast-in-Place Deadmen Installation
- Deep Burial Installation Guidelines.

21. RETENTION OF INSTALLATION MANUAL

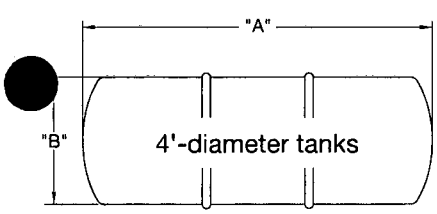
21.1. GENERAL

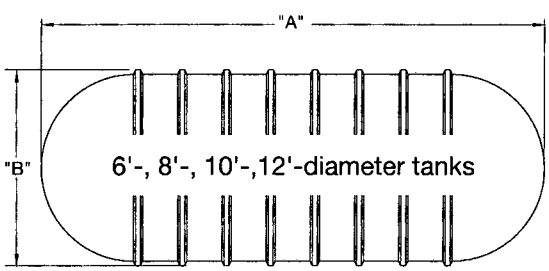
21.1.1. After installation, tank installer must give the Installation Manual and the completed Tank Installation Checklist to the tank owner.

21.1.2. After installation, tank owner must retain the Installation Manual for future reference to operating guidelines. Tank owner must also retain a copy of the Tank Installation Checklist.

APPENDIX A: XERXES TANK DATA CHART *

Nominal Tank Diameter (feet)	Nominal Tank Capacity (gallons)	Actual Tank Capacity ** (gallons)		Actual Tank Diameter (B) *** (feet/inches)	Actual Tank Length (A) (feet/inches)	Nominal Tank Weight (pounds)			Number of Anchor Straps Required
SW & DW	SW & DW	SW	DW	SW & DW	SW & DW *	SW	DW Dry	DW Wet	SW & DW
4	600	602	602	4'-1/2"SW 4'-1"DW	6'-11 7/8" SW 7'-3 1/2" DW	500	800	1,000	2
	1,000	1,009	1,009	4'-1/2"SW 4'-1"DW	11'-3 7/8" SW 11'-7 1/2" DW	700	1,100	1,400	2
6	2,000	2,376	---	6'-3 1/2" SW	13'-5 3/4" SW	1,000	---	---	2
	2,500	---	2,324	6'-3 1/2" DW	13'-5 3/4" DW	---	1,800	2,400	2
	3,000	2,973	2,910	6'-3 1/2"	16'-4 1/4"	1,200	2,100	2,800	2
	4,000	4,131	3,789	6'-3 1/2"	21'-11 1/8" SW 20'-8" DW	1,600	2,500	3,500	2
	5,000	5,064	4,961	6'-3 1/2"	26'-5"	1,900	3,100	4,300	4
	6,000	5,960	5,840	6'-3 1/2"	30'-8 3/4"	2,200	3,600	4,900	4
8	2,000	2,189	---	8'-0" SW	9'-1/2" SW	900	---	---	2
	3,000	3,271	---	8'-0" SW	12'-3" SW	1,200	---	---	2
	4,000	4,218	4,190	8'-0"	15'-1/2"	1,400	2,200	3,100	2
	5,000	5,165	5,089	8'-0"	17'-8 1/2"	1,700	2,600	3,700	2
	6,000	6,084	6,044	8'-0"	20'-6 1/2"	2,000	2,900	4,300	2
	8,000	7,950	7,899	8'-0"	26'-1/4"	2,500	3,600	5,400	4
	10,000	9,816	9,753	8'-0"	31'-6 1/2"	3,000	4,300	6,600	4
	12,000	11,682	11,608	8'-0"	37'-1/2"	3,500	5,000	7,700	4
	15,000	14,975	14,881	8'-0"	46'-9"	4,500	6,400	9,800	6
10	10,000	10,563	10,420	10'-4"	21'-5 1/4"	3,200	4,500	6,200	4
	12,000	12,068	11,904	10'-4"	24'-1/4"	3,600	5,000	7,000	4
	15,000	15,248	15,041	10'-4"	29'-5 3/4"	4,500	6,100	8,600	4
	20,000	20,055	19,782	10'-4"	37'-8 3/4"	5,700	7,700	11,000	6
	25,000	25,783	25,431	10'-4"	47'-6 3/4"	7,900	10,000	14,300	6
	30,000	30,590	30,172	10'-4"	55'-9 3/4"	9,400	11,900	17,000	6
	35,000	35,397	34,912	10'-4"	64'-3/4"	10,500	13,600	19,600	6
	40,000	41,004	40,443	10'-4"	73'-8 1/4"	12,100	16,000	23,000	6
12	20,000	20,781	---	11'-11"	29'-4"SW	9,200	---	---	6
	25,000	25,541	---	11'-11"	35'-7"SW	10,600	---	---	8
	30,000	31,253	---	11'-11"	43'-1"SW	12,500	---	---	10
	35,000	36,013	---	11'-11"	49'-4"SW	13,900	---	---	12
	40,000	39,821	---	11'-11"	54'-4"SW	15,000	---	---	12
	48,000	48,389	---	11'-11"	65'-7"SW	17,700	---	---	18
	50,000	50,293	---	11'-11"	68'-1"SW	18,300	---	---	18





NOTES:

* This chart is for Xerxes fiberglass single-compartment underground storage tanks. For information on additional tank sizes, go to www.xerxes.com.

** If an overfill-protection device is installed in the tank, the actual capacity will be reduced.

*** Actual height of the tank may be greater than the actual diameter due to fittings and accessories. Load height during shipping may vary due to tank placement on the shipping trailer.

APPENDIX B: XERXES PRIMARY BACKFILL REQUIREMENTS

B1. GENERAL

B1.1. The backfill material surrounding an underground storage tank (UST) is a critical part of a proper tank installation. This document gives guidelines for choosing the primary backfill material to use when installing Xerxes fiberglass tanks.

B1.2. The Xerxes Installation Manual specifies that select rounded stones or crushed stones are to be used as primary backfill material.

B1.3. Primary backfill material is to be clean, free-flowing, and free of dirt, sand, large rocks, roots, organic materials, debris, ice and snow.

B1.4. No backfill material shall be frozen or contain lumps of frozen material at any time during placement.

B1.5. Another important characteristic of good backfill material is hardness or stability when exposed to water or loads. Most materials have no problems meeting the hardness requirement.

B1.5.1. Materials like soft limestone, sandstone, sea shells or shale should not be used as backfill because they break down over time.

B2. ACCEPTABLE BACKFILL MATERIALS

B2.1. Coarse aggregate is a technical term for the material (rounded stones and crushed stones) that meets Xerxes' backfill size requirements.

B2.2. ASTM International and The American Association of State Highway and Transportation Officials (AASHTO) have specifications for standard sizes of coarse aggregate.

B2.3. TABLE B1-1 gives the standard sizes of coarse aggregate that meet Xerxes' backfill material specifications for rounded stones and crushed stones. It identifies standard sieve sizes used to grade aggregate material. For each aggregate size, the amount of material finer than each laboratory sieve (square openings) is given as a percentage of the total weight of the sample.

NOTE: ASTM uses size numbers 6, 67, 7 and 8 to describe specific gradation profiles for materials that pass through a series of sieves. Do not confuse these gradation profiles with sieve sizes.

B2.3.1. The percentages give an indication of the particle size distribution or gradation within a given aggregate size. With aggregate size number 6 of rounded stones, for example, 20–55 percent of the sample (measured by weight) should pass through a 1/2-inch sieve. And, with aggregate size number 7 of crushed stones, 0–15 percent of the sample (measured by weight) should pass through a No. 4 sieve.

B2.4. Some material suppliers may produce materials that meet Xerxes' requirements but are not identified by a standard coarse aggregate size number. The supplier should be able to provide a specification that identifies the size or gradation of the material.

B2.4.1. If the material supplier is unable to supply a gradation report, an independent testing laboratory can perform a sieve analysis on a sample of the material according to the ASTM C 136 testing specifications. The test results can then be compared against the size requirements for rounded or crushed stones *shown in table B1-1.*

B3. ROUNDED STONES

B3.1. When using select rounded stones, the material is to be a mix of rounded particles, sizes between 1/8 inch and 3/4 inch.

B3.2. The rounded stones must conform to the specifications of ASTM C 33, sizes 6, 67 or 7.

B3.3. No more than 5 percent (by weight) of the backfill may pass through a #8 sieve. *See TABLE B1-1* for additional information about specifications.

NOTE: Generally, rounded stones that meet the gradation requirements are larger than allowable crushed stones.

B4. CRUSHED STONES

B4.1. When using crushed stones, the material is to be a mix of angular particles, sizes between 1/8 inch and 1/2 inch.

B4.2. The crushed stones must conform to the specifications of ASTM C 33, sizes 7 or 8.

B4.3. No more than 5 percent (by weight) of the backfill may pass through a #8 sieve. *See TABLE B1-1* for additional information about specifications.

TABLE B1-1—Percent of Stones Passing Through Sieve by Sieve Size

Sieve Size	Rounded Stones			Crushed Stones	
					
	ASTM C 33 Size #	#6 Stone	#67 Stone	#7 Stone	ASTM C 33 Size #	#7 Stone	#8 Stone
	1 inch [25 mm]	100 %	100 %	— — —	1 inch [25 mm]	— — —	— — —
	3/4 inch [19 mm]	90—100 %	90—100 %	100 %	3/4 inch [19 mm]	100 %	— — —
	1/2 inch [12.5 mm]	20—55 %	— — —	90—100 %	1/2 inch [12.5 mm]	90—100 %	100 %
	3/8 inch [9.5 mm]	0—15 %	20—55 %	40—70 %	3/8 inch [9.5 mm]	40—70 %	85—100 %
	No. 4 .0187 inch [4.75 mm]	0—5 %	0—10 %	0—15 %	No. 4 .0187 inch [4.75 mm]	0—15 %	10—30 %
	No. 8 .094 inch [2.36 mm]	— — —	0—5 %	0—5 %	No. 8 .094 inch [2.36 mm]	0—5 %	0—10 %

APPENDIX C: XERXES SPLIT BACKFILL INSTRUCTIONS

C1. GENERAL

C1.1. Use select rounded or crushed stones for primary backfill material *as specified in the Xerxes Installation Manual in effect at time of installation, and the Xerxes APPENDIX B (and supplement), Primary Backfill Requirements.*

C2. SPLIT BACKFILL INSTALLATION

C2.1. Use the primary backfill material vertically up to at least 75 percent of the tank diameter. *See FIGURE C1-1.*

C2.2. *Follow the instructions in SECTION 6 of the Installation Manual* on the placement of this backfill material.

C2.3. Install a layer of geotextile filter fabric over the entire surface of the primary backfill material. *See SECTION 9* for more information about geotextile filter fabric.

C2.3.1. All joints in the filter fabric should be overlapped a minimum of 12 inches.

C2.3.2. Geotextile fabric must overlap onto the tank and excavation surface a minimum of 12 inches.

C2.3.3. Installations with unstable soil may require that the fabric line the entire excavation. *See SECTION 9* for specific information about using geotextile filter fabric in unstable-soil conditions.

C2.4. Clean native backfill may be used as secondary backfill material above the geotextile fabric to subgrade.

C2.4.1. Secondary backfill material must be clean, free-flowing, and free of large rocks, roots, organic materials, debris, ice and snow. Backfill material shall not be frozen or contain lumps of frozen material at any time during installation.

C2.5. Secondary backfill must be compacted to achieve a minimum of 85 percent standard proctor density.

C2.5.1. Do not use rammer-type compactors over the top of the tank.

C2.5.2. Some tank owners may require sample testing and written reports to verify the compaction of the backfill.

C2.6. Material must be installed in 12-inch to 24-inch lifts compatible with the compaction equipment used.

C2.7. In some conditions, frost heave may be encountered when using secondary backfill. Therefore, consider any problems that may occur.

C2.8. Specifications for secondary backfill material and compaction above the filter fabric layer may be determined by the requirements of the piping, surface slab or roadway.

C2.9. Refer to applicable codes or standards for base course and sub-base course material and compaction requirements.

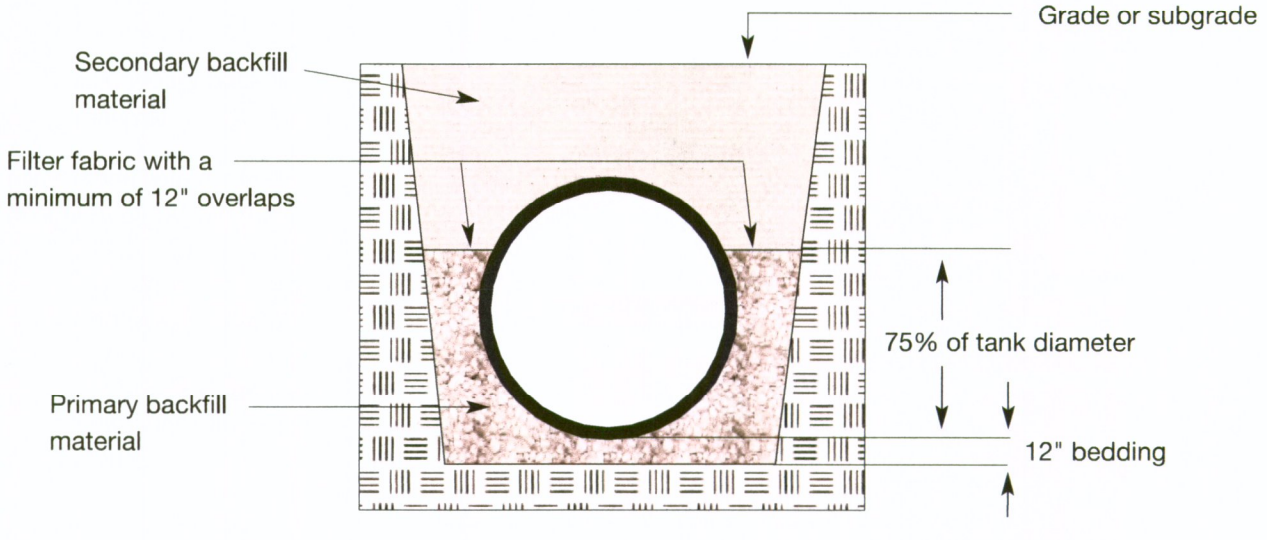
C2.10. The following are examples of acceptable secondary backfill material:

C2.10.1. clean native backfill

C2.10.2. coarse sand or gravel

C2.11. One hundred percent (100%) of all backfill material must pass through a 1-inch sieve.

FIGURE C1-1—Split Backfill Installation



XERXES TANK INSTALLATION CHECKLIST

The tank owner should retain a copy of the completed Tank Installation Checklist in order to facilitate any warranty claim. Unless other information is requested, initial each step to verify that the item has been performed or installed per Installation Manual specifications and instructions.

A1. GENERAL INFORMATION

Date of Installation _____

Address of Installation _____

Tank Owner Name _____ Telephone _____ Email _____

Address _____

Contractor Name _____ Telephone _____ Email _____

Address _____

A2. TANK INFORMATION

Tank Number	Tank #1	Tank #2	Tank #3	Tank #4
UL# (from tank label)				
Nominal Tank Diameter (in feet) & Capacity (in gallons)				
Tank Type (SW, DW, MC, OWS, Other, and Wet or Dry)				

A3. PREINSTALLATION (*See SECTIONS 2 and 3* for instructions and specifications.)

Visual Inspection (no damage)				
Tanks shipped under vacuum (SECTION 4.3. requirements met)				
Tanks with monitoring fluid (record fluid level in reservoir and check for absence of fluid in or on tank)				
Tank passed pressure/soap test if req'd				

A4. DIAMETER MEASUREMENTS (*See SECTION 11* for instructions and requirements. Mark location of measurements on site sketch.)

Measurement #1 (before installation)				
Measurement #2 (straps installed)				
Measurement #3 (backfilled to top of tank)				
Measurement #4 (backfilled to subgrade)				
Deflection measurement (#1—#4)				
Measurement meets req'ts of TABLE 11-1				

A5. INSTALLATION (*See SECTIONS 5, 6, 7, 8, 9, 12 and 14* for instructions and specifications.)

Primary backfill material				
Secondary backfill material (if used)				
Traffic loads (indicate yes or no)				
Excavation (size and condition)				
Hole condition (indicate dry or wet)				
Backfill bedding				
Tank spacing (between tanks and from excavation walls)				
Anchoring (indicate system used: none, deadmen or anchor slab)				
Anchoring (if used)				

XERXES TANK INSTALLATION CHECKLIST continued

Tank Number	Tank #1	Tank #2	Tank #3	Tank #4

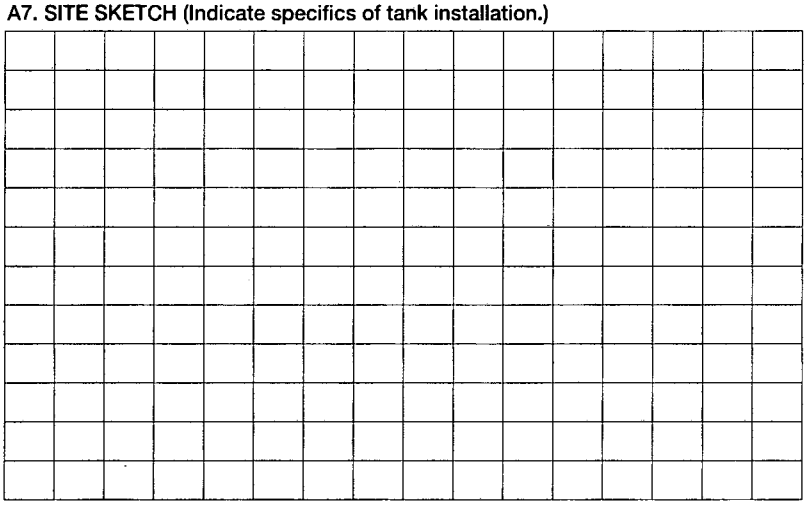
A5. INSTALLATION continued (*See SECTIONS 5, 6, 7, 8, 9, 12 and 14* for instructions and specifications.)

Anchor straps (if used)				
Geotextile (if used)				
Backfill placement & compaction				
Ballasting (if wet hole)				
Fittings & other metal components (coated for corrosion protection)				
Depth of backfill over tank (specify)				
Level of backfill after final inspection				
Type and thickness of surface pad				
Piping connections per requirements				

A6. POSTINSTALLATION (*See SECTIONS 13, 15 and 16* for instructions and specifications.)

Postinstallation tests for air-testable tanks				
Optional hydrostatic test				
Monitoring-fluid tanks (set fluid level when backfilling & top slab are complete, and record level in reservoir here)				
Monitoring-fluid tanks (verify there is no fluid inside tank)				
Containment sump (water test successful)				

A7. SITE SKETCH (Indicate specifics of tank installation.)



A8. ADDITIONAL NOTES
(including variations and/or deviations from instructions, with written authorizations attached)

A9. VERIFYING SIGNATURES

CONTRACTOR — Name _____ Date _____

I verify that this information is a true record of the installation of the tanks listed here.

Signature _____

TANK OWNER/REPRESENTATIVE — Name _____ Date _____

I verify that this information is a true record of the installation of the tanks listed here, and that I have received a copy of the Installation Manual and this Tank Installation Checklist.

Signature _____

XERXES® a ZCL company

www.xerxes.com
ximc05/11pp

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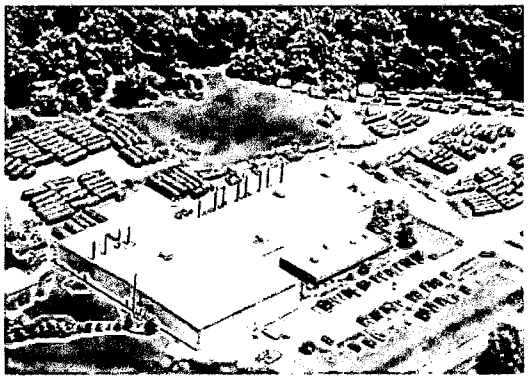

Hagerstown, MD

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Subsurface Drip Dispersal and Reuse

Design, Installation and Maintenance Guidelines

Geoflow, Inc.
506 Tamal Plaza
Corte Madera, CA 94925
Toll free: 800-828-3388
Fax: 415-927-0120
www.geoflow.com

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INTRODUCTION

Geoflow's WASTEFLOW®[1] drip system disperses effluent below the ground surface through ½" pressurized pipes. It is designed using the grid concept with supply and flush manifolds at each end of the dripline creating a closed loop system. The grid design provides a complete subsurface wetted area.

The objective with effluent dispersal is usually to disperse the effluent using the minimum area as quickly and safely as possible at an approximately uniform rate throughout the year. If the main purpose of the Geoflow system is to irrigate, then please use the standard irrigation manual for landscape available from Geoflow, Inc.

Subsurface drip is a highly efficient method to dispose of effluent. Small, precise amounts of water are uniformly applied under the soil surface from multiple points.

The main advantages of Geoflow's subsurface drip system for effluent dispersal are:

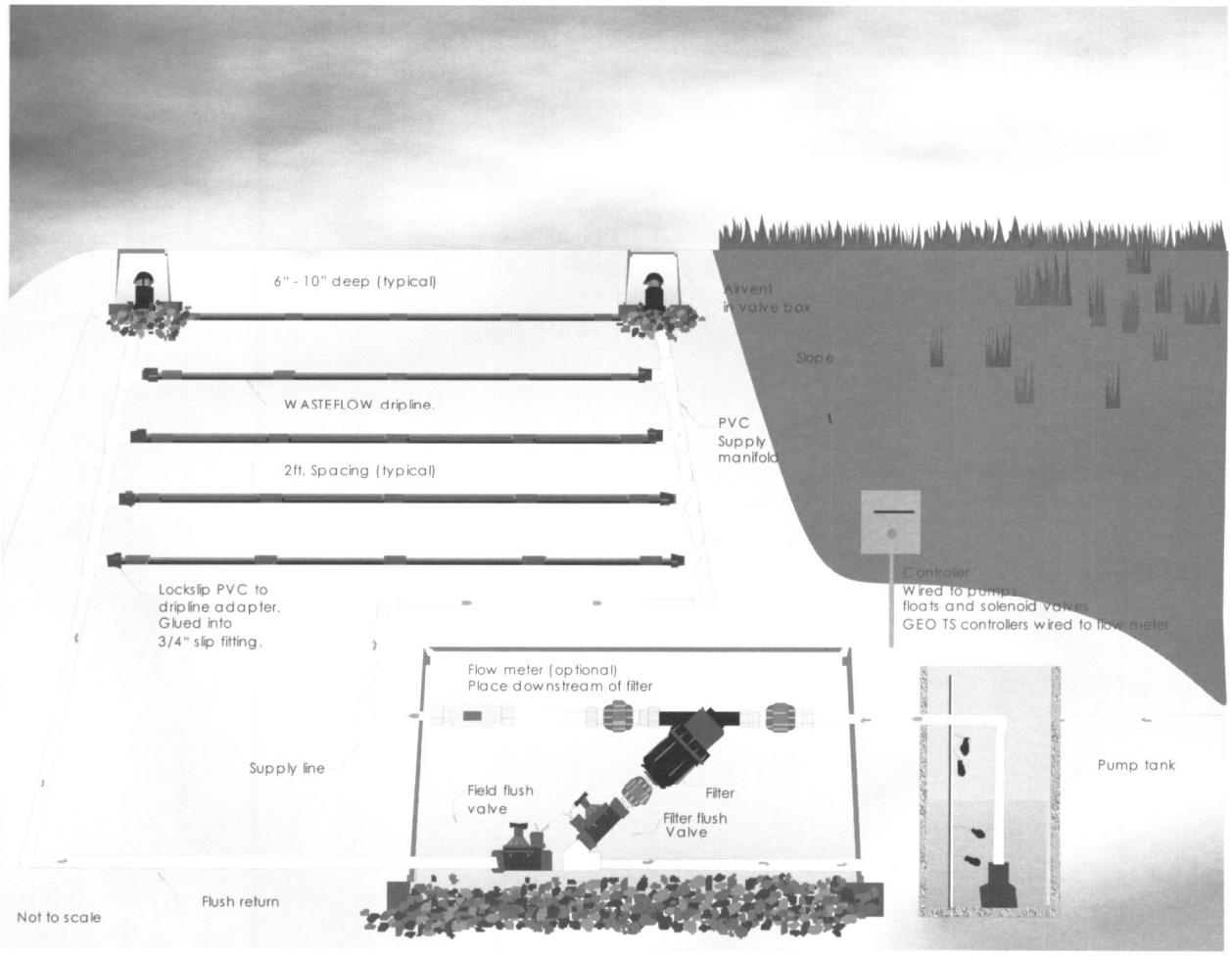
- Human and animal contact with effluent is minimized, reducing health risks.
- Correctly designed systems will not cause puddling or runoff.
- It can be used under difficult circumstances of high water tables, tight soils, rocky terrain, steep slopes, around existing buildings, trees or other vegetation, and on windy sites.
- Disposal of water is maximized by means of evapotranspiration.
- The system requires no gravel. It is easy to install directly into indigenous soils and the natural landscape can be maintained.
- Minimizes deep percolation.
- Consumption of nitrates by the plant material is increased.
- Invisible and vandal proof installations.
- Fifteen-year warranty for root intrusion, workmanship and materials. Systems are durable with a long expected life of approximately 30 years.
- Non intrusive. It allows use of the space while operating.
- Easily automated.
- Effluent can be re-used for irrigation.

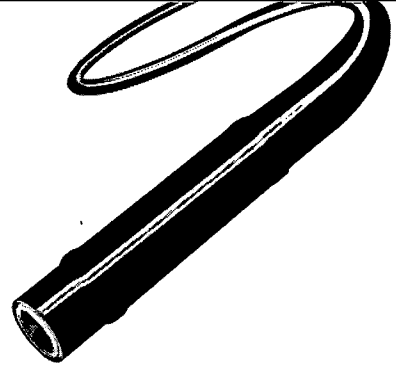
NOTES

- These guidelines are for secondary treated effluent. When using primary treated effluent, Geoflow recommends automating all the self flushing valves, and increasing the number of emission points in the dispersal field. For more information on septic tank dispersal, please check our website at www.geoflow.com or telephone Geoflow at 800-828-3388.
- Please follow your State and County Regulations for onsite wastewater dispersal. These guidelines are intended to be a guide to users of the Geoflow drip system and should be used only as a supplement to your local regulations.
- Occasionally, in forested area, the dripline is placed on the surface and covered with mulch.

1 WASTEFLOW® is a registered trademark of A.I.Innovations.

Diagram 1: Typical Dripfield layout





SYSTEM COMPONENTS

See Diagram 1 on page 3.

A typical drip system installation will consist of the elements listed below:

1. WASTEFLOW® DRIPLINE

(See product sheet for specification)

WASTEFLOW dripline carries the water into the dispersal/reuse area. The dripline is connected to the supply and return manifolds with Compression or Lockslip fittings. Typical spacing between each dripline and between drip emitters is 24" on center.

Twelve-inch spacing is used regularly for soils with very low or high permeability. Dripline is usually buried 6"-10" below ground. Standard coil length is 500-ft. Rolls of alternative lengths, diameters and dripper spacings may be special ordered.

WASTEFLOW dripline features:

a.) nano-ROOTGUARD®[2]

In 2008 Wasteflow dripline will have new nano-ROOTGUARD which has an extended expected life of 30 years. The risk of root intrusion with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. All Geoflow drip emitters are guaranteed to be protected against root intrusion with nano-ROOTGUARD. This patented process fuses the root-growth inhibitor, TREFLAN®[3] into each drip emitter during manufacturing. Treflan is registered with the United States EPA for this application. The nano-ROOTGUARD technology holds Treflan for extended time inside the plastic, slowly releasing it in minute quantities to prevent root cells from dividing and growing into the barrier zone. It is chemically degradable, non-systemic, and virtually insoluble in water (0.3 ppm). nano-ROOTGUARD carries a **15-year warranty** against root intrusion.

b.) *Geoshield™[4]* protection

Geoflow's WASTEFLOW has an inner lining impregnated with an antimicrobial, Tributyl tin maleate, to inhibit adhesion of biological growth on the inside walls of the tube and on the emitters. It does not have any measurable biological effect on the effluent passing through the tube. This minimizes the velocity required to flush WASTEFLOW dripline. The velocity only needs to move out the fine particles that pass through the 130 micron filter that, if not flushed, will ultimately accumulate at the distal end of each lateral. It is not necessary to scour growth off the inside wall of WASTEFLOW tubing. Since all pumps deliver more volume given less resistance to flow, just opening the flush valve will usually achieve this degree of flushing. When a minimum flushing velocity is requested by regulators, 0.5 feet per second is used with Wasteflow dripline to get the settled particles at the bottom of the pipe back into suspension. This equates to 0.375 gpm per dripline when using standard WASTEFLOW dripline (0.55"ID)

c.) Turbulent Flow Path

WASTEFLOW drip emitters are pre-inserted in the tube usually spaced 6", 12", 18", or 24" apart with 24" being the most popular. Angles in the emitter flow path are designed to cause turbulence in order to equalize flow between emitters and keep the emitters clean. Geoflow emitters boast large flow paths, which, coupled with turbulent flow, have proven over the years to be extremely reliable and dependable.

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2 nano-ROOTGUARD is a registered trademark of A.I.Innovations
3 Treflan is a registered trademark of Dow Agro Sciences
4 Geoshield is a registered trademark of A.I.Innovations

d.) WASTEFLOW Classic and WASTEFLOW PC Dripline

Both WASTEFLOW Classic and WASTEFLOW PC have turbulent flow path emitters with nano-ROOTGUARD and *Geoshield* protection.

The WASTEFLOW PC has the added element of a silicone rubber diaphragm that moves up and down over the emitter outlet to equalize flows regardless of pressure between 7 and 60 psi. To ensure a long life the recommended operating range is 10 to 45 psi.

For WASTEFLOW Classic, the flow rate delivered by the emitter is a function of the pressure at the emitter. The Classic dripline has the advantage of no moving parts or rubber that may degrade over time. Also, when minimum flushing velocities are required, the flows during a dosing cycle and flushing cycle are very similar with the Wasteflow Classic because when the flush valve is opened, the pressure is reduced, causing the flows from the emitters to decline. PC dripline requires significantly higher flow for flushing than dosing as the emitter flow does not go down during the flushing cycle.

We generally recommend using WASTEFLOW Classic, unless the economic advantages to using PC is substantial.

i. WASTEFLOW PC can run longer distances than WASTEFLOW Classic.

ii. Steep slopes. Systems should be designed for the dripline lateral to follow the contour. When this is practical, the extra cost of installing pressure regulators required for WASTEFLOW Classic would likely be less than the incremental cost of WASTEFLOW PC.

iii. Rolling terrain. If the difference in height from trough to peak exceeds six feet then WASTEFLOW PC should be used. Vacuum relief valves must be placed at the top of each rise.

2. CONTROLLERS

(See product sheet for specification)

Controllers are used for time dosing and time flushing of the filter and dripfields. GEO controllers include a programmable logic controller to increase flexibility and reliability in the field. They can be used on systems ranging in size from one to eight zones at the time this manual was printed. All controllers include a surge arrestor, elapsed time meter and counter. In 2007 Geoflow added a new controller with a touchscreen interface. It can vary dose times in each zone, monitor flow, ultraviolet, blower, and other optional inputs.

3. PUMPS, PUMP TANKS & FLOATS

WASTEFLOW dripfields depend on pumps to dose effluent under pressure to the field. These must be sized according to flow and pressure requirements. Look for submersible effluent pumps from a dependable source. Geoflow does not endorse a single manufacturer, but does advocate you use a pump that is readily serviced in your area. Two (duplex) pumps may be used. These will normally alternate at each signal from the control panel and are often used on commercial or large drip systems. Pump tanks should be sized according to your local rules and regulations. Geoflow controllers are set-up for 4 floats with the lowest one in the tank being the *redundant off float.* The *primary timer on/off float* is second from the bottom, followed by the *secondary timer float* third from the bottom and the *high level alarm float* on the top.

4. Filters

(See product sheet for specifications)

Geoflow systems require 120 mesh or 130 micron filtration to keep any oversized upstream contaminants from entering the dripline. Geoflow offers a full range of drip filters, with the tried and true Vortex screen filters for small commercial and residential systems, BioDisc filters with anti bacterial protection, and GeoVac suction cleaning filters for larger commercial and industrial systems.

5. Supply Manifold and Line

This carries the water from the dosing tank to the dispersal area. Rigid PVC schedule 40 is usually used. Schedule 80 is at times used to either avoid dips in the line that can collect water and freeze, or if pressure of at least 20 psi is required to pump water from the dose tank to the dripfield. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated. Refer to the PVC pipe sizing chart in the appendix to determine the best diameter for your application.

6. Return Manifold and Line

In order to help clean the system, the ends of the drip lines are connected together into a common return line, most often made of rigid PVC. This line will help equalize pressures in the system. Flushing should be done frequently during the installation period. Periodic flushing will help to keep the manifolds clean. Many designers use the same size return line as they do the supply line for simplicity, or some down size the return line since return flow is lower than supply. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated.

7. Pressure Regulator

(See product sheet for specification)

Pressure regulators fix the inlet pressure at a given rate. Under normal operating conditions, pressure in the drip lines should be 10 psi to 45 psi. With WASTEFLOW Classic it helps to know exactly what the pressure is in the dripline, so system flow can be easily calculated. With all dripline it is prudent to have a pressure regulator to avoid oversized pumps from blowing out fittings.

8. Air Vacuum Breaker

(See product sheet for specification)

Air vacuum breakers are installed at the high points, above dripline and below grade to keep soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in sloping conditions. One is used on the high end of the supply manifold and one on the high point of the return manifold. Additional air vents may be required in undulating terrain. Freezing conditions require the air vacuum breaker be protected with insulation.

9. Filter Flush Valves

(See product sheet for specifications)

Used to flush debris from the filter cleanout port back to the pretreatment or dosing tank, this can be an electronically activated solenoid valve or a manual valve. If manual, it should be opened for a full flushing at least every six months and left cracked open slightly to flush continuously. Cracking open a manual valve may be used to increase flow through the system to be within the efficient flow rate of the filter and/or pump, if necessary. Certain States may require automated electronic flushing. Please refer to your State codes.

10. Field Flush Valves

(See product sheet for specifications)

Used to flush out fine particles that have passed through the filter and accumulated on the bottom of the tube at the end of each lateral, the field flush valve can be manual or electronic. If manual, it should be opened for full flushing at least every six months and left cracked open slightly to flush continuously and provide for drainage of the flush line in freezing conditions. Cracking open a manual valve can also be used to; increase the flow through the system to be within the efficient flow rate of the filter and/or pump, or to set system pressure instead of a pressure regulator. Certain States do require automated electronic flushing. Please refer to your State codes.

11. Zone Valves

Used to divide single dispersal fields into multiple zones, these can be hydraulically activated index valves or electrical solenoid valves. Index valves are hydraulically operated, while solenoids use electricity.

12. Wasteflow Headworks

(See product sheet for specifications)

WASTEFLOW Headworks is a pre-assembled unit including the filter, valves and pressure gauge in a box or on a skid. It is installed between the pump and the field. Be sure to insulate the box in freezing climates.

DESIGN PARAMETERS

1. Select area

Select the area with careful consideration of the soil, the terrain and your State and County regulations. Be sure the field is not in a flood plain or bottom of a slope where excessive water may collect after rain. Surface water should be directed away from the proposed field area.

2. Water Quality

Determine the quality of the water entering the system. Is it secondary treated or primary treated? If using primary treated effluent, please refer to Geoflow's article for direct septic. Be aware of water conditions intrinsic to the area. If iron or iron bacteria are prevalent, please be sure to eliminate it upstream of the drip system with ozone, ultraviolet or chemical treatment. Iron can be recognized as orange stain on plumbing fixtures and may be treated prior to entering the facility.

3. Soil Application Design

Note: This section is based on Subsurface Trickle Irrigation System for On-Site Wastewater Disposal And Reuse by B. L. Carlile and A. Sanjines. The basis of the information is from the Texas Health Department regulations. The rules in your County and State may vary.

The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil. A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the "saturated hydraulic conductivity." Wastewater application rates should be less than 10 percent of this saturated equilibrium.

Even though the trickle irrigation system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is at or near saturation from rainfall events. The design must account for these periods and assume the worst case condition of soil saturation. *By designing for a safety factor of 10 or 12, based on the saturated hydraulic conductivity, the system will be under-loaded most of the time but should function without surface failure during extreme wet periods.*

By applying wastewater slowly for a few hours daily, particularly if applied in "pulses" or short doses several times per day near the soil surface where the soil dries the quickest would keep the soil absorption rate at the highest value and minimize the potential of water surfacing in poor soil conditions.

As stated previously, this design criterion will under-load the system at all times except when the soil is at or near saturation from rainfall. If designing for an efficient irrigation system, the water supply may not be sufficient to meet the demands of a lawn or landscaped area during peak water demand months. This problem can be overcome by either of two solutions: add additional fresh-water make-up to the system during the growing season to supply the needed water for plants in question; or split the system into two or more fields with necessary valves and only use one of the fields during the peak water demand months and alternate the fields during winter months or extremely wet periods, or use both fields simultaneously if the pump capacity will so allow.

Table 1 shows the recommended hydraulic loading rates for various soil conditions, using a safety factor of at least 12 with regard to the equilibrium saturated hydraulic conductivity rate of the soil. These loading rates assume a treated effluent with BOD and TSS values of less than 30 mg/l is produced in the pre-treatment system and that any anomalies such as iron bacteria have been removed prior to dosing.

TABLE 1.

MINIMUM SURFACE AREA GUIDELINES TO DISPOSE OF 100 GPD OF SECONDARY TREATED EFFLUENT

Soil Class	Soil Type	Soil Absorption Rates		Design Hydraulic Loading Rate (gal / sq. ft. per day)	Total Area Required sq. ft./ 100 gallons per day
		Est. Soil Perc. Rate minutes/in	Hydraulic Conductivity inches/hr		
I	Coarse- sand	<5	>2	1.400	71.5
I	Fine sand	5-10	1.5-2	1.200	83.3
II	Sandy loam	10-20	1.0-1.5	1.000	100.0
II	loam	20-30	0.75-1.0	0.700	143.0
III	Clay loam	30-45	0.5-0.75	0.600	167.0
III	Silt-clay loam	45-60	0.3-0.5	0.400	250.0
IV	Clay non-swell	60-90	0.2-0.3	0.200	500.0
IV	Clay - swell	90-120	0.1-0.2	0.100	1000.0
IV	Poor clay	>120	<0.1	0.075	1334.0

Dispersal field area calculation:
Total square feet area of dispersal field = Design flow divided by loading rate

NOTES:

1) The above chart is provided as a guide only. States and Counties may have regulations that are different. Check your State guidelines and consult with your local health department.
2) Problems with drip dispersal fields occur when soils are misinterpreted. If in doubt, choose the more restrictive soil type from the table above.
3) "Soil type" should be based on the most restrictive layer within two feet of the dripline. In many soils 1-ft. vertical separation from the limiting layer has proven successful with secondary treated effluent. Geoflow recommends you follow State and Local guidelines.
4) Table 1 above, with only minor modifications over the years, has served us well since 1990 with tens of thousands of systems operating successfully based upon this data. However, thanks to work by Jerry Tyler and his associates at the University of Wisconsin-Madison soil structure has become better understood and can now be used as a comprehensive tool to determine optimal hydraulic loading rates as seen in Table 2.

TABLE 2

DRIP LOADING RATES CONSIDERING SOIL STRUCTURE.

Table 2 is taken from the State of Wisconsin code and was prepared by Jerry Tyler.

Soil Textures	Soil Structure	Maximum Monthly Average BOD_5<30mg/L TSS<30mg/L (gallons/ft²/day)
Course sand or coarser	N/A	1.6
Loamy coarse sand	N/A	1.4
Sand	N/A	1.2
Loamy sand	Weak to strong	1.2
Loamy sand	Massive	0.7
Fine sand	Moderate to strong	0.9
Fine sand	Massive or weak	0.6
Loamy fine sand	Moderate to strong	0.9
Loamy fine sand	Massive or weak	0.6
Very fine sand	N/A	0.6
Loamy very fine sand	N/A	0.6
Sandy loam	Moderate to strong	0.9
Sandy loam	Weak, weak platy	0.6
Sandy loam	Massive	0.5
Loam	Moderate to strong	0.8
Loam	Weak, weak platy	0.6
Loam	Massive	0.5
Silt loam	Moderate to strong	0.8
Silt loam	Weak, weak platy	0.3
Silt loam	Massive	0.2
Sandy clay loam	Moderate to strong	0.6
Sandy clay loam	Weak, weak platy	0.3
Sandy clay loam	Massive	0.0
Clay loam	Moderate to strong	0.6
Clay loam	Weak, weak platy	0.3
Clay loam	Massive	0.0
Silty clay loam	Moderate to strong	0.6
Silty clay loam	Weak, weak platy	0.3
Silty clay loam	Massive	0.0
Sandy clay	Moderate to strong	0.3
Sandy clay	Massive to weak	0.0
Clay	Moderate to strong	0.3
Clay	Massive to weak	0.0
Silty clay	Moderate to strong	0.3
Silty clay	Massive to weak	0.0

4. Depth and Spacing

WASTEFLOW systems usually have emitter lines placed on 2 foot (600 mm) centers with a 2 foot emitter spacing such that each emitter supplies a 4 sq. ft (0.36 m^2) area. These lines are best placed at depths of 6-10 inches (150 - 250 mm) below the surface. This is a typical design for systems in sandy and loamy soils with a cover crop of lawn grass. Closer line and/or emitter spacing of 12 inches is used on heavy clay soils or very coarse sands where lateral movement of water is restricted. Using closer spacing should not reduce the size of the field.

5. Soil Layers and Types

The shallow depth of installation is an advantage of the subsurface dripfield since the topsoil or surface soil is generally the most biologically active and permeable soil for accepting effluent. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate. The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain uniform water spread. In many cases, particularly if the soil is compacted, soil properties can be greatly improved by ripping and disking.

6. Adding Fill to the Dispersal Field

Some dispersal sites require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer. Restrictive layers stop or greatly reduce the rate of downward water movement, as a result surfacing may occur during part of the year. In soils with high water tables treatment is minimized due to a lack of oxygen.

Placing drip lines in selected fill material above the natural soil provides an aerated zone for treatment. Dispersal however still occurs in the natural soil and the field size must be based on the hydraulic capability of the natural soil to prevent hydraulic overload.

Any time fill material is to be used, the area to receive the fill should have all surface grasses and other organic material removed or it must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement. Removal must be performed under dry conditions. Divert surface and subsurface water prior to adding fill.

Soils to be used should be determined by a soils expert. Uniform soil material with good structure should be chosen. Avoid platy or massive materials with no structure. Do not use topsoil.

The fill material should be applied in shallow layers with the first 4 to 6 inches incorporated into the natural soil to prevent an abrupt textural interface. Placement of fill should be uniform so preferential bypass flows do not occur. Soil should not be compacted. Continue this process until all fill has been incorporated.

The fill area should be left crowned to shed surface water and may need diversion ditches or some other devices to prevent surface water from infiltrating. The entire fill area should have a vegetative cover to prevent erosion. If possible, allow the fill to set at least seven to ten days before installing WASTEFLOW dripline.

It is generally agreed that fill should not be used on slopes greater than 20% unless means for controlling erosion, such as netting, are used. Consult a soils engineer on a case by case basis.

7. Slopes or Hilly Sites

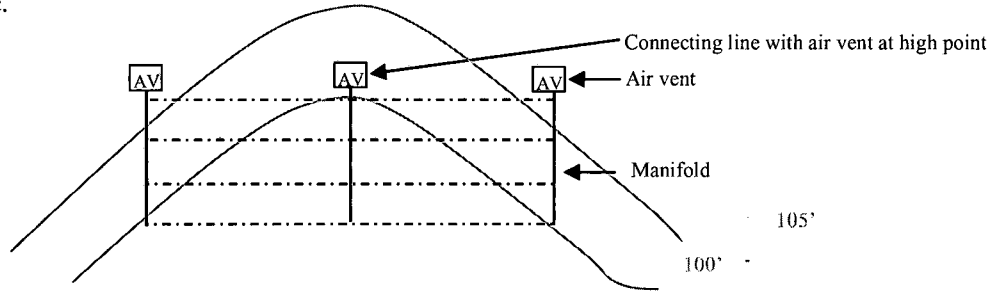
a.) High Points and siphoning

A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. For this reason:

i) At least one vacuum breaker should be installed at the highest point in each zone. It is best practice to install one at the high point of the supply and one at the high point of the return manifold.

ii) Drip lines should be connected at the end to a common return line with a flush valve.

iii) Run dripline along a contour if at all possible. Avoid installing lines along rolling hills where you have high and low points more than 3 ft. off contour along the same line. If the dripline is installed over a ridge, as shown below, connect all the high points together and install a vacuum breaker on the connecting line.



b.) Dripline Pressure Tolerances

As water travels through a manifold or uphill, pressure decreases, or conversely, if water moves downhill pressure increases, which can affect the flow variation between the first dripline and the last dripline on the manifold.

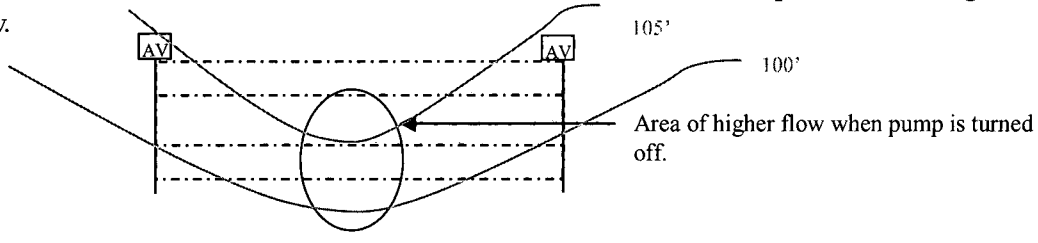
WASTEFLOW Classic: The Classic dripline can be operated in a range of 10 to 45 psi, however too wide a variance in the pressure in a single field will result in too high a variance in flow within that field. As a rule of thumb, if the level variation within a WASTEFLOW Classic zone exceeds six feet, individual pressure regulators should be placed for each six-foot interval.

WASTEFLOW PC: PC dripline can tolerate very large height variations provided the pressure remains within the 7 to 60 psi range, and preferably within 10 to 45 psi.

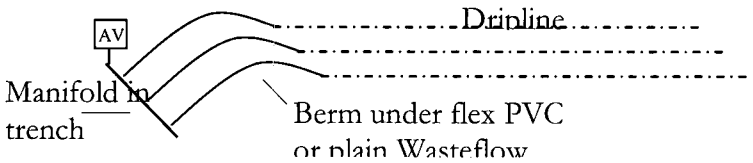
c.) Low Head Drainage

At the end of each dosing cycle, consideration must be taken for gravity. Where is the water going to drain when the pump shuts off? Water in the dripline will flow down to the lowest point within the drip zone. This is called "lowhead drainage." Use the following precautions to mitigate lowhead drainage.

i. The dripline should run along the contour if at all possible because water will run to the lowest point of the line every time the pump is turned off. If the lowest point in the line is in the middle of the lateral, there will be excess flow at this point. See Diagram below.



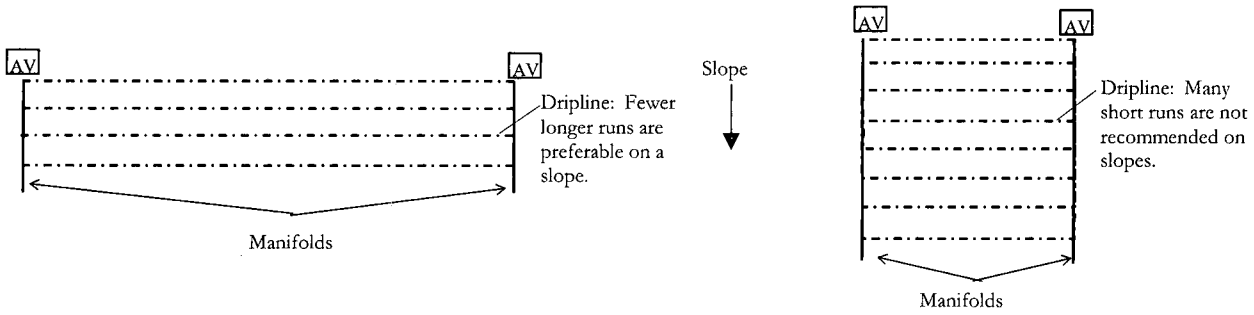
ii Have the dripline pass over an elevated berm between the manifold and beginning of the tubing to reduce gravity flow out of the lateral. In looped systems, elevating the loop will keep the effluent in its respective run.



iii. Use check valves or multiple zones to isolate the drip laterals. Check valves should only be used if there is no risk of freezing in the manifolds. They are placed on the supply and return manifolds coupled with an airvent on the downhill side. If unsure, as a rule of thumb, use a maximum of 1500 ft of Geoflow dripline within each zone or section.

iv. Install short manifolds with fewer longer dripline runs.

v. Slope the supply and return manifolds down to the pump tank so the effluent drains back down to the tank when the pump is turned off. Open the zone valves fully to drain the lines quickly.



Concentrate drip lines at the top of the hill with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer or engineer.

8. Multiple Zones

Drip dispersal fields can be divided into multiple zones or sections with solenoid valves or index valves for the following reasons:

a.) Steep slopes with a risk of lowhead drainage can be subdivided to distribute the water at system shut-down more uniformly in the field.

b.) Smaller zones reduce the required flow per minute which consequently reduces the size of the pump ,valves filters, supply and return lines.

c.) Subdividing the field is a tool used to achieve the optimum ranges required to efficiently operate the pumps, filters and valves.

d.) If the dispersal field is located in multiple areas on the property.

e.) To accommodate varying soils or vegetation on a single site.

Note. On multiple zones, a single Wasteflow Headworks can be used for filtration and flushing by placing zone valves downstream of the Headworks box. All zones would require a check valve on the individual flush lines upstream of each line joining a common flush line to keep flush water from one zone entering any other zone during the flush cycle. (See Geoflow Design Detail No. 588)

If the effluent has not been through secondary treatment, then each zone should have a dedicated filter or Wasteflow Headworks.

9. Winterization

Buried drip systems are not prone to frost damage because, in their design, vacuum release and drain valves are provided. The dripline itself is made of polyethylene and not susceptible to freezing. It drains through the emitters so it will not be full of water after pumps are turned off. Please follow these precautions:

a.) Manifolds, supply lines and return lines must be sloped back to their respective dosing or treatment tanks or buried below frost depth and or insulated. These lines need to drain rapidly. Be sure drain valve on flush line remains open long enough for entire field to drain.

b.) Remove the check valve at the pump.

c.) Insulate equipment boxes, including Headworks box or filter and field flush valve boxes as well as zone dosing valves, pressure regulator and air vacuum relief valves. Use closed-cell insulation such as Perlite in a plastic bag. Place metal pins near, or in, the boxes to help locate them when under snow.

d.) In severe freezing conditions, use heat tape or small heater in the Headworks box.

e.) When installing PVC supply and return lines and manifolds be sure there are no dips in the lines. This can be avoided by using large diameter pipes (over 2") or by using schedule 80 pipe.

f.) The top of air vacuum relief valves must be no higher than soil surface.

g.) If using an index valve to split field zones, be sure it is capable of self-draining.

H.) WASTEFLOW lines will self-drain through the emitters into the soil. If the cover crop over the dripfield is not yet adequately established, add hay or straw over the field for insulation.

i.) Mark the valve box with a metal pin so you can find it in the winter when covered in snow.

j.) If using manual filter flush valves or manual field flush valves, they should be left cracked open slightly to provide for rapid drainage of the flush line in freezing conditions.

k.) Fields dosed with relatively small quantities of effluent are more likely to freeze than those dosed with design quantities. If winter use is less than summer use, then only use proportional number of fields to maintain water application rates in the field being dosed.

l.) All loops connecting drip runs with 1/2" flexible PVC shall be slightly elevated (minimum 1") so that they drain into the drip tubing after the pump shuts off.

m.) All conduit into the panel shall be sealed to prevent condensation into the panel.

10. Lightning Protection

A direct lightning strike on your valve, controller or wire is going to cause unpreventable damage. It is difficult to completely prevent electricity from spreading as it jumps across air, runs along electrical wires and may even travel along your water pipes. Power fluctuations can be prevented. The controllers are built to take some electrical surge and pass it through to the ground without damage. This requires a ground wire connected to a grounding stake driven deep into the ground. The best protection would be to use a separate ground wire or rod, do not rely on the third ground wire in the building's electrical wiring circuits. If you are installing this system in an area with frequent lightning storms, we advise you to install a separate grounding rod. Each field controller must have at least one eight foot copper clad steel ground rod 5/8" in diameter, driven all the way into the ground, as close as possible to the controller. This is to be connected to the grounding lug on the back-plate of the panel. If the rod can't be driven in all the way, cut if off and drive in the remaining piece 2-3' from the other rod and connect the rods together with 6 AWG solid copper wire. Follow local electrical codes.

Inputs to the controller are more sensitive than outputs, so Geoflow offers a metal oxide varistor that protects the incoming power. It includes a metal strip for the controller power and relays for the floats. If hit, the metal or

11. Reuse for Irrigation

A good vegetative cover is an advantage to prevent erosion from the field and utilize water applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 0.25" to 0.35" (6.3-8.9mm) of water per day during the peak growing season. This calculates to be about 0.16 to 0.22 gal/ft^2/day. By over-seeding lawns with winter ryegrass, this use efficiency can be continued through much of the year. For vegetation using 0.16 to 0.22 gal/ft^2/day by evapotranspiration, a sewage flow of 1000 gallons per day would supply the water needs of a landscaped area of 4600 to 6400 sq. ft. without having to add fresh water. For areas larger than this, the plants will suffer water stress during the hot months unless additional fresh water is applied.

12. Water Application Formula

To determine the rate of application for various drip irrigation designs, use the following formula:

Water application (inches per hour) = (231 x (emitter flow rate gph)) / ((Emitter spacing inches) x (dripline spacing inches))

Example: Dripline with 1.3 gph flow rate emitters spaced 24" apart and dripline spaced 24" apart.

Water application = (231x1.3)/(24x24) = 0.52 inches of water per hour.

WORKSHEET:

The following worksheet is a simplistic guideline and is available as an Excel spreadsheet. It can be downloaded from Geoflow's homepage at www.geoflow.com. If you would like a copy sent to you at no charge, phone 800-828-3388.

To calculate the area required for your drip dispersal system you must know:

1. the quantity of effluent to be disposed of (in gallons per day) and
2. the soil acceptance rate (i.e. gallons per day per square foot).

Make a sketch of the dispersal area with contour lines.

WORKSHEET 1 - DISPERSAL FIELD DESIGN FOR SINGLE ZONE SYSTEM

Worksheet Dispersal Field	Formula
A. Quantity of effluent to be dispersed per day _____ *gpd*	
B. Soil type or hydraulic loading rate _____ *loading rate (gal/sq. ft./day)*	*Based on soil analysis* *Refer to State or Local regulations. If none, refer to Table 1 and 2 on page 9 & 10*
C. Determine the total area required _____ *square ft*	*Divide gpd by loading rate.* A/B
D. Choose the spacing between each WASTEFLOW line and each WASTEFLOW emitter *i)*_____ *ft. between WASTEFLOW lines* *ii)*_____ *ft. between WASTEFLOW emitters*	*Standard spacing is 2 ft.*
E. How many linear feet of dripline in the total area?_____ *ft.*	*(Area / 2) for 2ft. line spacing.* C/2.0 or *(Area / 1) for 1 ft. line spacing..* C/1.0 or *(Area / 1.5) for 1.5ft line spacing.* C/1.5
F. Calculate the number of emitters _____ *emitters*	*(Linear ft. of dripline / 2) for 2 ft emitter spacing.* E/2 or *(Linear ft. of dripline / 1) for 1 ft emitter spacing.* E/1 or *(Linear ft. of dripline /1.5) for 1.5 ft emitter spacing* E/1.5

Worksheet Dispersal Field	Formula
G. Choose pressure compensating or Classic dripline _____ *WASTEFLOW Classic dripline or* _____ *WASTEFLOW PC ½ gph dripline* _____ *WASTEFLOW PC 1 gph dripline*	*See page 4 and Appendix 1 for details*
H. Determine dripfield pressure _____ *psi*	*Standard pressure is 20 psi.* *WASTEFLOW Classic systems need between 15 and 45 psi (34.7 and 104 ft.) at the start of the dripfield.* *WASTEFLOW PC systems need between 10 and 45 psi (23.1 ft. to 104 ft.) at the start of the dripfield.*
I. Determine feet of head required at dripfield _____ *ft. of head*	*Multiply pressure by 2.31 to get head required.* *H x 2.31*
J. What is the flow rate per emitter? _____ gph / emitter	*See WASTEFLOW flow rates in Appendix 1.*
K. Determine total flow for the area _____ *gph* _____ *gpm*	*Number of emitters multiplied by the emitter flow rate at the design pressure.* *Gph = No of emitters (F) x gph per emitter (J)* *Gpm = gph/60*
L. Select pipe diameters for manifolds and submains _____ inches	*Based on total flow from (K) above, in gpm. See schedule 40 friction loss charts at the back of the appendixes. Optimum velocity is between 2 and 5 ft. per second.*
M. Select Filter or WASTEFLOW Headworks _____ Filter _____ WASTEFLOW Headworks	*Based on total flow from (K) above, in gpm. See minimum and maximum flow recommendations for each filter in Appendix 2.*
N. Sketch a layout of the WASTEFLOW lines in the dispersal plot to make sure that the maximum lateral length of each WASTEFLOW line is not exceeded.	*See Maximum Length of Run table in Appendix 1.*

WORKSHEET 2 - SELECT PUMP

Worksheet - Pumps		Formula
O. Minimum pump capacity	_____ gpm	*From (K)*
P. Header pipe size	_____ inches	*From (L)*
Q. Pressure loss in 100 ft. of pipe	_____ psi	*Refer to PVC charts.*
R. Friction head in 100 ft. of pipe	_____ ft. of head	*Multiply psi from (Q) above by 2.31*
S. Static head		
i) Height from pump to tank outlet	_____ft.	*Number of ft.*
ii) Elevation increase or decrease	_____ft.	*Height changes from pump to dripfield*
T. Total static head	_____ft.	*Add (Si) + (Sii)*
U. Friction head		
i) Equivalent length of fittings	_____ft.	*Estimate loss through fittings – usually inconsequential for small systems.*
ii) Distance from pump to field. X 2	_____ft.	*Measure length of sub-main supply & return*
iii) Total equivalent length of pipe.	_____ft.	*Add (Ui) + (Uii)*
iv) Total effective feet.	_____ft.	*(Uiii) / 100 x (R)*
v) Head required at dripfield	_____ft	*See line (I) in Worksheet 1 above.*
vi) Head loss through filter or Headworks	_____ft	*See pressure loss for filters in Appendix or see pressure loss for Headworks box in Appendix Multiply pressure by 2.31 to get head loss.*
vii) Head loss through zone valves	_____ft	*See pressure loss in Appendix for electric valves. or hydraulic valves. Multiply pressure loss in Psi by 2.31 to get head loss.*
V. MINIMUM Total friction head	_____ft	*Add (Uiv) + (Uv) + (Uvi) + (Uvii)*
W. MINIMUM Total Dynamic Head	_____ft	*Add (T) + (V)From line item (O) above*
X. MINIMUM pump capacity NOTE: Some States and Counties require additional flow for flushing. Please check your local regulations. If you need help on flushing design, see Geoflow's flushing worksheet at www.geoflow.com or call Geoflow at 800-828-3388.	_____gpm	

Y. Choose the pump. _____ ____ model number _____ _____ Manufacturer	*Based on pressure from line (W) above and flow from line (X) above.*

SYSTEM INSTALLATION

1. Installation Guidelines

All Geoflow drip systems require:

- Filtration with 120 mesh/130 micron
- Filter flush valve
- Field flush valve
- 2 Air vents in each zone
- All Wasteflow Classic drip systems require pressure regulation

Handle your dripline and components with care. nano-ROOTGUARD® is temperature sensitive. To assure a long life, store the dripline out of direct sunlight in a cool place.

a) All dripfield construction shall be done in accordance with Local rules and regulations.

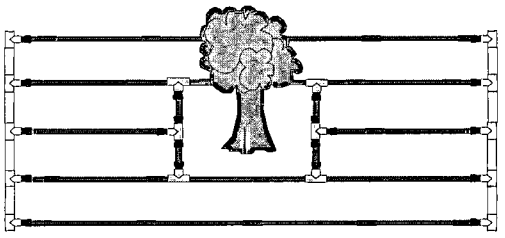
b) Protect the site prior to installation. Construction traffic and material stockpiling can change the soil profile. Fence off entire dripfield prior to any construction. No utilities, cable wire, drain tile, etc shall be located in dripfield.

c) System is not to be installed when ground is wet or frozen. When the moisture in the soil is near the plastic limit (soils will ribbon and not easily crumble), it will be prone to smearing.

d) Prior to construction note if any water is accessing the location of the dripfield. Dripfield should not be located at the low point of a site. Divert all downspouts and surface waters away from dripfield. If a curtain drain is to be used be sure it is serviceable and properly screened.

e) Excavation, filling and grading should have been finished prior to installation of the subsurface drip system. Be sure to minimize soil disturbance when clearing and grubbing the dripfield. Preserve as many trees as possible. Use light track equipment for tree removal and grind out roots to below dripline depth rather than fully removing the entire root.

f) Be sure you have everything required for the installation before opening trenches. Pre-assemble as many sets of components as practical above ground and in a comfortable place. Compression or Lockslip adapters should be glued to PVC tees, riser units should be pre-assembled, and the sub-main manifold with tees can be pre-assembled and used to mark the beginning and end of WASTEFLOW lines.



Loop dripline around trees

g) For particularly tough soil conditions, soil moisture the day before opening trenches or installing WASTEFLOW. Remember it is much easier to install the system in moist soil. The soil should be moist but still allow the proper operation of the installation equipment and not cause smearing in the trenches. The soil surface should be dry so that the installation equipment maintains traction.

h) Mark the four corners of the field. The top two corners should be at the same elevation and the bottom two corners should be at a lower elevation. In freezing conditions the bottom dripline must be higher than the supply and return line elevation at the dosing tank.

i) Install the dosing tank. It is critical that the tank is waterproof. If installing a riser, check that it is watertight, and the entry and exit ports are completely sealed. In freezing conditions the dosing tank should be at the lowest elevation of the entire system. Lid should be placed at grade and water should be able to shed over it.

j) Install zone valves; solenoid or hydraulic index valves.

k) Install the PVC supply line from the dosing tank, up hill through one lower and one upper corner stake of the dispersal field. Please refer to your State guidelines for depth of burial.

l) Paint a line between the two remaining corner stakes.

m) Install the Geoflow WASTEFLOW dripline from the supply line trench to the painted line, approximately 6" to 10" deep as specified. Upon reaching the painted line, pull the plow out of the ground and cut the dripline 1' above the ground. Tape the end of the dripline to prevent debris from entering. The tubing expands in warm temperatures and contracts in cold temperatures. If installing during the warmer months, be sure to allow some play in the tubing so it will not pull out of the fittings when it gets cold. Continue this process until the required footage of pipe is installed. Geoflow dripline must be spaced according to specification (2 ft. is standard). Depth of burial of dripline must be consistent throughout the field. Take care not to get dirt into the lines.

n) If the system is looped, install the looped ends with Geoflow plain tubing or flex PVC. If in a cold climate be sure to pitch these slightly so they do not hold water and freeze. The loops are to be installed on the outside of the measured field.

o) Install the supply header with tees lined up at each Geoflow line. Hook up the Geoflow lines to the supply header. Do not glue WASTEFLOW dripline.

Lockslip Fittings Installations

i. Hold the fitting in one hand and position the tubing with the other hand.
ii. Move the sleeve back, and push the tubing onto the exposed stem as far as possible.
iii. Push the sleeve out over the tubing and thread the sleeve onto tubing, as though tightening a nut to a bolt. Hand tighten. Do not use tools.
iv. Test the connection to make sure the sleeve threads have gripped the tubing tightly.

p) Install the filter headworks between the field and the pump tank on the supply line. Insulate the box in freezing conditions. When using an open bottom headworks box, place a rodent barrier down first. This can be made from bricks, paving stones, chicken wire, 3 layers of filter fabric or a 6" minimum depth of 1" gravel. Support the pipes entering and exiting the headworks with gravel.

q) If using a pressure regulator, install it downstream of the filter headworks, just ahead of the dispersal field, on the supply line. Although the pressure regulator can be buried directly into the soil, it is preferable to install it inside a small valve box for easy access. *Insulate the box in freezing conditions.

r) Install the floats in the dosing tank and wire up to the timer control. The timer control should be set to pump no more than the design flow, do not set to match the treatment capacity.

s) Install the pump. Fill the dosing tank with fresh water and turn on the pump. Check for flow out the ends of all of the Geoflow lines. Let the pump run for about five minutes to flush out any dirt. Shut off the pump and tape the ends of the lines.

t) Dig the return header ditch along the line painted on the ground and back to the pre-treatment tank. Start the return header at the farthest end from the dosing tank. The return line must have slope back to the treatment tank, septic tank or pump tank.

u) Install the return header and connect all of the Geoflow lines. Care must be taken not to kink the dripline.

v) Install air vacuum breakers at the highest points in the dispersal field. Use pipe dope or Teflon tape and hand tighten. Use a 6" minimum depth of 1" gravel below the boxes to keep rodents out. Insulate in freezing climates.

w) Install a ball or solenoid field flush valve on the return line to the pretreatment or pump tank unless a pre-assembled Wasteflow Headworks is being used. If a Headworks was installed on the supply line, connect the return line back through the Headworks box. Support the return pipe before it enters the Headworks with gravel. If using electric solenoid valves, connect the valve common and an individual output wire to the solenoid leads using watertight electrical connectors.

x) Allow glue fittings 1 – 2 hours to set. Open the field flush valve and turn on the pump to flush lines then close the valve and check the field and all piping and connections for leaks. Turn off the system

y) Check filters and valves for construction debris.

z) Turn on the pump and check:

i. Pressure at the air vacuum breaker(s) against design pressure. Check the pressure in the **WASTEFLOW HEADWORKS.** It should be five PSI or higher. If pressure gauges are on each side of the filter, noter these for benchmark differential pressure across the filter. If using a manual valve for field flushing, crack it open until at least on PSI is lost or design pressure is reached and leave in that position.

ii. Flow rates from flow meter or draw down on tank. Compare to design flow.

iii. Wet spots in the field. If any sections are particularly wet, determine if they are caused by faulty connections, drippers or shallow burial.

iv. Check that solenoid valves are functioning. Close the internal manual bleed after flushing the system. If solenoid will not close, first clean the solenoid with caution not to lose small spring, and if this fails, open the bonnet and clean the inside.

aa) Establish vegetation cover as specified.

bb) Provide owner with final as-built diagrams flow measurements and pressure readings at startup.

cc) Provide controller records at startup, including elapsed time meter, pump counts, secondary override counts, highwater counts and primary float counts.

dd) Solenoid Valve Installation and Operation

i. Wrap male adapters with 2 wraps of Teflon tape and thread the adapters into the valve inlet and outlet 1 turn past hand tight. CAUTION: over tightening may cause damage to the valve. The solenoid is located on the downstream side of the valve.

ii. Flush the laterals by opening the internal manual bleed lever on the downstream side of the solenoid. Turn the flow control stem fully open (counterclockwise) for flow control models.

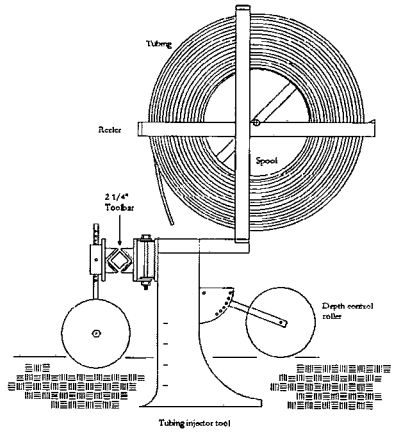
iii. Check that solenoid valves are functioning.

TABLE 3. SUBSURFACE DRIP INSTALLATION METHODS

NOTE: Disturbing the soil may affect the pore structure of the soil and create hydraulic conductivity problems. Please consult with your soil scientist or professional engineer before making the installation technique decision.

INSTALLATION METHOD *	ADVANTAGES	DISADVANTAGES
a) Hand Trenching*	• Handles severe slopes and confined areas • Uniform depth	• Slow • Labor intensive • Disrupts existing turf and ground • Back fill required
b) Oscillating or vibrating plow . Use the type that inserts the dripline directly in place, not one that pulls the dripline through the soil.	• Fast in small to medium installations • Minimal ground disturbance • No need to back fill the trench	• Depth has to be monitored closely • Cannot be used on steeper slopes(>20%) • Requires practice to set and operate adequately • Tends to "stretch" pipe. Shorter runs are required
c) Trenching machine: Ground Hog, Kwik-Trench, E-Z Trench*	• Faster than hand trenching • May use the 1" blade for most installations • Uniform depth	• Slower, requires labor • Disrupts surface of existing turf • Back fill required
d) Tractor with dripline insertion tool - see diagram 2.	• Fast • Little damage to existing turf because of the turf knife • Minimal ground disturbance • Does not stretch drip line • Adaptable to any tractor	• The installation tool is designed specifically for this purpose.
e)Tractor mounted 3-point hitch insertion implement	• Fastest. Up to four plow attachments with reels • A packer roller dumps back soil on top of the pipe	• Suitable for large installations only

* Installation methods are left to the discretion of the contractor and/or the engineer. Other installation methods may be used as long as care is taken to protect the tubing and the soil.



Diag. 2 Installation Tool

Worksheet 3 - As Built System Description

1. Site name: _____
2. Site address including State: _____
3. Dripfield designed by: _____
4. Dripfield installed by: _____
5. Date of installation: _____
6. Daily design flow: _____ gpd.
7. Soil percolation rate: _____
8. Is there secondary treatment on this job site? _____Yes _____No

   If "Yes" to question 8 above, please name manufacturer and model number:_____
9. Number of zones in dripfield: _____ If more than 1 zone, circle the valve used Hydraulic or Solenoid
10. Amount of dripline installed in each zone:

    Zone 1_____ ft. Zone 2_____ ft. Zone 3_____ ft. Zone 4_____ ft.
11. Wasteflow dripline model number &/or description: _____
12. Flow rate per zone:

    Zone 1_____ gpm. Zone 2_____ gpm. Zone 3_____ gpm. Zone 4_____ gpm.
13. Depth dripline installed below grade: _____ inches
14. Pump manufacturer, model number and number of pumps:_____
15. Filter or Headworks model number &/or description:_____
16. Pressure in each zone:

    Zone 1_____ psi Location pressure measured:_____

    Zone 2_____ psi Location pressure measured:_____

    Zone 3_____ psi Location pressure measured:_____

    Zone 4_____ psi Location pressure measured:_____
17. Size of filter flush valve: _____ inches. Is the filter flush valve manual or automatic? _____
18. Size of field flush valve: _____ inches. Is the field flush valve manual or automatic?_____

If more than 1 zone, do the zones (a) share 1 flush valve or (b) does each zone have its own flush valve?

19. Was any fill material supplied on the dripfield? _____

If "yes" to 18 above describe fill quality and quantity added. _____ _____

_____

20. Please provide owner with as-built drawings, including but not limited to direction of drip lines, location of air vents, pressure regulators if applicable, Headworks (filter and valves) and pump tank.
21. Startup Controller readings:

    ETM____ Pump ct.____ Secondary timer ct.____ High alarm ct.____ Primary ct.____
22. Note how long it takes to drain return line in freezing climates, and set controller

SYSTEM MAINTENANCE

The best way to assure years of trouble free life from your system is to continuously monitor the system and to perform regular maintenance functions. For large systems or systems with a BOD > 30 mg/l automation of maintenance is essential. For smaller systems with a BOD < 30 mg/l inspection and maintenance should be performed every six months.

Routine and Preventative Maintenance

1) Clean the filter cartridge. This may be done with a pressure hose. The screen filter cartridge should be cleaned from the outside inwards, while the discs in the disc filter cartridge should be separated and then cleaned. If bacteria buildup is a problem, we advise first trying lye, and if the problem persists, soak the filter cartridge in a chlorine bath - a mixture of 50% bleach and 50% water.
2) Open the field flush valve and flush the field for 3-5 minutes by activating the pump in "manual" position. Close the flush valve. On automatic solenoid valves the manual bleed lever should always be in the closed position and the dial on top should be free spinning. This allows it to open when pulsed electrically. Clockwise rotation closes valve.
3) With the pump in the "manual" position, check the pressure in the drip field by using a pressure gauge on the schrader valve located on the air vents and by reading the pressure gauge located in the Wasteflow Headworks box. The pressure should be the same as shown on the initial installation records. On systems with manual flush valves, close the field flush valve completely and then open the valve slightly until there is a 1-2 psi drop or design pressure is reached. This will allow the field to drain after each dose to prevent the manifold lines from freezing.
4) Remove the lids on the vacuum breaker and check for proper operation. If water is seen leaking from the top of the vacuum breaker, remove the cap of the vacuum breaker and press down on the ball to allow any debris to be flushed out. Be careful not to come in contact with the effluent.
5) Turn off the pump and reset the controller for auto mode.
6) Periodically remove and clean the air vents, field flush and filter flush valves.
7) Visually check and report the condition of the drip field, including any noticeable wetness.
8) Treatment and distribution tanks are to be inspected routinely and maintained when necessary in accordance with their approvals.
9) Record the elapsed time meter, pump counter, override counter, high-level alarm and power failures. This information can be obtained from the controller.

Home Owners Guide For Care and Maintenance of Geoflow Drip Dispersal Field

A drip dispersal system has been installed on your property for the subsurface dispersal of the effluent from your home.

The drip dispersal system consists of a series of ½" diameter drip tubing installed at a shallow depth of 6-10" below the ground surface. It is designed to effectively disperse the treated effluent in the ground with a combination of soil absorption and plant uptake. Your drip dispersal system will function for many years with only minimal maintenance being required, provided the following recommendations are followed:

- Establish landscaping (preferably a grass cover) immediately. This will stabilize the soil and allow for the grass to take up the water.
- Do not discharge sump pumps, footing drains or other sources of clear water to the system, except for the effluent discharge from your treatment system.
- Maintain all plumbing fixtures to prevent excess water from entering the dispersal system.
- Do not drive cars, trucks or other heavy equipment over the drip dispersal field. This can damage the drip components or the soil and cause the system to malfunction. Lawn mowers, rubber wheeled garden tractors and light equipment can be driven over the drip field.
- Do not drive tent stakes, golf putting holes, croquet hoops etc., into the dispersal field.
- Contact your service company if your high water alarm should sound. The pump chamber is sized to allow additional storage after the high water alarm sounds but you should refrain from excessive water usage (i.e., laundry) until the system has been checked.
- After a temporary shut down due to a vacation or other reason, the treatment plant ahead of the drip field filter initially may not function effectively, resulting in the filter blocking.Refer to maintenance guidelines above to clean the filter.

  Contact your service company if you notice any areas of excessive wetness in the field. In most cases, this is usually caused by a loose fitting or a nicked dripline and can be easily repaired. Note: There may be some initial wetness over the dripline following the system's installation. This should cease once the ground has settled and a grass cover is established.

Site Inspection Sheet

Site Address _____ **Date**_____

Site observations

1 Is dripfield located at the lowest point in the site where all waters may pond?
2 Is there any water coming in from neighbors? Downspouts? Irrigation?
3 Construction debris anywhere near the site, or compaction from construction or other causes?
4 How wet is the field before digging?
5 Will effluent drain back to tank in freezing climates? If not, is equipment insulated from freezing?

Pump tank

1 Watertight?
2 At grade. Allow surface water to run off.
3 Inlet and outlet lines to be laid in gravel or compacted soils.
4 Float tree designed for easy removal for service and adjustment.
5 Float settings correct to design?
6 Pump set a few inches up from the bottom of the tank.
7 Waterproof wire nuts used to wire pump junction box.

Headworks - Filter and flush valves

1 Waterproof wire nuts used in wiring solenoid valves
2 Is filter large enough to handle flow? Is it appropriate for the treatment unit?
3 Clean filter and valves after construction.
4 Check filter everytime system is serviced, and clean filter element.
5 Clean valves if they do not close properly. See if different valves have different toggles.
6 Insulate in freezing climates.
7 Have minimum of 1/2ft depth of 1" gravel under the Headworks for drainage and to keep gophers out.
8 Check pressure - across filter (if available).
9 Check pressure - on return line pressure should be as designed. Lower than 5 psi may be too low.

Zone valves

1 Index valves - Requires 10 gpm min. flow, needs to self drain in freezing climate.
2 Solenoids - Clean after installation if they do not close properly.

Supply and return lines

1 Make sure they are supported going into and out of the Headworks.
2 No dips.
3 Make sure water from dripline does not flow back into supply and return trenches.

Dripline

1 On contour.
2 Burial depth.
3 Check for kinking and local undulations (low areas) in installed driplines.
4 Flush lines during construction.
5 Is there ponding on surface?
6 Cover crop over field?

Airvents

1 Point of pressure measurement.
2 Insulate in freezing climates.
3 Make sure they are not in a position for surface or subsurface water to enter the system.
4 Check pressure at airvents. Should be as designed. Less than 7psi may be too low..

Return to?

1 Pump tank? Don't churn the tank on return.
2 Pretreatment? Can the equipment handle the additional flow.

Controller

1 Check field programmable settings against design.
2 Proper wiring of controller....wire floats and valves.
3 Keep moisture from running up wire into controller.

Notes

1 Use sheet for "As built" in Design Guidelines.
2 Keep a record of start-up pressures and system data screens.

Comments:

TROUBLE SHOOTING GUIDE:

Symptom: High water alarm activates periodically (1-2 times/week). During other times the water level in the pump chamber is at a normal level.

Possible cause: Peak water usage (frequently laundry day) is causing a temporary high water condition to occur.

Remedy: Set timer to activate the pump more frequently. Be sure to not exceed the total design flow. To avoid this, reduce the duration of each dose.

Remedy: Provide a larger pump tank to accommodate the peak flow periods.

Symptom: High water alarm activates during or shortly after periods of heavy rainfall.

Possible cause: Infiltration of ground/surface water into system.

Remedy: Identify sources of infiltration, such as tank seams, pipe connections, risers, etc. Repair as required.

Symptom: High water alarm activates intermittently, including times when it is not raining or when laundry is not being done.

Possible cause: A toilet or other plumbing fixture may be leaking sporadically but not continuously. Check water meter readings for 1-2 weeks to determine if water usage is unusually high for the number of occupants and their lifestyle. Also determine if water usage is within design range.

Remedy: Identify and repair fixture.

Symptom: High water alarm activates continuously on a new installation (less than 3 months of operation). Inspection of the filter indicates it is plugged with a gray colored growth. Water usage is normal. being done.

Possible cause: Slow start-up of treatment plant resulting in the presence of nutrient in the effluent sufficient to cause a biological growth on the filter. This is typical of lightly loaded treatment plants that receive a high percentage of gray water (i.e., from showers and laundry),

Remedy: Remove and clean filter cartridge in a bleach solution. Add a gallon of household bleach to pump tank to oxidize organics. Contact treatment plant manufacturer for advice on speeding up the treatment process possibly by "seeding" the plant with fresh activated sludge from another treatment plant.

Symptom: Water surfaces continuously at one or more isolated spots, each one foot or more in diameter.

Possible cause: Damaged drip line or a loose connection is allowing water be discharged under pressure and therefore at a much greater volume than intended.

Remedy: Dig up drip line. Activate pump and locate leak. Repair as required.

Possible cause: If water is at base of slope, can be caused by low-head drainage.

Remedy: Install check valves and airvents in the manifolds to redistribute water in the system after pump is turned off. This is not advised for freezing climates where manifold drainage is required.

Symptom: A portion of the drip field closest to the feed manifold is saturated while the rest of the field is dry.

Possible cause: Insufficient pump pressure. A pressure check at the return manifold indicates pressure of less than 10 psi.

Remedy: Check filter and pump intake to insure they are not plugged. If they are, clean as require.

Remedy: Leaks in the system may be resulting in loss of pressure. Check for water leaks in connections and fittings or wet spots in the field. Also check air vents to insure they are closing properly. Repair as necessary.

Remedy: Pump is worn or improperly sized. Pressure at feed manifold in less than 15 psi. Verify pressure requirements of system and provide a new or larger pump. As an alternate approach, the drip field may need to be divided into two or more zones.

Possible cause: The duration of each dose is of insufficient length to allow the drip field to become pressurized before the pump shuts off (or runs for only a brief time before turning off).

Remedy: Increase the pump run time and decrease the frequency of doses. Always calculate (or observe during field operation) how long the system takes to fully pressurize and add this time to the design dosing duration.

Symptom: High water alarm begins to activate continuously after a long period (1-2 years) of normal operation. Inspection of the filter indicates it is plugged with a heavy accumulation of sludge.

Possible cause: A buildup of solids in the pump tank due to carryover from the treatment plant.

Remedy: Replace the filter cartridge with a clean cartridge. Check the pump tank and if an accumulation of solids is noted, pump the solids out of the pump tank. Also, check the operation of the treatment plant to insure it is operating properly.

Symptom: Water surfaces at several spots in drip field during dosing periods. Installation is recent, less than 6 months of usage and the soil is a moderate to heavy clay. Possibly, the installation was completed using a non-vibratory plow.

Possible cause: Smearing of the soil may have occurred during installation of drip line. Also, the "cut" resulting from the installation allows an easy path for the water to surface during dosing.

Remedy: In most cases the sod will compact naturally around the drip line and the surfacing will diminish and ultimately cease. To help, reduce the duration of each dose and increase the number of doses/day. Also, it will help to seed the area to encourage the development of a good root zone.

Symptom: Entire area of drip field is wet, soft and spongy. It appears to be totally saturated with water. Situation occurs during dry season when there is little rainfall.

Possible cause: Water being discharged to drip field exceeds design. Excess water may be a result of infiltration, plumbing leaks or excessive water usage.

Remedy: Check water meter, elapsed time meter, pump counter, override counter or high level alarm counter to determine if water usage is in excess of design. Check for leaks or infiltration. Repair leaks as required. Reduce water usage by installing water saving fixture.

Remedy: If water usage cannot be reduced, enlarge drip field as required.

Possible cause: Area of drip field was inadequately sized and is too small.

Remedy: Provide additional soil analysis to verify sizing and enlarge as required.

Valve Troubleshooting

Symptom: Valve will not open manually

Check water supply and any possible master or gate valves to insure they are open.
Check that the valve is installed with the arrow pointing in the downstream direction
Check that the flow control is fully open, counterclockwise.
Turn off the water supply. Remove the solenoid and check for debris blocking the exhaust port.
Turn off the water supply. Remove the cover. Inspect the diaphragm for damage and replace if necessary.

Symptom: Valve will not open electrically

Check voltage at controller for 24 VAC station.
Check voltage across the solenoid lead wires for minimum 21 VAC.
Make sure handle on top of valve is free spinning. Not all the way open or all the way closed.
If the valve still does not operate, electrically replace the solenoid.

Symptom: Valve will not close

Insure the manual bleed lever is in the closed position.
Check for leaks around the flow control, solenoid or between valve cover and body.
Turn off the water supply. Remove the solenoid and check for debris or damage to the exhaust port.
Turn off the water supply. Remove valve cover and inspect for debris under diaphragm or debris in diaphragm ports.

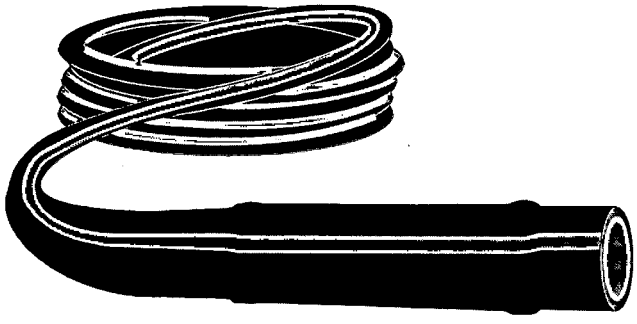
Symptom: Slow leak

Check for dirt or gravel embedded in the diaphragm seat.
Check actuator and exhaust fitting for proper seating.

WASTEFLOW™ Dripline

Description

The flexible 1/2" polyethylene dripline has large emitters regularly spaced in the line. With the dripline hidden about six inches below ground, effluent is distributed slowly and uniformly, reducing ponding, even in difficult soils and hilly terrain. WASTEFLOW is built to last. It is guaranteed to be trouble-free from root intrusion with built-in nano-ROOTGUARD® protection, and the dripline wall is protected from organic growth with the *Geoshield* lining. WASTEFLOW provides uniform distribution. The emitters have a Coefficient of variation of less than .05.



Different flow rates, dripline diameters and emitter spacings can be special ordered.

Use 600 series compression adapters or lockslip fittings to connect the dripline to PVC pipe.

nano-ROOTGUARD® Protection

NEW WASTEFLOW dripline features patented nano-ROOTGUARD technology to prevent roots from clogging the emission points. The pre-emergent, Treflan®, is bound into WASTEFLOW emitters when they are molded to divert roots from growing into the emitter outlet. The system is guaranteed against root intrusion for 15 years.

ANTI BACTERIAL Protection

Geoshield® is incorporated into the inner lining and emitter of WASTERFLOW dripline to prevent bacteria from growing on the walls of the tubing and emitters. It eliminates the need to scour the tubing. It is a tin based formula that defeats the energy system of microbial cells. This means smaller pumps or larger zones can be used with WATERFLOW dripline than unprotected dripline.

PC vs. CLASSIC

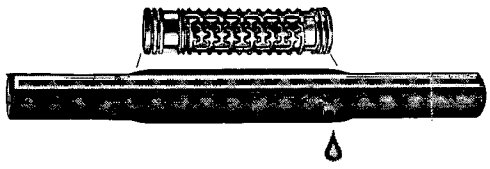
Geoflow, Inc. offers WASTEFLOW dripline in both pressure compensating (WASTEFLOW PC) and non-compensating (WASTEFLOW Classic) models.

We recommend that WASTEFLOW PC be used when the advantages are of substantial economic value.

a) Very long runs.
b) Steep slopes. Systems should be designed for the dripline lateral to follow the contour. If this is possible, the extra cost of pressure regulators required for WASTEFLOW Classic would likely be less than the incremental cost of WASTEFLOW PC.
c) Rolling terrain. If the difference in height from trough to peak exceeds six feet then WASTEFLOW PC should be used. Vacuum relief valves must be placed at the top of each rise.

WASTEFLOW PC and WASTEFLOW Classic can be interchanged to meet filter and zone flow requirements.

WASTEFLOW Classic



Available in 2 standard models

WF16-4-24 WASTEFLOW Classic 24"/1.3gph
WF16-4-12 WASTEFLOW Classic 12"/1.3gph
Alternate flow rates, diameters and spacing available upon request.

Flow Rate vs. Pressure

Pressure psi	Head ft.	ALL WASTEFLOW Classic Dripline
10 psi	23.10 ft.	.81 gph
15 psi	34.65 ft.	1.00 gph
20 psi	46.20 ft.	1.16 gph
25 psi	57.75 ft.	1.31 gph
30 psi	69.30 ft.	1.44 gph
35 psi	80.85 ft.	1.57 gph
40 psi	92.40 ft.	1.68 gph
45 psi	103.95	1.80 gph

Maximum Length of Run vs. Pressure

Flow variation +/- 5%

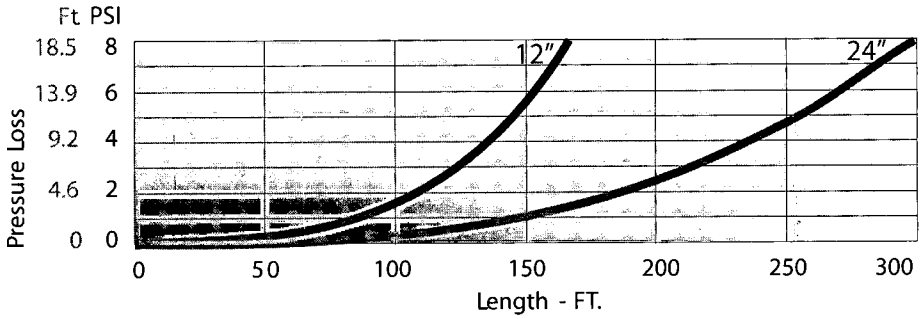
Pressure psi	Head ft.	Emitter Spacing 24"	18"	12"
10 psi	23.10 ft.	170'	165'	100'
15 psi	34.65 ft.	170'	165'	100'
20 psi	46.20 ft.	170'	165'	100'
25 psi	57.75 ft.	170'	165'	100'
30 psi	69.30 ft.	170'	165'	100'
35 psi	80.85 ft.	170'	165'	100'
40 psi	92.40 ft.	170'	165'	100'
45 psi	103.95 ft.	170'	165'	100'

Kd=0.9 Cv < .05

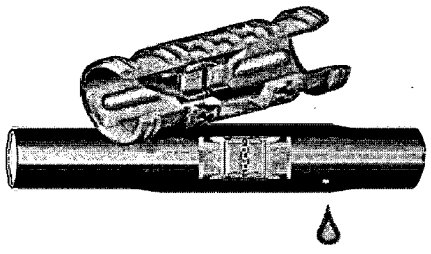
WASTEFLOW Classic Specification

The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow drip emitters bonded to the inside wall. The drip emitter flow passage shall be 0.053" x 0.053" square. The tubing shall have an outside diameter (O.D.) of approximately .64-inches and an inside diameter (I.D.) of approximately .55-inches. The tubing shall consist of three layers; the inside layer shall be *Geoshield*® protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 24" (or 12") apart. The turbulent flow emitters shall be molded from virgin polyethylene resin. The turbulent flow emitters shall have nominal discharge rates of 1.16 gallons per hour at 20 psi. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of fifteen years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. WASTEFLOW Classic dripline shall be Geoflow model number WF16-4-24 (or WF16-4-12).

Wasteflow Classic 1 gph
Pressure Loss vs. Length of Run



WASTEFLOW PC 1/2 gph



Standard products:

WFPC16-2-24 WASTEFLOW PC 24"/.53gph or 2lph
WFPC16-2-18 WASTEFLOW PC 18"/.53gph or 2lph
WFPC16-2-12 WASTEFLOW PC 12"/.53gph or 2lph
Alternative spacing, flow rates and diameters available upon request.

Flow Rate vs. Pressure

Pressure	Head	ALL WASTEFLOW PC 1/2 gph dripline
7-60 psi	16-139 ft.	0.53 gph

Maximum Length of Run vs. Pressure

Allows a minimum of 10 psi in the line.
Recommended operating pressure 10-45 psi.

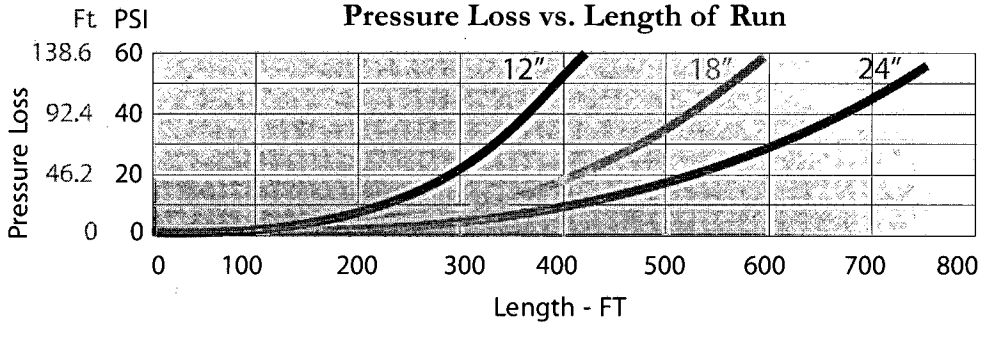
Pressure		Emitter Spacing			
psi	ft.	6"	12"	18"	24"
10 psi	23.10 ft.				
15 psi	34.65 ft.		174'	260'	321'
20 psi	46.20 ft.	120'	229'	330'	424'
25 psi	57.75 ft.		260'	377'	478'
30 psi	69.30 ft.	150'	288'	415'	535'
35 psi	80.85 ft.		313'	448'	576'
40 psi	92.40 ft.	172'	330'	475'	612'
45 psi	103.95 ft.		354'	501'	651'
50 psi	115.5 ft.		363'	523'	675'
55 psi	127.05 ft.		377'	544'	700'
60 psi	138.6 ft.		403'	563'	727'

Kd = 2.070

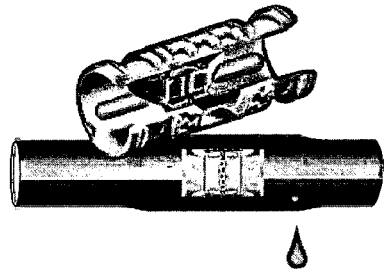
WASTEFLOW PC ½ gph PC Specification

The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow drip emitters bonded to the inside wall. The drip emitter flow passage shall be 0.032" x 0.045" square. The tubing shall have an outside diameter (O.D.) of approximately .64-inches and an inside diameter (I.D.) of approximately .55-inches. The tubing shall consist of three layers; the inside layer shall be a *Geoshield*® protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 24" (or 18" or 12") apart. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates of 0.53 gallons per hour. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of fifteen years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. 0.53 gph WASTEFLOW PC pressure compensating dripline shall be Geoflow model number WFPC16-2-24 (or WFPC16-2-18 or WFPC16-2-12) .

Wasteflow PC 1/2 gph
Pressure Loss vs. Length of Run



WASTEFLOW PC 1 gph



Standard Products:

WFPC16-4-24 WASTEFLOW PC 24"/1.02 gph or 4lph
WFPC16-4-18 WASTEFLOW PC 18"/1.02 gph or 4lph
WFPC16-4-12 WASTEFLOW PC 12"/1.02 gph or 4lph
Alternative spacing, flow rates and diameters available upon request.

Flow Rate vs. Pressure

Pressure	Head	ALL WASTEFLOW PC 1 gph dripline
7-60 psi	16-139 ft.	1.02 gph

Maximum Length of Run vs. Pressure

Allows a minimum of 10 psi in the line.
Recommended operating pressure 10-45 psi.

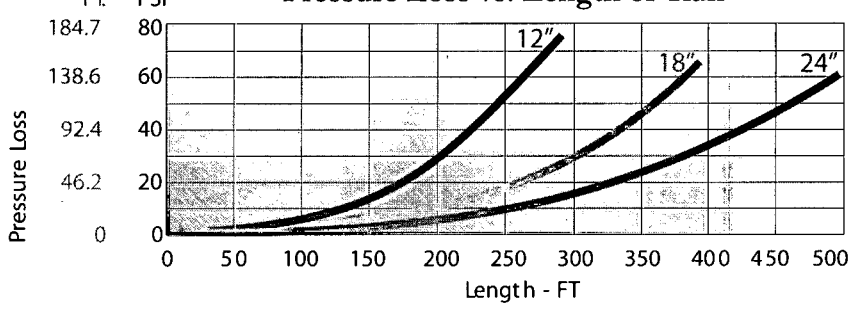
Pressure		Emitter Spacing			
psi	ft.	6"	12"	18"	24"
10 psi	23.10 ft.	50'	95'	140'	175'
15 psi	34.65 ft.	63'	115'	172'	211'
20 psi	46.20 ft.	74'	146'	210'	265'
25 psi	57.75 ft.	88'	171'	242'	315'
30 psi	69.30 ft.	94'	180'	266'	335'
35 psi	80.85 ft.	103'	199'	287'	379'
40 psi	92.40 ft.	110'	211'	305'	385'
45 psi	103.95 ft.	116'	222'	321'	429'
50 psi	115.5 ft.		232'	334'	431'
55 psi	127.05 ft.		240'	347'	449'
60 psi	138.6 ft.		249'	360'	465'

Kd = 2.070

WASTEFLOW PC 1 gph PC Specification

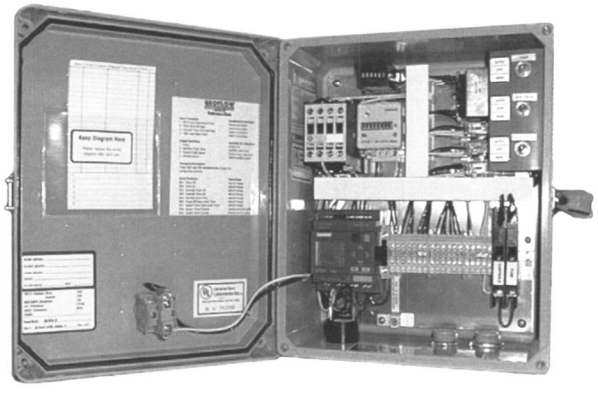
The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow drip emitters bonded to the inside wall. The drip emitter flow passage shall be 0.032" x 0.045" square. The tubing shall have an outside diameter (O.D.) of approximately .64-inches and an inside diameter (I.D.) of approximately .55-inches. The tubing shall consist of three layers; the inside layer shall be *Geoshield*® protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 24" (or 18" or 12") apart. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates of 1.02 gallons per hour. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of fifteen years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. 1.02 gph WASTEFLOW PC pressure compensating dripline shall be Geoflow model number WFPC16-4-24 (or WFPC16-4-18 or WFPC16-4-12) .

Wasteflow PC 1 gph
Pressure Loss vs. Length of Run



Controllers

Geoflow's controllers are the brain in the system, utilizing a programmable logic controller (PLC) to activate the pump(s) cycles, zone valves and flush valves when needed. Telemetry and SCADA control systems available. Please contact Geoflow for custom panel information.

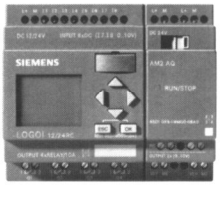
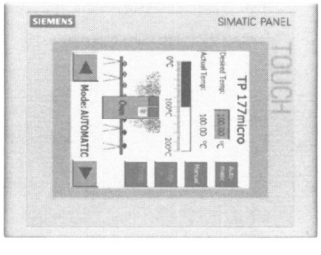


NEW

In 2007 Geoflow introduced a new touchscreen controller called the GeoTS.
Geared towards commercial sites with multiple zones or inputs, the key features of the Geo TS are:

- 6" Touchscreen. Inputting parameters such as pump times and flush times is in plain English with help menus.
- Each zone can be set independently. Run times can vary from zone to zone, which is particularly beneficial when zones vary in size, soils, vegetation, topography etc.
- Measures flow data per zone. The amount of total water and average gallons per minute are logged by zone when using the flow meter option.

Comparison Chart between Geo standard Logo and Geo Touchscreen

Features	**Geo Standard (Geo)**	**Geo Touchscreen (GeoTS)**
Interface	1" Logo with arrows 	6" Touchscreen 
Programmable Logic Controller PLC	Yes	Yes
Programmed for 4-floats	Yes	Yes
Touch-safe panel	No	Yes
Each zone can have different run times	No	Yes
Measure flow rate for each zone	No	Yes
Manual or automatic flushing	Auto or manual	Auto only
Enclosure	Nema 4X fiberglass	Nema 4X fiberglass
HOA switch - pump	Toggle 3-way	Rotary 3-way
HOA switch - solenoids	Toggle	Touchscreen

Features	Geo Standard (Geo)	Geo Touchscreen (GeoTS)
Lightning arrestor	Yes	Yes
Onscreen help menus	No	Yes
Log Functions		
- Elapsed time meter (ETM)	Yes	Yes
- Pump events	Yes	Yes- time & date stamped
- Filter Flush Counter	Yes	Yes- time & date stamped
- Field Flush Counter	Yes	Yes- time & date stamped
- Peak timer events	Yes	Yes- time & date stamped
- High level alarm events	Yes	Yes- time & date stamped
- Power failure events	Yes	Yes
- Push to silence	No	Yes- time & date stamped
- Add-on parts such as pressure sensor	No	Yes – if installed
- Flow data (avg GPM & Total Flow by zone)	No	Yes- if Geoflow FM Pulse meter is installed
Programmable Parameters		
Independent zone run times	No	Yes – new feature
Primary run and rest time	Yes	Yes
Secondary run and rest time	Yes	Yes
Filter Flush time & frequency	Yes	Yes
Field Flush time & frequency	Yes	Yes
Manifold Drain Back Time	Yes	Yes
Pre-built to accept the following optional parts:		
Flow meter	No	Geoflow FM-pulse meter
Remote alarm	Yes	Yes
Blower input	No	Yes
Ultraviolet non audible alarm	No	Yes with N/O contact
Rain Gauge	No	Yes with Geoflow gauge
Self diagnostics	No	Yes It has diagnosis capabilities for the floats, pumps, contactors and the PLC itself and any auxiliary components or standard features that have a sensor feedback wired to the panel.
Displays current status of equipment	No	Yes Gives the countdown on the screen to next event and what equip. is active.

Choose a GEO controller from the table below:

Step 1. Controller Type

- Choose between Geoflow's standard controller (Geo) and the Geo Touchscreen (Geo TS).

Step 2. No. of Zones

- If the zones are activated by the controller with solenoid valves, find the row that covers the number of zones in the project.
- If the zones are activated with index or Hydrotek valves, then choose a single zone controller. The single zone controllers do allow for index or Hydrotek valves.
- Zones activated with index & solenoid valve combinations can be special ordered.
- If the zones exceed the choices below, larger controllers can be special ordered.

Step 3: Number of pumps

- Choose one pump (simplex) or two pumps (duplex).

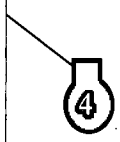
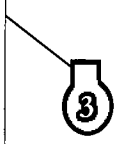
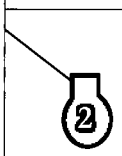
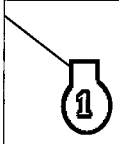
Step 4: Flushing operation

- Choose manual or electronic field and filter flushing. Geoflow requires all direct septic systems use electronic flushing.
- Manual flushing only available on the Geo 1 controllers. Geoflow recommends using Auto flush panels where maintenance is not mandatory.

Step 5: Treatment option (GeoTS only)

- If the GeoTS panel is capable of monitoring your pretreatment system, and if greater than NSF requirements, can also control your treatment system. If this option is desired choose the row that says "yes".

Step 1 Type	Step 2 Zones	Step 3 Pumps	Step 4 Flushing	Step 5 Treatment	Part Number
Geo	1	Simplex	Manual	-	GEO1-SIM-MAN
			Automatic	-	GEO1-SIM-AUT
		Duplex	Manual	-	GEO1-DUP-MAN
			Automatic	-	GEO1-DUP-AUT
	2 - 4	Simplex	Automatic	-	GEO4-SIM-AUT
		Duplex	Automatic	-	GEO4-DUP-AUT
	5 - 8	Simplex	Automatic	-	GEO8-SIM-AUT
		Duplex	Automatic	-	GEO8-DUP-AUT
Geo TS	1	Simplex	Automatic	-	GEOTS-01-SIM
				Yes	GEOTS-01-SIM-T
		Duplex	Automatic	-	GEOTS-01-DUP
				Yes	GEOTS-01-DUP-T
	2 - 8	Simplex	Automatic	-	GEOTS-08-SIM
				Yes	GEOTS-08-SIM-T.
		Duplex	Automatic	-	GEOTS-08-DUP
				Yes	GEOTS-08-DUP-T
	9 - 16	Simplex	Automatic	-	GEOTS-16-SIM
				Yes	GEOTS-16-SIM-T
		Duplex	Automatic	-	GEOTS-16-DUP
				Yes	GEOTS-16-DUP-T
	17 - 24	Simplex	Automatic	-	GEOTS-24-SIM
				Yes	GEOTS-24-SIM-T
		Duplex	Automatic	-	GEOTS-24-DUP
				Yes	GEOTS-24-DUP-T

Floats	Functions
	Float raised – Alarm enable. Activates the audible and visual alarm when raised. Audible alarm may be silenced by pressing the illuminated "PUSH TO SILENCE" button.
	Float raised – Peak Timer enable. The secondary timer will cycle the pump(s) more frequently. The secondary timer function will remain active until the Primary Timer enable float lowers. When the Peak Timer function has been completed and the Primary Timer enable float is reactivated, normal timer operation will resume.
	Float raised – Timer enable. The Primary Timer will control pump cycles, beginning with the off cycle. Note: On duplex panels the pumps will alternate with each timer cycle. The Primary float resets the secondary on/off float when in the down position.
	Float raised – Pump enable. Float lowered – Pump disable. Flashing visual & audible alarm enable. This is a secondary off float that will prevent the operation of the pump if the water level in the tank gets too low. Geo pump will be disabled in both the automatic and manual modes. GeoTS will allow you to run the pump for a short burst regardless of float position. This bottom float also activates the visual and audible alarms. Audible alarm may be silenced by pressing the illuminated "PUSH TO SILENCE" button.

Note: ETM and pump events are recorded whenever contactor is energized.

GEO-1 *MANUAL* CONTROLLERS

The Primary Timer (float 2-activated) controls the pump dose cycle during normal operating conditions. During high flow conditions the pump dosing cycles will be controlled by the Peak Timer (float 3 - activated). The Peak Timer off is typically set to trigger more frequent flow than the Primary Timer off setting.

If *duplex pump* option is chosen, the pumps are alternated every pump cycle and never operate simultaneously. There is a selection switch for pump 1, pump 2 or alternation. This allows one pump to be taken out of service for maintenance without affecting the operation of the system.

Pump dosing cycles are controlled by the timers when the H-O-A switch is in the auto position. Under normal conditions the Primary Timer (float 2) will control the pump(s). During high flow conditions, the Peak Timer (float 3) will control the pump(s). The Peak Timer will cycle the pump more frequently than the Primary Timer (field adjustable). The pump will dose for the same amount of time as it does when operated by the Primary Timer but the time in between doses, or the Peak timer "off time", will be 75 % of that of the Primary Timer "off time". Factory settings (operator adjustable) are 1 hr 55 minutes off and 5 minutes on for Primary Timer and Peak Timer is set to 1 hr 25 minutes off (1 hr 55 mins x 75%) and 5 minutes on. Consequently peak doses are more frequent than primary doses.

Hydraulically activated zone valve(s) will index each time the PLC calls for a dose. Each time the pump is turned on another zone is dosed. The controller does not dose all zones sequentially as "one" dose. For example if the Primary Timer is programmed to be off for 1hour on for 5minutes and there are four zones, each zone will get 6 doses - five minutes in length –in a 24-hour period. The controller will dose a single zone every hour and will not dose all zones every hour.

In the event of a *power outage* the Geo-TS controller continues the program where it left off, even if it was in the middle of an event. The Geo-1 resets itself and begins with a flush cycle in field 1.

GEO AND GEOTS *AUTOMATIC* CONTROLLERS

The Primary Timer (float 2 activated) controls the pump dose cycle during normal operating conditions. During high flow conditions the pump dosing cycles will be controlled by the Peak Timer (float 3 activated).

If *duplex pump* option is chosen, the pumps are alternated every pump cycle and never operate simultaneously. There is a selection switch for pump 1, pump 2 or alternation. This allows one pump to be taken out of service for maintenance without affecting the operation of the system. *The Vortex Filter flush valve* will open for 15 seconds (operator adjustable) at the end of the pump cycle to allow the filter to self-flush.

Pump dosing cycles are controlled by the timers when the H-O-A switch is in the auto position. Under normal conditions the Primary Timer (float 2) will control the pump. During high flow conditions, the Peak Timer (float 3) will control the pump. The Peak Timer will cycle the pump more frequently than the Primary Timer. The pump will dose for the same amount of time as it does when operated by the Primary Timer but the time in between doses, or the Peak Timer "off time", will be 75% that of the Primary Timer "off time". Factory settings (field adjustable) are 1 hr 55 minutes off and 5 minutes on for Primary Timer and Peak Timer is set to 1 hr 25 minutes off (1 hr 55 mins x 75%) and 5 minutes on.

Zone valve(s) will open when the PLC calls for a dose or flush. These can be electrically operated solenoid valves (requires any controller other than the Geo-1 or GeoTS-1) or hydraulically activated index valves (used with Geo-1 or GeoTS-1). If hydraulically activated index valves are used in combination with a solenoid field flush valve, a field setting for number of zones and number of zone valves is available. With Geo controllers the total doses of all zones in a 24-hour period must be considered when setting the "off" timer(s). After the pump is deactivated the solenoid valve will remain open to allow for drainage of the supply line. If hydraulically activated index valve is used, be sure to drain the supply line in freezing climates.

Field flush valve will open at the end of the dosing cycle. The pump will continue to run for 5 seconds (field adjustable) to accommodate the opening of this valve. After the pump is deactivated the field flush valve will remain open for five minutes (field adjustable) to allow for drainage of the return line in freezing conditions. It is best to clock the length of time it takes the return flush line to drain and use this to set your drain time.

The activated zone valve remains open at the end of the dose for same "#" minutes as return flush and filter flush valves to accommodate drainage of supply line.

To periodically *flush the dripfield,* after 10 dosing cycles (operator adjustable) the pump will operate for # minutes (field adjustable) with the field flush valve open. The field flush cycle will repeat until all zones have been flushed.

In the event of a *power outage* the Geo-TS controller continues the program where it left off, even if it was in the middle of an event. The Geo-1 resets itself and begins with a flush cycle in field 1.

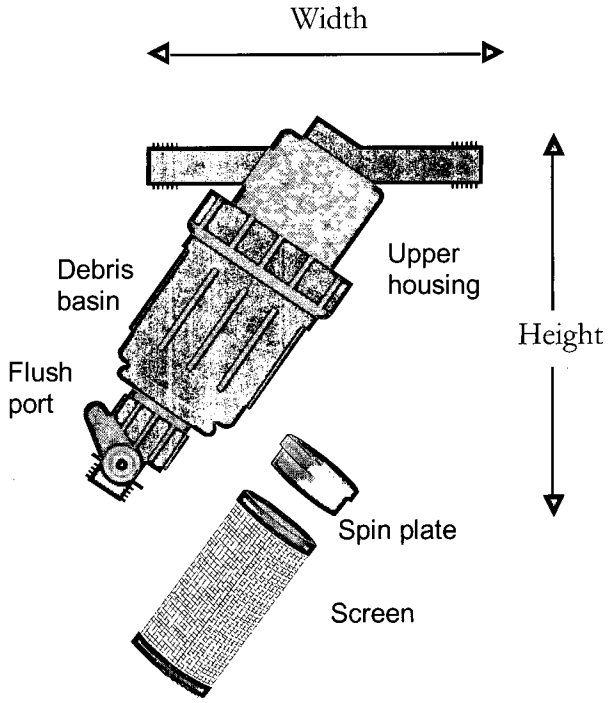
Vortex Filters

Description

The Vortex filters are placed between the pump and dripfield to screen out any debris. Spin plates at the top of each screen direct the flow of debris to the base of the screen for easy self cleaning.

Features

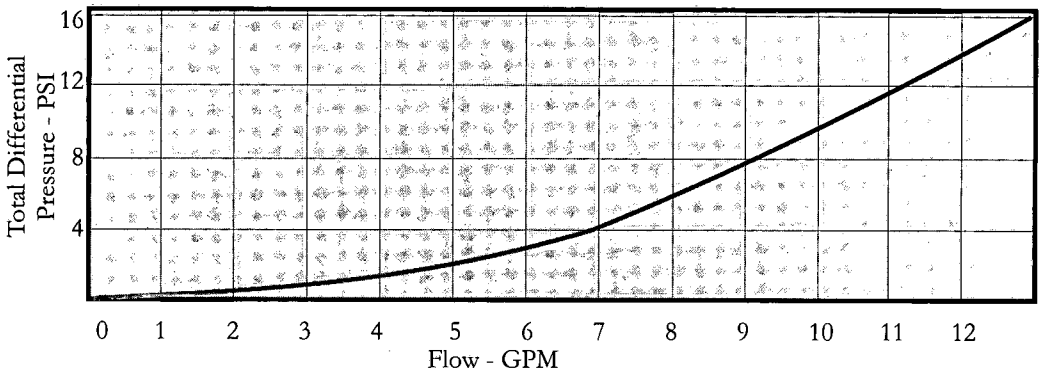
- Simple self cleaning filter. Geoflow's Vortex filter depends on a simple forward flush to self clean. Incoming water is forced through a directional nozzle plate onto the inside of the stainless steel screen. A centrifugal motion starts inside the screen chamber, throwing particles outward against the screen. Gravity moves the debris down the screen wall to the ¾" flush outlet at the base of the Vortex Filter.
- It is simple to install and operate, requiring very few moving parts.
- Can be plumbed to self clean periodically with electronically activated solenoid valves, or continuously with slightly opened ball valves.
- Sturdy stainless steel screen proven effective in onsite wastewater applications. A sintering process in which three pieces of stainless steel mesh are transformed into one; a perforated plate, 30m then 150 mesh.
- Body is a two-piece threaded housing with O-ring seal. Molded from high heat ABS and chemical resistant glass reinforced plastic.



Item Number	Size (MPT)	Max. Flow rate (GPM)	Max. Pressure (psi)	(ft.)	Width	Height	Flush Port (MPT)	Area of Filtration (inches^2)
AP4E-.75F	3/4"	10	80	185	6.0"	6.0"	3/4"	23.4
AP4E-1F	1"	20	80	185	6.0"	7.0"	3/4"	28.4
AP4E-1.5F	1.5"	45	100	231	12"	15.5"	3/4"	60.8
AP4E-2F	2.0"	70	80	185	12"	16.0"	3/4"	60.8

When in doubt, it is best to choose the filter with the larger screen area.

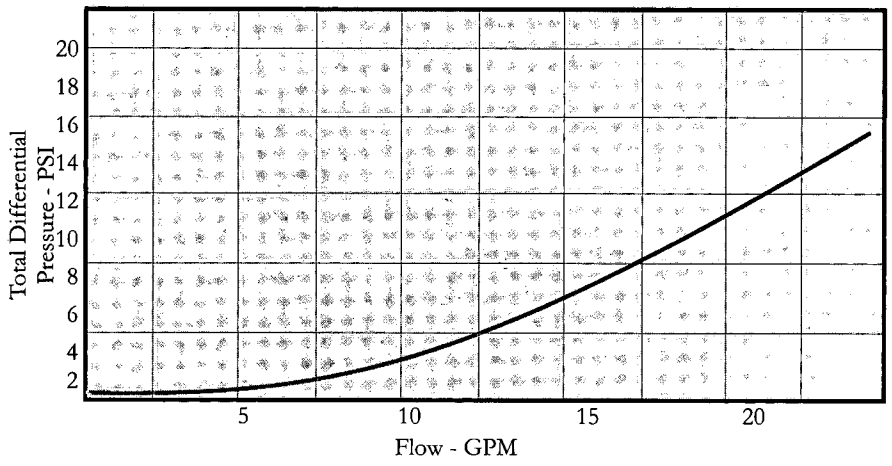
3/4" Vortex Filter AP4E-.75F



Specification:

The Y filter body shall be molded from glass reinforced engineering grade black plastic with a 3/4 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by untwisting and shall include an O-ring seal. An additional 3/4 inch MIPT outlet shall be capable of periodic flushing. The 150-mesh filter screen is all stainless steel, providing a 23.4 square inch filtration area. The screen collar shall be molded from vinyl. The ¾" filter shall be Geoflow Vortex Filter model number AP4E-75F.

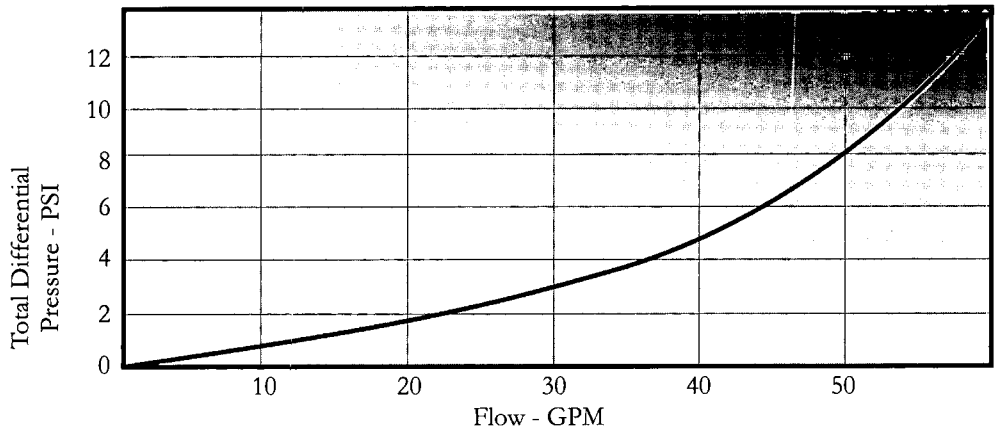
1" Vortex Filter AP4E-1F



Specification:

The Y filter body shall be molded from glass reinforced engineering grade black plastic with a 1 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by untwisting and shall include an O-ring seal. An additional ¾ inch MIPT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless steel, providing a 28.4 square inch filtration area. The screen collar shall be molded from vinyl. The 1" filter shall be Geoflow Vortex Filter model number AP4E-1F.

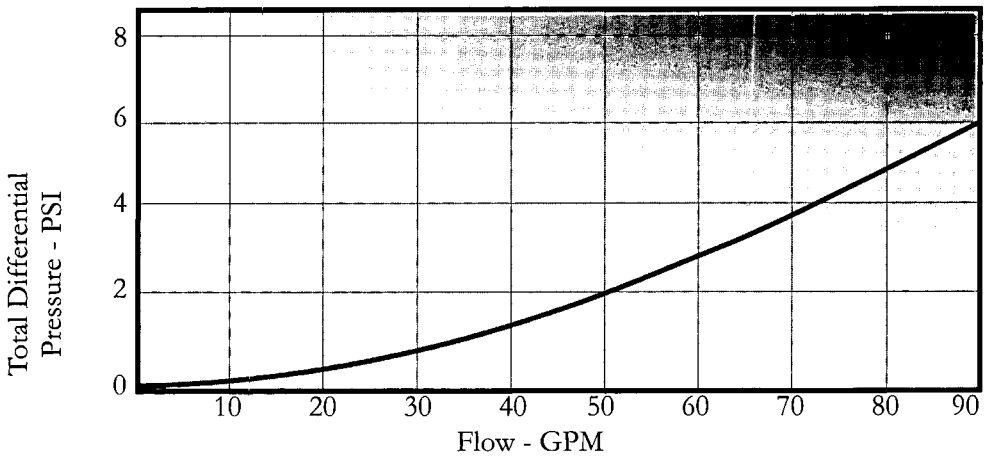
1.5" Vortex Filter AP4E-1.5F



Specification

The Y filter body shall be molded from glass reinforced engineering grade black plastic with a 1.5 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional 3/4" MIPT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless, providing a 60.8 square inch filtration area. The outer support shell shall be woven stainless steel wire, and the inner screen shall be made of stainless steel cloth. The inner and outer screens shall be soldered together. The screen collar shall be molded from vinyl. The 1 ½" filter shall be Geoflow model number AP4E-1.5F.

2" Vortex Filter AP4E-2F



Specification

The Y filter body shall be molded from glass reinforced engineering grade black plastic with a 2 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional 3/4" MIPT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless, providing a 60.8 square inch filtration area. The outer support shell shall be woven stainless steel wire, and the inner screen shall be made of stainless steel cloth. The inner and outer screens shall be soldered together. The screen collar shall be molded from vinyl. The 2" filter shall be Geoflow model number AP4E-2F.

BioDisc Filter

NEW

Description

The BioDisc(TM) filters are placed between the pump and dripfield to trap debris from entering the drip system.

Features

Geoflow's disc filters are protected with anti bacteria. Designed for applications with high organics, the *Geoshield®* is molded into each disc to discourage unwanted growth on the filter element. A single filter can be placed in line, and requires manual cleaning.

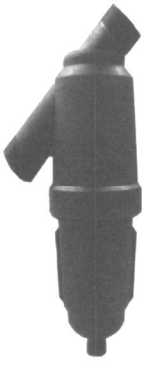
Specification

The BioDisc filter body and discs shall be molded of polyethylene resins. The disc shall include *Geoshield®* anti-bacterial compound to protect the filter element against slime build-up. Filtration shall be 120 mesh/130 micron. The two piece body shall be capable of being serviced by untwisting and shall include an O-ring seal. The seals shall be manufactured from Nitrilo rubber. The inlet and outlet shall be ____ inch MPT. The UF disc filter shall be part number BioDisc___ as supplied by Geoflow, Inc.

Part No.	Inlet/ Outlet diameter	Max Flow Rate per Filter	Max Pressure PSI	Max Temp (°F)	Length	Filtration Surface Area	Filtration Size	Weight lbs.
BioDisc-1.5F	1.5"	30 gpm	145psi 335ft.	140	12"	72.7 sq. in.	120 mesh 130 micron	3.3.
BioDisc- 2F	2"	60 gpm	145 psi 335 ft.	140	20"	156.9 sq. in.	120 mesh 130 micron	13.2

8.0"

1.5 " Disc Filter



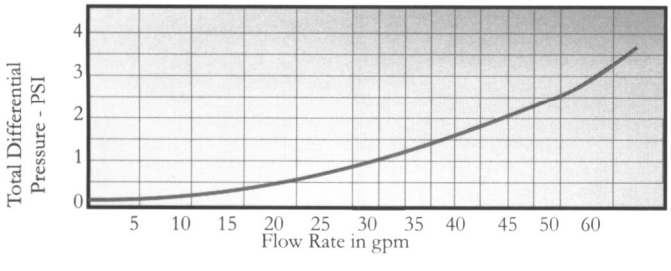
12"

11.5"

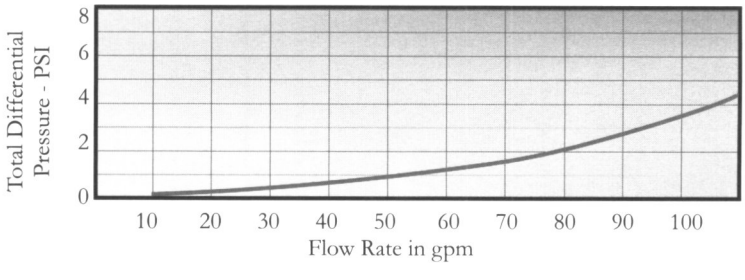
2 " Disc Filter

20"

Pressure Loss 1.5" Disc Filter



Pressure Loss 2" Disc FIlter



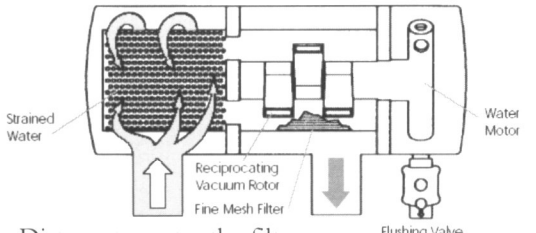
- **BioDisc** is a trademark of A.I.Innovations.
- **Geoshield®** is a registered trademark of A.I.Innovations.

GeoVac Filter

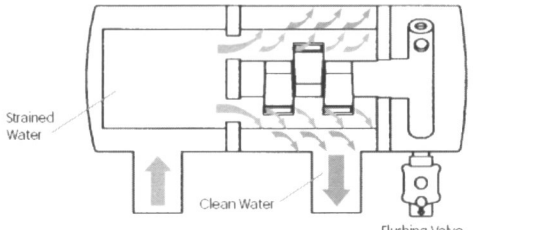
NEW

Description

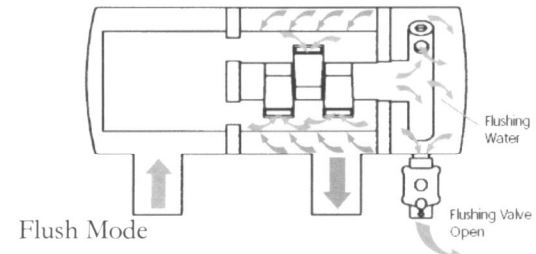
The GeoVac is a stainless steel filter with an automatic, self-cleaning, screen-type water filter for heavy loads of onsite wastewater.



Dirty water enter the filter



Strained water goes out to the drip field



Flush Mode

Features

The GeoVac avoids the danger of forcing contaminated water back into the system. The GeoVac filter will deliver clean water or no water. The entire filter flushing mechanism and fine screen assembly is modular and can be removed from the filter body without having to detach the filter from supply and delivery manifolds.

Filtering Mode

Pressurized water enters the filter inlet and travels through a fine stainless steel screen where contaminants are filtered out. The clean water passes through to the inside of the screen, then out to the drip field.

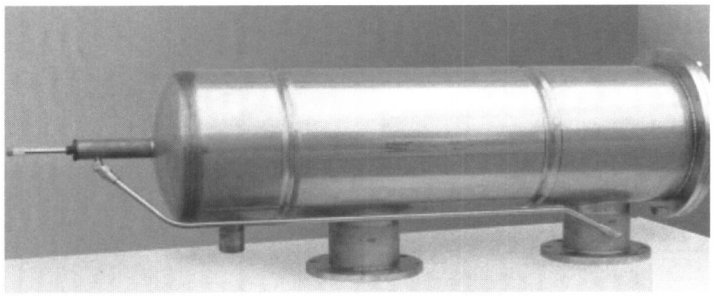
Flush Mode

A solenoid flush valve is time activated. When the flushing valve opens, the pressure differential is reduced on the area being swept by the reciprocating cleaning nozzles. This causes the clean water to reverse flow through the filter element as the cleaning nozzles rotate across the entire surface of the screen, pushing contaminants off the screen, through the nozzles, through the water motor and out through the flush valve.

The water passing through the angular holes in the motor creates a torsion rotation of the nozzles, thus vacuuming the entire inside diameter of the filter element.

At the end of the flushing cycle, the unit automatically returns to full filtering mode.

During the filter flush cycle the filtration process continues uninterrupted.



6" or 8" Filter with flanged connections

Specifications

Materials for 2" GeoVac	
Tank:	Stainless steel. Type 304, 18-gauge
Vacuum Motor and nozzle assembly	Glass-filled Noryl
Filter Screen	3-layer sintered stainless steel. Type 316
Materials for 3", 4", 6", 8" GeoVac	
Tank:	Stainless steel. Type 304, 18-gauge
Vacuum Motor and nozzle assembly	Engineered grade polymer
Filter Screen	3-layer sintered stainless steel. Type 316

	Model/Part No.				
	GeoVac 75-02	**GeoVac 150-03**	**GeoVac 250-04**	**GeoVac 500-06**	**GeoVac 700-08**
Max. flow rate (gpm)	75	150	250	500	700
Inlet/Outlet diameter (inches)	2"	3"	4"	6"	8"
Inlet/Outlet connection (included in box)	Grooved	Grooved	Grooved	Flange	Flange
Filter flush min. flow (gpm)	30	40	40	40	50
Filter flush min. time (seconds)	6	10	10	20	20
Min. downstream working pressure (psi)	35	35	35	35	35
Max. working pressure (psi)	125	125	125	150	150
Pressure loss at max. recommended flow rate	1psi/2.31 ft.	1psi/2.31 ft.	1psi/2.31 ft.	1psi/2.31 ft.	1psi/2.31 ft.
Screen area (inches^2)	118	224	448	867	1300
Screen sizes Micron	100	100	100	100	100
Mesh	150	150	150	150	150
Max. Temperature (F°)	180	180	180	180	180
Filter housing diameter (inches)	10"	10"	10"	15"	15"
Flushing outlet diameter (inches) NPT	1"	1"	1"	2"	2"
Supplied with flush valve	1.5"	1.5"	1.5"	2"	2"
Weight (lbs.)	30	55	80	395	435
Length (inches)	16.7"	39.2"	49.4"	60.6"	72.6"
Min. clearance req. on lid end	36"	36"	36"	56"	70"
Min. clearance req. on sensor end	12"	12"	12"	12"	12"

Installation

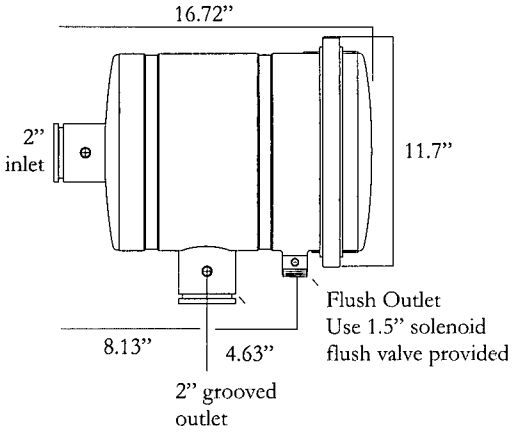
- Flush valve should be placed on the discharge nipple with the arrow pointing downwards.
- The tank can rest on the inlet/outlet nipples or can be mounted on a stand.
- Check the connections on the manifold or stand to make sure they are on the same plane. If improperly aligned the tank could be distorted when the filter connections are tightened.
- The back flush line should not run uphill. This will reduce the required backpressure differential and reduce the cleaning effectiveness.
- The GeoVac filter needs to be insulated against freezing.

Maintenance

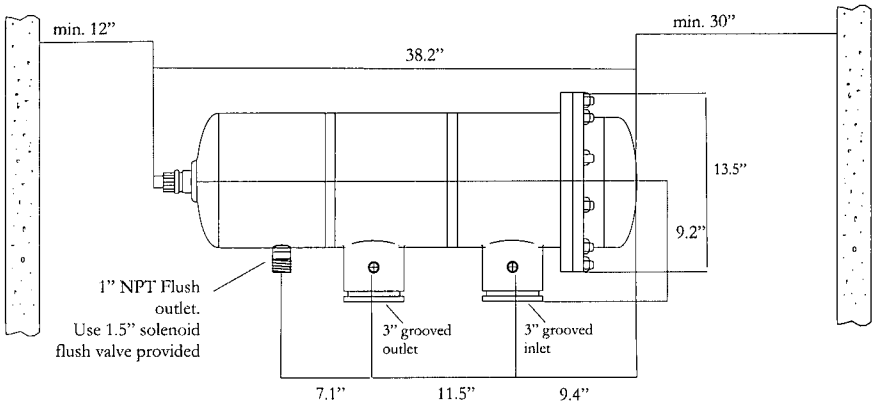
- Manually clean filter element periodically.
- Clean and grease all o-rings with waterproof lubricant.
- Check welds and hydraulic connections.
- Before servicing filter internals, slowly open the filter flush valve and allow the filter to empty out.
- Make sure pump is on manual off so it does not pressurize while servicing.
- Ensure bolts and nuts of covers and all connections are uniformly tightened.

GeoVac Dimensions

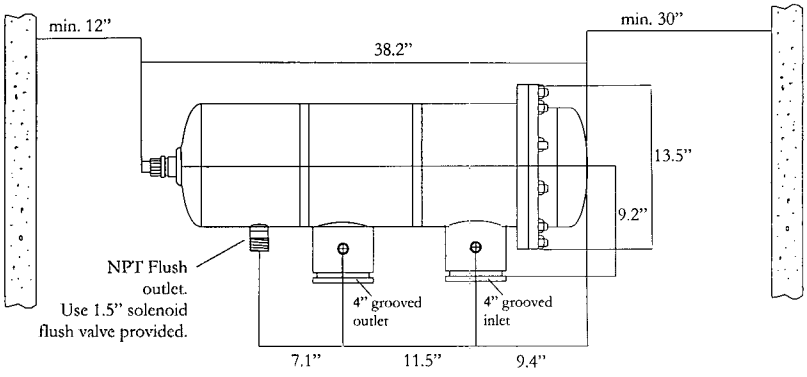
GeoVac 75-02



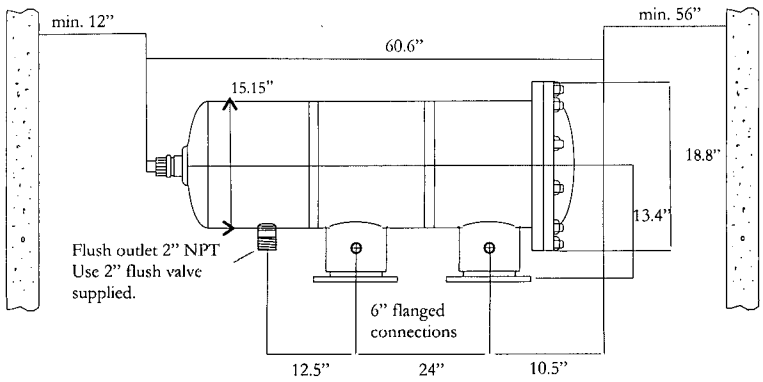
GeoVac 150-03



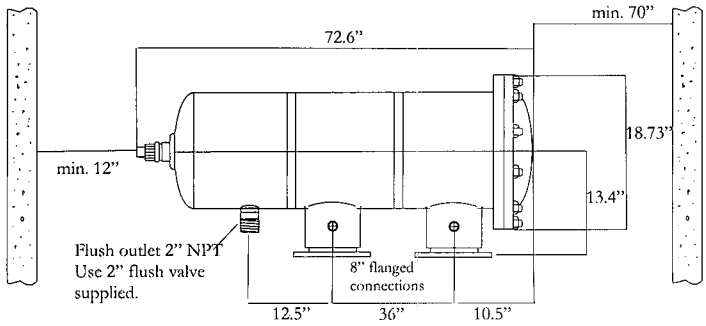
GeoVac 250-04



GeoVac 500-06



GeoVac 700-08



Flow Meter

Description

Geoflow's digital flow meters are a turbine style meter with rate/ totalizer – designed to measure and display both the rate of flow and total flow. The local display model includes a digital screen, while the Pulse Output Model is outfitted with a pulse access that can be read on your Geo Touchscreen controller.

FLOW METER – Digital Display

This is a stand alone meter with a local display that includes: Rate of Flow, Batch and Cumulative Totals. It is powered by lithium batteries for approximately 9000 hours.

Model No.	FM-DDS-050	FM-DDS-100	FM-DDS-150	FM-DDS-200
Meter size	3/4 " FPT	1" FPT	1.5" FPT	2" FPT
Flow Rate	2-20 gpm	5-50 gpm	10-100 gpm	20-200 gpm
Material - Housing - Bearings - Shaft - Rotor - Rings	 PVC Ceramic Tungsten carbide PVDF Stainless steel	 PVC Ceramic Tungsten carbide PVDF Stainless steel	 PVC Ceramic Tungsten carbide PVDF Stainless steel	 PVC Ceramic Tungsten carbide PVDF Stainless steel
Accuracy	3%	3%	3%	3%
Temp range	32°F-140°F	32°F-140°F	32°F-140°F	32°F-140°F
Max Pressure	150 psi	150 psi	150 psi	150 psi
Typical K factor	2400	540	215	100
Frequency range	48-480 Hz	45-450 Hz	36-460 Hz	33-330 Hz
Weight	0.88 lbs	1.0 lbs.	1.4 lbs.	1.68 lbs.

FLOW METER – Pulse Output Model

The pulse output flow meter is wired directly to the Geo Touchscreen controller, sending data that is logged by the controller and read on the controller screen. It uses no batteries.

Model No.	FM-PLS-100	FM-PLS-150	FM-PLS-200
Meter Size	1" FPT	1.5" FPT	2" FPT
Flow Rate	5-50 gpm	10-100 gpm	20-200 gpm
Material			
Housing	PVC	316 Stainless steel	316 Stainless steel
Bearings	Ceramic	Ceramic	Ceramic
Shaft	Ceramic	Tungsten carbide	Tungsten carbide
Rotor	PVDF	PVDF	PVDF
Rings	Fluorocarbon	316 Stainless steel	316 Stainless steel
Accuracy of reading	+/- 1.5%	+/- 1%	+/- 1%
Typical K factor	540	215	100
Pressure Rating	150 psi	1500 psi	1500 psi
Frequency Range	45-450 Hz	36-360 Hz	33-330 Hz
Shipping Weight	1.9 lbs.	4.6 lbs.	6.8 lbs.
Typical K factor	540	215	100
Wrench flat size	1-5/8"	2- 3/8"	3"

Installation:

Although the Geoflow flow meter is designed to withstand outdoor conditions, a cool dry location where the unit can be easily serviced is recommended.

The Geoflow meter can be mounted on horizontal or vertical runs of pipe. Mounting at the twelve o'clock position on horizontal pipe is recommended. Backpressure is essential on downward flows.
The GD Flow Meter accuracy is affected by disturbances such as pumps, elbows, tees, valves in the flow stream. Install the meter in a straight run of pipe as far as possible from any other disturbances. The distance required for accuracy will depend on the type of disturbance.

Type of Disturbance	Min. Inlet Pipe Length	Min. Outlet Pipe Length
Flange	10 x Pipe I.D.	5 x Pipe I.D.
Reducer	15 x Pipe I.D.	5 x Pipe I.D.
Elbow	20 x Pipe I.D.	5 x Pipe I.D.
Two Elbows 1 direction	25 x Pipe I.D.	5 x Pipe I.D.
Two Elbows – 2 directions	40 x Pipe I.D.	5 x Pipe I.D.
Pump or gate valves	50 x Pipe I.D.	5 x Pipe I.D.

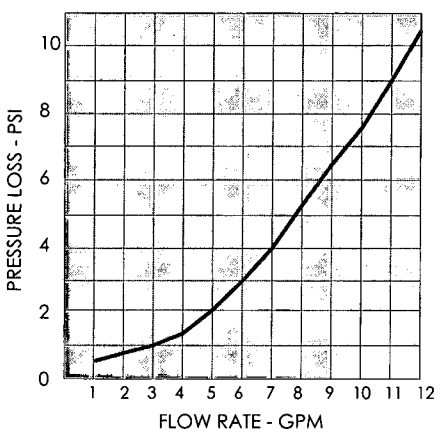
The flow meter is factory calibrated. When measuring total flow, accumulated error over time must be considered. Accuracy is based on laboratory testing of nominal pipe dimensions. Your actual accuracy will vary based on your actual pipe I.D. and other installation factors.

Maintenance

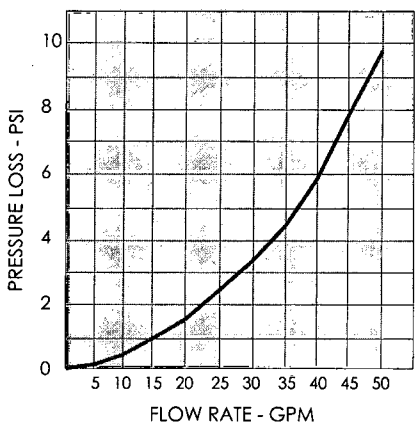
1. Periodically remove the sensor assembly from the pipe fitting and inspect the meter for signs of wear and obstructions. Clean the paddle of any foreign objects. Paddle and axle wear can be caused by chemicals and/or abrasive fluids. Replace the paddle and axle if worn.
2. Inspect O rings. Immediately replace the o-rings at any sign of wear, swelling, cracking or discoloration.
3. Replace the batteries every 12 months.

Flow Rate vs. Pressure

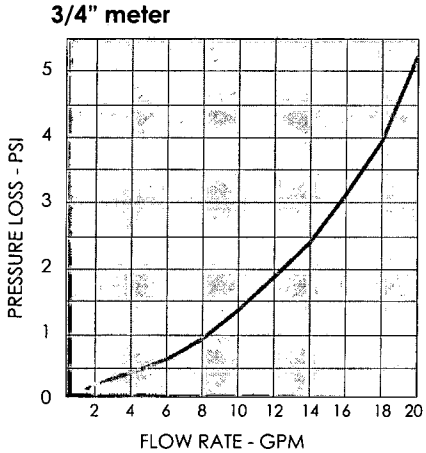
½" meter



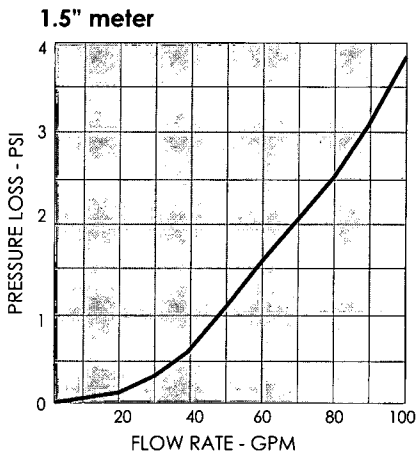
1" meter



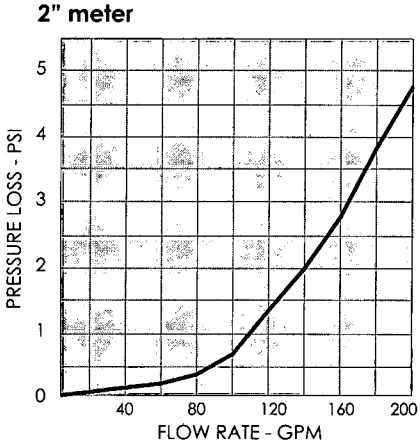
3/4" meter



1.5" meter

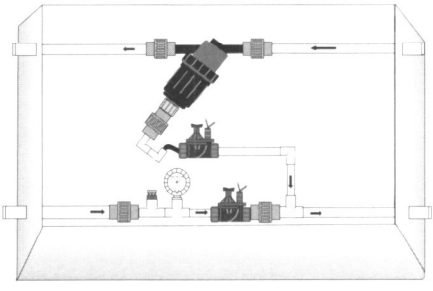


2" meter



Wasteflow Headworks

The headwork refers to the components that are placed between the pump tank and the dripfield itself. There are multiple options available, depending on the application, personal preferences or regulatory requirements. The following list is a guide to help choose the best headworks for your needs.



WHW Sporty

The following choices will need to be made:

1) Filter type and size

Geoflow offers 3 filter types;

a) Vortex **(V)** screen filter .75" 1" 1.5" 2"
b) BioDisc **(D)** filter 1.5" 2"
c) GeoVac™ filter. 2" 3" 4" 6" 8"

The Geovac filter is ordered from the filter specification page and always includes connections and filter flush valve. Field flush valves and flow meters can be added separately. See GeoVac filter product sheet for details.

2) Sporty vs. Ultra Headworks

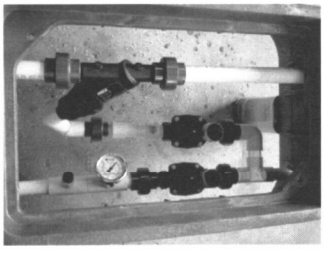
Geoflow offers sporty headworks **(WHWS)** that is simple and ultra headworks **(WHWU)** that can be used for commercial, industrial or residential projects. While all headworks include drip filters, flush valves and pressure readings, the Ultra headworks also includes a digital flow meter. The electrical wiring on the Ultra Headworks is bundled in a junction box for a water resistant connection.

3) Flushing

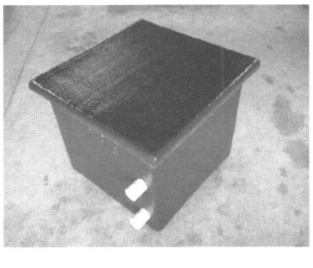
Will the system be flushed manually **(M)** with a ball valve or automatically with solenoid valves **(A)**. The Ultra headworks are only available with automatic field and filter flushing.

4) Flow Meter

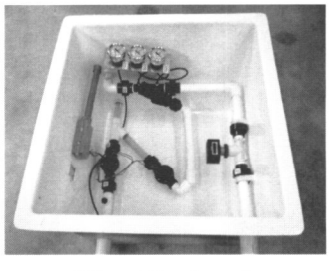
Sporty Headworks: Order a flow meter separately and install it downstream of the headworks.
Ultra Headworks comes with 2 choices; one with a local digital display **(DDS)**, and one with a pulse output **(PLS)** that is displayed on the touchscreen of the Geo-TS controllers.



Sporty Headworks



Ultra Headworks Box



Ultra Headworks

a) Vortex Headworks

Sporty Headworks

Item No.	Filter	Flushing	Dimensions (in.)
WHWS-V-75F-M	3/4" Vortex Filter	Manual Field & Filter	13 x 24 x 15
WHWS-V-75F-A	3/4" Vortex Filter	Automatic Field & Filter	13 x 24 x 15
WHWS-V-1F-M	1" Vortex Filter	Manual Field & Filter	13 x 24 x 15
WHWS-V-1F-A	1" Vortex Filter	Automatic Field & Filter	13 x 24 x 15
WHWS-V-1.5F-M	1.5" Vortex Filter	Manual Field & Filter	17 x 30 x 15
WHWS-V-1.5F-A	1.5" Vortex Filter	Automatic Field & Filter	17 x 30 x 15
WHWS-V-2F-M	2" Vortex Filter	Manual Field & Filter	17 x 30 x 15
WHWS-V-2F-A	2" Vortex Filter	Automatic Field & Filter	17 x 30 x 15

Ultra Headworks

Item No.	Filter	Flushing	Dimensions (in.)	Flow Meter
WHWU-V-75F-A	3/4" Vortex filter	Automatic Flush	25.5 x 25.5 x 22	Specify DDS or
WHWU-V-1F-A	1" Vortex filter	Automatic Flush	25.5 x 25.5 x 22	PLS at the end
WHWU-V-1.5F-A	1.5" Vortex filter	Automatic Flush	25.5 x 25.5 x 22	of the item no.
WHWU-V-2F-A	2" Vortex filter	Automatic Flush	25.5 x 25.5 x 22	

b) BioDisc Headworks

Sporty Headworks (Manual Filter Flush only)

Item No.	Filter	Flushing	Dimensions (in.)
WHWS-D-1.5F-M	1.5" Disc Filter	Manual Field Flush	17 x 30 x 15
WHWS-D-1.5F-A	1.5" Disc Filter	Automatic Field Flush	17 x 30 x 15
WHWS-D-2F-M	2" Disc Filter	Manual Field Flush	17 x 30 x 15
WHWS-D-2F-A	2" Disc Filter	Automatic Field Flush	17 x 30 x 15

Ultra Headworks

Item No.	Filter	Flushing	Dimensions (in.)	Flow Meter
WHWU-D-1.5F-A	1.5" DISC filter	Automatic Flush	25.5 x 25.5 x 22	Specify DDS or
WHWU-D-2F-A	2" DISC filter	Automatic Flush	25.5 x 25.5 x 22	PLS at the end
				of the item no.

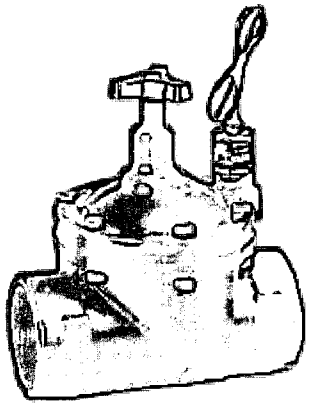
c) GeoVac

See GeoVac filter product sheet for details.

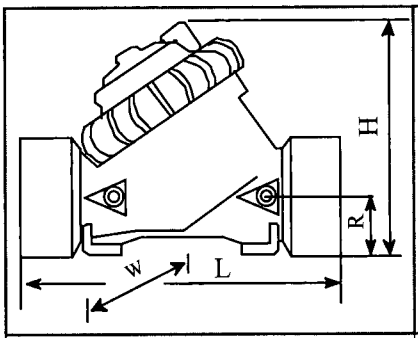
In 2007 Geoflow introduced a new solenoid valve, the SVLV-B. Recognized for its efficiency and productivity, the new SVLV-B valves have been tried and tested in onsite wastewater applications.

Description

The Solenoid Valve is used to flush field and filters and as zone valves. It is electrically operated. It is normally closed, and in the event of a power failure the valve will close. Geoflow does use normally open solenoid valves in the dual filter headworks. These may be special ordered.



New 2007 Model
Globe Valve
1" and 1.5"

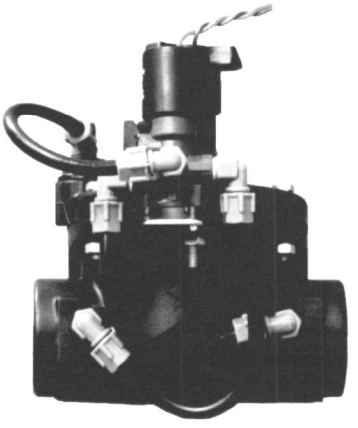
	SVLV-B-100	SVLV-B-150	SVLV-B-200	SVLV-B-300
Inlet/Outlet Size (FNPT)	1"	1.5"	2"	3"
Body Pattern	Globe	Globe	Y	Y
Length (L)	4.3"	6.3"	9.0"	12.2"
Height (H)	4.5"	7.2"	7.4"	11.0"
Width (W)	3.0"	5.0"	5.4"	
R	7/8"	1-3/8"	1-5/8"	4.0"
Weight	12.5 oz	2.2 lbs.	2.97 lbs.	8.8 lbs.
Valve Pattern	Globe	Globe	Wye	Wye
Operating Range	10-150 psi	10-150 psi	7-140 psi	7-140 psi
Max temperature	180° F	180° F	180° F	180° F
Materials				
Body & cover	Nylon reinforced	Nylon reinforced	Glass filled nylon	Glass filled nylon
Metal Parts	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Diaphragm	Natural Rubber	Natural Rubber	NBR (Buna-N), nylon reinforced fabric	NBR (Buna-N), nylon reinforced fabric
Seals	NBR & NR	NBR & NR	NBR (Buna-N)	NBR (Buna-N)

Installation

The manual bleed lever should always be in the VERTICAL position and the dial on top should be free spinning. Clockwise rotation closes valve.
Pressure Loss through valves (in psi)
Recommended minimum pressure differential: 7 psi

Maximum Length of wire run- Controller to Valve

# Wire	Resistance	Maximum Run
	Ohm/ 1000'	
#18	6.39	800 ft.
#16	4.02	1,275 ft.
#14	2.58	2,000 ft.
#12	1.62	3,200 ft.
#10	1.02	5,100 ft.
#8	0.641	8,000 ft.
#6	0.403	12,750 ft.
#4	0.253	20,500 ft.
#2	0.158	32,500 ft.



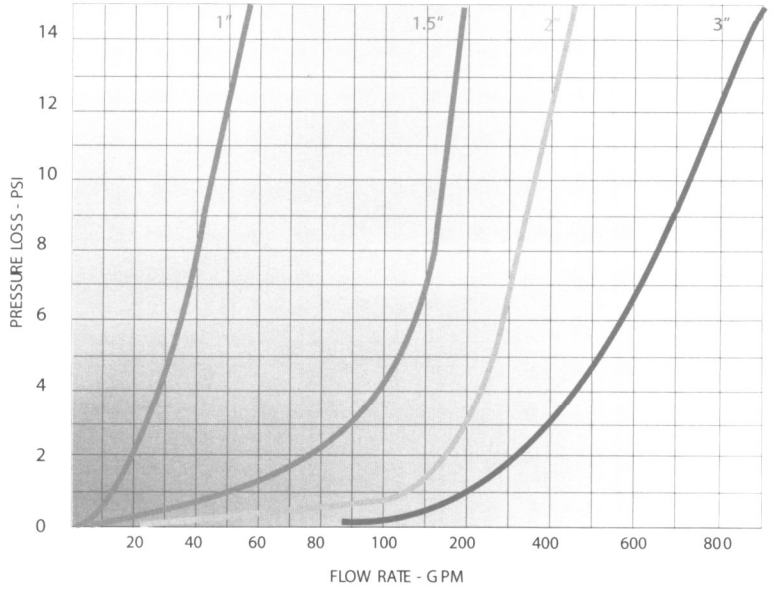
Y Valve
2" and 3"

Electrical data:
Wiring requires a single lead from the controller to each solenoid valve, plus a common neutral to all solenoids. Type UF wire, UL listed, is recommended for all hookups.

Standard 24V ACV (50-60Hz)
Current Holding 0.24A 5.76 VA
Current Inrush 0.46A 11.04VA
Maximum allowable loss 4.8 Volts for the 24V AC system
Contact Geoflow for optional voltages or larger valves

Maximum Voltage loss with a valve with a three way Solenoid is 4.8 volts

Solenoid Valve Flow vs. Pressure Chart

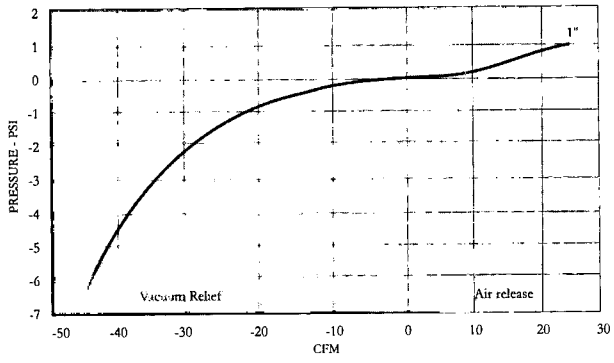


Description

Air release allows air to escape the system at startup and vacuum relief allows air to enter the system during shutdown. Air vents are installed at the high point of the drip field to keep soil from being sucked into the drip emitter due to back siphoning or back pressure. This is an absolute necessity with underground drip systems. They are also used for proper drainage of the supply and return manifolds. Use one on the high point of the supply manifold and one on the high end of the return manifold and any high points in the system. A pre-installed schrader valve allows pressure testing off the air/vacuum breaker.

Item No.	Inlet	Pressure to seal	Max pressure	Height inches	Width inches	Weight Lbs.
APVBK-1	1" MPT	5 psi	80 psi	5.5	3.43	.67
APVBK-2	2" MPT	1 psi	200 psi	10.75	3.98	6.62

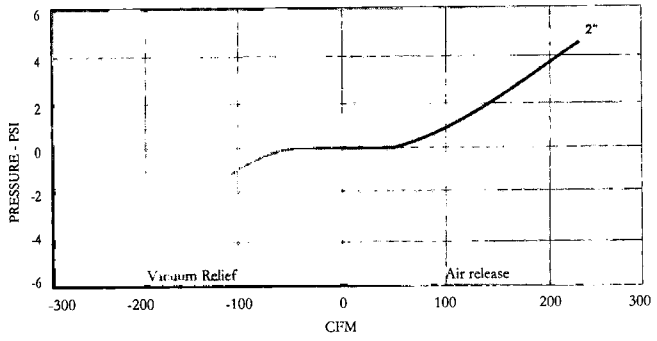
1" Vacuum Relief/Air Release



Specification 1"

The air vacuum breakers provide instant and continuous vacuum relief and non-continuous air release It shall be rated to 80 psi. Both the body and the removable dirt cover shall be constructed of molded plastic. The body and the dirt cover shall be connected with a ¾ inch hose thread. The ball shall be constructed of low density plastic and the internal seat shall be constructed of vinyl. Inlet size shall be 1 inch male pipe thread. The air/vacuum relief valve shall Geoflow Item no. APVBK-1.

2" Vacuum Relief/Continuous Air Release



Specification 2"

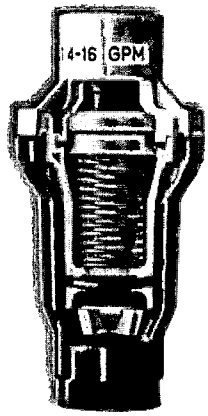
The air vent shall provide instant and continuous vacuum relief and air release and continuouis air release. Both the body and the removable dirt cover shall be constructed of molded plastic. It shall be rated to 200 psi. The ball shall be constructed of low density plastic and the internal sear shall be constructed of vinyl. Inlet size shall be 2 inch male pipe thread. Outlet shall be 1.25" socket ell. The air/vacuum relief valve shall Geoflow Item no. APVBK-2.

Pressure Regulators

Description

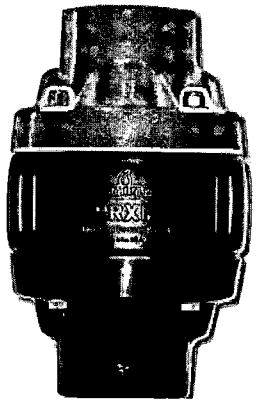
The regulators are preset to regulate pressure in the field. These are required with Wasteflow Classic and optional with Wasteflow PC. Under normal operating conditions the pressure in the dripline should be: 10 - 45 psi for Wasteflow Classic and Wasteflow PC.

Low, Medium and High Flow Regulator



Pressure Regulator Specification

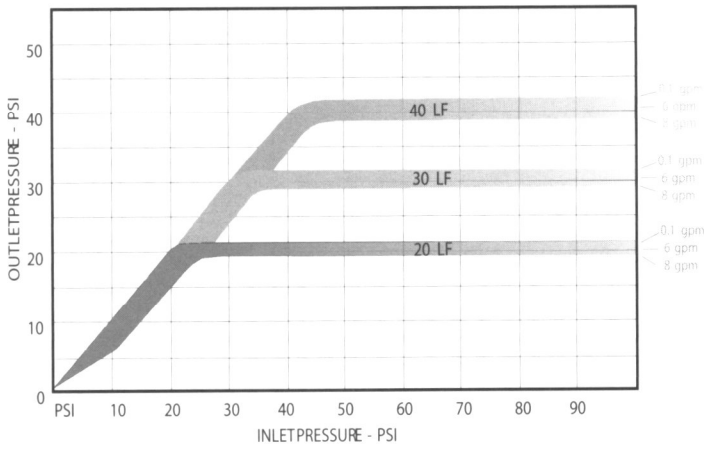
Geoflow's pressure regulator shall be designed to handle steady inlet pressures of ___ psi and withstand severe water hammer extremes. It shall handle flow rates between ___ gpm and ___ gpm. Flow restriction shall be negligible until the factory preset pressure is reached. Regulatory accuracy shall be within +/- 6%. Inlet and outlet size shall be ____" FIPT. The body shall be constructed of high impact engineering grade thermoplastics. Regulation shall be accomplished by a fixed stainless steel compression spring enclosed in a chamber separate from the normal water passage. Each regulator shall be water tested for accuracy. Pressure regulator shall be Geoflow model number PMR-____ - _ F. Refer to table to fill in the blanks.



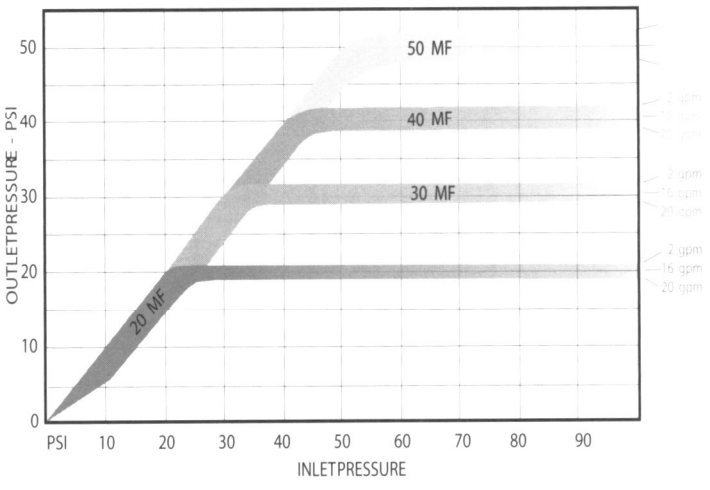
Extra Flow Regulator- flows up to 90 gpm

ITEM NO.	OUTLET PRESSURE	FLOW RANGE	MAX. INLET PRESSURE Psi	MAX. INLET PRESSURE ft.	INLET SIZE	OUTLET SIZE	HEIGHT X WIDTH
PMR-20-LF	20 psi	1/10 - 8 gpm	150	347	¾" fipt	¾" fipt	5" x 2.25"
PMR-20-MF	20 psi	2 - 20 gpm	150	347	1"fipt	1"fipt	6" x 2.75"
PMR-20-HF	20 psi	10 - 32 gpm	100	23	1.25" x 1" fipt	1.25"fipt	6" x 3"
PMR-20-XF	20 psi	20 - 90 gpm	90	208	3"ID socket	3"ID socket	11.25" x 7.5"
PMR-30-LF	30 psi	1/10 - 8 gpm	150	347	¾" fipt	¾" fipt	5" x 2.25"
PMR-30-MF	30 psi	2 - 20 gpm	150	347	1" fipt	1"	6" x 2.75"
PMR-30-HF	30 psi	10 - 32 gpm	100	23	1.25" x 1"fipt	1.25"	6" x 3"
PMR-30-XF	30 psi	20 - 90 gpm	100	23	3"ID socket	3"ID socket	11.25" x 7.5"
PMR-40-LF	40 psi	1/10 - 8 gpm	150	347	¾" fipt	¾" fipt	5" x 2.25"
PMR-40-MF	40 psi	2 - 20 gpm	150	347	1" fipt	1"	6" x 2.75"
PMR-40-HF	40 psi	10 - 32 gpm	100	23	1.25" x 1" fipt	1.25"	6" x 3"
PMR-40-XF	40 psi	20 - 90 gpm	125	289	3"ID socket	3"ID socket	11.25" x 7.5"
PMR-50-MF	50 psi	2 - 20 gpm	150	347	1" fipt	1"	6" x 2.75"
PMR-50-HF	50 psi	10 - 32 gpm	100	23	1.25" x 1" fipt	1.25"	6" x 3"
PMR-50-XF	50 psi	20 - 90 gpm	125	289	3"ID socket	3"ID socket	11.25" x 7.5"

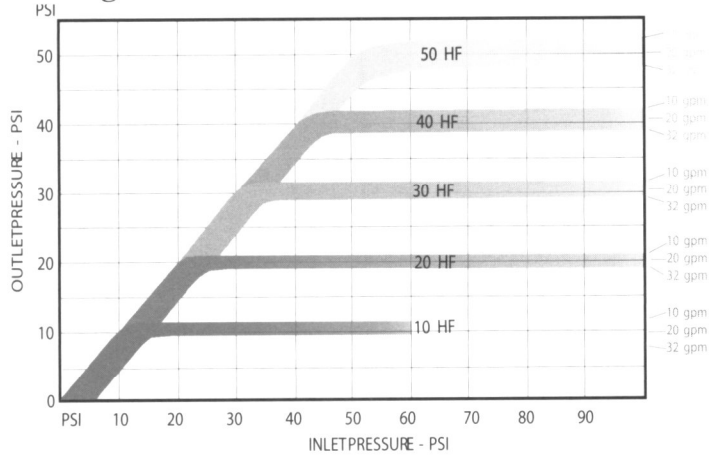
Low Flow



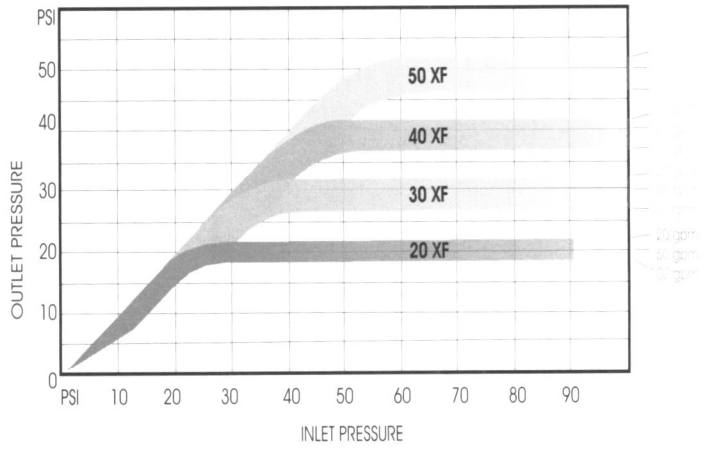
Medium Flow



High Flow



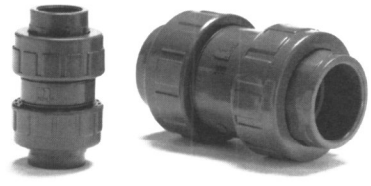
Extra Flow



True Union Ball Check Valve

Ball Check Description

The Ball Check valves prevent backflow or drain down in the system. The true union provides easy access for in-line installation and servicing. The true union ball check is designed for quick positive sealing with minimum turbulence, low restriction, and efficient fluid transfer. It can be installed vertically or horizontally. System pressure will unseat the ball, allowing flow. Backflow or head pressure of 30" or 1 to 2 psi will seat the ball and stop back flow. Each check valve ships with female thread and socket adapters. This valve is manufactured 100% from thermolastic materials, making is less suseptable to corrosion.



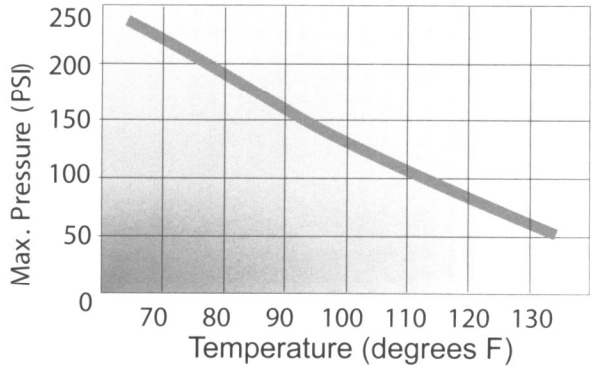
Ball Check Valve

Ball Check Model No.	Inlet/Outlet Size (FPT or socket)	Length (inches)	Height (inches)	Max Temp	Weight (lbs.)
CV-B-05	0.5"	3.50"	2.0"	140 °	0.75
CV-B-10	1.0"	5.09"	2.31"	140 °	1.1
CV-B-15	1.5"	6.59"	3.81"	140 °	2.2
CV-B-20	2.0"	7.53"	4.22"	140 °	3.0

Ball Check Specifications

All thermoplastic check valves shall be True Union Ball type constructed from PVC Type I Cell Classification 12454. Socket end connections are manufactured to ASTM D2467-94. Threaded connections are manufactured to ASTM D2464-88. The O-Ring seat shall be Viton®. All valve components shall be replaceable. The check valve shall be pressure rated at 235 psi, non-shock water at 73° F.

True Union Ball Check Maximum Pressure Rating
at Given Temperature



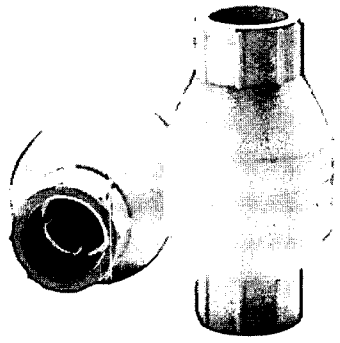
Ball Check Installation

Connection - Each Geoflow ball check valve ships with female thread and socket adapters. Install in a box for easy access. It is recommended that these check valves be installed no closer than 10 pipe diameters from a pump and no closer than 5 pipe diameters from an elbow.

Spring Check Valve

Spring Check Valve Description

The spring check valve is used to prevent backflow and siphoning. The ½ pound stainless steel spring maintains a positive seal, even when no back pressure is present. Minimum of 2 psi required to open the valve.



Spring Check Valve

Spring Check Model No.	Inlet/Outlet Size (FPT or socket)	Length (inches)	Height (inches)	Max Temp
CV-S-05	0.5"	4.13"	2.22"	140 °
CV-S-10	1.0"	5.25"	2.88"	140 °
CV-S-15	1.5"	5.9"	3.89"	140 °
CV-S-20	2.0"	7.0"	4.29"	140 °

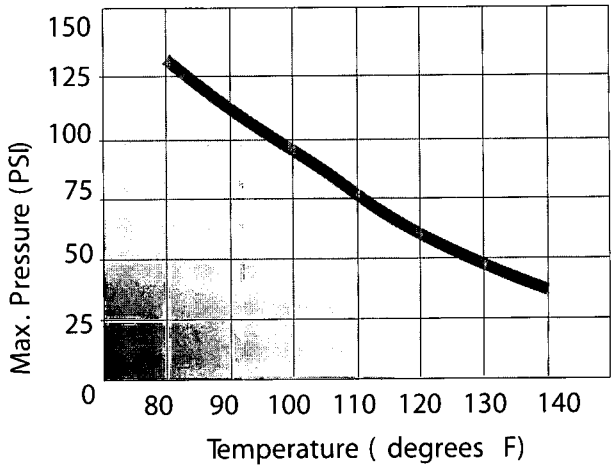
Spring Check Specifications

Thermoplastic Spring check valves shall be constructed from PVC Type 1, cell class 12454 material conforming to ASTM D-1784. Seals shall be EPDM. Valves shall have socket end connections for solvent weld. All Spring check valves shall be pressure rated at 150 psi at 73 degrees F. All spring check valves shall require 2 psi to open.

Spring Check Installation

Connection - FIPT slip connections. Install in a box for easy access. It is recommended that these check valves be installed no closer than 10 pipe diameters from a pump and no closer than 5 pipe diameters from an elbow.

Spring Check
Maximum Pressure Rating at Given Temperature



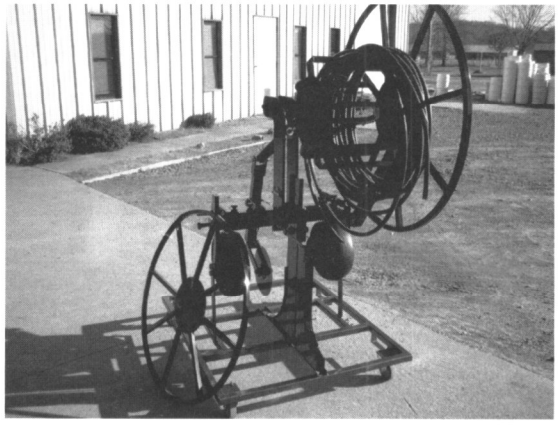
Drip Plow

Description

The drip plow is a state of the art direct burial plow that pulls dripline below ground with minimum disturbance to the soils. Developed by an industry professional who formerly installed industrial cable and drip irrigation lines, this plow is built with meticulous care to details for ease of use.

Features

- Heavy duty. Solid parts are carefully welded and worked for a clean, professional plow that is built to last for many years.
- Large chute that easily allows fittings to slide through.
- Two levelers mounted on the assembly to easily make alignments as needed. Shank drafts down and lifts soil up so there is little damage to the structure. The angle of the shaft does not wedge sideways and compress or smear the soil.
- Sod cutter included.
- Unique tubing hold to keep coils from slipping off the reel.
- Mounts to toolbar. Gang one, two three or four in a row for multi-row installations.
- Tubing reel has tension setting.
- Depth control.
- Articulates. Hinges to make tight curves.



PVC 40 FRICTION LOSS CHART

	½" pipe		¾" pipe		1" pipe		1 ¼" pipe		1 ½"pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
1	1.05	0.43	0.60	0.11	0.37	0.03				
2	2.11	1.55	1.2	0.39	0.74	0.12	0.43	0.03		
3	3.17	3.27	1.8	0.83	1.11	0.26	0.64	0.07	0.47	0.03
4	4.22	5.57	2.41	1.42	1.48	0.44	0.86	0.11	0.63	0.05
5	5.28	8.42	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08
6	6.33	11.81	3.61	3.01	2.23	0.93	1.29	0.24	0.95	0.11
8	8.44	20.10	4.81	5.12	2.97	1.58	1.72	0.42	1.26	0.20
10	10.55	30.37	6.02	7.73	3.71	2.39	2.15	0.63	1.58	0.30
15			9.02	16.37	5.57	5.06	3.22	1.33	2.36	0.63
20					7.42	8.61	4.29	2.27	3.15	1.07
25					9.28	13.01	5.36	3.42	3.94	1.63
30					11.14	18.22	6.43	4.80	4.73	2.27
35							7.51	6.38	5.52	3.01
40							8.58	8.17	6.30	3.88
45							9.65	10.16	7.09	4.80
50							10.72	12.35	7.88	5.83
60									9.46	8.17
70									11.03	10.87

	2" pipe		2 ½" pipe		3" pipe		4" pipe		6" pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
6	0.57	0.03								
8	0.76	0.06	0.54	0.02						
10	0.96	0.09	0.67	0.04						
15	1.43	0.19	1.01	0.08	0.65	0.03				
20	1.91	0.32	1.34	0.13	0.87	0.05				
25	2.39	0.48	1.67	0.20	1.08	0.07				
30	2.87	0.67	2.01	0.28	1.30	0.10				
35	3.35	0.89	2.35	0.38	1.52	0.13	0.88	0.03		
40	3.82	1.14	2.64	0.48	1.73	0.17	1.01	0.04		
45	4.30	1.42	3.01	0.60	1.95	0.21	1.13	0.05		
50	4.78	1.73	3.35	0.73	2.17	0.25	1.26	0.07		
60	5.74	2.42	4.02	1.02	2.60	0.35	1.51	0.09		
70	6.69	3.22	4.69	1.36	3.04	0.47	1.76	0.12		
80	7.65	4.13	5.36	1.74	3.47	0.60	2.02	0.16		
90	8.60	5.13	6.03	2.16	3.91	0.75	2.27	0.20		
100	9.56	6.23	6.70	2.63	4.34	0.91	2.52	0.24	1.11	0.03
125	11.95	9.42	8.38	3.97	5.42	1.38	3.15	0.37	1.39	0.05
150			10.05	5.56	6.51	1.93	3.78	0.51	1.67	0.07
175					7.59	2.57	4.41	0.68	1.94	0.09
200					8.68	3.40	5.04	0.90	2.22	0.12

GEOFLOW LIMITED WARRANTY

A. WASTEFLOW® PERFORMANCE WARRANTY

GEOFLOW products which contain nano-ROOTGUARD® are warranted to remain free of root intrusion for a period of fifteen (15) years from the date of delivery to the buyer, provided such product is stored and installed according to the manufacturer's instructions. Any such products that may be clogged by intrusion of roots shall in the first ten years be replaced 100% by Geoflow. And thereafter, for the eleventh (11th) to fifteenth (15th) years, at the price of such replacement less 20% per year. This warranty is expressly limited to providing the buyer with a replacement for any defective product or part and does not include the cost of installation of the replacement and in no case shall GEOFLOW be liable for any special incidental or consequential damages. In addition, the terms of our Basic Warranty set out below, apply to all WASTEFLOW products.

B. BASIC WARRANTY

All GEOFLOW products are warranted to be free from defects in material and workmanship for a period of two (2) years from the date of delivery to the buyer, provided that the product is correctly installed and maintained by qualified persons according to the manufacturer's recommendations. Geoflow shall have the option to repair or replace all, or part of the defective product, or refund all or part of the purchase price within the warranty period. Technical support is provided when the drip package includes exclusively genuine Geoflow controllers, headworks, valves and filters installed in conjunction with Geoflow dripline. If Geoflow provides technical support for products at no charge to the buyer, it shall be given at buyer's sole risk without any express or implied warranty, and Geoflow shall not be responsible or liable for the results thereof.

WARRANTY TERMS & CONDITIONS

CLAIMS: All claims must be made in writing to GEOFLOW, Inc. within fifteen (15) days after the defect was discovered.

THESE WARRANTIES DO NOT COVER: Conditions caused by others including but not limited to: abuse, misuse, neglect, carelessness, damage by animals or chemicals, accident or disaster: unauthorized alterations, modifications or repairs; transportation or installation; water pressure in excess of or short of recommended amounts; improper or inadequate water treatment or filtration; or failure to follow storage, installation, operation and maintenance instructions.

LIMITATIONS: These warranties constitute the exclusive warranties made by GEOFLOW for its products and is expressly in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose. These are the only warranties made by GEOFLOW and GEOFLOW does not authorize any employee, dealer, agent, representative or other person to create for it any other obligation or liability.

LIMITATION OF REMEDIES: As indicated above, in no case shall GEOFLOW be liable for any special incidental or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theories. Some states do not allow limits on warranties or remedies for breach in certain transactions. In such states the limits of this paragraph and the preceding paragraph may not apply. This warranty gives you specific legal rights, and you may have other rights, which vary from state to state.

GEOFLOW reserves the right to make changes and improvements in their products without incurring any obligation to similarly alter products previously purchased.

CHOICE OF LAW: These warranties and any liability of GEOFLOW hereunder shall be governed by, construed and enforced according to the laws of the State of California. Any disputes arising out of or relating to these warranties, not resolved by mutual agreement, shall be submitted to final and binding arbitration before JAMS, or its successor.

10/19/2007

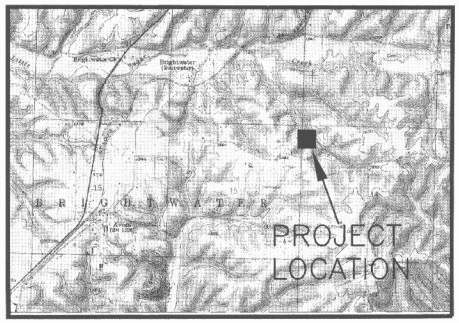
Geoflow, Inc

Geoflow, Inc.
506 Tamal Plaza
Corte Madera, CA 94925
Toll Free: 800-828-3388
Tel: 415-927-6000
Fax: 415-927-0120
www.geoflow.com

October 2007 v.2

WASTE WATER TREATMENT PLANS
FOR
DEER HAVEN SUBDIVISION
PROJECT No. 06-1001
AVOCA , BENTON COUNTY ARKANSAS

NORTH



VICINITY MAP
SCALE: NONE

TABLE OF CONTENTS

GOVERNING AGENCIES

BENTON CO. WATER AUTH., DIST. #1
P.O. BOX 127
111 E. ROSE ST.
AVOCA, AR 72711
CONTACT: WAYNE ALLEN
TEL.: (877) 647-8030
CELL.: (479) 936-0333

ADEQ
8001 NATIONAL DRIVE
P.O. BOX 8913
LITTLE ROCK, AR 72219-8913
CONTACT: HENRY INSUA
TEL.: (501) 682-0651

ARKANSAS DEPARTMENT OF HEALTH & HUMAN SERVICES
4815 WEST MARKHAM STREET
P.O. BOX 3867
LITTLE ROCK, ARKANSAS 72205-3867
CONTACT: ROY DAVIS
TEL.: (501) 661-2000
FAX.: (501) 661-2032

APPROVALS

ARKANSAS DEPARTMENT OF HEALTH AND HUMAN SERVICES:
DATE: _____ No. 56608-3

ADEQ:
DATE: _____

BENTON COUNTY WATER DISTRICT #1:
DATE: _____

OWNER

FRANKLIN MILLER
1000 CAPTAIN GOOD ST.
PEA RIDGE, AR 72751
(479) 451-9030

CERTIFICATE OF AUTHORIZATION
PRESLEY, BRANNAN, & ASSOCIATES, INC.
NO. 1315
ARKANSAS ENGINEER

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 9981
CHARLES L. PRESLEY

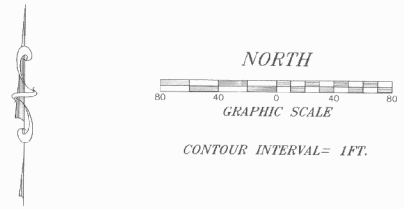
SAFETY NOTICE TO CONTRACTOR

In accordance with generally accepted construction practices, the contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not limited to normal working hours.

The duty of the engineer to conduct construction review of the contractor's performance is not intended to include review of the adequacy of the contractor's safety measures, in, or near the construction site.

CALL BEFORE YOU DIG
1-800-482-8998
ARKANSAS ONE CALL SYSTEM

PRESLEY, BRANNAN, & ASSOCIATES, Inc.
CONSULTING ENGINEERS
2143 WORTH LANE
SPRINGDALE, AR 72764
OFFICE: (479) 756-8720
FAX: (479) 756-8714



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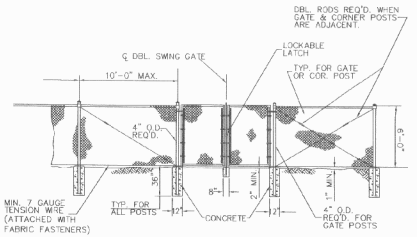
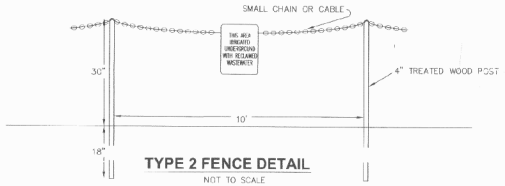


TYPE 1 FENCE DETAIL
NOT TO SCALE

All drip disposal lines shall be buried a min. of 10 feet from all property lines.
Biocore Wastewater treatment plant shall have a 100 feet min. distance from all lot lines.

Check valves and air/vac release valves shall be places according to the specifications.



TYPE 2 FENCE DETAIL
NOT TO SCALE

25 TEST PIT LOCATIONS

CHECK VALVE

(W) SHALLOW GROUNDWATER MONITORING WELL (SEE DETAIL, SHEET 4/4)

LYSIMETER LOCATION (SEE SPECIFICATIONS)

1-1 ZONE-CELL LABELS

CERTIFICATE OF AUTHORIZATION
PRESLEY, BRANNAN, & ASSOCIATES, INC.
NO. 1015
ARKANSAS ENGINEER

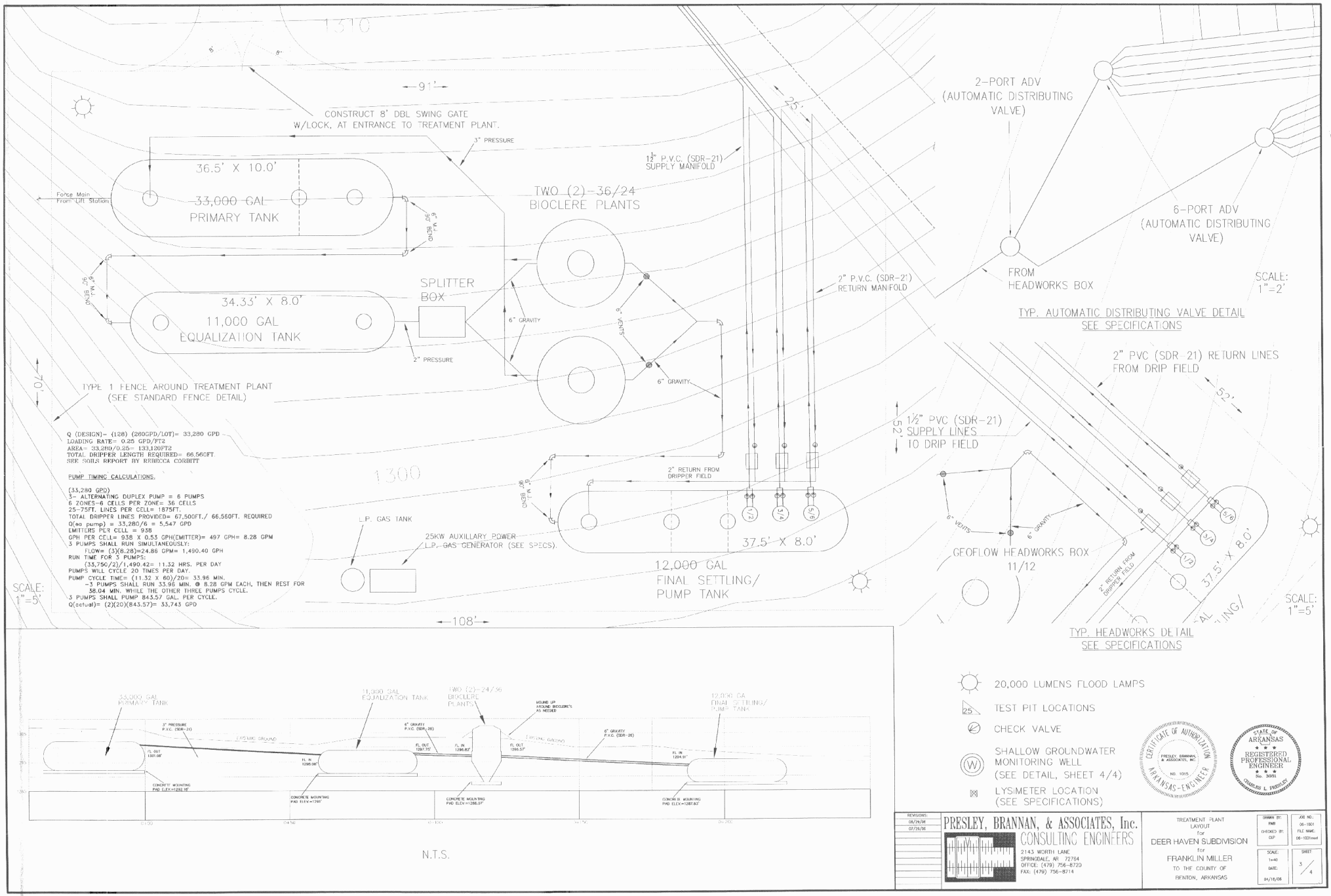
STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 3061
CHARLES T. PRESLEY

REVISIONS:
06/26/06
07/26/06

PRESLEY, BRANNAN, & ASSOCIATES, Inc.
CONSULTING ENGINEERS
2143 WORTH LANE
SPRINGDALE, AR 72764
OFFICE (479) 756-8720
FAX (479) 756-8714

DRIPPER FIELD LAYOUT
for
DEER HAVEN SUBDIVISION
for
FRANKLIN MILLER
TO THE COUNTY OF
BENTON, ARKANSAS

DRAWN BY: PWB
CHECKED BY: CLP
JOB NO.: 06-1001
FILE NAME: 06-1001.mxd
SCALE: 1=40
DATE: 04/19/06
SHEET 2/4



CERTIFICATE OF AUTHORIZATION — PRESLEY, BRANNAN, & ASSOCIATES, INC. — NO. 1015 — ARKANSAS-ENGINEER

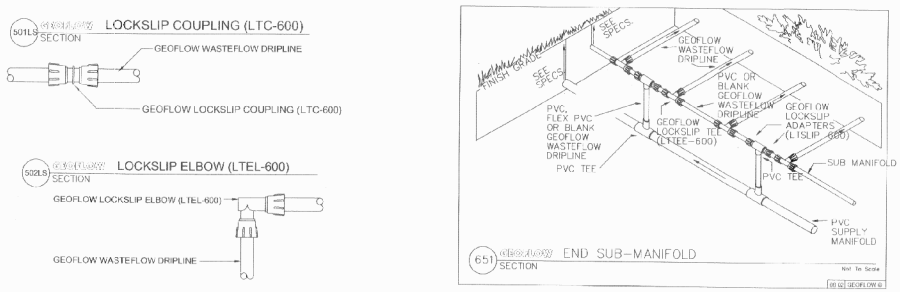
STATE OF ARKANSAS — REGISTERED PROFESSIONAL ENGINEER — No. 3651 — CHARLES L. PRESLEY

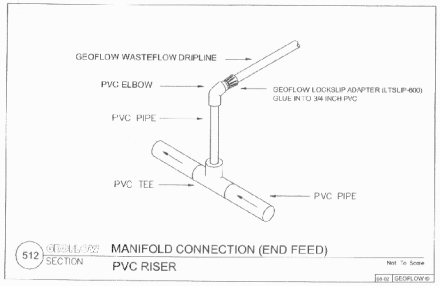
REVISIONS:
08/29/06
07/26/06

PRESLEY, BRANNAN, & ASSOCIATES, Inc.
CONSULTING ENGINEERS
2143 WORTH LANE
SPRINGDALE, AR 72764
OFFICE: (479) 756-8720
FAX: (479) 756-8714

TREATMENT PLANT LAYOUT
for
DEER HAVEN SUBDIVISION
for
FRANKLIN MILLER
TO THE COUNTY OF
BENTON, ARKANSAS

DRAWN BY:	JOB NO.:
PMB	06-1001
CHECKED BY:	FILE NAME:
CLP	06-1001mod
SCALE: 1=40	SHEET: 3/4
DATE: 04/18/06	





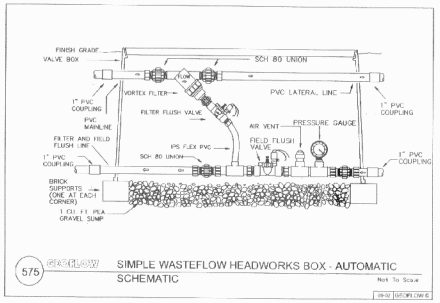
NOTES:
1) CONTRACTOR SHALL NOT DISTURB AREA WITHIN DRIPPER FIELD AREA OR ALTERNATE AREA (SEE DASHED LINES ON PLAN). NO STRIPPING, GRADING, STAGING, OR ACCESS ACROSS THE AREA WILL BE ALLOWED.

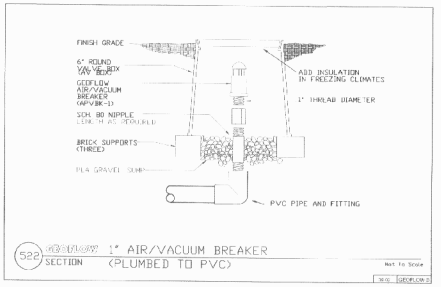
ALL MATERIALS AND CONSTRUCTION FOR WATER LINES SHALL COMPLY WITH STANDARD SPECIFICATIONS AND REQUIREMENTS OF THE MADISON COUNTY WATER FACILITIES BOARD AND ARKANSAS DEPT OF HEALTH AND HUMAN SERVICES. ALL TAPS SHALL BE MADE UNDER DIRECT SUPERVISION OF THE MADISON COUNTY WATER FACILITIES BOARD. PRIOR TO CONSTRUCTION A PRE-CONSTRUCTION CONFERENCE SHALL BE SCHEDULED WITH ENGINEER AND THE MADISON COUNTY WATER FACILITIES BOARD.

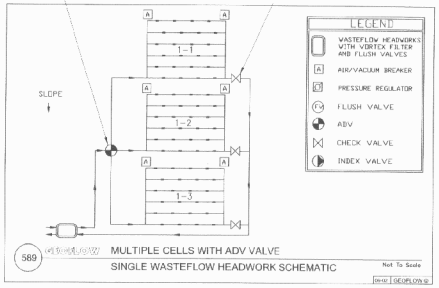
A MAINTENANCE BOND IN THE AMOUNT OF 50% OF CONSTRUCTION COST FOR WATER AND SEWER IMPROVEMENTS SHALL BE REQUIRED

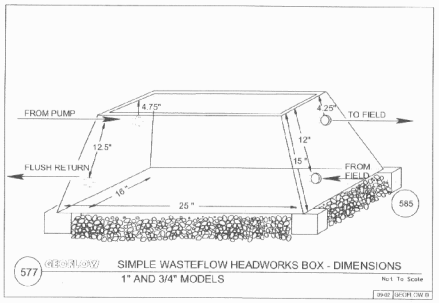
A MINIMUM HORIZONTAL DISTANCE OF TEN FEET SHALL BE MAINTAINED BETWEEN WATER LINES AND SEWER LINES OR OTHER SOURCES OF CONTAMINATION. WATER LINES AND SEWERS SHALL NOT BE LAID IN THE SAME TRENCH EXCEPT ON THE WRITTEN APPROVAL OF THE ARKANSAS DEPARTMENT OF HEALTH. WATER MAINS NECESSARILY IN CLOSE PROXIMITY TO SEWERS MUST BE PLACED SO THAT THE BOTTOM OF THE WATER LINE WILL BE AT LEAST 18 INCHES ABOVE THE TOP OF THE SEWER LINE AT ITS HIGHEST POINT. IF THIS DISTANCE MUST UNAVOIDABLY BE REDUCED, THE WATER LINE OR THE SEWER LINE MUST BE ENCASED IN WATERTIGHT PIPE WITH SEALED WATERTIGHT ENDS EXTENDING AT LEAST TEN FEET EITHER SIDE OF THE CROSSING. ANY JOINT IN THE ENCASEMENT PIPE IS TO BE MECHANICALLY RESTRAINED. THE ENCASEMENT PIPE MAY BE VENTED TO THE SURFACE IF CARRYING WATER OR SEWER UNDER PRESSURE. WHERE A WATER LINE MUST UNAVOIDABLY PASS BENEATH THE SEWER LINE, AT LEAST 18 INCHES OF SEPARATION MUST BE MAINTAINED BETWEEN THE OUTSIDE OF THE TWO PIPES IN ADDITION TO THE PRECEDING ENCASEMENT REQUIREMENT. EXCEPTIONS TO THIS MUST BE APPROVED IN WRITING BY THE ARKANSAS DEPARTMENT OF HEALTH.

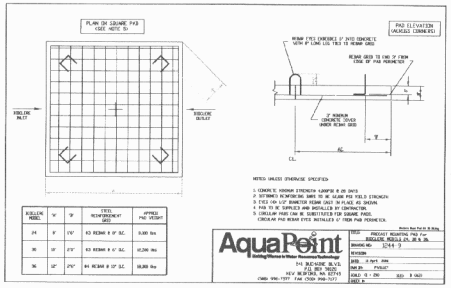
RELATIVE LOCATION OF WATER AND SEWER LINES
NTS

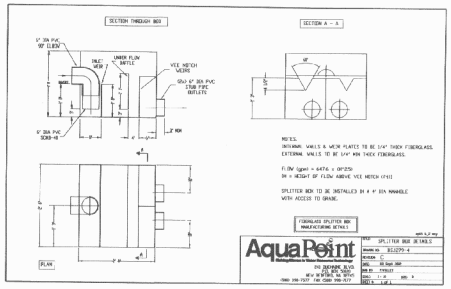


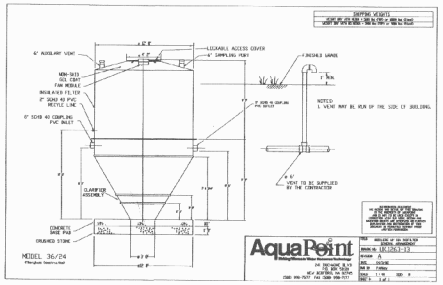


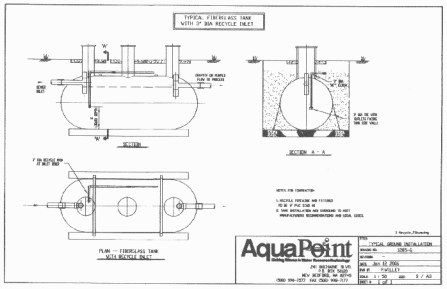


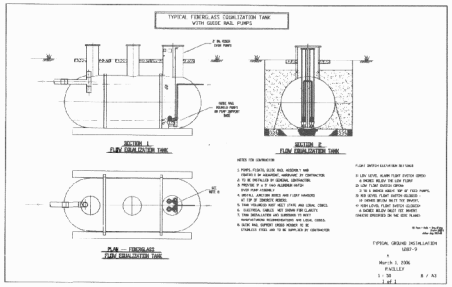


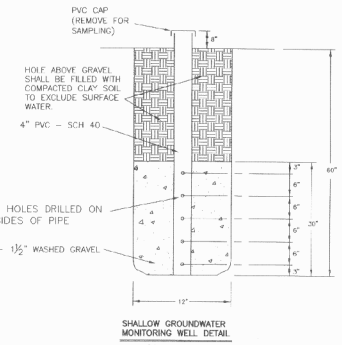












SHALLOW GROUNDWATER MONITORING WELL DETAIL
SCALE: NTS

ALL ENGINEERED FILL BELOW PROPOSED WATER & SEWER LINES SHALL BE COMPACTED TO MIN 100% S.P.D. DENSITY TESTS FOR EACH LIFT SHALL BE TAKEN W/MAX. SPACING OF 100 FT ALONG PIPELINE

CERTIFICATE OF AUTHORIZATION
PRESLEY, BRANNAN & ASSOCIATES, INC.
NO. 1015
ARKANSAS - ENGINEER

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
CHARLES L. PRESLEY
No. 3081

REVISIONS

PRESLEY, BRANNAN, & ASSOCIATES, Inc.
CONSULTING ENGINEERS
2143 WORTH LANE
SPRINGDALE, AR 72764
OFFICE: (479) 756-8720
FAX: (479) 756-8714

STANDARD SEWER DETAILS
for
DEER HAVEN SUBDIVISION
for
FRANKLIN MILLER
TO THE COUNTY OF
BENTON, ARKANSAS

DRAWN BY: KNW
CHECKED BY: CLP
JOB NO.: 06-1001
FILE NAME: 06-1001mod
SCALE: n.t.s.
DATE: 04/18/06
SHEET: 4 / 4

DETAILED PLANS:

DEER HAVEN

PART OF SECTION 15, T-20-N, R-29-W
BENTON COUNTY, ARKANSAS

JANUARY 2006
REVISED: FEBRUARY 2006
REVISED: MAY 2006

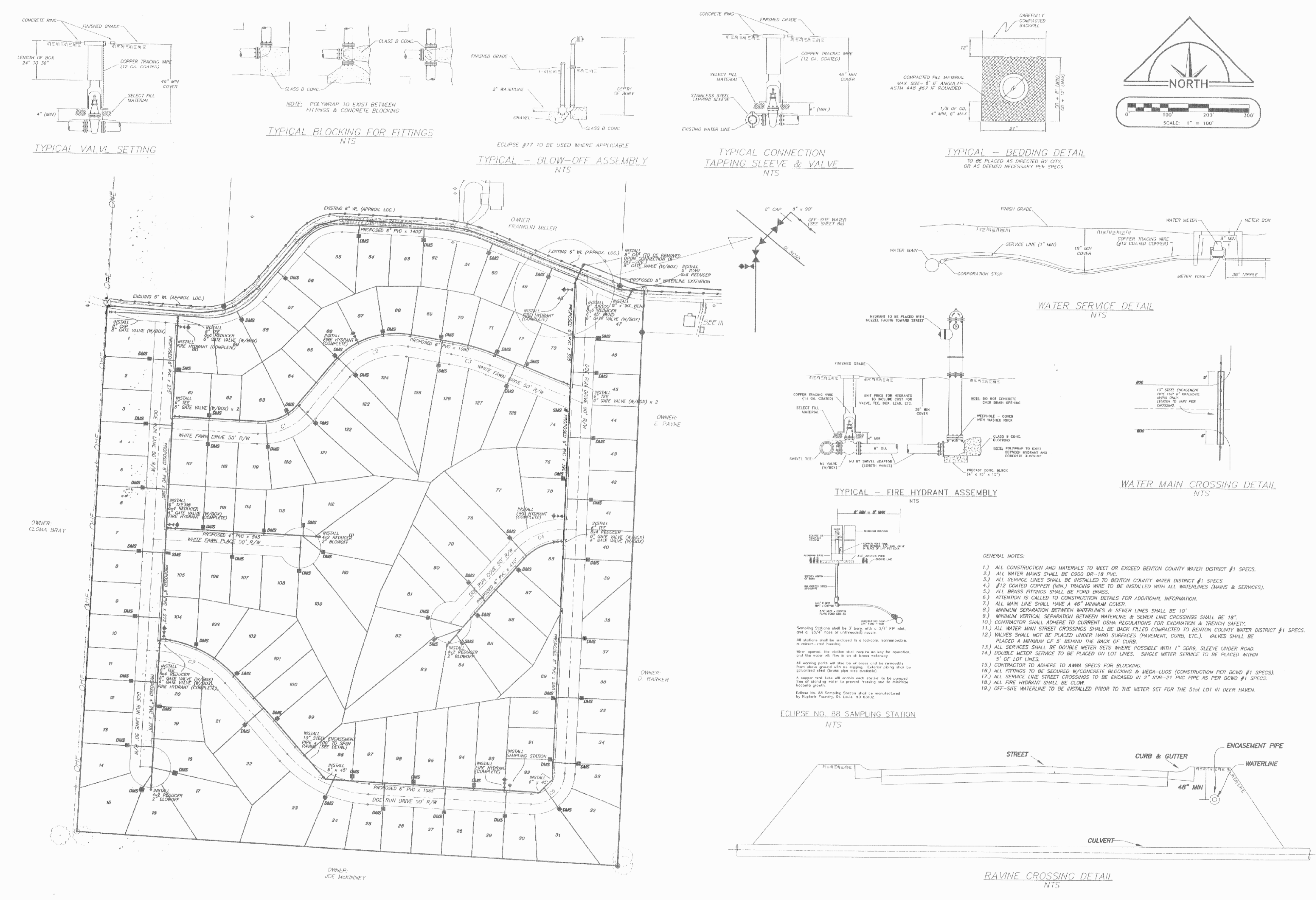
PREPARED FOR:

MP DEVELOPMENT, LLC
1000 CAPTAIN GOOD STREET
PEA RIDGE, ARKANSAS 72751

Prepared By:

LEMONS ENGINEERING CONSULTANTS, INC.
204 CHERRY STREET
CABOT, ARKANSAS 72023

INDEX OF SHEETS



GENERAL NOTES:

1.) ALL CONSTRUCTION AND MATERIALS TO MEET OR EXCEED BENTON COUNTY WATER DISTRICT #1 SPECS.
2.) ALL WATER MAINS SHALL BE C900 DR-18 PVC.
3.) ALL SERVICE LINES SHALL BE INSTALLED TO BENTON COUNTY WATER DISTRICT #1 SPECS.
4.) #12 COATED COPPER (MIN.) TRACING WIRE TO BE INSTALLED WITH ALL WATERLINES (MAINS & SERVICES).
5.) ALL BRASS FITTINGS SHALL BE FORD BRASS.
6.) ATTENTION IS CALLED TO CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.
7.) ALL MAIN LINE SHALL HAVE A 46" MINIMUM COVER.
8.) MINIMUM SEPARATION BETWEEN WATERLINES & SEWER LINES SHALL BE 10'
9.) MINIMUM VERTICAL SEPARATION BETWEEN WATERLINE & SEWER LINE CROSSINGS SHALL BE 18".
10.) CONTRACTOR SHALL ADHERE TO CURRENT OSHA REGULATIONS FOR EXCAVATION & TRENCH SAFETY.
11.) ALL WATER MAIN STREET CROSSINGS SHALL BE BACK FILLED COMPACTED TO BENTON COUNTY WATER DISTRICT #1 SPECS.
12.) VALVES SHALL NOT BE PLACED UNDER HARD SURFACES (PAVEMENT, CURB, ETC.). VALVES SHALL BE PLACED A MINIMUM OF 5' BEHIND THE BACK OF CURB.
13.) ALL SERVICES SHALL BE DOUBLE METER SETS WHERE POSSIBLE WITH 1" SDR9, SLEEVE UNDER ROAD.
14.) DOUBLE METER SERVICE TO BE PLACED ON LOT LINES. SINGLE METER SERVICE TO BE PLACED WITHIN 5' OF LOT LINES.
15.) CONTRACTOR TO ADHERE TO AWWA SPECS FOR BLOCKING.
16.) ALL FITTINGS TO BE SECURED W/CONCRETE BLOCKING & MEGA-LUGS (CONSTRUCTION PER BCWD #1 SPECS).
17.) ALL SERVICE LINE STREET CROSSINGS TO BE ENCASED IN 2" SDR-21 PVC PIPE AS PER BCWD #1 SPECS.
18.) ALL FIRE HYDRANT SHALL BE CLOW.
19.) OFF-SITE WATERLINE TO BE INSTALLED PRIOR TO THE METER SET FOR THE 51st LOT IN DEER HAVEN.

No.	Revisions	Date	By
1	Revised street names per 911 administration & revision per Benton Co. Water Department.	2/13/06	lbh
2	Added details per BCWD #1.	2/17/06	lbh
3	Revised general note #2	APR 2006	Stanley
4	Revised details & off-site bend just off site.	5/30/06	lbn

☐ CONCEPT ☐ DRAFT ☐ PRELIMINARY ☐ BID/CONSTR ☐ FINAL ☐ AS-BUILT ☐

Project No.: 05-046 | Date: January 2006 | File: 'deerWtr.dwg' | Scale: 1" = 100' | Sheet: 8 of 17 | Drawn By: L. Hazeslip

Prepared For: MP Development, 1000 Captain Good Street, Pea Ridge, AR 72751

WATER LAYOUT
DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

LEMONS ENGINEERING CONSULTANTS, INC.
204 CHERRY STREET, CABOT, AR 72023, PH: (501) 843-5081 | 100 S. SPRING STREET, SEARCY, AR 72143, PH: (501) 279-1285
CIVIL ENGINEERING & PLANNING
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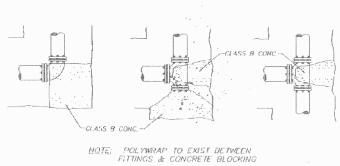
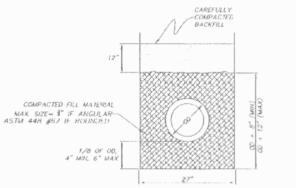
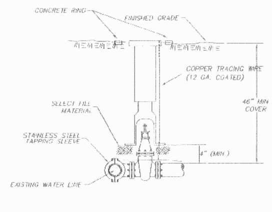


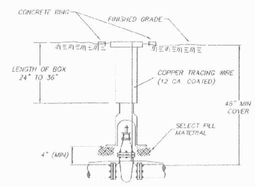
TYPICAL BLOCKING FOR FITTINGS
NTS



TYPICAL – BEDDING DETAIL
TO BE PLACED AS DIRECTED BY COUNTY, OR AS DEEMED NECESSARY PER SPECS



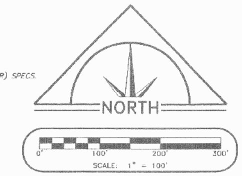
TYPICAL CONNECTION
TAPPING SLEEVE & VALVE
NTS

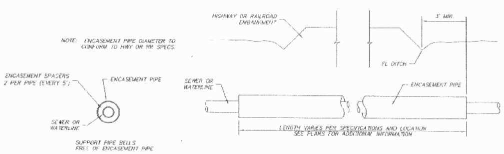


TYPICAL VALVE SETTING
NTS

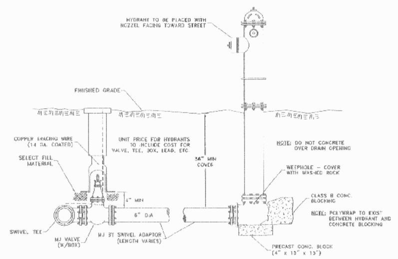
GENERAL NOTES:

1.) ALL CONSTRUCTION AND MATERIALS TO MEET OR EXCEED BENTON COUNTY WATER DISTRICT #1 (OPERATOR) SPECS. CONTRACTOR TO VERIFY MATERIALS W/OPERATOR PRIOR TO COMMENCEMENT OF CONSTRUCTION.
2.) ALL WATER MAINS SHALL BE C-900 PVC.
3.) ALL SERVICE LINES SHALL BE AS PER OPERATOR SPECS.
4.) #12 COATED COPPER (MIN) TRACING WIRE TO BE INSTALLED WITH ALL WATERLINES (MAINS & SERVICES).
5.) ALL BRASS FITTINGS SHALL BE FORD BRASS.
6.) ATTENTION IS CALLED TO CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.
7.) MINIMUM SEPARATION BETWEEN WATERLINES & SEWERLINES SHALL BE 10'
8.) CONTRACTOR SHALL ADHERE TO CURRENT OSHA REGULATIONS FOR EXCAVATION & TRENCH SAFETY.
9.) ALL WATER MAIN STREET CROSSINGS SHALL BE BACK FILLED COMPACTED TO OPERATOR SPECS.
10.) VALVES SHALL NOT BE PLACED UNDER HARD SURFACES (PAVEMENT, CURB, ETC.). VALVES SHALL BE PLACED A MINIMUM OF 5' BEHIND THE BACK OF CURB.
11.) DOUBLE METER SERVICE TO BE PLACED ON LOT LINES. SINGLE METER SERVICE TO BE PLACED WITHIN 5' OF LOT LINES.
12.) CONTRACTOR TO ADHERE TO AWWA SPECS FOR BLOCKING.
13.) OFF-SITE WATERLINE TO BE INSTALLED PRIOR TO THE METER SET FOR 51ST LOT IN DEER HAVEN.

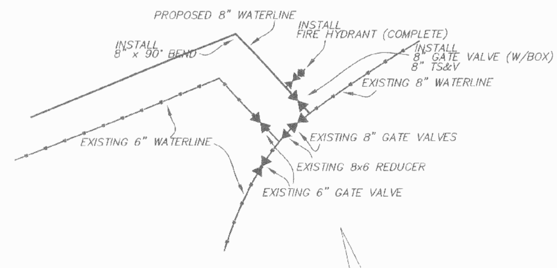


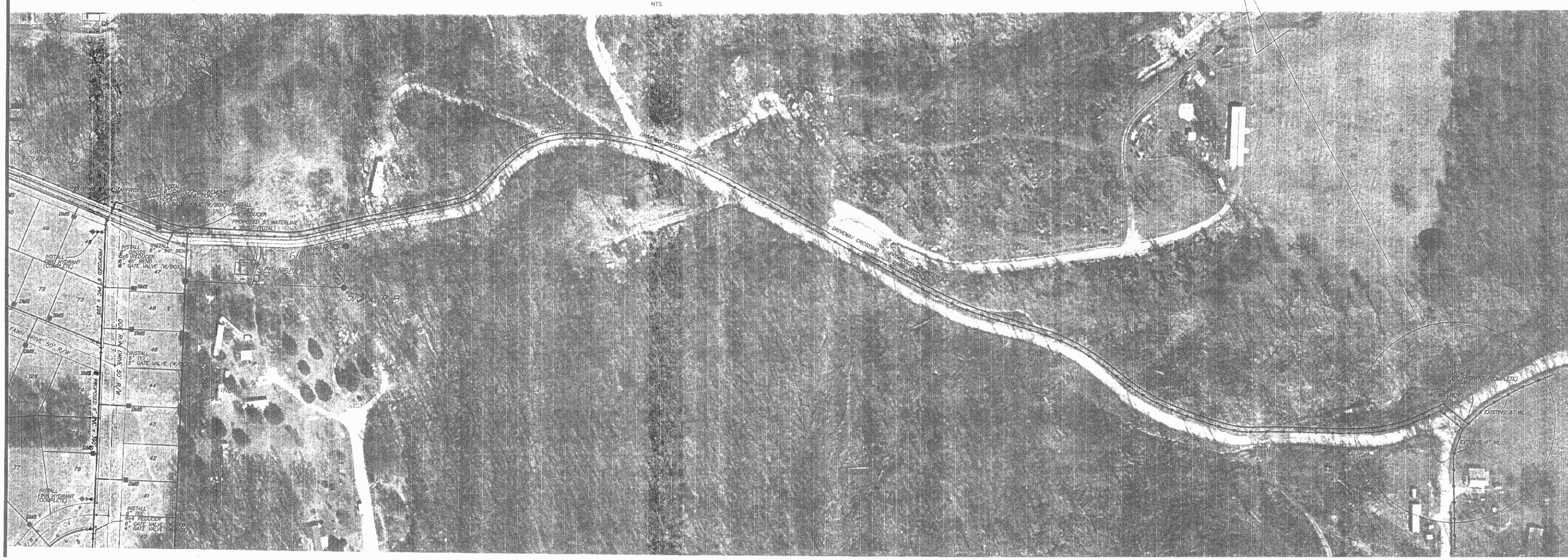


PIPE ENCASEMENT – HIGHWAY & RAILROAD CROSSING
NTS



TYPICAL – FIRE HYDRANT ASSEMBLY
NTS





No.	Revisions	Date	By
1	Revised off-site bend just off site.	5/30/06	tph

☐ CONCEPT
☐ DRAFT
☐ PRELIMINARY
☐ BID/CONSTR.
☐ FINAL
☐ AS-BUILT
☐

Prepared For:
MP Development
1000 Captain Good Street
Pea Ridge, AR 72751

OFF-SITE WATERLINE EXTENTION
DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

LEMONS ENGINEERING CONSULTANTS, INC.
204 CHERRY STREET, CABOT, AR 72023, PH: (501) 843-5081
100 S. SPRING STREET, SEARCY, AR 72143, PH: (501) 279-1285
CIVIL ENGINEERING & PLANNING
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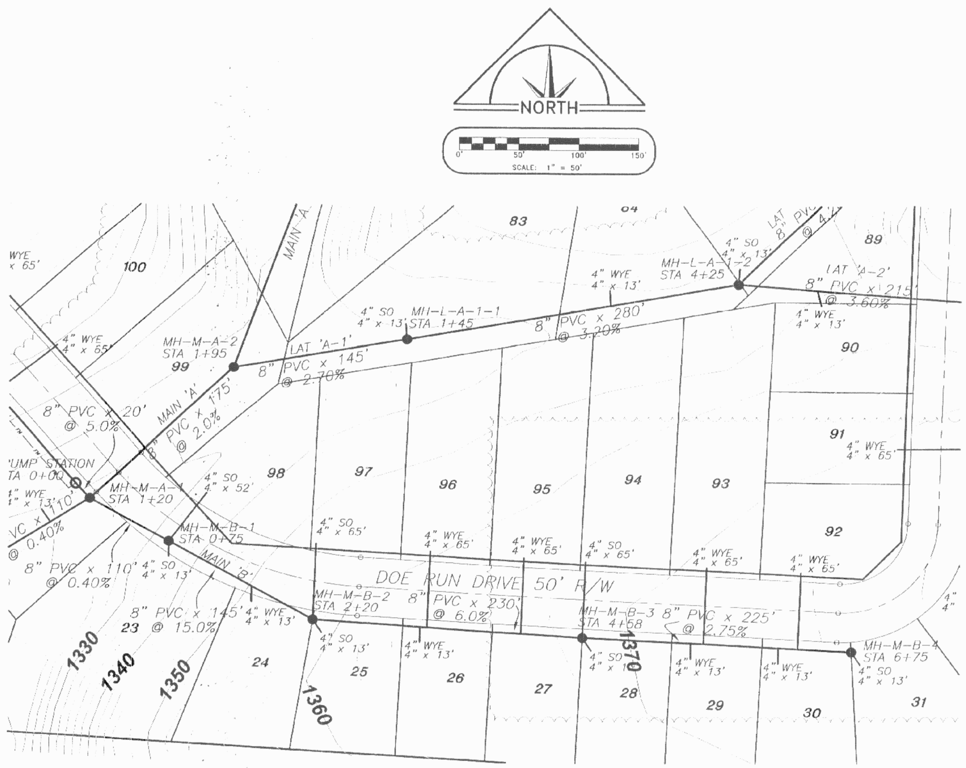
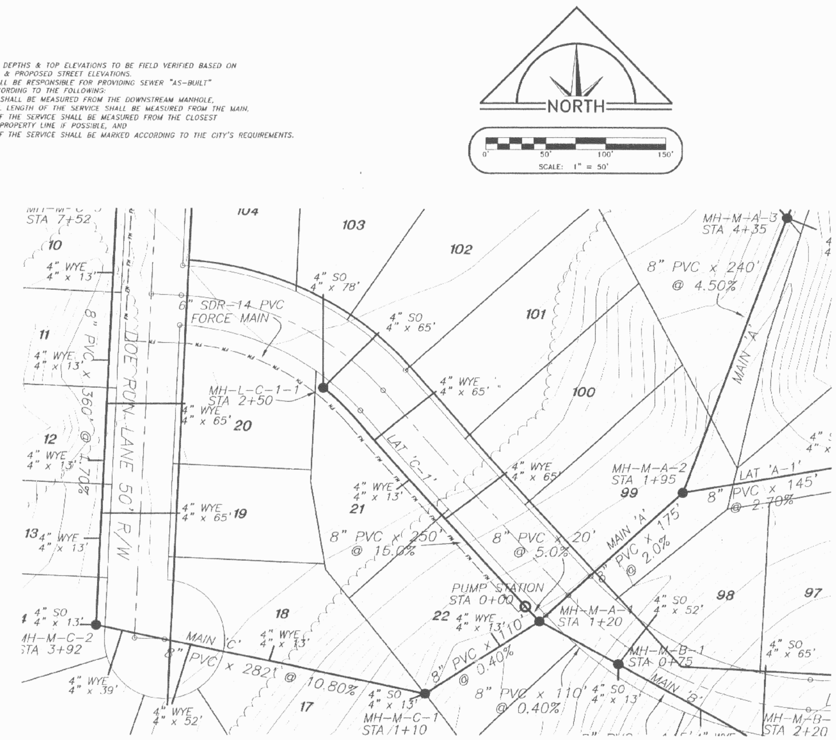
...nuary 2006
= 100'
Hazeslip

GENERAL NOTES:

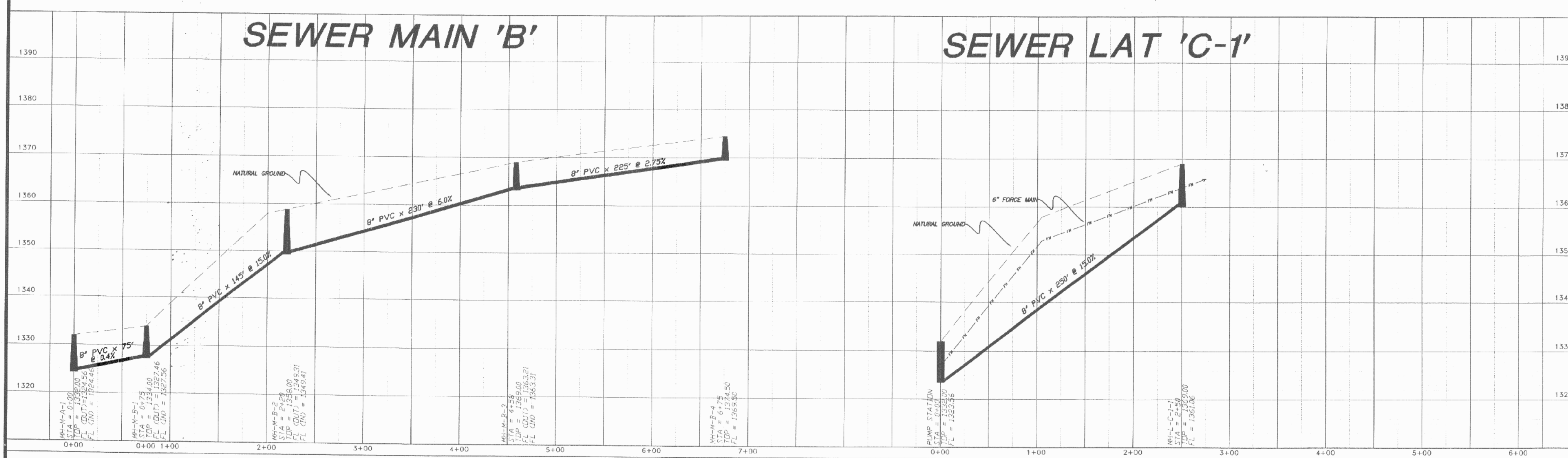
1.) ACTUAL MANHOLE DEPTHS & TOP ELEVATIONS TO BE FIELD VERIFIED BASED ON FINISHED GRADES & PROPOSED STREET ELEVATIONS.
2.) CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING SEWER "AS-BUILT" INFORMATION ACCORDING TO THE FOLLOWING:
   A) EACH WYE SHALL BE MEASURED FROM THE DOWNSTREAM MANHOLE,
   B) THE ACTUAL LENGTH OF THE SERVICE SHALL BE MEASURED FROM THE MAIN,
   C) THE END OF THE SERVICE SHALL BE MEASURED FROM THE CLOSEST ADJACENT PROPERTY LINE IF POSSIBLE, AND
   D) THE END OF THE SERVICE SHALL BE MARKED ACCORDING TO THE CITY'S REQUIREMENTS.





SEWER MAIN 'B'

SEWER LAT 'C-1'



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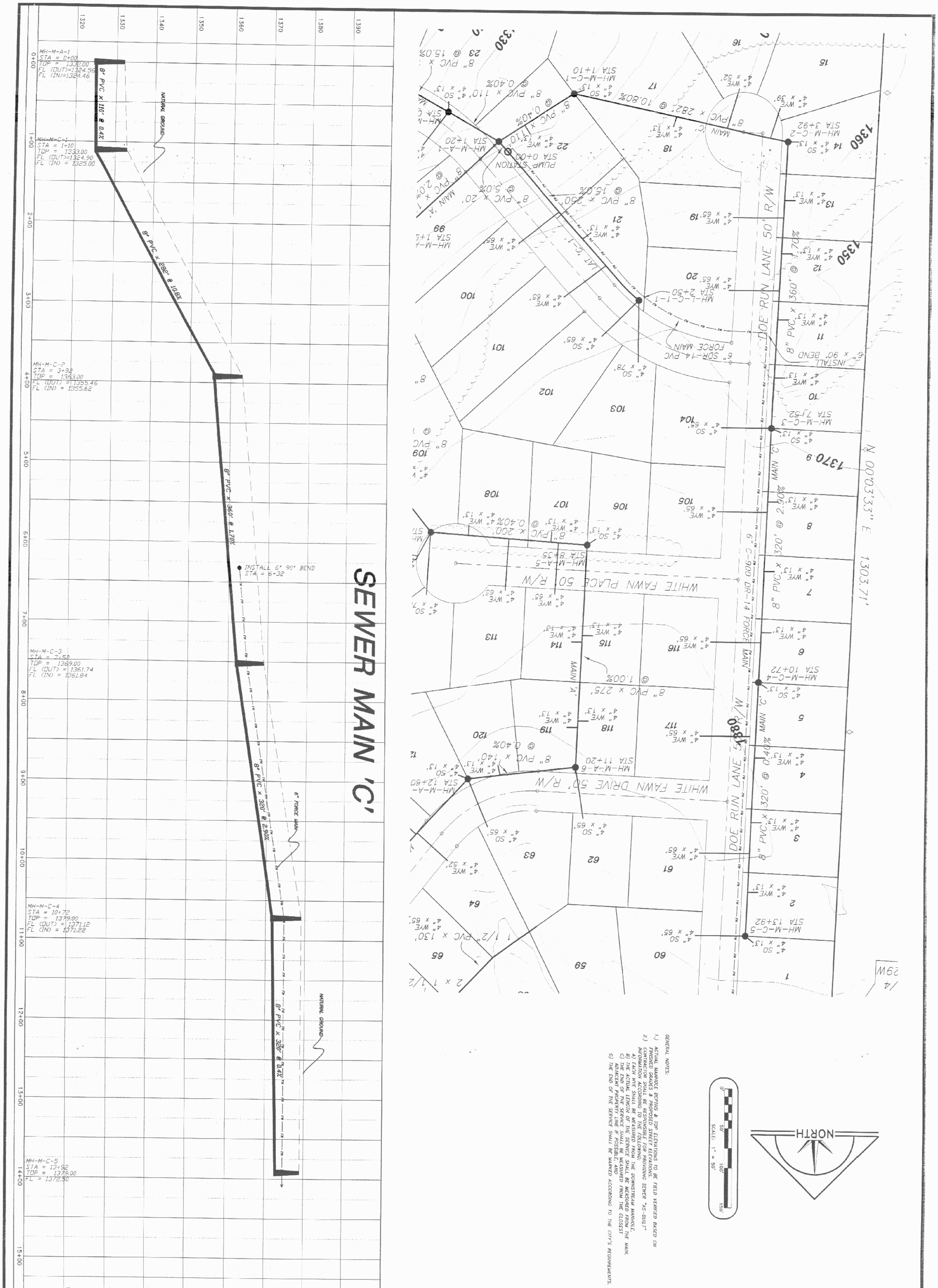
SEWER PLAN/PROFILE – MAIN 'B' & LAT 'C-1' – DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

Prepared For:
MP Development
1000 Captain Good Street
Pea Ridge, AR 72751

☐ CONCEPT ☐ DRAFT ☐ PRELIMINARY ☐ BID/CONSTR. ☐ FINAL ☐ AS-BUILT ☐

No.	Revisions	Date	By
1	Added force main to profile view.	5/30/06	tbh

Project No.: 05-046
Date: January 2006
File: 'deerSwr.dwg'
Scale: 1" = 50'
Drawn By: L. Hazeslip
Sheet: 14 of 17



Project No.	Date:	No.	Revisions	Date	By	
05-046	January 2006	1	Added force main to profile view.	5/30/06	lbh	☐ CONCEPT ☐ DRAFT ☐ PRELIMINARY ☐ BID/CONSTR. ☐ FINAL ☐ AS-BUILT ☐
File: deerSwr.dwg	Scale: 1" = 50'					
Sheet: 15 of 17	Drawn By: L. Hazeslip					

Prepared For:
MP Development
1000 Captain Good Street
Pea Ridge, AR 72751

SEWER PLAN/PROFILE – MAIN 'C'
DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

LEMONS ENGINEERING CONSULTANTS, INC.
204 CHERRY STREET, CABOT, AR 72023, PH: (501) 843-5081
100 S. SPRING STREET, SEARCY, AR 72143, PH: (501) 279-1285
CIVIL ENGINEERING & PLANNING
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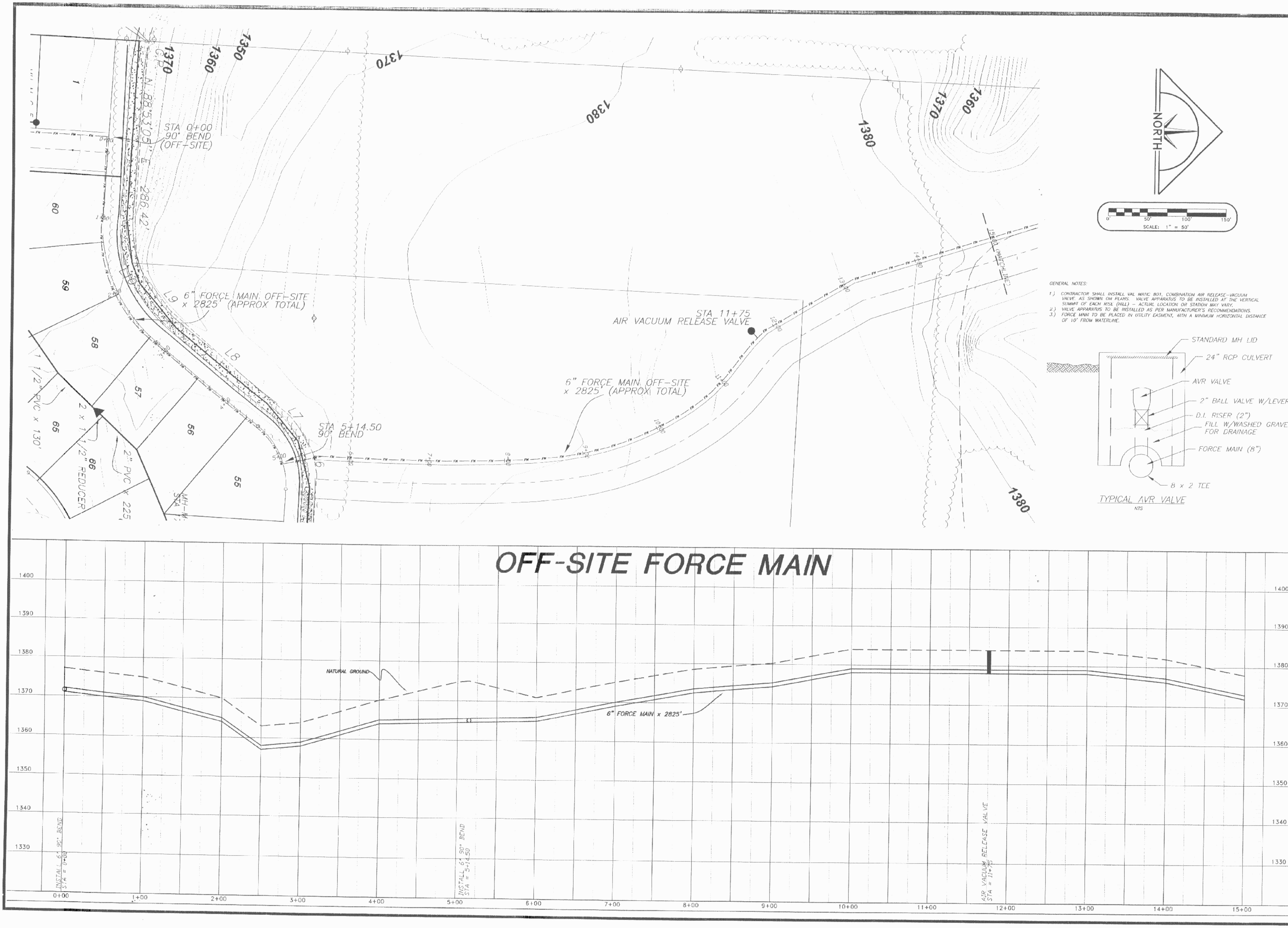

GENERAL NOTES:

1.) CONTRACTOR SHALL INSTALL VAL MATIC 801, COMBINATION AIR RELEASE–VACUUM VALVE. AS SHOWN ON PLANS. VALVE APPARATUS TO BE INSTALLED AT THE VERTICAL SUMMIT OF EACH RISE (HILL) – ACTUAL LOCATION OR STATION MAY VARY.
2.) VALVE APPARATUS TO BE INSTALLED AS PER MANUFACTURER'S RECOMMENDATIONS.
3.) FORCE MAIN TO BE PLACED IN UTILITY EASMENT, WITH A MINIMUM HORIZONTAL DISTANCE OF 10' FROM WATERLINE.

OFF-SITE SEWER LAYOUT
DEER HAVEN

PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

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Prepared For:
MP Development
1000 Captain Good Street
Pea Ridge, AR 72751

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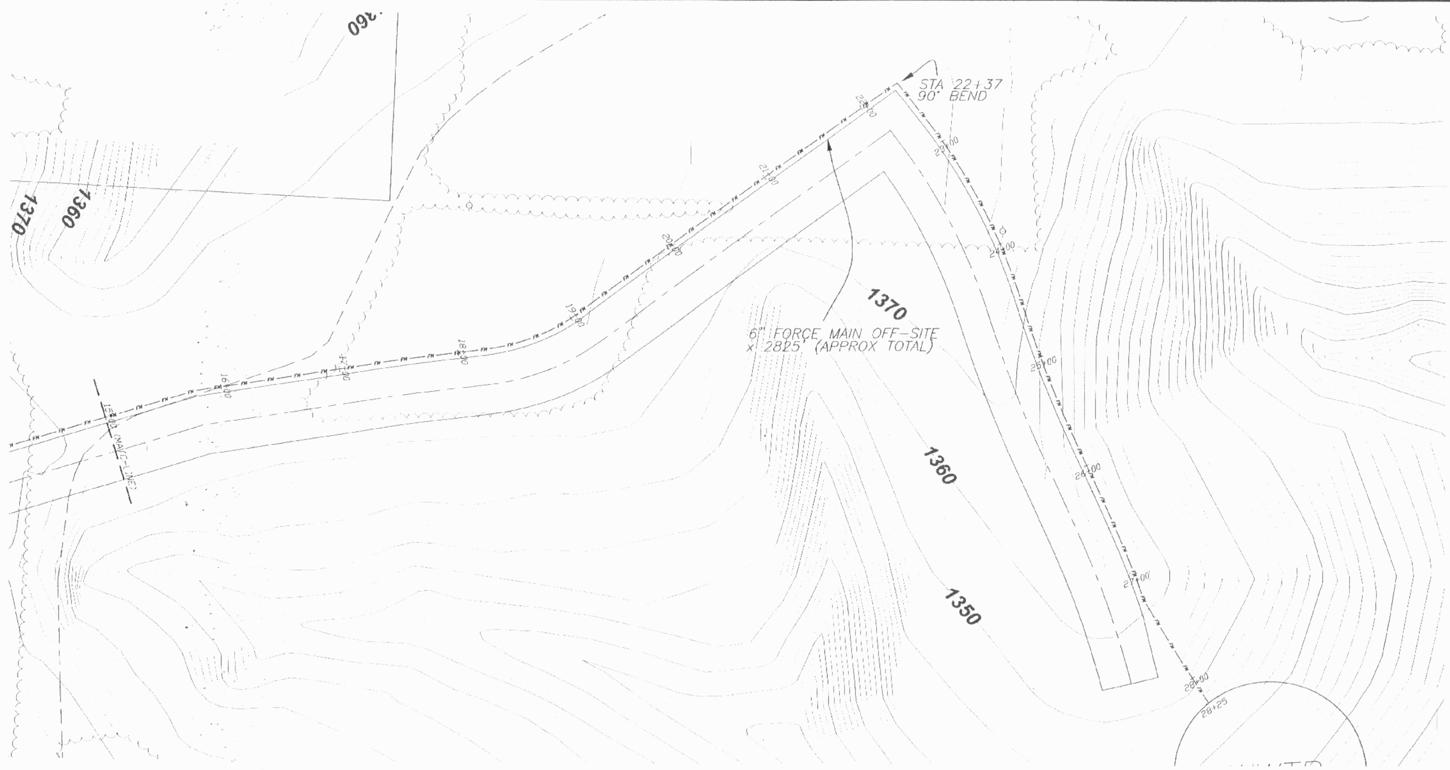
☐ BID/CONSTR.
☐ FINAL
☐ AS-BUILT
☐

No.	Revisions	Date	By

Project No.: 05-046
Date: May 2006
File: 'deerSwr-offsite.dwg
Scale: 1' = 200'
Drawn By: L. Hazeslip
Sheet: 15a of 17



NORTH

SCALE: 1" = 50'

GENERAL NOTES:

1.) CONTRACTOR SHALL INSTALL VAL MATIC 801, COMBINATION AIR RELEASE-VACUUM VALVE, AS SHOWN ON PLANS. VALVE APPARATUS TO BE INSTALLED AT THE VERTICAL SUMMIT OF EACH RISE (HILL) - ACTUAL LOCATION OR STATION MAY VARY.
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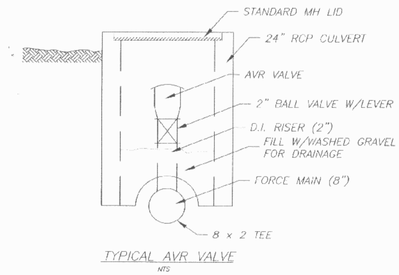
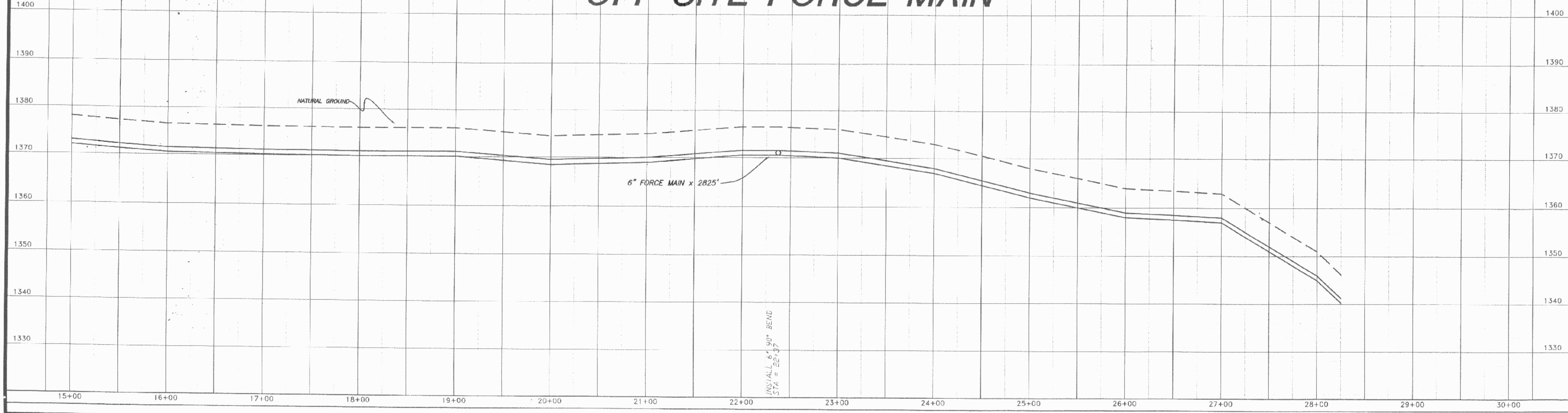


TYPICAL AVR VALVE
NTS

OFF-SITE FORCE MAIN



LEMONS ENGINEERING CONSULTANTS, INC.
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OFF-SITE SEWER LAYOUT
DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

Prepared For:
MP Development
1000 Captain Good Street
Pea Ridge, AR 72751

☐ CONCEPT
☐ DRAFT
☐ PRELIMINARY
☐ BID/CONSTR.
☐ FINAL
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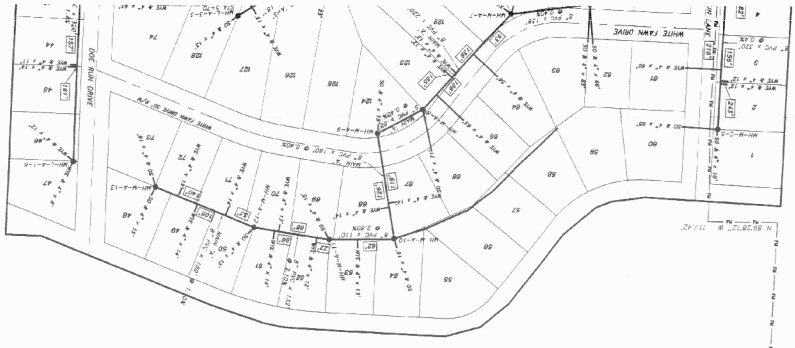
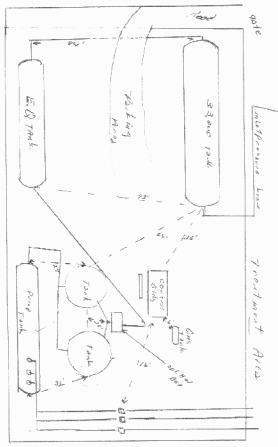
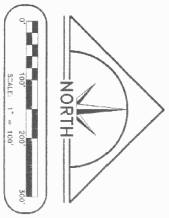
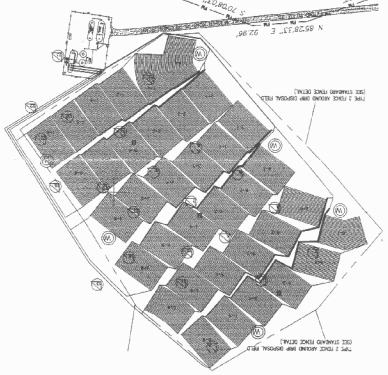
No.	Revisions	Date	By

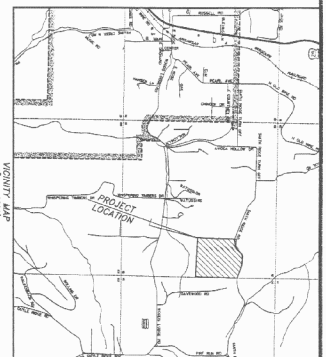
Project No.: 05-046	Date: May 2006
File: 'deerSwr-offsite.dwg	Scale: 1' = 200'
Sheet: 15b of 17	Drawn By: L. Hazeslip











Project No.: 05-046	Date: August 2007	No.	Revisions	Date	By	☐ CONCEPT ☐ DRAFT ☐ PRELIMINARY ☐ BID/CONSTR. ☐ FINAL ☐ AS-BUILT ☐ _____	Prepared For: MP Development 1000 Captain Good Street Pea Ridge, AR 72751
File: DeerHavenSwrAB.dwg	Scale: 1" = 100'						
Sheet: 1 of 1	Drawn By: B. Deck						

SEWER – 'AS BUILTS' – OFF-SITE
DEER HAVEN

PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

LEMONS ENGINEERING CONSULTANTS, INC.
204 CHERRY STREET, CABOT, AR 72023, PH: (501) 843-5081
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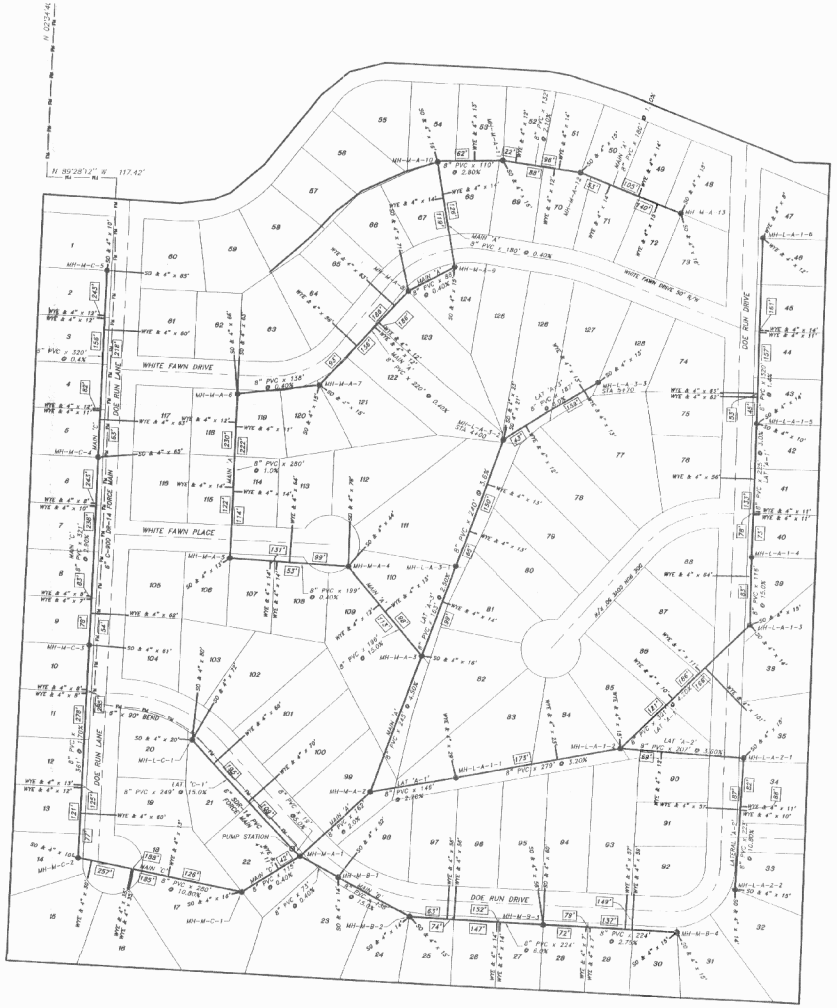

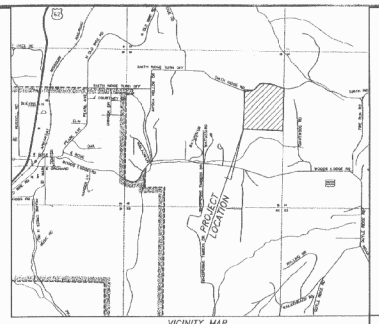

VICINITY MAP
1" = 2000'

MANHOLE DATA

PUMP STATION: TOP = 1345.88
BOTTOM = 1316.38

MH-M-A-1: TOP = 1343.98
FL(OUT) = 1324.67
FL(IN M-A) = 1324.75
FL(IN M-B) = 1324.81
FL(IN M-C) = 1324.81

MH-M-A-2: TOP = 1336.18
FL(OUT) = 1327.89
FL(IN M-A) = 1327.99
FL(IN L-A-1) = 1328.03

MH-M-A-3: TOP =1347.00
FL(OUT) = 1338.99
FL(IN M-A) = 1339.27
FL(IN L-A-3) = 1339.17

MH-M-A-4: TOP = 1378.27
FL(OUT) = 1368.12
FL(IN) = 1368.23

MH-M-A-5: TOP = 1379.45
FL(OUT) = 1369.94
FL(IN) = 1370.02

MH-M-A-6: TOP = 1380.38
FL(OUT) = 1372.71
FL(IN) = 1372.81

MH-M-A-7: TOP = 1379.89
FL(OUT) = 1373.50
FL(IN) = 1373.57

MH-M-A-8: TOP = 1380.16
FL(OUT) = 1374.41
FL(IN) = 1374.53

MH-M-A-9: TOP = 1382.47
FL(OUT) = 1374.88
FL(IN) = 1374.98

MH-M-A-10: TOP = 1381.61
FL(OUT) = 1375.84
FL(IN) = 1375.89

MH-M-A-11: TOP = 1384.66
FL(OUT) = 1378.91
FL(IN) = 1379.00

MH-M-A-12: TOP = 1387.57
FL(OUT) = 1381.82
FL(IN) = 1381.97

MH-M-A-13: TOP = 1389.65
FL(OUT) = 1384.09

MH-M-B-1: TOP = 1345.50
FL(OUT) = 1325.06
FL(IN) = 1325.23

MH-M-B-2: TOP = 1358.02
FL(OUT) = 1348.04
FL(IN) = 1348.11

MH-M-B-3: TOP = 1369.88
FL(OUT) = 1362.97
FL(IN) = 1363.05

MH-M-B-4: TOP = 1374.99
FL = 1369.56

MH-M-C-1: TOP = 1333.93
FL(OUT) = 1325.29
FL(IN) = 1325.45

MH-M-C-2: TOP = 1363.45
FL(OUT) = 1354.95
FL(IN) = 1355.10

MH-M-C-3: TOP = 1370.52
FL(OUT) = 1361.41
FL(IN) = 1361.48

MH-M-C-4: TOP = 1378.78
FL(OUT) = 1370.96
FL(IN) = 1371.03

MH-M-C-5: TOP = 1379.37
FL = 1372.52

MH-L-A-1-1: TOP = 1338.79
FL(OUT) = 1361.9
FL(IN) = 1331.91

MH-L-A-1-2: TOP = 1348.03
FL(OUT) = 1341.02
FL(IN) = 1341.08

MH-L-A-1-3: TOP = 1362.27
FL(OUT) = 1353.74
FL(IN) = 1353.99

MH-L-A-1-4: TOP = 1380.17
FL(OUT) = 1371.89
FL(IN) = 1371.99

MH-L-A-1-5: TOP = 1387.09
FL(OUT) = 1378.82
FL(IN) = 1378.94

MH-L-A-1-6: TOP = 1389.65
FL = 1383.52

MH-L-A-2-1: TOP = 1358.42
FL(OUT) = 1348.58
FL(IN) = 1348.89

MH-L-A-2-2: TOP = 1377.89
FL = 1372.86

MH-L-A-3-1: TOP = 1352.54
FL(OUT) = 1342.99
FL(IN) = 1343.18

MH-L-A-3-2: TOP = 1364.03
FL(OUT) = 1351.33
FL(IN) = 1351.54

MH-L-A-3-3: TOP = 1375.97
FL = 1366.82

MH-L-C-1-1: TOP = 1368.90
FL = 1360.83

100' – INDICATES DISTANCE OF SERVICE LINE FROM DOWN STREAM MANHOLE.

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CIVIL ENGINEERING & PLANNING
WATER • SEWER • TRANSPORTATION • SUBDIVISIONS
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CABOT, ARKANSAS 72023 | Ph: (501) 279-1285
Ph: (501) 843-5081

SEWER - 'AS BUILTS'
DEER HAVEN
PART OF THE E 1/2 OF THE NW 1/4 OF SECTION 15, T-20-N, R-29-W, BENTON COUNTY, ARKANSAS

Prepared for:
MP Development
1000 Captain Good Street
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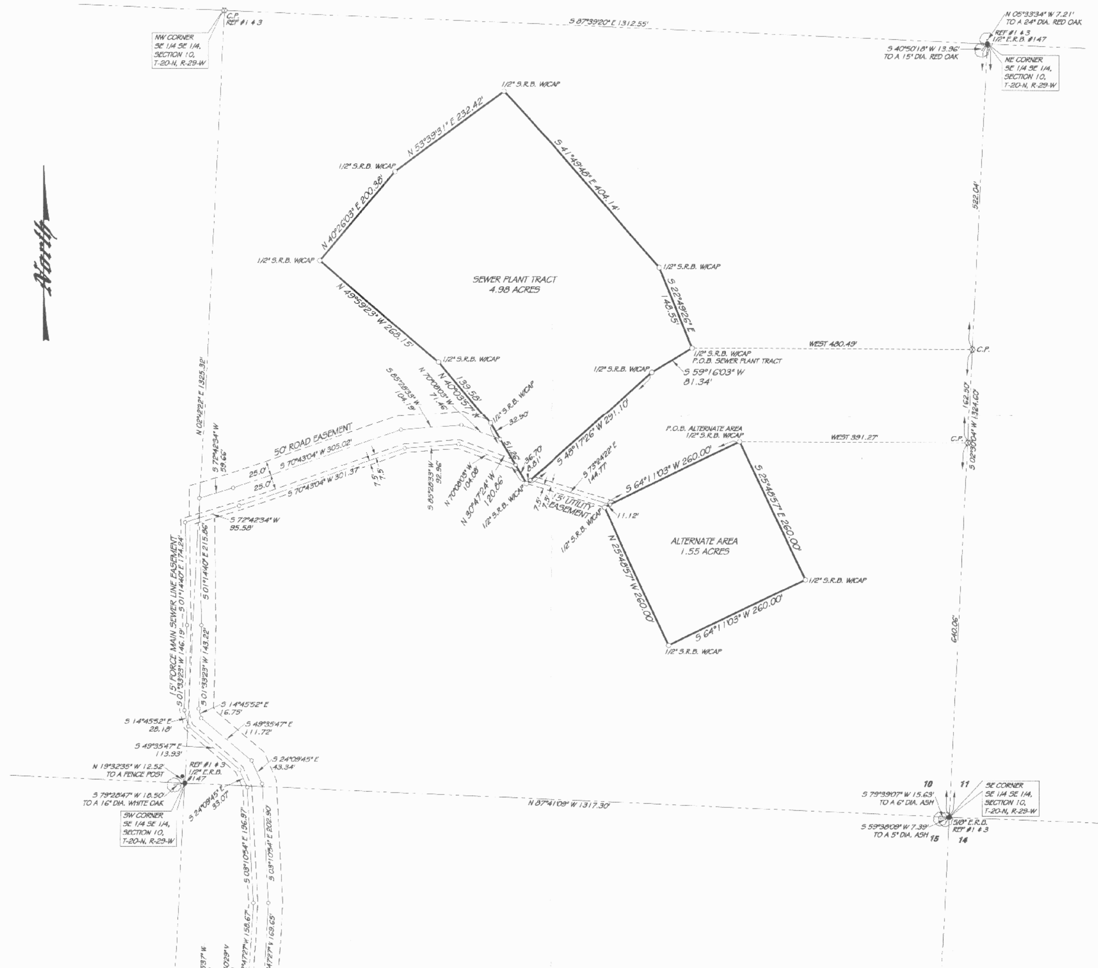
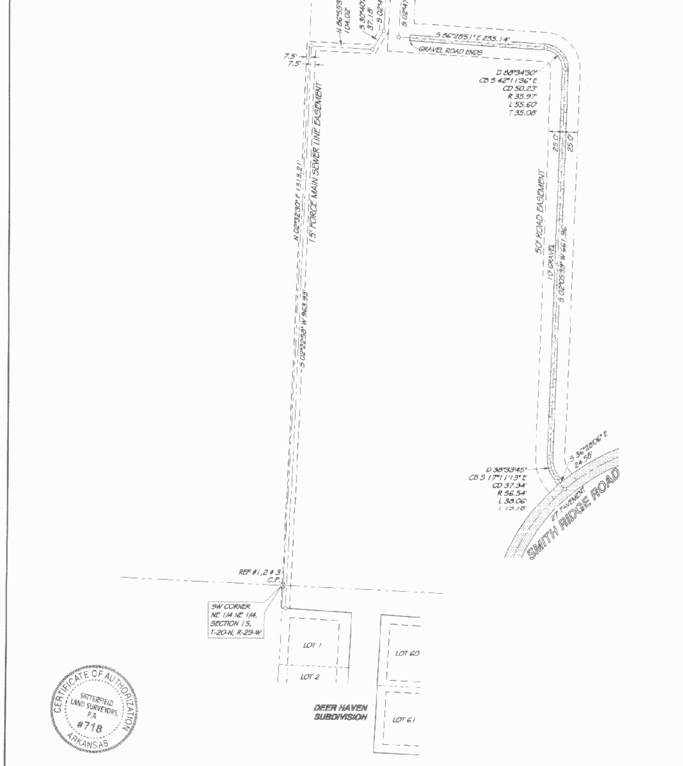
☐ CONCEPT
☐ DRAFT
☐ PRELIMINARY
☐ BID/CONSTR.
☐ AS-BUILT

No.	Revisions	Date	By

Project No.: 05-046
File: DeerHavenSewrAB.dwg
Date: August 2007
Scale: 1" = 100'
Drawn By: B. Davis
Sheet: 1 of 1





PROPERTY DESCRIPTION
Sewer Plant Tract
Part of the Southeast Quarter of the Southeast Quarter of Section 10, Township 20 North, Range 29 West, Benton County, Arkansas being more particularly described as follows:

Commencing at an existing rebar marking the Northeast Corner of the Southeast Quarter of the Southeast Quarter. Thence along the East line of said Forty, South 02 degrees 30 minutes 04 seconds West, 522.04 feet. Thence leaving said East line, West, 480.49 feet to a set rebar with cap and the Point of Beginning. Thence South 59 degrees 16 minutes 03 seconds West, 81.34 feet to a set rebar with cap. Thence South 48 degrees 17 minutes 26 seconds West, 291.10 feet to a set rebar with cap. Thence North 30 degrees 47 minutes 24 seconds West, 120.86 feet to a set rebar with cap. Thence North 40 degrees 03 minutes 57 seconds West, 139.58 feet to a set rebar with cap. Thence North 49 degrees 59 minutes 23 seconds West, 268.15 feet to a set rebar with cap. Thence North 40 degrees 26 minutes 03 seconds East, 200.38 feet to a set rebar with cap. Thence North 53 degrees 39 minutes 31 seconds East, 232.42 feet to a set rebar with cap. Thence South 41 degrees 49 minutes 48 seconds East, 404.14 feet to a set rebar with cap. Thence South 22 degrees 49 minutes 26 seconds East, 148.55 feet to the Point of Beginning, containing 4.98 acres and subject to Road Rights of Way and any Easements of Record.

Also a 15.00 foot Force Main Sewer Line Easement being 7.50 feet each side of a centerline and being more particularly described as follows:

Commencing at a set rebar with cap marking the Southwest Corner of the above described tract. Thence along the West line of said tract, North 30 degrees 47 minutes 24 seconds West, 36.70 feet to the Point of Beginning. Thence North 70 degrees 08 minutes 03 seconds West, 104.08 feet. Thence South 85 degrees 28 minutes 33 seconds West, 92.96 feet. Thence South 70 degrees 43 minutes 04 seconds West, 301.37 feet. Thence South 72 degrees 42 minutes 34 seconds West, 95.58 feet. Thence South 01 degrees 14 minutes 40 seconds East, 174.24 feet. Thence South 01 degrees 33 minutes 23 seconds West, 146.19 feet. Thence South 14 degrees 45 minutes 52 seconds East, 28.18 feet. Thence South 49 degrees 35 minutes 47 seconds East, 113.93 feet. Thence South 24 degrees 09 minutes 45 seconds East, 33.07 feet. Thence South 03 degrees 10 minutes 54 seconds East, 196.97 feet. Thence South 02 degrees 47 minutes 27 seconds West, 158.67 feet. Thence South 30 degrees 40 minutes 29 seconds West, 37.18 feet. Thence North 86 degrees 55 minutes 37 seconds West, 104.02 feet. Thence South 02 degrees 22 minutes 58 seconds West, 963.93 feet to a point on the North line of Lot 1, Deer Haven Subdivision and the Point of Termination.

Also having rights to a 50.00 foot Road Easement being 25.00 feet each side of a centerline and being more particularly described as follows:

Commencing at a set rebar with cap marking the Southwest Corner of the above described tract. Thence along the West line of said tract, North 30 degrees 47 minutes 24 seconds West, 87.96 feet to the Point of Beginning. Thence North 70 degrees 08 minutes 03 seconds West, 71.46 feet. Thence South 85 degrees 28 minutes 33 seconds West, 104.19 feet. Thence South 70 degrees 43 minutes 04 seconds West, 305.02 feet. Thence South 72 degrees 42 minutes 34 seconds West, 59.66 feet. Thence South 01 degrees 14 minutes 40 seconds East, 215.86 feet. Thence South 01 degrees 33 minutes 23 seconds West, 143.22 feet. Thence South 14 degrees 45 minutes 52 seconds East, 16.75 feet. Thence South 49 degrees 35 minutes 47 seconds East, 111.72 feet. Thence South 24 degrees 09 minutes 45 seconds East, 43.34 feet. Thence South 03 degrees 10 minutes 54 seconds East, 202.90 feet. Thence South 02 degrees 47 minutes 27 seconds West, 169.65 feet. Thence South 86 degrees 28 minutes 51 seconds East, 255.14 feet. Thence around a curve to the right, having a radius of 35.97 feet, and subtended by a chord bearing and distance of South 42 degrees 11 minutes 36 seconds East, 50.23 feet. Thence South 02 degrees 05 minutes 39 seconds West, 661.96 feet. Thence around a curve to the left, having a radius of 56.54 feet, and subtended by a chord bearing and distance of South 17 degrees 11 minutes 13 seconds East, 37.34 feet. Thence South 36 degrees 28 minutes 06 seconds East, 24.58 feet to the centerline of Smith Ridge Road and the Point of Termination.

Also a 15.00 foot Utility Easement being 7.50 feet each side of a centerline and being more particularly described as follows:

Commencing at a set rebar with cap marking the Southwest Corner of the above described Tract. Thence along the South line of said Tract, North 48 degrees 17 minutes 26 seconds East, 8.81 feet to the Point of Beginning. Thence South 73 degrees 24 minutes 22 seconds East, 144.77 feet to the Point of Termination.

Alternate Area
Part of the Southeast Quarter of the Southeast Quarter of Section 10, Township 20 North, Range 29 West, Benton County, Arkansas being more particularly described as follows:

Commencing at an existing rebar marking the Northeast Corner of the Southeast Quarter of the Southeast Quarter. Thence along the East line of said Forty, South 02 degrees 30 minutes 04 seconds West, 684.54 feet. Thence leaving said East line, West, 391.27 feet to a set rebar with cap and the Point of Beginning. Thence South 25 degrees 48 minutes 57 seconds East, 260.00 feet to a set rebar with cap. Thence South 64 degrees 11 minutes 03 seconds West, 260.00 feet to a set rebar with cap. Thence North 25 degrees 48 minutes 57 seconds West, 260.00 feet to a set rebar with cap. Thence North 64 degrees 11 minutes 03 seconds East, 260.00 feet to the Point of Beginning, containing 1.55 acres and subject to any Easements of Record.

CERTIFICATE OF AUTHORIZATION — SATTERFIELD LAND SURVEYORS, P.A. — #718 — ARKANSAS

SURVEYOR'S NOTE: All building, surface and subsurface, improvements on and adjacent to the site are not necessarily shown. The location and/or existence of utility service lines to the property surveyed are unknown and are not shown. Surveyor has made no investigation or independent search for easements of record, encumbrances, restrictive covenants, ownership title evidence, or any other facts which an accurate and current title search may disclose.

SURVEYOR'S NOTE: This survey was conducted under the supervision of Clovis W. Satterfield, No. 0147, or Ricky Hill, No. 1443, Satterfield Land Surveyors, P.A., Certificate of Authorization No. 718. Satterfield Land Surveyors, P.A., 1-(479)-632 3565 Hwy. 71 North, P.O. Box 640, Alma, AR 72921

500-20N-29W-0-10-220-04-0147-1443

100 50 0 GRAPHIC SCALE 100 200

REFERENCE DEED

SURVEY REFERENCES
1 - SATTERFIELD LAND SURVEYORS - #34,381 - 5-11-07
2 - LEMONS ENGINEERING CONSULTANTS, INC. #05 046 - 2-07
3 - SATTERFIELD LAND SURVEYORS - #31,978 - 3-18-05

BASIS OF BEARING
ASSUMED S 87°39'20" E ON THE NORTH LINE OF THE SE 1/4 SE 1/4 FROM SURVEY REFERENCE #1.

REVISIONS

VICINITY MAP
T-20-N R 29 W

LEGEND

SURVEYORS DISCLAIMER AND STATEMENT OF USE

This survey was conducted by the written or verbal authorization of the person named as the buyer and/or Use by as shown on this plat. No one has the authority to use the data or legal description from this survey except those named or their agents and the survey is only certified to the date shown on this plat. This plat is protected by copyright and any person other than those named using or relying upon this plat will be held responsible. Satterfield Land Surveyors, P.A. will not be responsible or have any liability to any other person or company who uses this plat without written authorization.

REGISTERED PROFESSIONAL LAND SURVEYOR — STATE OF ARKANSAS — No. 1443
Ricky W. Hill 3-14-08

BENTON COUNTY, ARKANSAS
SURVEY OF PART OF THE

SE 1/4 SE 1/4, SECTION 10, T-20-N, R-29-W

FOR USE BY: FRANKLIN MILLER

DRAWN BY:	J.D.B.
SCALE:	1"=100'
DATE:	3-14-08
JOB NO.	35,336

Satterfield Land Surveyors P.A.
REG. ARK & OKLA
1928 HWY. 71 NORTH, ALMA, ARK. PHONE No. (479) 632-3565
FAX (479) 632-5002 - WEBSITE: http://www.slsurveying.com

FedEx Express **NEW Package US Airbill**

FedEx Tracking Number 8768 4001 6240

Form ID No. 0200

Recipient's Copy

1 From

Date 10/13/11 [redacted]

Sender's Name K Brallett Phone 479 527 7880

Company GCD

Address 4516 Mesa

Dept./Floor/Suite/Room

City Fayetteville State AR ZIP 72704

2 Your Internal Billing Reference

3 To

Recipient's Name Colby Ungerank Phone

Company ADEQ - Water Permits

Address 5301 Northshore

We cannot deliver to P.O. boxes or P.O. ZIP codes. Dept./Floor/Suite/Room

Address

Use this line for the HOLD location address or for continuation of your shipping address.

City N Little Rock State AR ZIP ~~72205~~ 72114

- [ ] HOLD Weekday — FedEx location address REQUIRED. NOT available for FedEx First Overnight.
- [ ] HOLD Saturday — FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

8768 4001 6240

4 Express Package Service * To most locations.

NOTE: Service order has changed. Please select carefully.

Packages up to 150 lbs. *For packages over 150 lbs., use the new FedEx Express Freight US Airbill.*

Next Business Day

- [ ] FedEx First Overnight — Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [x] FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.

2 or 3 Business Days

- [ ] NEW FedEx 2Day A.M. — Second business morning.* Saturday Delivery NOT available.
- [ ] FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

5 Packaging * Declared value limit $500.

- [ ] FedEx Envelope*
- [ ] FedEx Pak*
- [x] FedEx Box
- [ ] FedEx Tube
- [ ] Other

6 Special Handling and Delivery Signature Options

- [ ] SATURDAY Delivery — NOT available for FedEx Standard Overnight, FedEx 2Day A.M., or FedEx Express Saver.
- [ ] No Signature Required — Package may be left without obtaining a signature for delivery.
- [ ] Direct Signature — Someone at recipient's address may sign for delivery. *Fee applies.*
- [ ] Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods?

One box must be checked.

- [x] No
- [ ] Yes — As per attached Shipper's Declaration.
- [ ] Yes — Shipper's Declaration not required.
- [ ] Dry Ice — Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

- [ ] Cargo Aircraft Only

7 Payment *Bill to:*

Enter FedEx Acct. No. or Credit Card No. below.

- [ ] Sender — Acct. No. in Section 1 will be billed.
- [ ] Recipient
- [ ] Third Party
- [x] Credit Card
- [ ] Cash/Check
- [ ] Obtain recip. Acct. No.

[redacted]

Total Packages	Total Weight	Total Declared Value†	Credit Card Auth.
2	6 lbs.	$ .00	

†Our liability is limited to $100 unless you declare a higher value. See the current FedEx Service Guide for details.

612

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