ENGINEERING REPORT

FOR

SANITARY SEWER SYSTEM

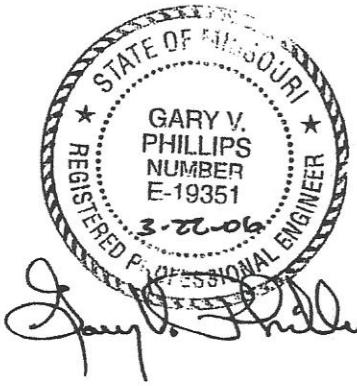
TO SERVE

COUNTRY HILL ESTATES

FOR

CENTRAL RIVERS WASTEWATER UTILITY, INC.
P.O. BOX 528
211 PLATTE CLAY WAY
KEARNEY, MO 64060

BY



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GARY V. PHILLIPS, PE
MARCH 2006

WHITEHEAD CONSULTANTS, INC.
114 NORTH MAIN STREET
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660 885 8311

LOCATION

Country Hill Estates is a proposed 30-lot residential subdivision development located on the West side of Interstate 35 approximately 2 miles south of the business district of Cameron in Clinton County, Missouri.

EXISTING CONDITIONS

There are presently no central sewage treatment systems in the area. The closest treatment plant with collection lines is approximately 2 miles to the North in Cameron. There does not appear to be any limiting conditions for the use of a recirculating sand filter sewage treatment system to serve the subdivision. There is no proposed future growth of the development.

PROPOSED IMPROVEMENTS

The recirculating sand filter system is designed to treat 30 lots with an expected density of 3.7 people per lot and 100 gallons of sewage per person per day. The proposed treatment system will be constructed in one phase.

Each lot will have a septic treatment effluent pump (STEP) in a septic tank that will pump to a 2" low pressure main. These tanks area also called interceptor tanks. The effluent from the residential home tanks is expected to be less than 150 mg/l BOD and less than 50 mg/l TSS. The effluent will be pumped from the individual septic tanks at not more than 5 gpm to the main. The septic tanks on the lots will be sized according to the number of bedrooms of the proposed house as shown on the detail sheet. The mains will carry the screened effluent to a minimum 8,325-gallon capacity recirculation tank. The screened effluent will have no solids so manholes are not used. Pigging ports will be installed at strategic locations as shown on the plans.

The pretreated sewage in the recirculation tank will be filtered and pumped to the sand filter bed where it will be distributed and dosed on the filter media. The filtered effluent will flow out to a splitter valve that will discharge 20% and recirculate 80% back to the recirculation tank. The dosing pumps will be controlled by float switches and timers to ensure that the filter media is dosed adequately to maintain a biomat within the media. At times of low flow 100% of the effluent will be recirculated.

The operation and maintenance of the system will be provided by the continuing authority: Central Rivers Wastewater Utility, Inc. A sieve analysis of the proposed filter media will be sent with the application for operating permit.

CALCULATIONS FOR THE SAND FILTER

Design flow = 30 lots x 100 gallons per day x 3.7 persons per lot = 11,100 gpd

Filter bed area = 11,100 gpd / 5 gallons per sq.ft. = 2,220 sq.ft. (minimum)

Using a filter area of 48' x 50' = 2,400 sq ft

Pump size needed = number of orifices x 0.43gpm = 24 orifices / line x 3 lines / zone x 0.43 gpm = 30.96 gpm minimum.

Total dynamic head per spread sheet = 45.63 ft

Calculation Chart and the pump curve for the pump selected is included with this report.

Detailed specifications for the STEP system components and sand filter are included with this report.

Each orifice will be limited to 1.50 gallons per dose. The time of dose will therefore be limited to 3.5 minutes at 0.43 gpm.

The control panel will be initially set to operate the alternating pumps for 72 cycles per day. The time on will be 3.11 minutes and the time off will be for 16.89 minutes. This will produce a total dosage of 6,932.6 gallons per zone. With 8 zones the total dosage will be 55,460.5 gallons per day. This rate will permit the total pump-out at a recirculation ratio of 4:1, as planned.

Each cycle = 16.89 + 3.11 = 20.00 min. or 72 cycles per day.

Pumps 1 & 3 will operate for 3.11 minutes then shut down for 16.89 minutes. Pumps 2 & 4 will operate for 3.11 minutes then shut down for 16.89 minutes. This cycle will continue indefinitely.

The organic loading rate for a recirculating sand filter is determined by the formula: Rate = BOD / 0.01252 x 80% (for pretreatment in septic tanks) and BOD = 30 lots x 3.7people x 0.17 pound per person = 18.87 lbs.
Rate = 18.87 x .80 / 0.01252 = 1206 sf < 2,400 sf designed.

Peak Flow, Qp, is determined from the equation EDU / 2 + D and EDU is determined from the Qa, (average design flow in gpd) / Kp, (normal design Q per person) (50) x P, (normal design persons per home) (3) or EDU = Qa / (Kp x P) = 11,100 / (50 x 3) = 74 for 30 lots and Qp = (74 / 2) + D where D is accepted as 15 therefore: Qp = 37 + 15 = 52 gpm.

The sand filter bed is designed to treat 5 gallons per square foot per day of domestic sewage based on the fact that there is no stronger waste entering the system and there will be a 4:1 recirculation ratio. The orifices are 1/8" diameter allowing 0.43 gpm dose at 5 ft of pressure head. The orifices are spaced 2 feet apart and the laterals are 2 feet apart. The pressure will be set to deliver 5 feet of head at the last orifice.

The filter bed is 50 feet deep and 48 feet wide creating 2,400 sf of area. At 5 gallons per square foot the bed can treat 12,000 gpd. The design Q is 11,100 gpd.

CALCULATIONS FOR THE STEP COLLECTION SYSTEM

Each lot has an interceptor tank with a pump that will activate when the fluid level causes the float switch to close the circuit. Therefore, unlike gravity collection system analysis the EDU is not used to compute the estimated flow in the collection mains. Each tank pump will have a flow controller to limit the flow to 5 gpm. This low flow prevents turbulence in the tank and can be accomplished using ½ horsepower pumps. A main line working sketch and a site layout plan is included at the back of this report.

The pressure in the main is computed using a C = 120 and the friction head formula: Hf = [(10.44 x L) / d to the 4.87 power] x [(Q / C)] to the 1.85 power. Where H is in feet, L is in feet, d is in inches and Q is in gpm.

The maximum pressure head in the main will be approximately 170' as determined by graphical methods.

The effluent pumps to be used in all of the tanks are rated at 5 gpm at 177 ft head. Each pump assembly will have a ¼" orifice flow controller to limit the flow from 5 to 10 gallons per minute.

Pressure Main Calculations

It is impossible to determine how many STEP units will be pumping simultaneously in any subdivision development. Historical records accumulated by Orenco for STEP systems show a design flow of ½ gallon per minute per lot. For this subdivision the expected design flow would only be 30 x .5 = 15 gpm. The peak flow rate for STEP systems is given by: Q = (EDU/2) + D where Q is in gpm, EDU is 2.467 x lots, and D is 0 to 20 and used as 15 in this application. For 30 lots the Q would be (2.47x30)/2 + 15 = 52.05 gpm. This would occur at the tank entrance. The velocity would be 5.25 fps. A layout of the main is attached for reference.

All of these computations are based on maximums and ultimate development with every lot being occupied. Actual flows and pressures will be at or less than these shown.

EMERGENCY PLAN

An automatic dialer will be connected to the control panel to notify the owner or the continuing authority of outages or other problems with the treatment system. A technical data sheet for the dialer is attached to the specifications.

At least 3 spare treatment system pumps will be kept at a readily accessible location close to the site to minimize down time of the system due to mechanical failure. At least 3 spare pumps for the individual home pump tanks will be stored on site also. Continuing authority personnel will be trained in the method of pump and other part replacement procedures.

A backup power supply generator will be stored at a convenient place to be able to be connected to the treatment system within 24 hours. If there is an electrical outage the home pump tanks will not be adding any effluent to the treatment system.

		SAND FILTER DESIGN CALCULATIONS							
		FOR: COUNTRY HILLS ESTATES 8/9/05							
		#05-286							
NUMBER OF LOTS			30.00						
PERSONS PER LOT			3.70						
FLOW PER PERSON			100.00						
DAILY FLOW (GPD)			11100.00	GALLONS PER DAY					
LOADING RATE			5	GALLONS PER DAY/SQ. FT.					
FILTER SIZE SQ FT @ 5GPD			2220.00	SQ. FT. REQUIRED					
		WIDTH	LENGTH	AREA					
DESIGN SIZE (IN FEET)		48	50	2400	SQ FT DESIGN				
NUMBER OF CELLS			2	input					
NUMBER OF ZONES PER CELL			4	input					
ZONE CALCULATIONS		WIDTH	LENGTH	AREA					
ZONE SIZE		6	50	300	SQ FT DESIGN				
NUMBER OF LATERALS (2' O.C.)			3						
LATERAL LENGTH (IN FEET)			48						
NUMBER 1/8" ORIFICE/LATERAL (2 FT O.C.)			24						
TOTAL ORIFICES			72						
GPM FOR 5' RESIDUAL HEAD			30.96						
NUMBER OF CYCLES PER DAY PER ZONE			48	72	96				
MINUTES ON (5:1 RATIO)			4.67	3.11	2.33				
MINUTES OFF			25.33	16.89	12.67				
Min. Required Velocity in Discharge Pipe - 2 fps			5.62	input					
DISCHARGE LINE DIAMETER (INCHES)			1.50	input	1"	1.25"	1.5"	2"	
DISCHARGE ASSEMBLY FRICTION LOSS			0.34	input	0.37	0.35	0.34	0.32	
HAZEN - WILLIAMS PIPE FOULING FACTOR			120.00						
LENGTH OF SUPPLY PIPE			70.00	input					
LOSS IN SUPPLY PIPE			8.29						
DIAMETER OF LATERAL (INCHES)			1.00	input					
LOSS IN LATERALS			10.00						
ELEV. DIFF. STATIC (PUMP TO SF SURFACE)			7.00	input					
RESIDUAL HEAD			5.00						
LOSS THROUGH DISTRIBUTING VALVE			15.00	input					
TOTAL HEAD NEEDED			45.63						

RECIRCULATING TANK CALCULATIONS

RUN-OFF PERIOD (USE IN EQUATION IN E69)

SUBDIVISION =	16
SCHOOL =	8
RESTAURANTS =	12-16
INSTITUTIONS =	16
COMMERCIAL =	12
RESORTS =	16
MOTELS =	16

Qmax/Qavg	% DAILY FLOW
1	0
1.5	13
2	22
2.5	29
3	33
3.5	37
4	40
5	44
6	48
7	50
8	52
9	53
10	55

DAILY FLOW (Q AVERAGE) =	11100.00		
PEAK FLOW FACTOR =	3.33		
Q MAX = PEAK X DAILY X 24 / RUN-OFF PERIOD =		55444.50	input d42 thru d48
Q MAX / Q AVG =		3.00	input
% DAILY AVG. FLOW FOR STORAGE =		33.00	input
STORAGE BETWEEN 100% RECIRC. MECH. & HIGH WATER ON =		3663.00	
VOLUME BETWEEN TANK BOTTOM & 100% RECIRC =		4440.00	
VOLUME BETWEEN LOW WATER OFF & 100% RECIRC. =		2220.00	
MINIMUM VOLUME OF RECIRC TANK W/O FREEBOARD =		8103.00	

ıt Parameters

Orifice Size	1/8	inches
Residual Head at Last Orifice	5.0	feet
Orifice Spacing	2.00	feet
Number of Laterals per Cel	12	
Lateral Length	46.0	feet
Lateral Pipe Class/Schedul	40	
Lateral Line Size	1.00	inches
Distributing Valve Mode	4404	
Manifold Length	4.0	feet
Manifold Pipe Class/Schedul	40	
Manifold Line Size	1.00	inches
Lift to Manifold	7.0	feet
Transport Length	70.0	feet
Transport Pipe Class/Schedul	40	
Transport Line Size	1.50	inches
Discharge Assembly Size	1.50	inches
Flow Meter	None	inches
'Add-on' Friction Losses	10.0	feet

Calculation

Minimum Flow Rate pe	0.43	gpm
Number of Orifices per Zone	72	
Total Flow Rate per Zone	31.9	gpm
Number of Laterals per Zone	3	
% Flow Differential 1st and Last	9.3	%

Static Heads

Lift to Manifold	7.0	feet
Residual Head at Last Orifice	5.0	feet

Frictional Head Losses

Head Loss in Laterals	1.1	feet
Head Loss through Distributing	12.9	feet
Head Loss in Manifold	0.5	feet
Head Loss in Transport Pipe	4.2	feet
Head Loss through Discharge	3.1	feet
Head Loss through Flow	0.0	feet
'Add-on' Friction Losses	10.0	feet

Size Pump For

Design Flow Rate	31.9	gpm
Total Dynamic Head	43.9	feet

Nominal diameter of distribution laterals. Choose from the list of standard sizes.

Calculate

Generate Chart

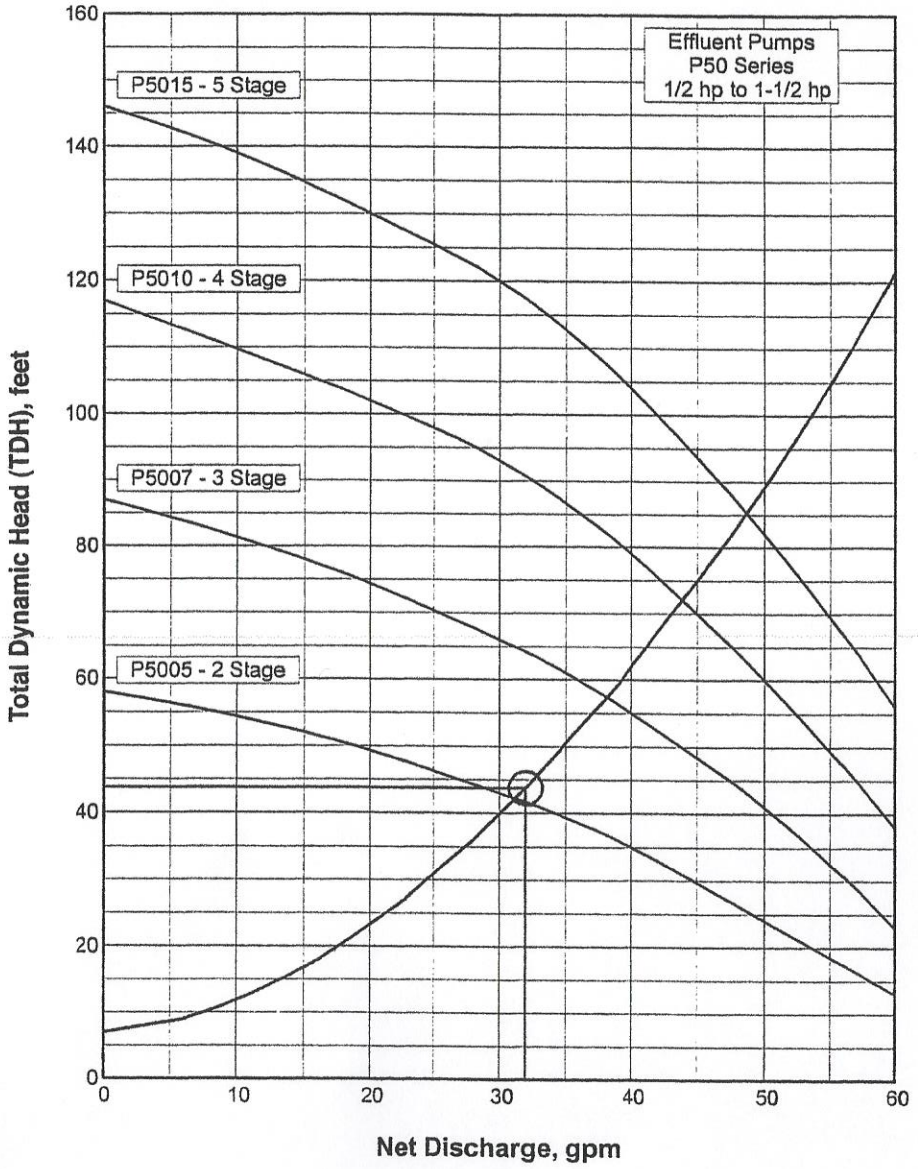
Pump Selection for a Pressurized System

Input Parameters

Orifice Size	1/8	inches
Residual Head at Last Orifice	5.0	feet
Orifice Spacing	2.00	feet
Number of Laterals per Cell	12	
Lateral Length	46.0	feet
Lateral Line Size	1.00	inches
Lateral Pipe Class/Schedule	40	
Distributing Valve Model	4404	
Manifold Length	4.0	feet
Manifold Line Size	1.00	inches
Manifold Pipe Class/Schedule	40	
Lift to Manifold	7.0	feet
Transport Length	70.0	feet
Transport Line Size	1.50	inches
Transport Pipe Class/Schedule	40	
Discharge Assembly Size	1.50	inches
Flow Meter	None	inches
'Add-on' Friction Losses	10.0	feet

Calculations

Minimum Flow Rate per Orifice	0.43	gpm
Number of Orifices per Zone	72	
Total Actual Flow Rate	31.9	gpm
Number of Lines per Zone	3	
% Flow Differential 1st and Last Orifice	9.3	%
Lift to Manifold	7.0	feet
Residual Head at Last Orifice	5.0	feet
Head Loss in Laterals	1.1	feet
Head Loss Through Distributing Valve	12.9	feet
Head Loss in Manifold	0.5	feet
Head Loss in Transport Pipe	4.2	feet
Head Loss Through Discharge	3.1	feet
Head Loss Through Flow Meter	0.0	feet
'Add-on' Friction Losses	10.0	feet
Total Flow Rate	**31.9**	**gpm**
TDH	**43.8**	**feet**



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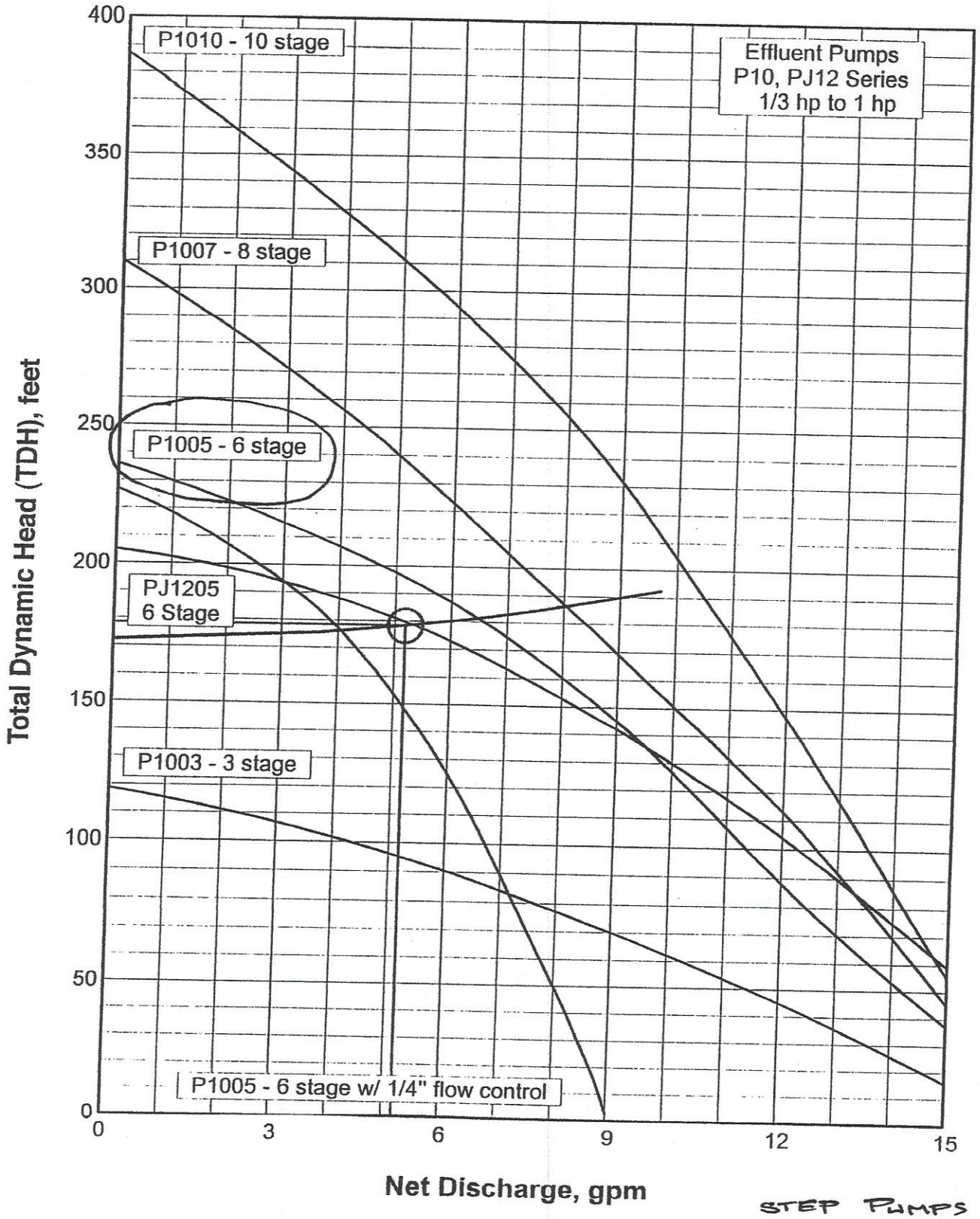
TREATMENT SYST

APPENDIX 5B



STEP PUMPS
FOR HOME TANKS

APPENDIX 5B

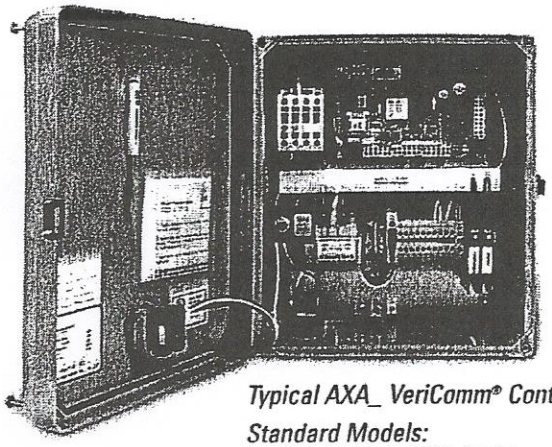
VeriComm® S_RO Control Panels

Technical Data Sheet

For On-Demand Applications

Applications

VeriComm S1RO and S2RO remote telemetry control panels are used with on-demand simplex pumping operations. Coupled with the VeriComm Web-based Monitoring System, these affordable control panels give water/wastewater system operators and maintenance organizations the ability to monitor and control each individual system's performance remotely, with real-time efficiency, while remaining invisible to the homeowner.



Typical AXA_ VeriComm® Control Panel

Standard Models:
VCOM AXA1, VCOM AXA2

To Specify...

To specify this panel for your installation, require the following:

Basic Control Logic: Three Operating Modes

- A "Start-up Mode" for the initial 30 days, during which the system collects trend data to establish operating standards for future reference.
- A "Normal Mode" that manages day-to-day functions.
- A "Test Mode" that suspends data collection and alarm reporting during installation and service.

Data Collection and Utilization

- Data logs of system conditions and events, such as pump run times, pump cycles, and alarm conditions.

Troubleshooting and Diagnostic Logic

- Troubleshooting capabilities that can report suspected failed components, which then trigger Alarms.

Advanced Control Logic

- Advanced control logic that activates during float malfunctions to diagnose the situation and keep the system operating normally until servicing.

Communication and Alarm Management

- Remote telemetry capabilities coupled with a Web-based monitoring application (see VeriComm Monitoring System, ATD-WEB-VCOM-1) for communication and alarm management. Updating of point values and receipt of queued changes during each communication session with host. Communication sessions that occur monthly, at a minimum, and more frequently during alarm conditions.
- Multiple methods of communication, as follows:

Call-In to VeriComm® Host

  - Automatic notification to host of "Alarms," which signal fault conditions that need to be addressed immediately (e.g., pump failure).
  - Automatic notification to host of "Alerts," which signal less critical fault conditions and which trigger the panel's troubleshooting logic and alternative operating mode (e.g., stuck float switch).
  - Automatic notification to host of "Updates," which include alarm updates or all-clear notifications following Alarms/Alerts, as well as normally scheduled monthly panel reports.
  - Manual, forced communication from panel to host to effect an updating of point values and receipt of queued changes.

Real-Time Direct Connection to Panel

  - Manual, direct connection at the site via RS-232 serial port, to allow a local operator real-time access to detailed logged data and the ability to change point values from a laptop.
  - Manual, forced communication by local operator/homeowner at the site to initiate an auto-answer mode, allowing a remote operator real-time access to detailed logged data and the ability to change point values.

During real-time, manual connections, software with open architecture (and password security) is used; no proprietary software is required. VT100 protocol allows access and control from any computer modem (Mac or PC) with a simple communication program (e.g., Windows® HyperTerminal); multilevel password protection in panel ensures that only qualified personnel can access the panel's data.

Additional Features

- Status light indicators on the board, including . . .
  - Flashing green LED for normal operation
  - Yellow LEDs for status of digital inputs
  - Red LEDs for status of digital outputs and modem activity
- UL-recognized and FCC-approved

For more information, try our online demo at www.vericomm.net (no password required).

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