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TREATMENT WORKS APPROVAL PERMIT APPLICATION ENGINEER ABSTRACT FOR THE
BIOSLURPING SYSTEMS NWS EARLE NJ
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FOSTER WHEELER ENVIRONMENTAL CORPORATION

TREATMENT WORKS APPROVAL PERMIT APPLICATION
ENGINEER'S ABSTRACT FOR THE
BIOSLURPING SYSTEMS
AT
NAVAL WEAPONS STATION - EARLE
COLTS NECK, NEW JERSEY

Prepared:

September 26, 1997

Prepared on behalf of:

Naval Facilities Engineering Command
10 Industrial Highway
Lester, PA 19113

Prepared by:

Foster Wheeler Environmental Corporation
2300 Lincoln Highway
One Oxford Valley - Suite 200
Langhorne, PA 19047 - 1829

REMEDIAL ACTION CONTRACT N62472-94-D-0398
DELIVERY ORDER NO. 0017
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ENGINEER'S ABSTRACT FOR THE
NAVAL WEAPONS STATION-EARLE'S BIOSLURPER RECOVERY AND
TREATMENT UNITS

(i.) Description of Waste Treatment System

General Description

The main components of each of the two bioslurper recovery/treatment systems are: an exhauster skid, a free product skid, an oil/water separator, a waste oil storage tank, a bag filter, clay absorption units and activated carbon units. A description of each component is provided below and the specification sheets for the equipment are attached.

The exhauster skid is equipped with a 7.5 HP liquid ring vacuum pump and seal water supply/vacuum separation tank. Potable water is fed into the seal water tank to supply the liquid ring pump which supplies the vacuum to the recovery wells. The seal water tank also serves as a knockout tank to remove liquids from the vapor phase of the recovery system. The water supply/vacuum separation tank is equipped with low and high sensors. The low and high sensors monitor the water level in the tank to ensure there is an adequate supply of water to the liquid ring pump. If either the low or high water level switches are activated, the entire system is automatically shut down and a report is faxed to several locations indicating the system condition. The potable water feed is from a water line inside Building C-16. The water supply line is equipped with a backflow prevention valve. A discharge line atop the seal water tank discharges the vapor to the atmosphere. The vapor discharge is covered under an air discharge permit. The oil/water/vapor is drawn into the treatment system buildings by the liquid ring pump.

The free product skid is comprised of an 80 gallon phase separation tank into which the vapor, oil and water enter under vacuum. The water and product drop out in this tank and the vapor phase enters the seal water tank on the exhauster skid. The tank on the free product skid is equipped with low, high and high/high level switches. The low and high switches send a signal to control a cavitation pump to pump the product and water into an adjacent oil/water separator. Upon activation of the high/high sensor on the tank the entire system is shut down and a report is faxed to several locations indicating that a high level condition has occurred. The line from the cavitation pump is equipped with a gate valve in order to regulate the flow to the oil/water separator. The exact flow rate to the oil/water separator shall be dependent upon the amount of oil/water entering the system from the recovery wells. The pump is activated intermittently depending upon the levels of oil/water inside the phase separation tank. The valve shall be set such that the intermittent flow rate shall not exceed 20 gallons per minute (gpm) to the oil/water separator.

The oil/water separator design flow rate is 128 gallons per minute (gpm) and is equipped with the following: coalescing corrugated plates, polishing media pack, oil skimmer

weir, integral oil collection tank and an integral effluent tank. The integral oil accumulation tank and effluent water tank are equipped with low, high, and high/high sensors. The low and high sensors activate pumps, and the high/high sensors monitor high oil or effluent conditions respectively. The high/high sensors are wired to a master control panel which upon activation shall shut the entire system down and fax a report to several locations, indicating that the high level condition has occurred. The discharge lines from the integral oil accumulation tank and effluent accumulation tank are each connected to pumps. The oil from the oil accumulation tank is pumped to a double-walled oil storage tank, located inside the bioslurper building. The oil storage tank is equipped with a high level sensor which monitors high oil conditions inside the tank. If the high level sensor inside the oil storage tank is activated, the entire system is automatically shut down and a report is faxed to several locations indicating a high level condition has occurred. The effluent is pumped through a series of treatment units. The effluent is first pumped through a 35 micron bag filter assembly to remove suspended solids. The effluent then passes through two clay absorption units, in series, to remove free oil or emulsified oil which may have passed through the oil/water separator. The effluent then passes through two activated carbon units, in series, to remove any dissolved-phase organics prior to discharge to a sanitary sewer drain line inside Building C-16.

Preparation of Site for Installation of Units

In accordance with 40 CFR Part 280, and Spill Prevention, Control and Countermeasure Regulations (N.J.A.C. 7:1E) secondary containment devices shall be utilized. Each cargo container unit is equipped with a sump and a float sensor. Any spill inside the cargo container will accumulate within the sump, activate the float, and automatically shut down the entire system. To prevent the migration of any spilled material from the cargo container, the units shall be located on bermed asphalt pads. Asphalt is currently present at the location of the unit by Building C-16. A 10 foot wide by 45 foot long asphalt berm, six (6) inches in height, shall be constructed on the existing asphalt in order to contain any spill from the cargo unit. A coal tar seal with unvulcanized rubber shall be applied to the bermed area.

A crushed aggregate base and asphalt pad shall be constructed north of Building C-50 for the bioslurper unit to be installed in this area. The base shall be four (4) inches thick and the asphalt shall be four (4) inches thick. The perimeter of the asphalt pad shall have a six (6) inch high berm and the asphalt shall be coated with a coal tar seal resistant to petroleum products.

Each of the cargo containers shall be situated on the middle of each bermed asphalt pad in such a manner that shall allow any spills from the systems to be contained inside the bermed area until the appropriate personnel can respond to the spill. Each bermed asphalt pad will provide a spill capacity of approximately 1,600 gallons.

Bioslurper System Component Details

The principal components of each system are detailed below:

Exhauster Skid

The exhauster skid functions as the source of the vacuum placed on the recovery wells, and also functions as a vapor phase drop-out tank (seal water tank). In addition, the tank is equipped with a vapor phase discharge line. The exhauster skid is connected to the free product skid via a three (3) inch diameter vacuum line and a 0.5 inch manual blowdown line. The main components of the exhauster skid are as follows:

- 7.5 HP liquid ring vacuum pump
- 80 gallon vapor-liquid separation tank, which also supplies seal water to the liquid ring vacuum pump
- Three (3) inch vapor discharge line equipped with a magnehelic gauge
- Heat exchanger

Free Product Skid

The free product skid is equipped with a tank to drop out the oil and water phase of the vapor/water/oil mixture which is pulled, via vacuum, from the recovery wells. The vacuum to the wells is controlled at this location by an air bleed valve and measured with a vacuum gauge. The oil and water in this tank is transferred by a pump to the oil/water separator skid. The main components of the free product skid are:

- 80 gallon phase separator tank equipped with float switches
- A cavitation transfer pump to transfer liquid to the oil/water separator

Oil/Water Separator

The oil/water separator unit consists of an oversized parallel corrugated plate coalescing oil/water separator and a product transfer pump. The main components of the oil/water separator are as follows:

- 200 gallon integral sump
- 100 gallon integral product storage compartment
- Sight glass assembly with level controls
- Internal sludge baffle
- Stainless steel effluent (water) discharge pump (5 HP)
- Stainless steel product discharge pump (1 HP)
- 210 gallon product tank

Effluent Treatment

The effluent treatment train treats the effluent (water) from the oil/water separator. The treatment train will consist of two inter-changeable series of bag filters, clay absorption units and activated carbon adsorption units. The system will be set up so there is always a backup series of clay absorption units. The effluent treatment system will consist of the following items:

- One 20 gpm bag filter unit
- Two high pressure clay absorption units (300 lbs. each) in series
- Two activated carbon units (300 lbs. each) in series for polishing of the effluent.

In addition, the unit near Building C-50 shall be equipped with a 60 gallon sump tank and a pump in order to pump effluent from the unit to Building C-16 for discharge into the sewer drain line.

Automated Instrumentation

The two bioslurper systems shall be equipped with numerous switches and alarms to ensure that if one part of the system is not functioning properly, the system shall automatically shut-down. Alarm reports shall be automatically sent via facsimile to Foster Wheeler Environmental Langhorne, PA office, as well as the Navy's Northern Division office, NWS- Earle's Environmental office and ROICC offices. The following switches shall be configured to turn off the entire system:

- High/high sensor on the phase separator tank
- High and low sensors on the seal water tank
- High/high sensor on the integral effluent tank of the oil/water separator
- High/high sensor on the integral product tank of the oil/water separator
- High sensor on the product storage tank
- Pressure transducer on the effluent treatment train
- High level alarm in a floor sump inside the building
- The sensors inside the secondary containment piping of the vacuum extraction lines.

FeREMEDE® Injection Equipment

A sequesterent/dispersant shall be injected into the vacuum line of the wells in order to reduce the amount of iron oxidization and to maintain oxidized iron in a state which is amenable to subsequent treatment operations.

The FeREMEDE® chemical shall be injected at a rate of 3×10^{-4} ml. for every gallon of liquid influent flow. The metering pumps shall be equipped with specialized valves to

prevent the siphoning of the chemical under vacuum. The metering pumps will be wired such that they automatically shut off when the bioslurper system shuts down.

The FeREMEDE® chemical shall be contained in 55 gallon drums and be located on secondary containment skids inside the control rooms of the bioslurper units, which shall keep the chemical from coming into contact with any other portion of the system. The FeREMEDE® chemical will be in the liquid form and require no mixing or dilution. Variable speed precision metering pumps shall be used to dispense the FeREMEDE® chemical to the manifold pipes connecting the recovery wells. A dispensing tube shall be tied into the manifold pipe in order to inject the chemical into the influent as soon as possible after extraction from the wells. In the system adjacent to Building C-16, a chemical feed line shall be tied into the line going to 16MW-04 and 16MW-13, another line shall be fed into the manifold for the five extraction wells on the eastern most run, and a feed line shall be tied into the manifold for 16MW15 and 16MW-14. Each metering pump shall be set to achieve a supply rate of 3.1×10^{-4} ml per gallon of liquid extracted. Each metering pump shall be calibrated in such a manner as to supply the proper feed rate of the chemical to the manifold pipe for that line of wells. Since all the manifold piping eventually converges, the overall chemical feed will be blended in the phase separation tank. The flow rate of the entire system shall be evaluated weekly and the chemical feed rates adjusted accordingly.

Master Control Panel

The control panel will consist of a Program Logic Control (PLC) based master control panel and telemonitoring/datalogging system. The system shall be Microsoft Windows based operation and configuration software. The master control panel shall consist of the following:

- LCD local display of all functioning systems
- Internal fax modem
- Control voltage transformer
- Intrinsically safe relays and zenar barriers
- Interactive remote monitoring
- Run lights
- Alarm lights
- Remote viewing of product flow and effluent gauges

Treatment Buildings

Two treatment buildings (refurbished 40'x 8' and 8.5' high cargo containers) shall be delivered to the site with all the recovery and treatment equipment mounted, plumbed and wired internally to NEMA 7 (explosion-proof) standards. The complete turnkey system will be connected to a power source, telephone line, water, and the recovery wells upon arrival. The following components shall be included with the building:

- End mounted double doors
- Explosion proof heat, vent, and lights
- Explosion proof emergency stop switch
- Full studding and insulation
- Oak floor planking with non-skid covering
- A separate control room equipped with a NEMA 4 circuit breaker panel

(i.i) The Ultimate Destination of all Wastewater and Residuals

The treated wastewater from Bioslurper Unit #2 shall be pumped through a two (2) inch diameter PVC pipe, enclosed inside a four (4) inch diameter pipe (for secondary containment), below grade to Bioslurper Unit #1, located near Building C-16. The treated wastewater from Bioslurper Unit #2 shall be piped into the discharge line for the treated wastewater from Bioslurper Unit #1. The connection shall be made inside the Bioslurper Unit #1 building and be constructed of a wye pipe and a check valve to prevent water from Bioslurper Unit #2 from entering the treatment train of Bioslurper Unit #1. The wastewater inside the two (2) inch diameter discharge line from Bioslurper Unit #1, which is heat tapped and enclosed in a four (4) inch diameter PVC pipe (for secondary containment), is pumped into the adjacent Building C-16. The two (2) inch diameter discharge line connects to an existing four (4) inch diameter drain line inside Building C-16. The four (4) inch diameter drain line was visually inspected and appeared to be in good condition. The four (4) inch diameter drain line inside Building C-16 gravity drains to a six (6) inch diameter sewer pipe outside of Building C-16. The sewer pipe gravity drains to the NWS-Earle Treatment Plant. The water from the NWS-Earle Treatment Plant is discharged, under NJPDES Permit No. NJ0023540, to Yellow Brook.

Four types of residuals shall be generated by the bioslurper recovery and treatment process: recovered oil, spent bag filters, spent clay media, and spent carbon. The recovered oil shall be recycled through a local oil recycler.

The oil recovered from the bioslurper system shall be stored in a 210 gallon steel tank, equipped with an secondary wall/overflow sump. The 210 gallon oil storage tank is located inside the bioslurper units. The oak plank floor of the units is covered with non-skid rubber matting and the unit is sloped towards a sump. The sump is equipped with a high level sensor which is tied back to the master control panel. If the sensor is activated, the entire system will shut down and a report shall be automatically sent via facsimile to Foster Wheeler and the Navy.

The clay absorption media shall be recycled as a supplemental fuel source in the production of cement or otherwise properly disposed off-site. Following characterization sampling, the clay media will be vacuumed out of the clay absorption vessels by the recycler when routine monitoring results of the effluent indicate that the clay media is

nearing saturation. The saturated clay media shall not be stored in any other vessels on the site prior to removal off-site.

The activated carbon media in the carbon vessels shall be removed off-site by a vendor for reactivation. Following characterization sampling, the carbon media will be vacuumed out by the vendor when routine monitoring results of the effluent indicate that the carbon is nearing capacity. The activated carbon shall not be stored in any other vessels on the site prior to off-site removal.

The spent bag filters shall be placed in a DOT #1A2 open top drum, and stored inside a nearby flammable storage shed. Upon filling, the filter material shall be properly disposed off-site. It is anticipated that the filters will be classified as non-hazardous based on characterization sampling.

(i.i.i) Listing of All Pollutants, Including Regular and Intermittent Flows Which May Enter the System

Both oil and water shall be recovered from the extraction wells by the bioslurper systems. The water shall be treated prior to discharge to the existing on-site sanitary sewer system. The on-site sanitary sewer system drains to a sanitary sewer treatment plant owned and operated by the U.S. Navy. The NWS-Earle Sanitary Sewer Plant has NJPDES Permit No. NJ0023540 to discharge to the Yellow Brook. Since the bioslurper shall be treating and discharging water from a diesel fuel spill, the only parameter of concern in the NWS-Earle Sewer Treatment Plant's NJPDES permit effluent parameters and limitations is Oil and Grease. According to the NJPDES permit, the effluent limitation of Oil and Grease is 10 mg/l. The following mass balance information shall demonstrate that the bioslurper's groundwater treatment system is capable of meeting the effluent parameters established under the NJPDES permit even before it enters the existing sanitary sewer treatment plant.

The recovered oil and water are first pumped through an oil/water separator to separate the free phase oil. The oil/water separators installed in the bioslurper units are equipped with coalescing plates and a polishing media to effectively remove the free-phase oil. The oil/water separators were oversized for this application to ensure maximum separation, as well as to allow for any increased flow. The attached calculations demonstrate that each oil/water separator, with 24 cubic feet of coalescing media, has a safety factor of 10 for the separation of free phase oil at a flow rate of 20 gpm. Based on the size of the phase separator tank, and the location of the level sensors, the anticipated flow rate to the oil/water separator is not expected to be greater than 15 gpm, pumping in intervals lasting two to three minutes.

The effluent from the oil/water separator shall first be pumped through a 35 micron bag filter to remove suspended particles. The effluent shall then be pumped through two high pressure vessels filled with modified clay and anthracite filtration media. The clay media

removes oil and grease as well as other high molecular weight organics. Attached are calculation sheets provided from the clay media manufacturer to estimate the efficiency of the clay absorption units for removal of Oil and Grease, as well as dissolved contaminants. The Oil and Grease concentration used for the calculations was obtained from the effluent discharge of the oil/water separator used for the pilot-study bioslurper system. It should be noted that the oil/water separator used for the pilot study was a significantly smaller and less efficient unit and the actual Oil and Grease concentrations of the effluent from the full-scale oil/water separators is anticipated to be significantly lower. As demonstrated by the clay media calculations, the Oil and Grease concentration of the effluent after the second clay unit is anticipated to be 1.4 ppm.

Subsequent to the clay units, the effluent shall be pumped through two 300 pound activated carbon units in series. The purpose of the activated carbon units is to polish the effluent, further reducing concentrations of oil and grease, as well as any other dissolved contaminants which may be present. The isotherms for benzene, toluene, and xylenes are attached to demonstrate that the activated carbon is capable of removing any contaminants remaining in the effluent with a high safety factor.

(i.v.) Average and Peak Flows

There shall be two separate bioslurper units at the Naval Weapons Station-Earle facility. The first unit, located near Building C-16, shall be connected to a total of nine oil/water recovery wells and two vapor recovery wells. The second unit, located near Building C-50, shall be connected to two oil/water recovery wells. The flow rate of liquid from each well shall be approximately 0.5 gallons per minute (gpm). The flow rate of 0.5 gpm of liquid from each well is based upon previous operating experiences from similar bioslurper units. The flow rate is manually controlled with valves on each of the recovery wells.

The flow rate into the first bioslurper unit is anticipated to be 4.5 gpm based on nine recovery wells operating at 0.5 gpm each. The vacuum at each of the wells shall be modified in order to optimize the amount of oil withdrawn while minimizing the amount of water withdrawn. The amount of oil withdrawn from individual wells shall be dependent upon the amount of oil present at each recovery well. Based on the pilot study, and previous bioslurper applications, it is anticipated that between 0.05 to 0.75% of the liquid phase recovered from the wells will be oil. The oil/water shall flow into the first bioslurper unit at a rate of approximately 4.5 gpm.

The oil/water which enters the system drops out in the phase separator tank. Once the high level switch is activated, the oil/water from the phase separator tank is pumped into the oil/water separator. The rate at which the water is pumped from the phase separator tank to the oil/water separator is manually controlled with a gate valve. The anticipated flow rate from the phase separator tank to the oil/water separator is approximately 15 gpm. This flow is not continuous, and is controlled by the high/low level switches inside

the phase separator tank and the gate valve. Based on the size of the phase separator tank and the locations of the high and low sensors controlling the transfer pump, the transfer pump is anticipated to pump at a rate of 15 gpm for two to three minute intervals.

The oil/water separator is rated for a design flow rate of 128 gpm. The oil/water separator was oversized to ensure the maximum separation of oil and water. Once separated, the oil is gravity fed through a weir to a 100 gallon oil accumulation tank inside the oil/water separator, and the water is dispensed to an integral 200 gallon effluent tank. The oil shall accumulate inside the integral oil accumulation tank until the high level switch is activated. A pump shall transfer the oil from the integral product storage tank to a product storage tank upon activation of the high level sensor. The water in the effluent tank shall be pumped through several treatment units upon activation of the high level sensor inside the tank. The hydraulic flow through the treatment units is controlled by the low and high sensors on the effluent tank and the gate valve. The anticipated flow through the treatment units is approximately 15 gpm. The water shall first be pumped through a 35 micron bag filter, then two 300 lb. clay absorption units in series, then two 300 lb. activated carbon units in series. The water pumped through the treatment units shall be pumped through a two (2) inch diameter PVC pipe into the adjacent Building C-16. The two (2) inch diameter discharge pipe shall be connected to existing piping inside Building C-16 that drains to the sanitary sewer system.

The second bioslurper unit, located near Building C-50, shall operate in an identical manner to the first bioslurper unit with several exceptions. The second bioslurper unit shall only be connected to two extraction wells. It should be noted that additional wells may be added on to this unit at a later date. The flow rate into the second unit is anticipated to be approximately one (1) gpm, based on two wells at 0.5 gpm each. The hydraulic profile of the second unit is analogous to the first unit except for the addition of a sump and pump after the treatment units. A 60 gallon effluent sump and a one (1) horsepower pump were installed inside the second unit in order to pump the effluent from the second bioslurper unit, below grade to the first bioslurper unit by Building C-16. The effluent from the second bioslurper unit shall be piped into the effluent discharge from the first unit, which discharges into existing piping inside Building C-16 which ultimately drains to the sanitary sewer system.

The expected peak flows of the systems would be double the rates previously discussed in this section. The peak flow for Bioslurper Unit #1 would be nine (9) gpm and the peak flow from Bioslurper Unit #2 would be two (2) gpm. The peak flow estimates are based upon peak flows observed during the operation of the pilot bioslurper system at Earle. The peak flows would result from a rise in the water table which would cause additional water to be extracted from each recovery well. The peak flows shall be kept in control by monitoring the groundwater levels in the extraction wells on a weekly basis and ensuring that the vacuum extraction tubes inside the wells are properly situated for minimal water withdrawal.

(v.) **The Expected Composition of Effluent from the Treatment System**

Based upon the treatment train explained in section i.i.i, the expected composition of the effluent from the system is below detection limits to 1.4 ppm of Oil and Grease.

OIL/WATER SEPARTOR CALCULATIONS

Given the following data:

Q =	20	flowrate (gpm)
T =	35	fluid temperature (°F)
Psg =	0.9	oil specific gravity
S =	0.75	media spacing (in.)
SP =	48	media specific surface area (sq.ft./cu.ft.)
M =	60	micron removal size (microns)

determine the media pack size needed to meet the effluent quality requirements. For a rectangular model separator, the tank requirements are:

L =	3	media length (ft.)
H =	2	media height (ft.)
Lt =	4	tank length (ft.)

First, determine the rate of rise of the oil particles according to Stokes Law:

$$V_r = C_1 * (W_{sg} - P_{sg}) * (M / 10000)^2 / W_v = 0.024 \text{ ft./min.}$$

where:

C1 = Combination of conversion factors =	107.2
Wsg = Water specific gravity at given low temperature =	1.00
Wv = Water viscosity at given temperature =	0.0164 poise.

Next calculate the surface area needed to accomplish separation based on the above Vr:

$$A_{min} = Q / V_r / C_2 = 112.5 \text{ sq.ft.}$$

where:

C2 = Conversion factor (7.48 gal./cu.ft.).

Now determine the minimum volume of media required for this separation:

$$V_{min} = A_{min} / SP = 2.3 \text{ cu.ft.}$$

Given the following media pack width, determine the operating characteristics of the pack:

W = 4 media width (ft.)

Media Pack Characteristics

Actual Coalescing Area	1152	sq.ft.
Actual Settling Area	288	sq.ft.
Actual Media Volume	24	cu.ft.
Fluid Velocity in Pack	0.33	ft./min.
Specific flowrate	0.0174	gpm/sq.ft.
Detention Time in Pack	9.0	min.
Actual Safety Factor	10.2	
Reynolds No. (Low Temp.)	38	
Reynolds No. (High Temp.)	67	

Since the Reynolds Number is less than 500, the flow in the pack is laminar. Therefore Stokes Law applies and optimal separation will be achieved.

OIL WATER SEPARATOR

Operation

The separator shall be a special purpose prefabricated parallel corrugated plate gravity displacement type oil/water separator designed to remove free and dispersed non-emulsified oil and settleable solids, in accordance with API 421. The separator shall be comprised of a tank containing an inlet compartment, sludge chamber and clean water outlet chamber.

INLET COMPARTMENT

The inlet chamber will be comprised of a non-clog diffuser pipe to distribute the flow across the width of the separator chamber. The inlet compartment shall be of sufficient volume to effectively reduce influent suspended solids, dissipate energy and begin separation. A sludge baffle will be provided to prevent settleable solids and sediment from entering the separation chamber.

SEPARATION CHAMBER

The separation chamber will contain parallel corrugated plates for enhanced oil/water separation. The plates will be spaced for optimum removal of free oil and settleable solids, and the corrugations will have a 60 degree angle with respect to the horizontal. Flow through the plate pack will be in a cross-flow configuration. This allows the oil to collect and coalesce in the high points of the corrugations while the solids collect at the low points. This also allows oil to rise without interfering with the falling solids, reducing the possibility of clogging. Plates shall be enclosed in a stainless steel frame to facilitate installation and removal.

SLUDGE CHAMBER (Option)

The sludge chamber can be located under the separation chamber and will provide an adequate volume for the settling of any solids. The angle of repose of the sludge chamber is 45 degrees to ensure easy and complete removal of the solids through outlet flanges provided on each side of the separator.

OIL COLLECTION

The oil will be collected at the end of the separation chamber by a fixed weir trough or rotatable skimmer. Either collection method will provide for automatic decant of the separated oil through gravity outlet(s) on the side(s) of the separator. The type of oil collector depends upon the application.

INTEGRAL OIL STORAGE COMPARTMENT (Option)

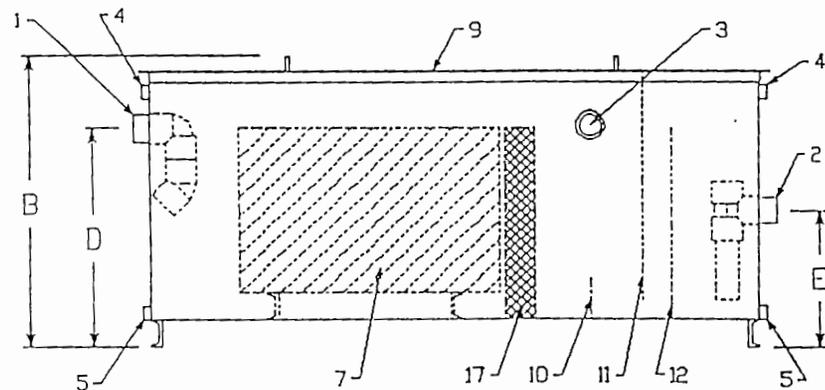
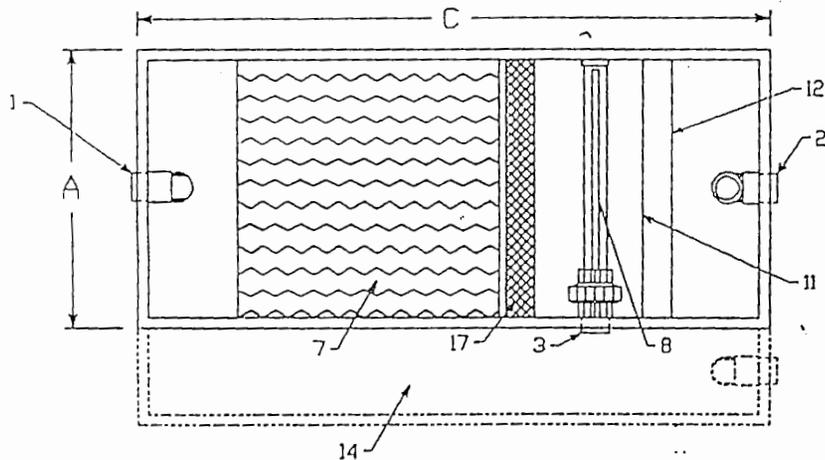
An integral oil storage compartment can be provided for storing separated oil. The compartment adjacent to the coalescing compartment would collect and store the oil discharged from the oil collector.

CLEAN WATER CHAMBER

The water will pass under the oil retention baffle and over the adjustable effluent weir, which maintains the liquid level throughout the separator, and exit through the outlet provided at the end of the separator.

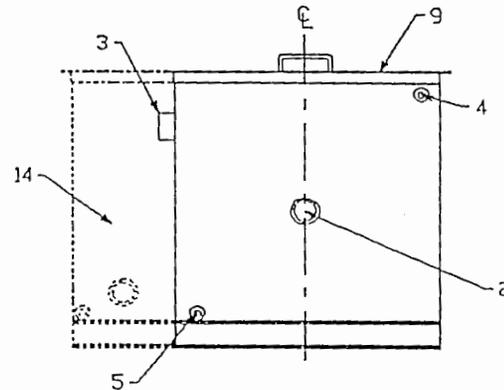
COVERS

The separator is provided with a vapor tight cover that can easily be removed for service and maintenance.



NOTES:

- 1) CONSTRUCTION: 1/8" OR 1/4" A36 CARBON STEEL.
- 2) COVER GASKET: NEOPRENE.
- 3) HARDWARE: 10-8 STAINLESS STEEL.
- 4) PVC PIPE & FITTINGS: GRAY SCHEDULE 80.
- 5) INTERIOR COATING: EPOXY PAINT.
- 6) EXTERIOR COATING: EPOXY PAINT.
- 7) TANKS CONSTRUCTED IN ACCORDANCE WITH API STANDARDS 620 & 650.
- 8) ALL CONNECTIONS 4" AND SMALLER ARE NPT COUPLINGS. ALL CONNECTIONS 6" AND LARGER ARE FLAT FACE FLANGES WITH ANSI 150# DRILLING.
- 9) ANCHOR BOLTS TO BE 1/2" DIA MINIMUM WITH 6" EMBEDMENT AND 2" PROJECTION.
- 10) OPTIONAL OIL RESERVOIR IS A SEPARATE COMPARTMENT ON THE SIDE AS SHOWN. CAPACITIES RANGE FROM 100 TO 400 GAL. RESERVOIR CAN BE FITTED FOR PUMP CONTROL AND/OR HIGH LEVEL ALARMS.



ITEM	QTY	STANDARD EQUIPMENT
1	1	INLET NOZZLE (SEE SCHEDULE)
2	1	OUTLET NOZZLE (SEE SCHEDULE)
3	1	OIL OUTLET (SEE SCHEDULE)
4	2	VENT (SEE SCHEDULE)
5	2	DRAIN (SEE SCHEDULE)
6	1	LEVEL SENSOR PORT (SEE SCHEDULE)
7	A/R	PARALLEL PLATE MEDIA
8	1	OIL SKIMMER
9	A/R	VAPOR TIGHT COVER
10	1	SLUDGE BAFFLE
11	1	OIL STOP VEIR
12	A/R	EFFLUENT OVERFLOW VEIR
13	4	LIFTING LUG
OPTIONAL EQUIPMENT		
14	1	OIL RESERVOIR (SEE NOTE 10)
15	A/R	LEVEL CONTROLS - NEHA ENCLOSUR
16	A/R	IMMERSSION HEATER(S)
17	A/R	POLISHING MEDIA
18	A/R	INFLUENT / EFFLUENT PUMPS
19	1	OIL PUMP
CUSTOMER SUPPLIED EQUIPMENT		
20	1	CEMENT PAD
21	A/R	ANCHOR BOLTS
22	A/R	EXTERNAL PIPING
23	A/R	VENT PIPING

PERFORMANCE

SIZING OF OIL/WATER SEPARATOR TANK TO BE DETERMINED BY HYDRO DUMP BASED ON REMOVING NON-FLOTTIFIED FREE AND DISPERSED OIL AND SOME SETTLEABLE SOLIDS.

ANALYSIS MUST INDICATE THAT AT THE CALCULATED OVERFLOW RATE, THE OIL/WATER SEPARATOR WILL BE EQUIPPED WITH THE REQUIRED PROJECTED PLATE AREA TO REALIZE THE SPECIFIED PERFORMANCE UNDER LAMINAR FLOW CONDITIONS. CALCULATIONS TAKE INTO ACCOUNT FLOW RATE, FLUID TEMPERATURE RANGE, INFLUENT CONCENTRATIONS AND SPECIFIC GRAVITIES OF OIL AND SOLIDS TO BE REMOVED. ACCEPTABLE DISCHARGE LIMITS, POTENTIAL SURGE FLOWS, PARTICLE CHARACTERISTICS, AND pH.

THE AG MODEL WILL EFFICIENTLY REMOVE 100% OF ALL 20 MICRON AND LARGER PARTICLES AND PRODUCE AN EFFLUENT OF 10 mg/l AS MEASURED BY API METHOD 481.

MODEL	SCHEDULE					ITEM NO.					SLUDGE CAP. (GAL)	SHIP WEIGHT (LBS)	OPER. WEIGHT (LBS)
	A D.A. WIDTH	B D.A. HEIGHT	C D.A. LENGTH	D INLET HEIGHT	E OUTLET HEIGHT	1 INLET DIA	2 OUTLET DIA	3 OIL DIA	4 VENT DIA	5 DRAIN DIA			
AGS-1	15'	30'	51'	20"	12"	1"	1"	1"	1"	1"	3	288	1307
AGS-2	27'	30'	51'	20"	12"	2"	2"	2"	1"	1"	5	428	2466
AGS-3	40'	30'	52'	20"	12"	2"	2"	2"	1"	1"	8	567	3625
AG-1	15'	42'	87'	32"	20"	2"	2"	2"	1"	1"	12	539	1559
AG-2	27'	42'	87'	32"	20"	3"	3"	3"	1"	1"	24	771	2810
AG-3	40'	42'	88'	32"	20"	4"	4"	3"	1"	1"	36	1003	4061
AG-4	52'	42'	88'	32"	20"	6"	6"	4"	2"	2"	48	2253	6312

→ Model AG-4 will be used.

B	ADDED OPTIONAL OIL STORAGE	2/7/95	DFH
A	ADDED MODEL AGS	2/14/95	DFH
REV.	DESCRIPTION	DATE	DFH

TITLE	OIL/WATER SEPARATOR MODELS AGS / AG	DRN BY: DFH
		CHD BY: MPT
PROJECT		DATE: 1/16/96
REF:	FILE: AG-SALE(00)	SCALE: 10-E
THE DRAWING IS PROPERTY OF BISCO ENVIRONMENTAL INC AND MUST NOT BE REPRODUCED OR DISTRIBUTED WITHOUT WRITTEN PERMISSION FROM BISCO ENVIRONMENTAL.		REV: 0

→ 30 Micron Sizing

		Maximum Flowrate (gpm)											
		1/2" Media				3/4" Media				1-1/8" Media			
Spec. Gravity		0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95
M O D E L	AGS-1	6	3	2	1	4	2	-	-	2	1	-	-
	AGS-2	13	6	4	2	9	4	3	1	5	2	1	-
	AGS-3	19	9	6	3	13	6	4	2	8	4	2	1
	AG-1	39	19	13	6	27	13	9	4	17	8	5	2
	AG-2	78	39	26	13	54	27	18	9	35	17	11	5
	AG-3	118	59	39	19	82	41	27	13	53	26	17	8
	AG-4	157	78	52	26	109	54	36	18	70	35	23	11
	HP-0	78	39	26	13	54	27	18	9	35	17	11	5
	HP-1	157	78	52	26	109	54	36	18	70	35	23	11
	HP-2	210	105	70	35	146	73	48	24	94	47	31	15
L	HP-3	315	157	105	52	219	109	73	36	141	70	47	23
	HP-4	420	209	140	70	292	146	97	49	188	94	63	31
	HP-5	525	262	175	88	365	182	122	61	235	118	78	39
	HP-6	630	315	210	105	438	219	146	73	282	141	94	47
	HP-7	735	368	245	123	511	256	171	85	328	165	110	55
	HP-8	840	420	280	141	584	292	195	98	375	189	126	63
	HP-9	945	473	316	158	657	329	219	110	421	212	141	71
	HP-10	1,050	525	351	176	730	365	244	122	468	236	157	79

Selected Model for Earle

Assumptions: Temp. Range = 40-75°F
 Removal = 30 microns
 Act. Safety Factor = 1.50 minimum
 Using Brentwood specific surface area

		Maximum Flowrate (gpm)											
		1/2" Media				3/4" Media				1-1/8" Media			
Spec.Gravity		0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95
M O D E L	AGS-1	25	12	8	4	15	8	5	2	11	5	3	1
	AGS-2	50	25	17	8	31	16	10	5	23	11	7	3
	AGS-3	75	38	25	13	47	24	16	8	35	17	11	5
	AG-1	55	55	51	26	37	37	32	16	24	24	23	11
	AG-2	110	110	103	52	74	74	64	32	48	48	46	22
	AG-3	165	165	155	78	111	111	96	48	72	72	69	33
	AG-4	220	220	207	104	148	148	128	64	96	96	92	44
	HP-0	110	110	103	52	74	74	64	32	48	48	48	22
	HP-1	168	168	155	78	114	114	96	48	75	75	75	35
	HP-2	220	220	220	138	148	148	148	84	96	96	96	62
L	HP-3	330	330	330	207	222	222	222	126	144	144	144	93
	HP-4	440	440	440	276	296	296	296	168	192	192	192	124
	HP-5	550	550	550	345	370	370	370	210	240	240	240	155
	HP-6	660	660	660	414	444	444	444	252	288	288	288	186
	HP-7	770	770	770	483	518	518	518	294	336	336	336	217
	HP-8	880	880	880	552	592	592	592	336	384	384	384	248
	HP-9	990	990	990	621	666	666	666	378	432	432	432	279
	HP-10	1,100	1,100	1,100	690	740	740	740	420	480	480	480	310

Selected Model for Earle

Assumptions: Temp. Range = 40-75°F
 Removal = 60 microns
 Act. Safety Factor = 1.50 minimum
 Using Munters specific surface area

After 1st Clay Absorption Unit
of Biosorber Unit #1

GTM-115

Clarion Media Design Criteria/Calculations

<u>Contaminants</u>	<u>Concentration</u>		<u>Removal Efficiency</u>	<u>PPM Removed</u>	<u>PPM Remaining</u>
Oil & Grease	<u>557</u> ppm	x	95%	<u>529</u> ppm	<u>28</u> ppm
Pentachlorophenol	_____ ppm	x	95%		
Benzene	_____ ppm	x	20%		
Toluene	<u>1.2</u> ppm	x	70%	<u>0.84</u> ppm	<u>0.36</u> ppm
Ethyl Benzene	_____ ppm	x	90%		
Xylene	<u>0.36</u> ppm	x	95%	<u>0.34</u> ppm	<u>0.02</u> ppm
_____	_____ ppm	x	_____		
_____	_____ ppm	x	_____		
Totals				<u>530</u> ppm	<u>28</u> ppm

Contaminant Loading

Total removed 530 ppm x 0.0000084 = 0.0045 pounds of organics/gallon

0.0045 Pounds of organics/gallon x ^{4.5gpm} GPM (flow rate) = 0.02 pounds of organics/minute

0.02 Pounds of organics/minute x 1440 minutes operated/day = 28.8 pounds of organics/day

Media Consumption(50% absorption efficiency)

28.8 Pounds of organics/day ÷ 0.50 efficiency = 58 pounds media/day

_____ Pounds of media/day x _____ operating days/year = _____ pounds of media/year

Estimated Bed Life

300 Pounds of media in vessel ÷ pounds of media/day = 5 days of bed life



After 2nd Clay Unit
of Biosorber Unit #1

Clarion Media Design Criteria/Calculations

<u>Contaminants</u>	<u>Concentration</u>		<u>Removal Efficiency</u>	<u>PPM Removed</u>	<u>PPM Remaining</u>
Oil & Grease	28 ppm	x	95%	26.6	1.4
Pentachlorophenol	_____ ppm	x	95%		
Benzene	_____ ppm	x	20%		
Toluene	0.36 ppm	x	70%	0.25	0.11
Ethyl Benzene	_____ ppm	x	90%		
Xylene	0.02 ppm	x	95%	0.019	0.001
_____	_____ ppm	x	_____		
_____	_____ ppm	x	_____		
Totals				27 ppm	1.5 ppm

Contaminant Loading

Total removed 27 ppm x 0.0000084 = 0.0002 pounds of organics/gallon

0.0002 Pounds of organics/gallon x GPM (flow rate) ^{4.5 gpm} = 0.0009 pounds of organics/minute

0.0009 Pounds of organics/minute x 1440 minutes operated/day = 1.3 pounds of organics/day

Media Consumption(50% absorption efficiency)

1.3 Pounds of organics/day ÷ 0.50 efficiency = 2.6 pounds media/day

_____ Pounds of media/day x _____ operating days/year = _____ pounds of media/year

Estimated Bed Life

300 Pounds of media in vessel ÷ ^{2.6} pounds of media/day = 115 days of bed life

LAB SAMPLE RESULTS FOR WATER STREAM FROM EARLE PILOT STUDY
(UNTREATED)

Page 1/4
Received: 03/19/97

TOXIKON CORP. REPORT
03/24/97 10:47:36

Work Order # 97-03-314

REPORT FOSTER & WHEELER
TO 1 OXFORD VALLEY, SUITE 200
LANGHORNE, PA. 19047
215-702-4015 FAX: 4092

PREPARED TOXIKON CORPORATION
BY 15 WIGGINS AVE
BEDFORD, MA 01730


CERTIFIED BY

ATTEN MICHAEL HEFFRON

ATTEN PAUL LEZBERG
PHONE (617)275-3330

CONTACT CHUCKC

CLIENT FOSTER SAMPLES 2

COMPANY FOSTER & WHEELER
FACILITY 1 OXFORD VALLEY, SUITE 200
LANGHORNE, PA. 19047

MA CERT # M-MA064: TRACE METALS, SULFATE, CYANIDE, RES. FREE
CHLORINE, Ca, TOTAL ALK., TDS, pH, THMs, VOC, PEST., NUTRIENTS.
DEMAND. O&G, PHENOLICS, PCBs . CT DHS #PH-0563, NY #10778
FL HRS E87143, NJ DEP 59538, NC DNR286, SC 88002, NH 204091-C.

WORK ID NAVY EARLE PROJECT #17

TAKEN 3/18/97

VERIFIED BY: 

TRANS _____

TYPE WATER

P.O. # _____

INVOICE under separate cover

SAMPLE IDENTIFICATION

TEST CODES and NAMES used on this workorder

01 NE-WD01
02 NE-WD02

602 PURGEABLE AROMATICS
MEXDWG METALS DIS.EXT. WATER-GFAA
MEXTWG METALS, TOT WATER EXT.-GFAA
MEX HG METALS, EXT. FOR MERCURY
O G GR O. & G. by Gravimetric
PH W PH - AQUEOUS
TALW TAL METALS
TSS TOTAL SUSPENDED SOLIDS

SAMPLE ID	<u>NE-WD01</u>	SAMPLE #	<u>01</u>	FRACTIONS:	<u>A,B</u>
		Date & Time Collected	<u>03/18/97 15:00:00</u>	Category	<u>WATER</u>
O_G_GR	<u>557</u>	PH_W	<u>5.9</u>	TSS	<u>84.0</u>
mg/L	DL=5.0	PH UNITS		mg/L	DL=4.0

SAMPLE ID NE-WD01 FRACTION 01A TEST CODE 602 NAME PURGEABLE AROMATICS
Date & Time Collected 03/18/97 15:00:00 Category WATER

EPA 602

	RESULT	LIMIT
BENZENE	<u>ND</u>	<u>100</u>
TOLUENE	<u>1180</u>	<u>100</u>
ETHYLBENZENE	<u>ND</u>	<u>100</u>
XYLENES (TOTAL)	<u>355</u>	<u>100</u>

Notes and Definitions for this Analysis:

UNITS: ug/L
DATE RUN: 03/23/97
ANALYST: PL
INSTRUMENT: V5
DIL. FACTOR: 100

ND = not detected at detection limit

SAMPLE ID NE-WD01 FRACTION 01A TEST CODE TALW NAME TAL METALS
Date & Time Collected 03/18/97 15:00:00 Category WATER

TAL METALS

	RESULT	LIMIT
Silver	<u>ND</u>	<u>0.005</u>
Cadmium	<u>ND</u>	<u>0.002</u>
Chromium	<u>0.011</u>	<u>0.002</u>
Copper	<u>0.472</u>	<u>0.002</u>
Nickel	<u>0.005</u>	<u>0.005</u>
Lead	<u>0.229</u>	<u>0.002</u>
Zinc	<u>0.273</u>	<u>0.005</u>
Arsenic	<u>ND</u>	<u>0.002</u>
Selenium	<u>ND</u>	<u>0.002</u>
Beryllium	<u>ND</u>	<u>0.002</u>
Antimony	<u>0.004</u>	<u>0.002</u>
Thallium	<u>ND</u>	<u>0.003</u>
Barium	<u>0.011</u>	<u>0.002</u>
Iron	<u>91.7</u>	<u>0.010</u>
Manganese	<u>0.116</u>	<u>0.002</u>
Cobalt	<u>ND</u>	<u>0.002</u>
Vanadium	<u>0.003</u>	<u>0.002</u>
Aluminum	<u>0.603</u>	<u>0.010</u>
Calcium	<u>26.4</u>	<u>0.010</u>
Potassium	<u>1.61</u>	<u>0.500</u>
Sodium	<u>119</u>	<u>0.500</u>
Magnesium	<u>4.59</u>	<u>0.005</u>
Mercury	<u>ND</u>	<u>0.0002</u>

Notes and Definitions for this Report:

EXTRACTED..... 03/20/97
DATE RUN..... 03/21/97
ANALYST..... BKO
INSTRUMENT.... TRACE
CONC FACTOR... 1
UNITS..... mg/L

ND = not detected at detection limit

Clarion® PM-100

WASTEWATER FILTRATION MEDIA

SYSTEM AC®

CLARION PM-100 is a chemically modified clay and anthracite filtration media that reliably removes oil, grease and other high-molecular weight organics from wastewater. Engineered for column operation, CLARION PM-100 is an effective treatment technology. It can also be used as a pre-treatment or post-treatment to many other filtration technologies.

CLARION® PM-100 is an excellent pre-treatment for activated carbon, reverse osmosis and desalination systems. For example, by absorbing up to 60% of its weight in oil and grease, CLARION PM-100 will increase the effectiveness of activated carbon by preventing the pore blinding problem associated with oil, grease and other less water-soluble organics. CLARION PM-100 can extend the lifetime of the carbon by factors of 2 to 10 times, while resulting in higher carbon sorption capacity. In general, anytime oil and grease extractable are 1 ppm or greater, PM-100 will be an economic advantage as a pre-treatment for carbon.

As a stand alone media, CLARION PM-100 is the best technology available for treatment of oil contaminated wastestreams and boiler condensate.

CLARION PM-100 is an extremely efficient post-treatment media downstream of equipment such as dissolved and induced air flotation units, API oil separators, corrugated plate separators, granular media oil coalescers, ultrafiltration, air strippers and our own wastewater treatment systems.

ADVANTAGES AND BENEFITS

- **Economical to use.** PM-100's large absorption capacity (up to 60% its weight) for oil and other high molecular weight organics makes it the cost effective oil-removal alternative relative to other filtration materials.
- **Dependable.** PM-100 can accommodate increases in flow rates and contaminant concentration levels caused by accidental spills and plant upsets. When oil is not present, PM-100 is not being expended, thus providing a "fail safe" method to prevent oil contamination.
- **Simple to Apply.** PM-100 is employed in conventional filtration contactors.
- **Non-Hazardous.** Fresh PM-100 is non-hazardous; therefore, the waste classification of the spent material is determined by the constituents removed.

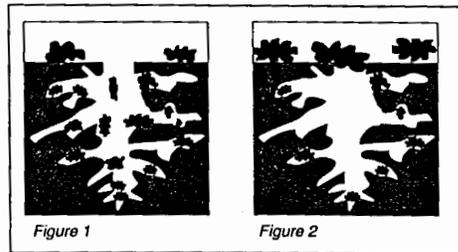


Figure 1 (Left)
Activated carbon surface area sorption.

Figure 2 (Right)
Blinded activated carbon pore resulting in lower organic adsorption.

CLARION PM-100 differs from activated carbon in the mechanism of organic sorption from water. Activated carbon absorbs organics through a surface area related mechanism (Figure 1) which tends to foul activated carbon by blinding the pore structure (Figure 2) and lowering the available surface area for adsorption. CLARION PM-100 technology absorbs organics through a platelets partitioning process (Figure 3) that increases the organic absorption capacity to approximately 60% of its weight.

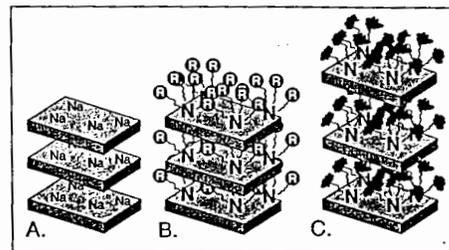


Figure 3
(A.) Clay platelets.

(B.) Clay surface chemically modified to form CLARION.

(C.) CLARION saturated with organic contaminants. Clay platelets expanded.

CLARION PM-100 SYSTEM DESIGN CRITERIA

The design criteria of PM-100 systems is similar to a typical granular activated carbon system. The following design parameters are recommended:

Granular Oil Absorbent	PM-100
Bed Depth	3 feet (min.)
Hydraulic Loading	3-4 gpm/sq. ft. (max)
Contact Time	2-5 minutes
Bed Expansion	20%

SPECIFICATIONS

Particle Size:	16x40 mesh (US sieve)
Moisture	8%
Water Retention, Drained	10%
Density	Shipped 52-54 lb./ft. ³ Backflushed, settled in column 58 lb./ft. ³

Standard Packaging

Packaged in 50 Lb. boxes and 2000 Lb. bulk bags.



COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

INDUSTRIAL SERVICES GROUP
1350 West Shure Drive
Arlington Heights, IL 60004-1440
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800/527-9948

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Clarion PM-100

Protection for Activated Carbon Water Treatment Systems

A technical problem in the application of activated carbon water treatment systems is the presence of oil and grease extractable organics. These organics tend to be higher molecular weight, less water-soluble compounds occurring many times as emulsions. Such organic contaminants tend to foul activated carbon by blinding the pore structure of the carbon and lowering the available surface area for adsorption, resulting in loss of capacity.

The PM-100 technology is a unique approach to sorption of organics from water. However, it differs from activated charcoal in the mechanism of sorption. Activated carbon adsorbs organics through a surface area related mechanism. PM-100 operates through a partitioning phenomena that has little relationship to surface area. The effectiveness of PM-100 to absorb organics is directly related to the water solubility of the organic. The partition coefficient for several organics on PM-100 versus the water solubility of the organics is presented in figure 1.

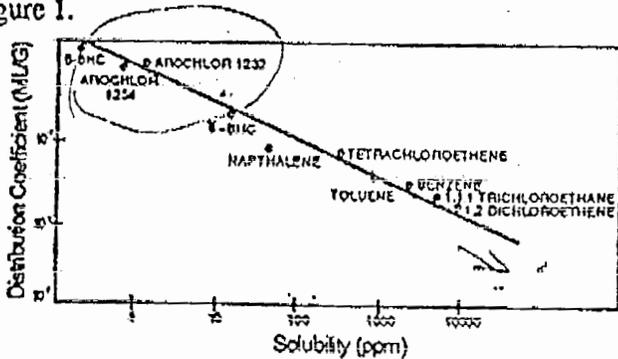


Figure 1.

As can be seen, there is a linear relationship between the partition coefficient and water solubility of the organic. In practical terms this means that any organic that would be extracted in a traditional oil and grease determination will be absorbed strongly by PM-100, but organics that are highly water soluble or that are quite volatile will absorb poorly onto PM-100. The PM-100 will efficiently remove from water, free, mechanical emulsified, and dissolved organics which are sparingly water soluble.

The PM-100 product is specifically designed to solve the fouling problem in activated carbon systems associated with

oil and grease. PM-100 will absorb up to 60% of its weight in oil and grease. In contrast, carbon, will adsorb only 2 to 3% of its own weight. In addition, PM-100 will absorb lightly emulsified oil and grease from solution. When PM-100 is utilized as a pre-treatment to carbon, it removes the oil and grease extractables and allows carbon to remove the water soluble organics more efficiently, and with higher capacity. This effect can be dramatic. The lifetime of carbon can be extended when combined with PM-100 by factors of 2 to 10 times, depending upon oil and grease levels in the waste stream. The PM-100, because of its large capacity, must be changed only a fraction of the times that the carbon is changed. In general, any time the oil and grease extractables are 1 ppm or greater, PM-100 will be of an economic advantage in combination with carbon. The overall cost of combining PM-100 with carbon will be lower than carbon alone. In many cases, this cost reduction factor is 1/2 to 1/4 the cost of carbon alone, depending upon the oil and grease level in the waste.

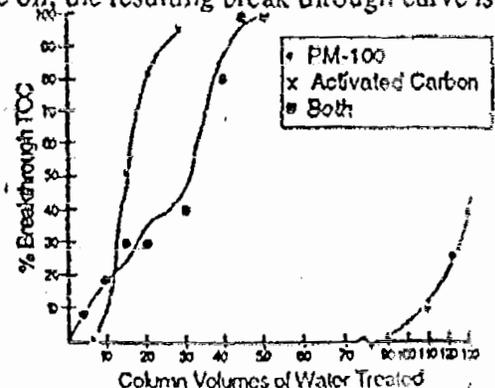
Example of PM-100 Efficacy

The breakthrough curves for the application of PM-100 to a waste water containing 200 ppm oil and grease and 200 ppm toluene is presented in Figure 2.

The first curve is the breakthrough obtained with activated carbon alone. It is obvious that carbon is very inefficient for removing the mix of contaminants.

The second curve is the same waste treated with PM-100 alone. The PM-100 performs substantially better than the carbon column. However, when PM-100 is utilized to protect the carbon from the oil, the resulting break through curve is superior in performance as compared to either technology alone.

Figure 2



I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge, in accordance with TABLE III-A-1 to the Yellow Brook which is classified as FW2-NT at the following coordinates:

Latitude: 40° 16' 25" Longitude: 74° 09' 55"

This facility is classified as a minor facility.

The influent monitoring location shall be before any treatment, other than degritting, and before the addition of any internal wastestreams. The effluent monitoring (including acute WET) location shall be post dechlorination at the effluent weir. Unless otherwise noted, only effluent monitoring is required and all limitations are expressed as maximums. Other requirements pertaining to monitoring and reporting are contained in Part I-DSW.

Except due to natural conditions, for direct discharges to surface water, the discharge of foam, or foaming of the receiving water as a direct result of the discharge is prohibited when foam,

- forms objectionable deposits on the receiving water,
- forms floating masses producing a nuisance,
- produces objectionable color or odor, or
- interferes with a designated use of the waterbody.

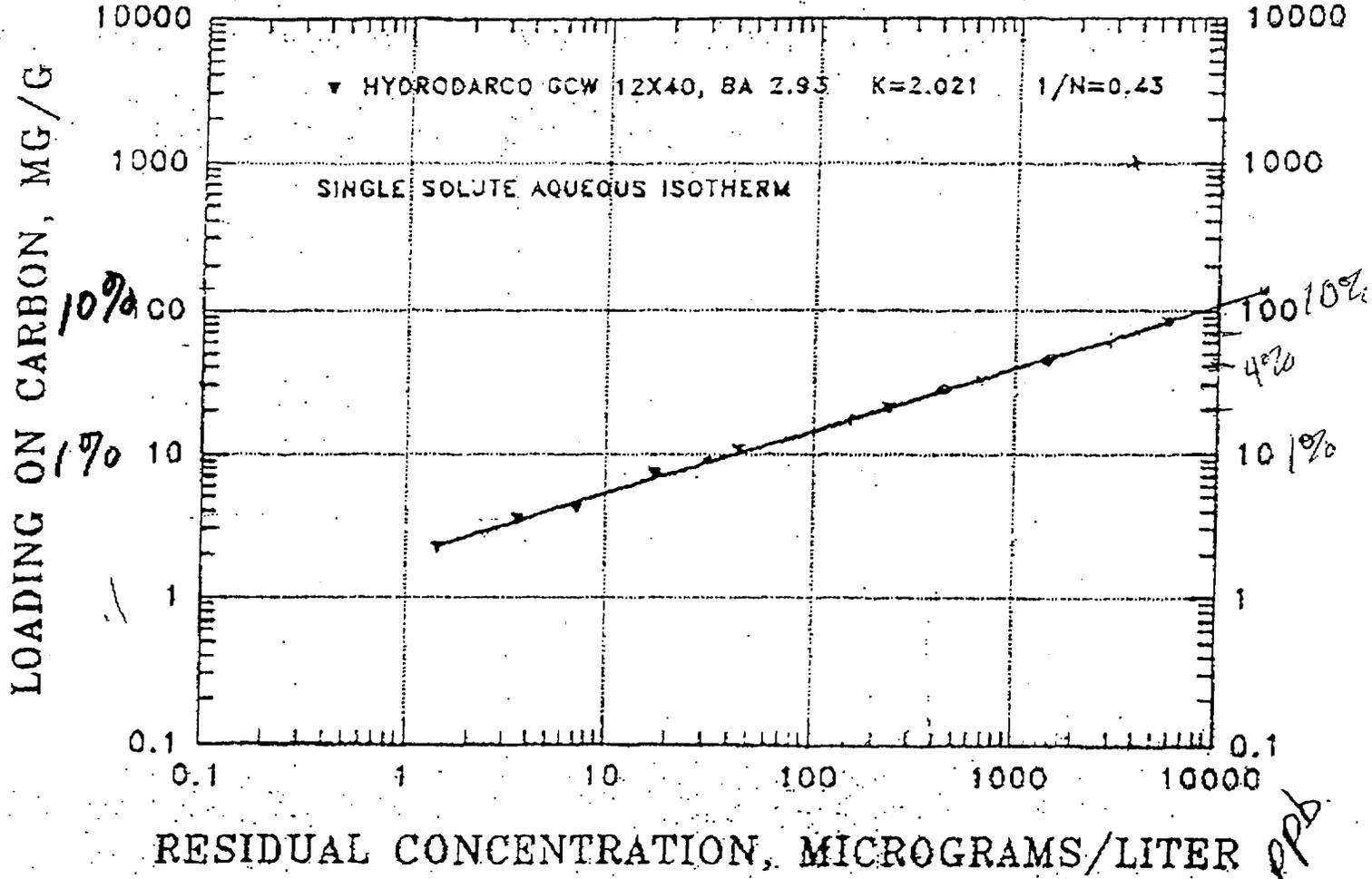
TABLE III-A-1

PARAMETER	UNITS	DURATION	FINAL	MONITORING	
			EFFLUENT	FREQUENCY	SAMPLE
			LIMITATIONS		TYPE
Flow	MGD	Monthly Avg. Daily Max	0.37 (2)	Continuous	Continuous
5-Day Biochemical Oxygen Demand (BOD ₅) (1)	kg/d	Monthly Avg. Weekly Avg.	42 63	2/Month	Calculated
5-Day Biochemical Oxygen Demand (BOD ₅) (1)	mg/L	Monthly Avg. Weekly Avg.	30 45	2/Month	6Hr Composite
BOD ₅ Minimum Percent Removal	%	Monthly Avg.	90	2/Month	Calculated
Total Suspended Solids (TSS) (1)	kg/d	Monthly Avg. Weekly Avg.	42 63	2/Month	Calculated
Total Suspended Solids (TSS) (1)	mg/L	Monthly Avg. Weekly Avg.	30 45	2/month	6Hr Composite
TSS Minimum Percent Removal	%	Monthly Avg.	85	2 month	Calculated
Fecal Coliform (geometric mean)	# per 100 ml	Monthly Avg. (4)	200 400	2/Month	Grab
Dissolved Oxygen (minimum)	mg/L	Inst. Minimum Daily Avg.	5.0 6.0	2/Month	Grab
Oil and Grease	mg/L	Monthly Avg Inst Max	10 15	Quarterly	Grab
Temperature (1)	°C	Minimum Monthly Avg Maximum	(2) (2) (2)	Daily	Grab

pH (1)	SU	Minimum Maximum	6.0 9.0	Daily	Grab
Chlorine Produced Oxidants	mg/L	Monthly Avg. Daily Max	(2) 0.02 (3)	Daily	Grab
Acute Toxicity [LC50] (Acute Toxic Units)	%	Minimum (Maximum)	50% (2TU's)	Annual	See Part IV-A

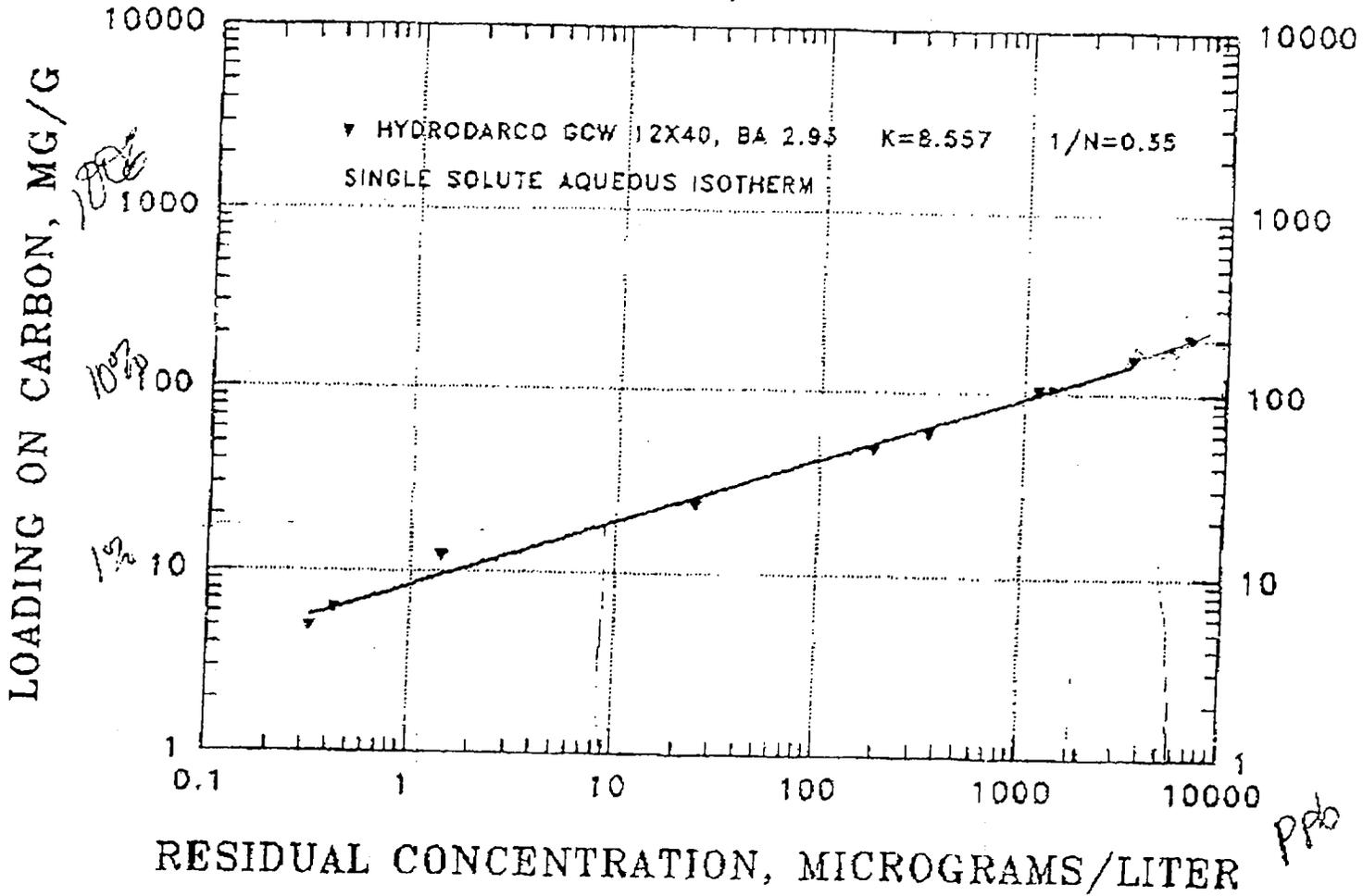
- (1) Influent and effluent monitoring and reporting are required.
- (2) Monitor and Report Only
- (3) The permittee shall comply with the current enforceable permit level of level of 0.1 mg/L as a daily Maximum concentration. Analysis for Chlorine Produced Oxidants (CPO) should be by those methods available for Total Residual Chlorine.
- (4) No more than 10% of the total samples taken during any thirty (30) day period shall exceed 400/100 ml.

BENZENE



WARNING: HORIT AMERICAS INC. does not take any responsibility for the interpretation of this information which remains its property and must be treated confidentially.

TOLUENE

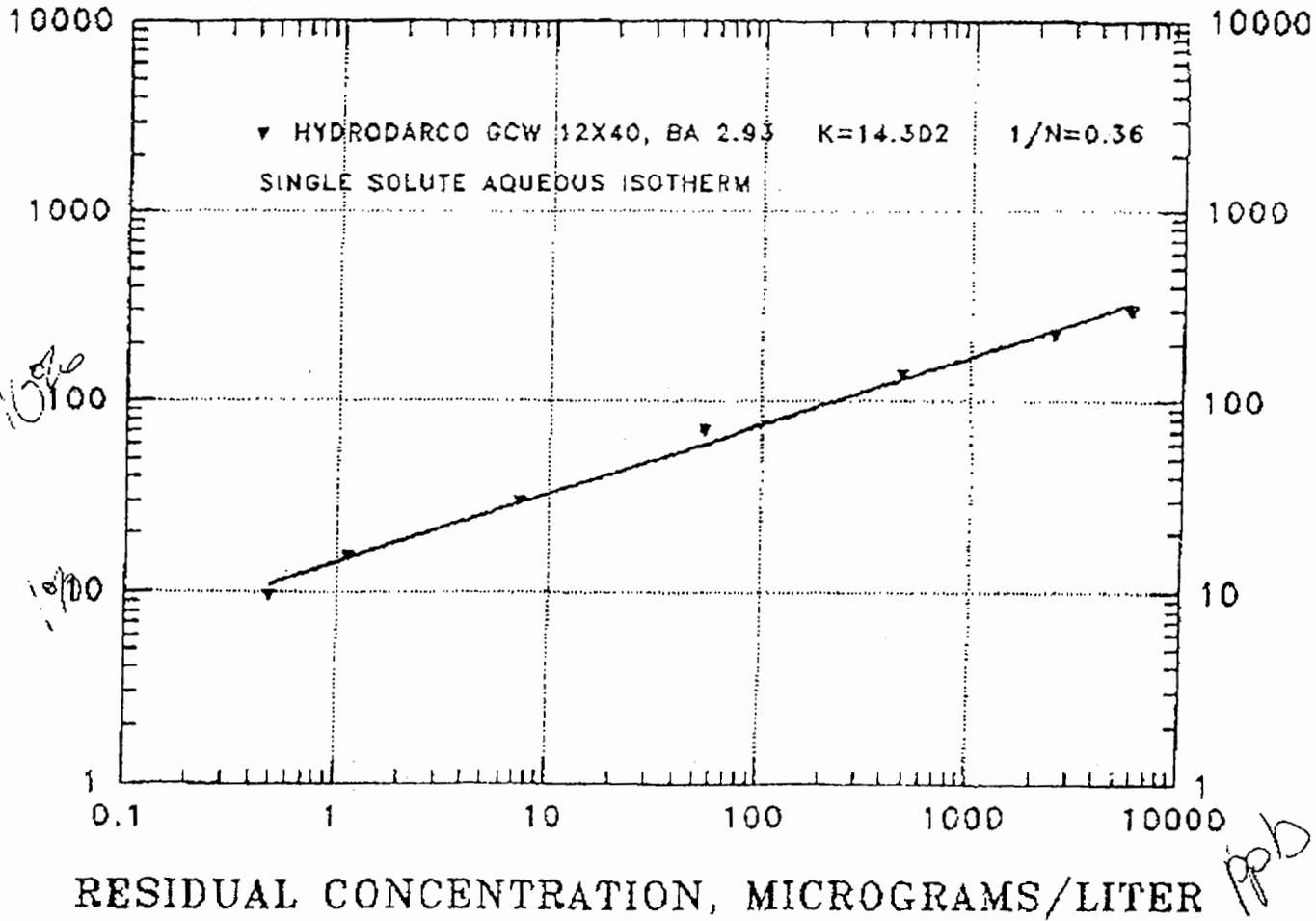


9033380913

14-15-1994 02:37PM

LOADING ON CARBON, MG/G

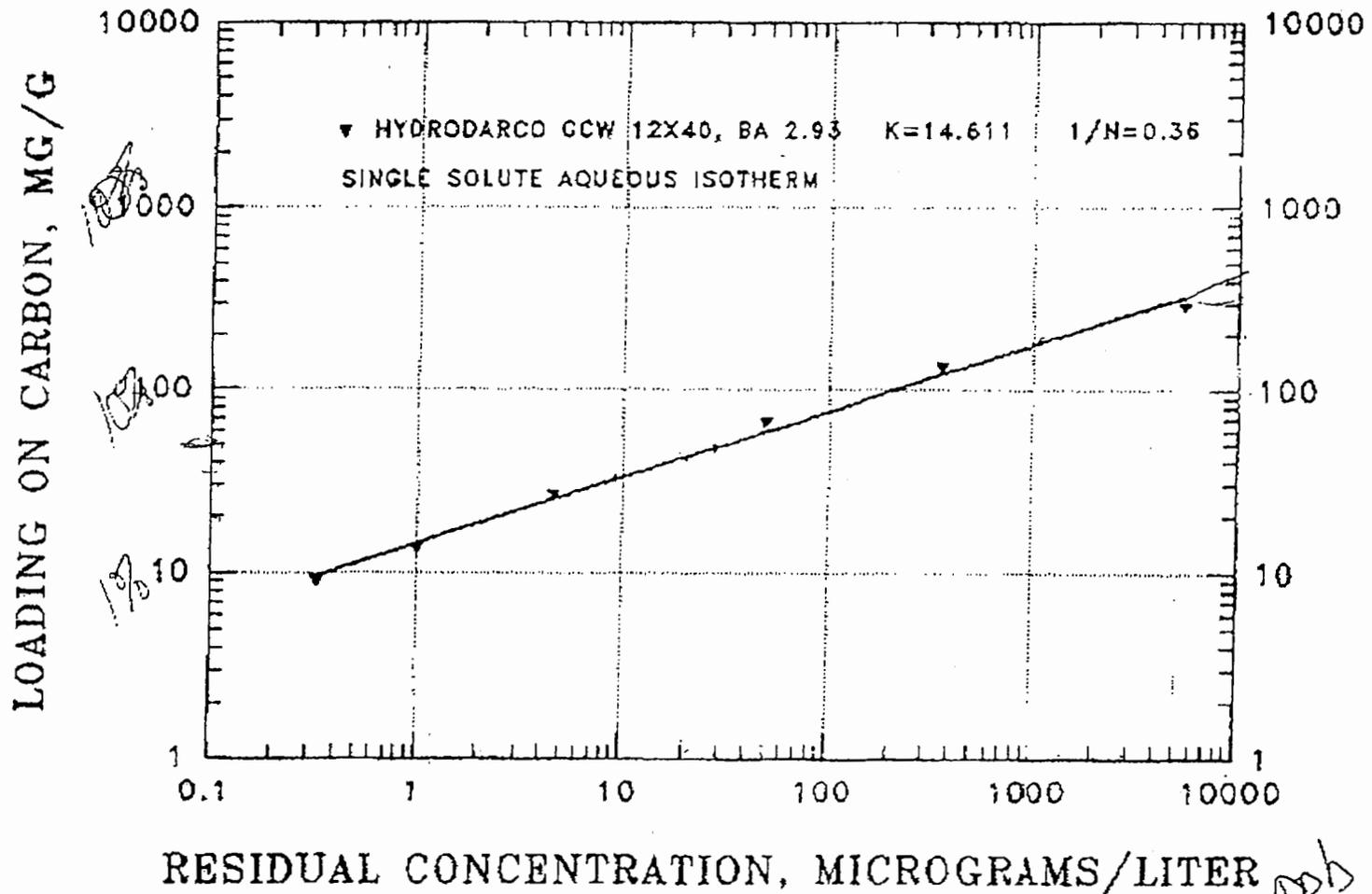
ETHYLBENZENE



RESIDUAL CONCENTRATION, MICROGRAMS/LITER

ppb

O-XYLENE



APB

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SECTION 02302

EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES
03/97



PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB14 (1992) Highway Bridges

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-103 (1990) Concrete Pipe Installation Manual

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.3 (1996) Process Piping

MILITARY SPECIFICATIONS (MIL)

MIL-P-28584 (Rev. B) Pipe and Pipe Fittings, Glass Fiber Reinforced Plastic, Adhesive Bonded Joint Type, for Condensate Return Lines

MIL-P-29206 (Rev. A; Am. 2) Pipe and Pipe Fittings, Glass Fiber Reinforced Plastic, for Liquid Petroleum Lines

1.2 DEFINITIONS

1.2.1 Backfill

Material used in refilling a cut, trench or other excavation.

1.2.2 Cohesive Materials

Soils classified by ASTM D 2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

1.2.3 Cohesionless Materials

Soils classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.4 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in [ASTM D 698 or ASTM D 1557 for general soil types] [or ASTM D 4253 or ASTM D 4254 (Relative Density) for isolated cohesionless materials], abbreviated in this specification as 90 percent ASTM D maximum density."

1.2.5 Granular Pipe Bedding

A dense, well-graded aggregate mixture of sand, gravel, or crushed stone (mixed individually, in combination with each other, or with suitable binder soil) placed on a subgrade to provide a suitable foundation for pipe. Granular bedding material may also consist of poorly graded sands or gravels where fast draining soil characteristics are desired.

1.2.6 Hard Material

Weathered rock, dense consolidated deposits, or conglomerate materials (excluding man made materials such as concrete) which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal. [Material indicated in the soil boring logs as having a standard penetration resistance as determined by ASTM D 1586 between 197 and 1968 blows per meter 60 and 600 blows per foot is arbitrarily defined herein as "Hard Material."]

1.2.7 In-Situ Soil

Existing in place soil.

1.2.8 Lift

A layer (or course) of soil placed on top of subgrade or a previously prepared or placed soil in a fill or backfill.

1.2.9 Refill

Material placed in excavation to correct overcut in depth.

1.2.10 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding [0.76] [0.38] [_____] cubic meter [1] [1/2] [_____] cubic yard in volume. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production. [Material identified in the soil boring logs as having a standard penetration resistance as determined by ASTM D 1586 greater than 1968 blows per meter 600 blows per foot is arbitrarily defined herein as "Rock."]

trench is as indicated. Hard material identified as railroad ballast on the borings shall not be considered as rock and removal of such material shall not give cause for a claim for additional compensation regardless of hardness or difficulty in removing. Rock as defined in paragraph entitled "Definitions," will not be encountered.]

- [c. The character of the material to be excavated or found in the trench is as indicated. Rock or hard material as defined in paragraph entitled "Definitions," will not be encountered.]
- [c. The character of the material to be excavated or found in the trench is as indicated. In addition to rock as indicated and as defined in paragraph entitled "Definitions," hard material in the form of conglomerate clay, sand, silt will be encountered. Remove such hard material to the lines and grades indicated regardless of the hardness or quantity.
- d. Ground water elevations indicated are those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. [Historical data indicates that ground water elevations vary from 6 feet in the winter to 10 feet in the summer.]
- [f. [Borrow material] [Suitable backfill] [and] [bedding material] in the quantities required is available at the project site on Government property from the existing trenches. Bedding sand shall also be obtained from a near-by quarry.
- [g. Blasting [will] [will not] be permitted.]

1.6 PROTECTION

1.6.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. [Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company.] [Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, ice, or other deleterious and objectionable materials.

2.1.1 Backfill

Bring trenches to grade indicated on the drawings using material [excavated on the site of this project. This material will be considered unclassified and no testing other than for compaction will be required before use as backfill.

2.1.2 [Special Backfill for Structures and Pavements

Backfill trenches under roads, structures, and paved areas with material conforming to the requirements stated above except that the liquid limit of the material cannot exceed 35 percent when tested in accordance with ASTM D 4318.

2.1.3 [Sand

Clean, coarse-grained sand classified as [SW] [or] [SP] by ASTM D 2487 for [bedding] [and] [backfill] [as indicated].]

2.1.4 [Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof or having a classification of [GW] [GP] in accordance with ASTM D 2487 for [bedding] [and] [backfill]. [Maximum particle size shall not exceed 3 inches.]]

TABLE 02302-1 UTILITY EARTHWORK REFERENCES

<u>PIPE MATERIALS</u>	<u>NAVY SPECIFICATION</u>	<u>SOIL MATERIALS REFERENCE</u>	<u>INSTALLATION REF</u>
d. [Cast-Iron Soil] [Ductile Iron] [and] [Ductile Iron Pressure] Pipe	02630 02530 02551 02510 02554	AWWA C600, except refill of overcut shall be gravel, bedding shall be [GW][GP][SW][SP].	AWWA C600
m. Metallic Water Service Line Pipe (Steel, Copper Tube, Brass)	02510	AWWA C600	Same
p. Polyvinyl Chloride (PVC) Pressure Pipe	02811 02510	ASTM D 2774, except bedding shall be [GW] [GP] [SW] [SP] and all material sur- rounding pipe shall have maximum particle size of 13 mm	ASTM D 2774

Provide material for pipe bedding consisting of [GW] [GP] [SW] [SP] [sand] [gravel] as classified in accordance with ASTM D 2487].

TABLE 02302-1 UTILITY EARTHWORK REFERENCES

<u>PIPE</u> <u>MATERIALS</u>	<u>NAVY</u> <u>SPECIFICATION</u>	<u>SOIL</u> <u>MATERIALS REFERENCE</u>	<u>INSTALLATION</u> <u>REF</u>
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2.2 BURIED WARNING AND IDENTIFICATION TAPE

[Polyethylene plastic] [and] [metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic] warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, [3]inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

[Yellow:] [Gas, Oil, Dangerous Materials]

2.2.1 [Warning Tape for Metallic Piping]

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm 0.003 inch. Tape shall have a minimum strength of 10.3 MPa 1500 psi lengthwise, and 8.6 MPa 1250 psi crosswise, with a maximum 350 percent elongation.]

2.2.2 [Detectable Warning Tape for Non-Metallic Piping]

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.10 mm 0.004 inch. Tape shall have a minimum strength of 10.3 MPa 1500 psi lengthwise and 8.6 MPa 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.90 m3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.]

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum diameter of 12 AWG.

2.4 MATERIAL FOR PIPE CASING

2.4.1 Casing Pipe

ASTM A 139, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated.

Protective coating is not required on casing pipe.

PART 3 EXECUTION

3.1.1 [Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.]

3.1.2 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. [The Contractor shall contact the [Public Works Department] for assistance in locating existing utilities.] [The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.]

3.1.3 Structures and Surfaces

Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance. [Perform work in accordance with requirements specified in Section 01575, "Temporary Environmental Controls."]

3.1.4 [Disposal of Excavated Material

Dispose of excavated material so that it will not obstruct the flow of runoff, streams, endanger a partly finished structure, impair the efficiency or appearance of any facilities, or be detrimental to the completed work.]

3.1.5 [Channels and Ditches

Construct (rip-rap) rock protection in areas indicated to the lines and thicknesses [specified] [indicated] to dissipate stream energy and prevent channel erosion. Place rip-rap [in bedding of [granular material] [grout] [on a layer of filter fabric].]

3.2.1 Earthwork for Pipeline Casings

Provide excavation and backfilling for pipeline casings under this section.

3.3 SURFACE PREPARATION

3.3.1 Cutting Pavement, Curbs, and Gutters

[Saw cut] [Make cuts] with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. [When the saw cut is within 1 foot of an existing joint, remove pavement to the existing joint.]

3.4 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the Contracting Officer immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the [pipe]. Excavate ledge rock, boulders, and other unyielding material to an overdepth at least 150 mm 6 inches below the bottom of the pipe unless otherwise indicated or specified. [Blasting will not be permitted.] Overexcavate soft, weak, or wet excavations. Use bedding material or sand placed in 6 inch maximum layers to refill overdepths to the proper grade. At the Contractor's option, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified. Grade bottom of trenches accurately to provide uniform bearing and support on undisturbed soil, or bedding for making proper joints. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be [only 13 mm 1/2 inch greater than length, width, and depth of bell] [as required for properly making the particular type of joint] to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be two feet wide by 3 feet deep.

3.5 BEDDING

Of materials and depths as [indicated] [or] [specified] for utility lines and utility line structures. Place bedding in 150 mm 6 inch maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

3.6 BURIED WARNING AND IDENTIFICATION TAPE

Install tape in accordance with manufacturer's recommendations except as modified herein. Bury tape [at the depth indicated.] 300 mm 12 inches below finished grade; under pavements and slabs, bury tape 150 mm 6 inches below top of subgrade.]

3.7 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm 12 inches above the top of pipe. The wire shall extend continuously and unbroken. The wire shall remain insulated over its entire length.

3.8 BACKFILLING

Construct backfill in two operations (initial and final) as indicated and specified in this section. Place initial backfill in 150 mm 6 inch maximum loose lifts to one foot above [pipe] unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. Bring up evenly on each side and along the full length of the pipe. Ensure that

no damage is done to the utility or its protective coating. Place the remainder of the backfill (final backfill) in 225 mm 9 inch maximum loose lifts unless otherwise specified. Compact each loose lift as specified in the paragraph entitled "General Compaction" before placing the next lift. Do not backfill in freezing weather or where the material in the trench is already frozen or is muddy, except as authorized. Provide a minimum cover from final grade of 2 1/2 feet for steel casings and 2 feet for other piping. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities. [Testing for the following shall be complete before final backfilling: hydrostatic testing of wastewater discharge line and vacuum extraction line.] [Provide buried warning and identification tape installed in accordance with the manufacturer's recommendation.]

3.9 COMPACTION

Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements.

3.9.1 Compaction of Material in Subcuts or Overexcavations

In rock, compact to [95] percent of [ASTM D 1557 maximum] [ASTM D 4254 relative] density. [In soft, weak, or wet soils, tamp refill material to consolidate to density of adjacent material in trench wall.] In stable soils, compact to 90 percent of [ASTM D 1557 maximum] [ASTM D 4254 relative] density.

3.9.2 Compaction of Pipe and Conduit Bedding

In rock, compact to [95] percent [and] [in soil, compact to 90 percent of [ASTM D 1557 maximum] [ASTM D 4254 relative]] density.

3.9.3 Compaction of Backfill

Compact initial backfill material surrounding pipes, cables, conduits, or ducts, to [90] percent of [ASTM D 698] [ASTM D 1557] [ASTM D 4254] maximum density except where bedding and backfill are the same material. Where bedding and backfill are the same material, compact initial backfill to the density of the bedding.

3.10 SPECIAL EARTHWORK INSTALLATION REQUIREMENTS

3.10.1 [Compaction for Structures and Pavements

Place final backfill in 6 inch maximum loose lifts. If a vibratory roller is used for compaction of final backfill, the lift thickness can be increased to 9 inches. Compact all backfill surrounding pipes, ducts, conduits, and other structures to 90 percent of ASTM D 1557 maximum density except compact the top 300 mm 12 inches of subgrade to 95 percent of ASTM D 1557 maximum density. Backfill to permit the rolling and compacting of the

completed excavation with the adjoining material, providing the specified density necessary to enable paving of the area immediately after backfilling has been completed.

3.11.4 FINISH OPERATIONS

3.11.1 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur and as required in Section 01575, "Temporary Environmental Controls." Repair or reestablish damaged grades, elevations, or slopes.

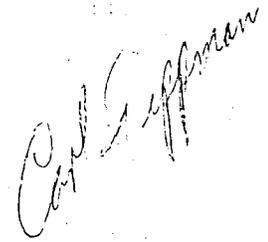
3.14.2 Pavement Repair

Repair pavement, curbs, and gutters. Do not repair pavement until trench or pit has been backfilled and compacted as specified herein. Provide a temporary road surface of [gravel] [crushed stone] over backfilled portion until permanent pavement is repaired. Remove and dispose of temporary road surface material when permanent pavement is placed. As a minimum, maintain one-way traffic on roads and streets crossed by trenches. Fully open roads and streets to traffic within 2 days.

3.15 FIELD QUALITY CONTROL

Test [bedding] [and] [backfill] for moisture-density relations in accordance with [ASTM D 698] [ASTM D 1557] [and] [ASTM D 4253] as specified herein. [Perform at least one of each of the required tests for each material provided.

SECTION 02510
WATER DISTRIBUTION
03/96



PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|-----------------|---|
| ANSI B16.18 | (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings |
| ANSI B18.5.2.1M | (1981; R 1995) Metric Round Head Short Square Neck Bolts |

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

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| AREA MRE | (1994) Manual for Railway Engineering (Fixed Properties) |
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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|------------------|---|
| ASME/ANSI B16.22 | (1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
|------------------|---|

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM B 88 | (1995) Seamless Copper Water Tube |
| ASTM D 1785 | (1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2241 | (1994) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2466 | (1994; Rev. A) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2564 | (1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D 2855 | (1993) Making Solvent-Cemented Joints with |

Poly(Vinyl Chloride) (PVC) Pipe and Fittings

ASTM F 402

(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

ANSI/AWWA C151/A21.51

(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C153/A21.53

(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service

AWWA M23

(1980) PVC Pipe - Design and Installation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-80

(1987) Bronze Gate, Globe, Angle and Check Valves

1.2 [RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with additions and modifications specified herein.]

1.3 DESIGN REQUIREMENTS

1.3.1 Water Service Lines

[Provide water service lines indicated as 3/4 inchlines from water distribution main to building service at [a point approximately 1.5 m 5 feet from building] [the point[s] indicated]. Water service lines shall be [copper pipe] [copper tubing]and valves as specified for water mains may also be used for service lines.]

[Provide water service lines indicated as less than 100 mm 4 inchlines from water distribution main to building service at [a point approximately 1.5 m 5 feet from building]. Water service lines shall be [copper tubing]. Provide water service line appurtenances as specified [and where ndicated]. Submit design calculations of water piping.]

1.4 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.4.1 SD-05, Design Data

- a. Design calculations of water piping

1.4.2 SD-06, Instructions

- a. Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Do not store materials directly on the ground. Keep inside of pipes, fittings, [valves] free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench.

PART 2 PRODUCTS

2.1 WATER AND WASTEWATER DISTRIBUTION MATERIALS

2.1.1 Piping Materials

2.1.1.1 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of AREA MRE, except for casing pipe, provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.2 WATER SERVICE LINE MATERIALS AND WASTEWATER LINE

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, FS WW-P-460, 825 kPa 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88M ASTM B 88, Type K. Fittings for solder-type joint, ANSI B16.18 or ASME/ANSI B16.22; fittings for compression-type joint, ASME/ANSI B16.26, flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

- a. Polyvinyl Chloride (PVC) Plastic Piping: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 1000 kPa 150 psi minimum pressure rating. Fittings, ASTM D 2466. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: [PVC 1120/PVC I; PVC 1220/PVC 12;] PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

- a. Water Piping Installation Parallel With Sewer Piping

(1) Unusual Conditions: When local conditions prevent a horizontal separation of 3.0 m 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

possible from the sewer piping.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section [2302, "2.1.2."]

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the

formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports [where indicated and] where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. [Depth of cover over top of pipe shall not be less than 760 mm 2 1/2 feet.]

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

[With connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure [in accordance with the recommended procedures of the manufacturer of the pipe being tapped] [as indicated] [, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe].]

3.1.2.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

(1) Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

(2) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

(3) Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

- b. Protection of Buried Steel Service Line Piping: [Unless otherwise specified,] prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded [single layer of felt wrap in accordance with AWWA C203] [double felt wraps in accordance with AWWA C203]. For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.1.2.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 [and ASTM D 2855], unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

- a. Jointing: [Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855.] [Make solvent-cemented joints for ABS plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with the recommendations of the pipe manufacturer, as approved.] Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing [, except that water and electric power needed for field tests will be furnished as set forth in Section [_____, "_____"]]. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. [Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.]

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." [Test ductile-iron water mains [and water service lines] in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints [or push-on joints] shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method.] [Test PVC plastic water mains [and water

service lines made with PVC plastic water main pipe] in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed.] [Test concrete water mains in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines shall not exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline.] [Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints shall not exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. Repair of welded joints to stop leakage shall be done by welding only.] Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at [copper pipe joints] [copper tubing joints (soldered, compression type, brazed)] [plastic pipe joints] [flanged joints] [and] [screwed joints].

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 375 kPa 50 psigreater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 50 mm 2 inches in diameter, hydrostatic test pressure shall be not less than 1400 kPa 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --

TABLE 1
NAVAL WEAPONS STATION - EARLE
DELIVERY ORDER NO. 0017
BIOSLURPING SYSTEM - SUMMARY OF SYSTEM START-UP

1. Before turning on the main power to the system turn the Liquid Ring Pump (LR-1), Transfer Pumps TP-1, TP-2, TP-3, and TP-4 (TP-4:only in building by C-50) to the "OFF" position
2. Open the valves on the recovery wells.
3. Ensure drain Valves #7 and Valve #9 are closed.
4. Fully open the Dilution Air Filter Valve (Valve #4), and close Valve #3.
5. Fully open Valve #2, Valve #5, Valve #11, Valve # 14, Valve #16, Valve #17, Valve #19, and in the unit near Building C-50, Valves #20 and #21.
6. Open the following valves in the 1/4 open position: Valve #6, Valve #12, and Valve #18.
7. Close the following valves: Valve #10, Valve #13, and Valve #15.
8. Turn on the main power to system. In the control room side of the unit, turn the Liquid Ring Pump (LR-1) and Transfer Pumps TP-1, TP-2, TP-3, TP-4 switches to the "Auto" position.
9. Turn the oil skimmer pipe inside the Oil/Water Separator to the 12:00 position.
10. Open Valve #1 to allow water to enter the Seal Water Tank. The seal water tank will be full when the low level alarm light on the control panel near the Seal Water Tank goes out. Keep Valve #1 open at all times to allow fresh water into the Seal Water Tank.
11. Turn the Liquid Ring Pump (LR-1) selector switch, which is located on the control panel attached to the liquid Ring Pump Skid, to the "ON" position.
12. Once the Liquid Ring Vacuum Pump LR-1 is on and running, gradually close the air bleed valve to achieve a vacuum of 20-25"Hg, as indicated on the vacuum indicator gauge near Valve #3.
13. Adjust Valve #2 to a flow of approximately 3 gpm.
14. Gradually open Valve #3 which will begin the extraction process on the recovery wells. It may be necessary to adjust Valve #4 to achieve the desired vacuum.

During the operation, it is important that the Liquid Ring Pump (LR-1) always pulls a small amount of air through Valve #4. Failure to bleed air into the Liquid Ring Vacuum Pump (LR-1) may cause the pump to overload with water, which will cause the motor to shut down on high amperage draw. If this occurs, allow the motor and starter to cool and then restart the system with more air bleed through Valve #4.

15. Once the system is in operation, several valves will need to be adjusted to ensure that the oil and water are flowing through the system at a rate in which all the transfer pumps can keep up with influent.

TABLE 3
NAVAL WEAPONS STATION - EARLE
DELIVERY ORDER NO. 0017 - MODIFICATION NO. 06
BIOSLURPING SYSTEM - SUMMARY OF SYSTEM MAINTENANCE

	SYSTEM COMPONENT	MAINTENANCE FREQUENCY	MAINTENANCE ACTIVITY
1.	Entire System	Each shift (minimum)	Visual check of overall system. Check for leaks and proper operation of each system component.
2.	MPX Vacuum Level	When vacuum level drops	Shut down system and check strainer on the seal water supply to the liquid ring vacuum pump. Clean, if necessary.
3.	MPX Vacuum Level	When vacuum level increases	Shut down system and check strainer on the inlet between the well and the MPX free product separation tank. Clean, if necessary.
4.	MPX Free Product Separation Tank	When high level switch is energized	Check transfer pump for proper operation.
5.	Seal Water Tank	Weekly	Blow down the seal water tank to allow fresh water make up to prevent the build-up of mineral salts. Open the blowdown control valve for 15 minutes to allow the water to be pulled into the MPX free product separation tank. Close the blowdown control valve.
6.	MPX Liquid Ring Vacuum Pump	Every 4 years	Grease motor bearings.
7.	MPX Free Product Transfer Pump	Weekly	Grease packing at zert.
8.	Flow Meters/Level Flouts	Periodically	Visually inspect for missing hardware, loose connections, broken register glass, damaged wiring, or other signs of wear or deterioration. Repair or replace components as required. Loss of pressure may indicate the need for cleaning the meter screen. Clean all dust, dirt, grease, moisture or other foreign material from exterior of meter.
9.	Valves	Periodically	Visually inspect valves for leaks, loose connections or other signs of wear or deterioration. Repair or replace components as required. Completely close and open the valve to check operation.
10	Oil/Water Separator	Weekly	Check and record oil volume. Perform periodic removals for disposal.

TABLE 1
NAVAL WEAPONS STATION - EARLE
DELIVERY ORDER NO. 0017
BIOSLURPING SYSTEM - SUMMARY OF SYSTEM START-UP

1. Before turning on the main power to the system turn the Liquid Ring Pump (LR-1), Transfer Pumps TP-1, TP-2, TP-3, and TP-4 (TP-4:only in building by C-50) to the "OFF" position
2. Open the valves on the recovery wells.
3. Ensure drain Valves #7 and Valve #9 are closed.
4. Fully open the Dilution Air Filter Valve (Valve #4), and close Valve #3.
5. Fully open Valve #2, Valve #5, Valve #11, Valve # 14, Valve #16, Valve #17, Valve #19, and in the unit near Building C-50, Valves #20 and #21.
6. Open the following valves in the 1/4 open position: Valve #6, Valve #12, and Valve #18.
7. Close the following valves: Valve #10, Valve #13, and Valve #15.
8. Turn on the main power to system. In the control room side of the unit, turn the Liquid Ring Pump (LR-1) and Transfer Pumps TP-1, TP-2, TP-3, TP-4 switches to the "Auto" position.
9. Turn the oil skimmer pipe inside the Oil/Water Separator to the 12:00 position.
10. Open Valve #1 to allow water to enter the Seal Water Tank. The seal water tank will be full when the low level alarm light on the control panel near the Seal Water Tank goes out. Keep Valve #1 open at all times to allow fresh water into the Seal Water Tank.
11. Turn the Liquid Ring Pump (LR-1) selector switch, which is located on the control panel attached to the liquid Ring Pump Skid, to the "ON" position.
12. Once the Liquid Ring Vacuum Pump LR-1 is on and running, gradually close the air bleed valve to achieve a vacuum of 20-25"Hg, as indicated on the vacuum indicator gauge near Valve #3.
13. Adjust Valve #2 to a flow of approximately 3 gpm.
14. Gradually open Valve #3 which will begin the extraction process on the recovery wells. It may be necessary to adjust Valve #4 to achieve the desired vacuum.

During the operation, it is important that the Liquid Ring Pump (LR-1) always pulls a small amount of air through Valve #4. Failure to bleed air into the Liquid Ring Vacuum Pump (LR-1) may cause the pump to overload with water, which will cause the motor to shut down on high amperage draw. If this occurs, allow the motor and starter to cool and then restart the system with more air bleed through Valve #4.

15. Once the system is in operation, several valves will need to be adjusted to ensure that the oil and water are flowing through the system at a rate in which all the transfer pumps can keep up with influent.

TABLE 1
(Continued)

16. Adjust Valve #6 so that Transfer Pump TP-1, which pumps the oil and water from the Phase Separation Tank, starts no more than once every 10 minutes. Adjustment in this manner will allow the pump discharge rate to keep of the system influent rate.
17. Valve #12 will need to be adjusted to the optimal flow rate which will allow the effluent water to pass through the treatment units at a fairly slow rate, but not too slow to cause the effluent tank to back up to the high high level in the oil water separator.
18. If at any time the high/high sensor in the system is activated and the system turns off, then the proper adjustments should be made to the valves to ensure optimal flow throughout the system.
19. The oil skimmer on the Oil/Water Separator needs to be manually adjusted in order to efficiently draw off the oil. The oil skimmer pipe in the Oil/Water Separator should initially be turned so that the slot in the pipe used to draw off the oil is pointed straight up (12:00) to allow a significant thickness of oil to build up prior to attempting to draw it off. Once the oil in the Oil/Water Separator has accumulated to a thickness of approximately 2 inches, the oil skimmer can be adjusted to the proper setting.
20. As Transfer Pump TP-1 filling the Oil/Water Separator, adjust the oil skimmer pipe to draw off a thin layer of the oil. The oil will gravity feed into the integral product tank on the side of the Oil/water Separator. It will take some practice adjusting the pipe so that only oil and a minimal amount of water is drawn through the oil skimmer pipe.

TABLE 2
NAVAL WEAPONS STATION - EARLE
DELIVERY ORDER NO. 0017
BIOSLURPING SYSTEM - SUMMARY OF SYSTEM SHUT-DOWN

The entire system can be shut down inside the operational side of the bioslurper units by pressing the emergency stop button. The emergency stop button can also be activated remotely through the PLC system. The entire system can also be shut down from the control room side of the bioslurper units by turning off the main control panel. The entire system may be brought back on line by reactivating the switch.

In order to conduct a controlled shut down from the control room, follow the following procedures:

1. Turn the switch for the liquid ring vacuum pump to the "Off" position. The other pumps will continue to pump until the liquid levels in the associated tanks are pumped to the "low" level of the tank. The run light of the pumps will turn off after all tank levels have been pumped to the proper levels. Walk into the operational side of the unit to ensure all pumps have stopped operating.
2. Turn the switches for the following pumps to the "Off" position: TP-1, TP-2, TP-3 and TP-4.
3. If the system will be turned off for an extended period, the phase separator tank, seal water tank and oil/water separator tanks should be drained. In order to drain the tanks, refer to the P&ID drawing for valve numbers: 7, 9, and 11.

TABLE 3
NAVAL WEAPONS STATION - EARLE
DELIVERY ORDER NO. 0017 - MODIFICATION NO. 06
BIOSLURPING SYSTEM - SUMMARY OF SYSTEM MAINTENANCE

	SYSTEM COMPONENT	MAINTENANCE FREQUENCY	MAINTENANCE ACTIVITY
1.	Entire System	Each shift (minimum)	Visual check of overall system. Check for leaks and proper operation of each system component.
2.	MPX Vacuum Level	When vacuum level drops	Shut down system and check strainer on the seal water supply to the liquid ring vacuum pump. Clean, if necessary.
3.	MPX Vacuum Level	When vacuum level increases	Shut down system and check strainer on the inlet between the well and the MPX free product separation tank. Clean, if necessary.
4.	MPX Free Product Separation Tank	When high level switch is energized	Check transfer pump for proper operation.
5.	Seal Water Tank	Weekly	Blow down the seal water tank to allow fresh water make up to prevent the build-up of mineral salts. Open the blowdown control valve for 15 minutes to allow the water to be pulled into the MPX free product separation tank. Close the blowdown control valve.
6.	MPX Liquid Ring Vacuum Pump	Every 4 years	Grease motor bearings.
7.	MPX Free Product Transfer Pump	Weekly	Grease packing at zert.
8.	Flow Meters/Level Flouts	Periodically	Visually inspect for missing hardware, loose connections, broken register glass, damaged wiring, or other signs of wear or deterioration. Repair or replace components as required. Loss of pressure may indicate the need for cleaning the meter screen. Clean all dust, dirt, grease, moisture or other foreign material from exterior of meter.
9.	Valves	Periodically	Visually inspect valves for leaks, loose connections or other signs of wear or deterioration. Repair or replace components as required. Completely close and open the valve to check operation.
10	Oil/Water Separator	Weekly	Check and record oil volume. Perform periodic removals for disposal.

**TABLE 4
SAMPLING AND ANALYSIS REQUIREMENTS FOR EFFLUENT DISCHARGE**

<i>Media</i>	<i>Analyses</i>	<i>Frequency</i>	<i>Quantity *</i>	<i>Method</i>	<i>Rationale</i>
Effluent Water	Oil and Grease	Initial sample during the system start-ups. One effluent sample after oil water separators, one sample after 1st clay unit, one sample after 2nd clay unit, and one sample after last carbon unit.	8	EPA Method 413.1	Analytical results shall be used to ensure compliance with the discharge requirements of NWS-Earle Sewer Treatment Plant
Effluent Water	Oil and Grease	Weekly samples of effluent from each system, one from after the clay absorption units and one after the activated carbon.	4 weekly	EPA Method 413.1	Analytical results shall be used to evaluate the effectiveness of the treatment system and schedule media change-outs.

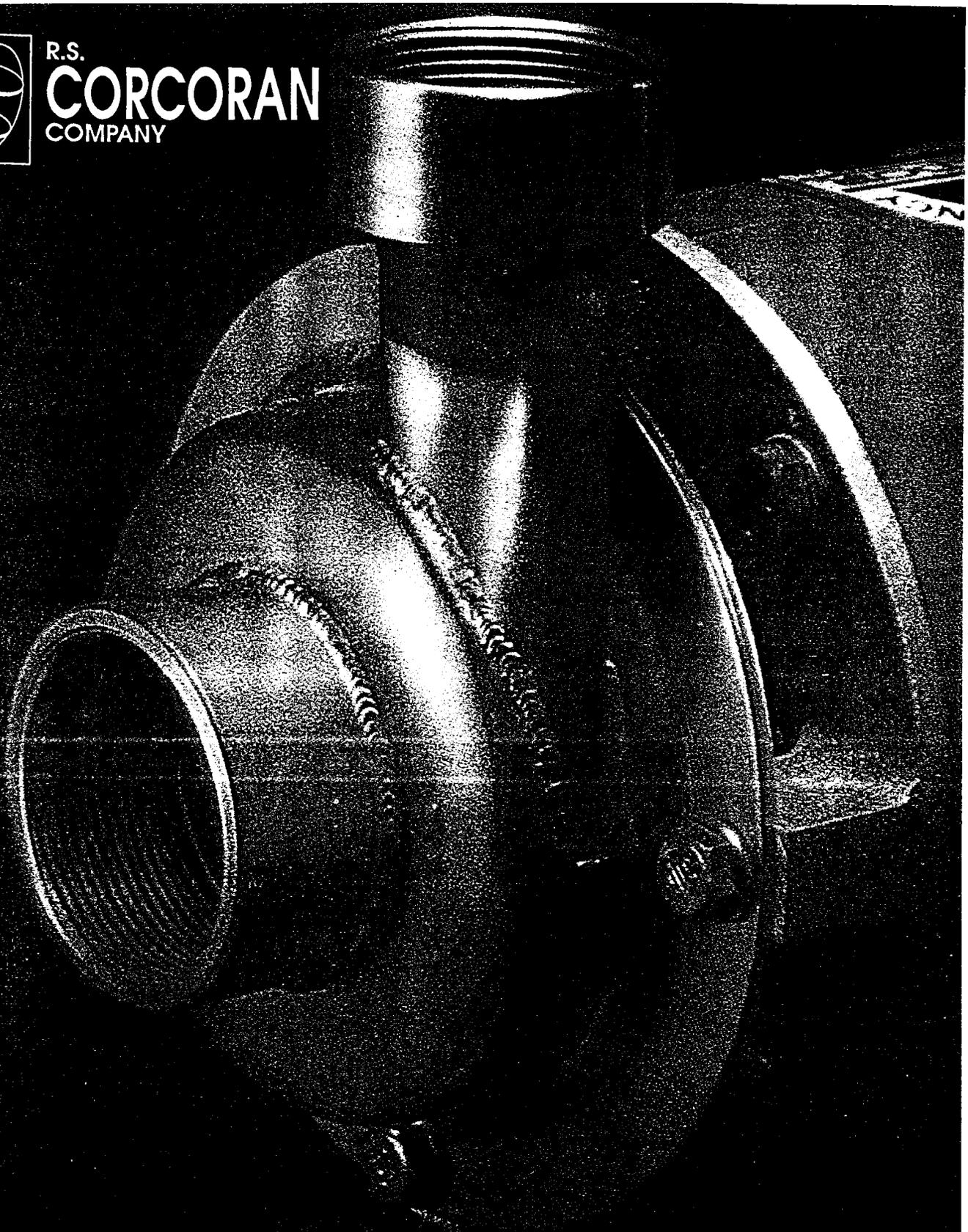
* Quantities do not include quality assurance samples

Note: The frequency and parameters of the Effluent Water analyses may be reduced based on historical data collected and the requirements of the NWS-Earle sewer treatment facility.



R.S.

CORCORAN
COMPANY



SERIES

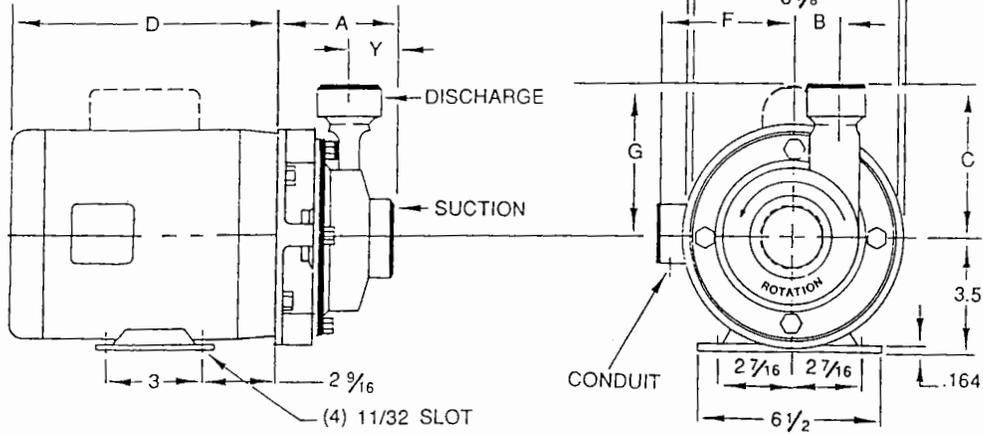
2000

**CORROSION RESISTANT
CENTRIFUGAL PUMPS**

Model 2000 D Close-Coupled, Single Seal
Model 2000 DH Close-Coupled, Double Seal
Model 2000 G Pedestal Mount, Single Seal
Model 2000 GH Pedestal Mount, Double Seal

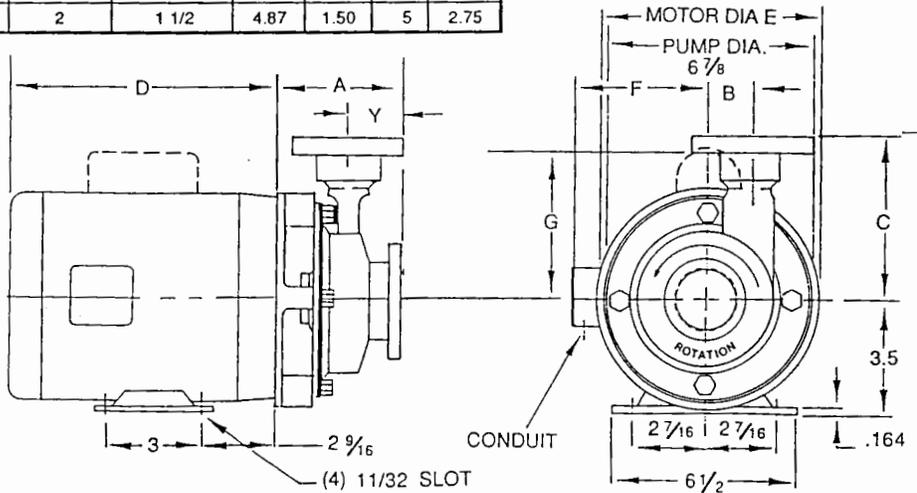
MODEL 2000D THREADED PORTS

Model	Suction	Discharge	A	B	C	Y
1/2 x 3/4	3/4	1/2	4.37	2	4	2.25
3/4 x 1	1	3/4	4.12	1.75	5	2
1 x 1 1/2	1 1/2	1	4.12	1.62	5	2
1 1/2 x 2	2	1 1/2	3.87	1.50	5	1.75

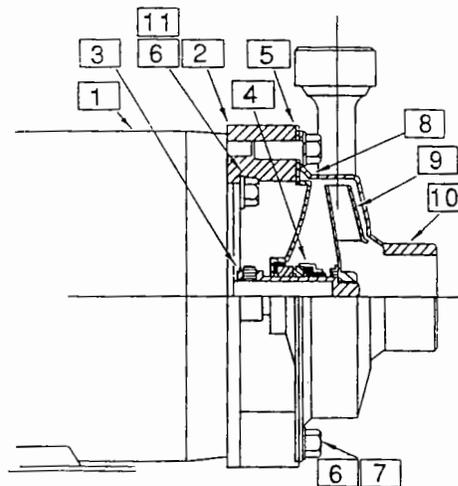


MODEL 2000D FLANGED PORTS

Model	Suction	Discharge	A	B	C	Y
1/2 x 3/4	3/4	1/2	4.75	2	4	2.62
3/4 x 1	1	3/4	4	1.75	5	1.87
1 x 1 1/2	1 1/2	1	4.37	1.62	5	2.25
1 1/2 x 2	2	1 1/2	4.87	1.50	5	2.75



Item	Qty	DESCRIPTION	MTL
1	1	MOTOR	
2	1	EXTENDER CASTING	AL
3	1	SHAFT EXTENSION	316
4	1	SEAL ASSEMBLY	
5	1	ADAPTOR	316
6	4	LOCKWASHER	S/S
7	4	HEX HD CAP SCREW 3/8-16 x 1	S/S
8	1	HOUSING GASKET	
9	1	IMPELLER	316
10	1	HOUSING	316
11	4	HEX HD CAP SCREW 3/8-16 x 3/4	S/S



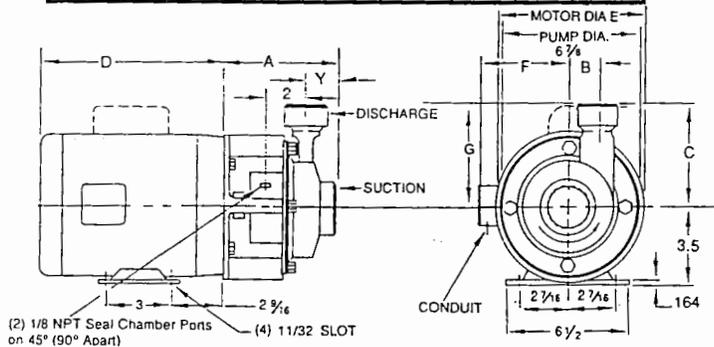
MOTOR DIMENSIONS

HP	RPM	PHASE	ENCL.	D	E	F	G	CONDUIT
1/6	1800	1	ODP	8.19	5.68	4.5	4.9	1/2 Hole
1/6	1800	1	TEFC	9.31	5.68	4.5	4.9	1/2 Hole
1/4	1800	1	ODP	8.18	5.68	4.5	4.9	1/2 Hole
1/4	1800	1	TEFC	9.31	5.68	4.5	4.9	1/2 Hole
1/4	1800	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1/4	1800	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1/3	1800	1	ODP	9.18	5.68	4.5	4.9	1/2 Hole
1/3	1800	1	TEFC	10.31	5.68	4.5	4.9	1/2 Hole
1/3	1800	1	XP	12.31	6.68	6.75	-	1/2 NPT
1/3	1800	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1/3	1800	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1/3	1800	3	XP	12.31	6.75	6.75	-	1/2 NPT
1/3	3600	1	ODP	8.18	5.68	4.5	4.9	1/2 Hole
1/3	3600	1	TEFC	9.31	5.68	4.5	4.9	1/2 Hole
1/3	3600	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1/3	3600	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1/2	1800	1	ODP	9.18	5.68	4.5	4.9	1/2 Hole
1/2	1800	1	TEFC	11.31	5.68	4.5	4.9	1/2 Hole
1/2	1800	1	XP	12.31	6.68	6.75	-	1/2 NPT
1/2	1800	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1/2	1800	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1/2	1800	3	XP	12.31	6.68	6.75	-	1/2 NPT
1/2	3600	1	ODP	8.18	5.68	4.5	4.9	1/2 Hole
1/2	3600	1	TEFC	9.31	5.68	4.5	4.9	1/2 Hole
1/2	3600	1	XP	12.31	6.68	6.75	-	1/2 NPT
1/2	3600	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1/2	3600	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1/2	3600	3	XP	12.31	6.68	6.75	-	1/2 NPT
3/4	1800	1	ODP	9	6.62	5.25	5.56	1/2 Hole
3/4	1800	1	TEFC	11.25	6.62	5.25	5.56	1/2 Hole
3/4	1800	1	XP	13.18	6.68	6.75	-	1/2 NPT
3/4	1800	3	ODP	9.18	5.68	4.5	-	1/2 Hole
3/4	1800	3	TEFC	10.31	5.68	4.5	-	1/2 Hole
3/4	1800	3	XP	12.31	6.68	6.75	-	1/2 NPT
3/4	3600	1	ODP	9.18	5.68	4.5	4.9	1/2 Hole

HP	RPM	PHASE	ENCL.	D	E	F	G	CONDUIT
3/4	3600	1	TEFC	10.31	5.68	4.5	4.9	1/2 Hole
3/4	3600	1	XP	12.31	6.68	6.75	-	1/2 NPT
3/4	3600	3	ODP	8.18	5.68	4.5	-	1/2 Hole
3/4	3600	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
3/4	3600	3	XP	12.31	6.68	6.75	-	1/2 NPT
1	1800	1	ODP	10	6.62	5.25	5.56	1/2 Hole
1	1800	1	TEFC	11.25	6.62	5.25	5.56	1/2 Hole
1	1800	1	XP	13.18	6.68	6.75	-	1/2 NPT
1	1800	3	ODP	10.18	5.68	4.5	-	1/2 Hole
1	1800	3	TEFC	11.31	5.68	4.5	-	1/2 Hole
1	1800	3	XP	12.31	6.68	6.75	-	1/2 NPT
1	3600	1	ODP	10.18	5.68	4.5	4.9	1/2 Hole
1	3600	1	TEFC	11.25	6.62	5.25	5.56	1/2 Hole
1	3600	1	XP	13.18	6.68	6.75	-	1/2 NPT
1	3600	3	ODP	8.18	5.68	4.5	-	1/2 Hole
1	3600	3	TEFC	9.31	5.68	4.5	-	1/2 Hole
1	3600	3	XP	12.31	6.68	6.75	-	1/2 NPT
1-1/2	1800	1	ODP	10	6.62	5.25	5.56	1/2 Hole
1-1/2	1800	1	TEFC	12.12	6.62	5.25	5.56	1/2 Hole
1-1/2	1800	3	ODP	9	6.62	5.25	-	1/2 Hole
1-1/2	1800	3	TEFC	10.25	6.62	5.25	-	1/2 Hole
1-1/2	1800	3	XP	12.31	6.68	6.75	-	1/2 NPT
1-1/2	3600	1	ODP	10	6.62	5.25	5.56	1/2 Hole
1-1/2	3600	1	TEFC	11.25	6.62	5.25	5.56	1/2 Hole
1-1/2	3600	3	ODP	9	6.62	5.25	-	1/2 Hole
1-1/2	3600	3	TEFC	10.25	6.62	5.25	-	1/2 Hole
2	1800	3	ODP	10	6.62	5.25	-	1/2 Hole
2	1800	3	TEFC	10	6.62	5.25	-	1/2 Hole
2	1800	3	XP	13.18	6.68	6.75	-	1/2 NPT
2	3600	1	ODP	10	6.62	5.25	5.56	1/2 Hole
2	3600	1	TEFC	12.12	6.62	5.25	5.56	1/2 Hole
2	3600	3	ODP	9	6.62	5.25	-	1/2 Hole
2	3600	3	TEFC	11.25	6.62	5.25	-	1/2 Hole
3	3600	3	ODP	10	6.62	5.25	-	1/2 Hole
3	3600	3	TEFC	12.12	6.62	5.25	-	1/2 Hole

MODEL 2000DH THREADED PORTS

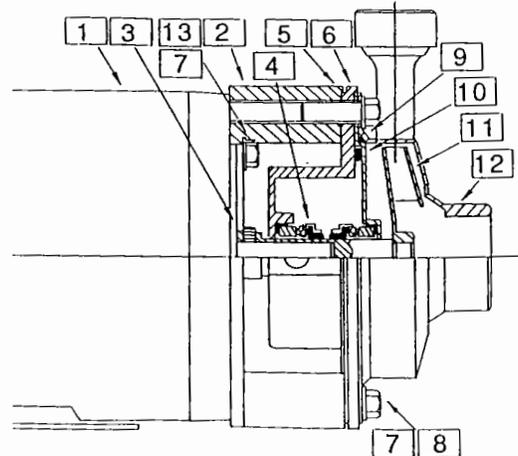
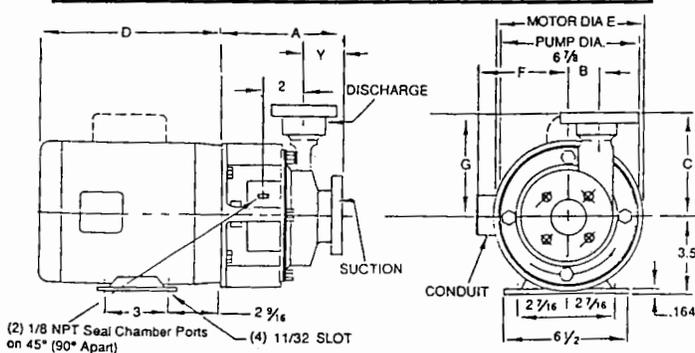
Model	Suction	Discharge	A	B	C	Y
1/2 x 3/4	3/4	1/2	5.59	2	4	2.25
3/4 x 1	1	3/4	5.31	1.75	5	2
1 x 1 1/2	1 1/2	1	5.31	1.62	5	2
1 1/2 x 2	2	1 1/2	5.06	1.50	5	1.75



Item	Qty	DESCRIPTION	MTL
1	1	MOTOR	
2	1	EXTENDER CASTING	AL
3	1	SHAFT EXTENSION	316
4	1	SEAL ASSEMBLY	
5	1	SEAL CHAMBER	AL
6	1	ADAPTOR	316
7	8	LOCKWASHER	316
8	4	HEX HD CAP SCREW 3/8-16 x 1	316
9	1	HOUSING GASKET	
10	1	CHAMBER GASKET	
11	1	IMPELLER	316
12	1	HOUSING	316
13	4	HEX HD CAP SCREW 3/8-16 x 3/4	S/S

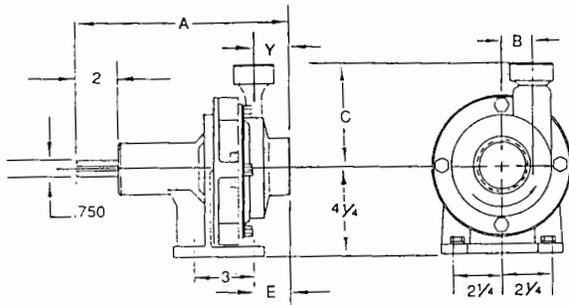
MODEL 2000DH FLANGED PORTS

Model	Suction	Discharge	A	B	C	Y
1/2 x 3/4	3/4	1/2	5.93	2	4	2.62
3/4 x 1	1	3/4	5.18	1.75	5	1.87
1 x 1-1/2	1-1/2	1	5.59	1.62	5	2.25
1-1/2 x 2	2	1-1/2	6.06	1.50	5	2.75



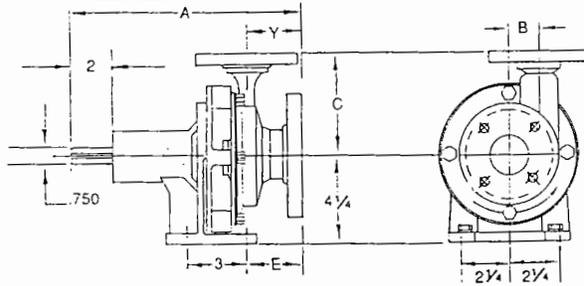
MODEL 2000G THREADED PORTS

Model	A	B	C	Y	E
1/2 x 3/4	11.06	2	4	2.25	2.31
3/4 x 1	10.83	1.75	5	2	2.06
1 x 1-1/2	10.83	1.62	5	2	2.06
1-1/2 x 2	10.59	1.50	5	1.75	1.84

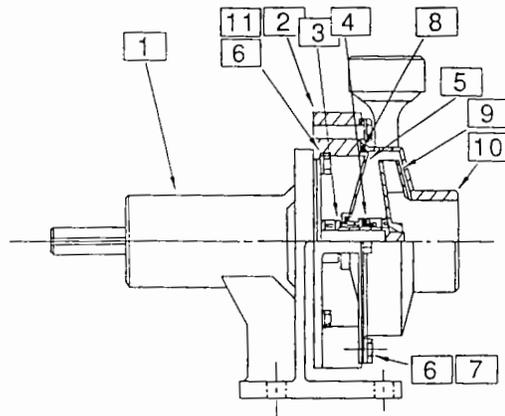


MODEL 2000G FLANGED PORTS

Model	A	B	C	Y	E
1/2 x 3/4	11.50	2	4	2.62	2.75
3/4 x 1	10.71	1.75	5	1.87	2
1 x 1-1/2	11.09	1.62	5	2.25	2.34
1-1/2 x 2	11.59	1.50	5	2.75	2.84

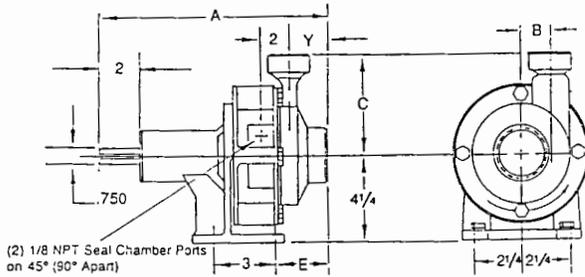


Item	Qty	Description	MTL
1	1	BEARING FRAME	CI
	1	A. SHAFT	STL
	2	B. BEARINGS	STL
	1	C. WAVE WASHER	STL
	1	D. SNAP RING	STL
2	1	EXTENDER CASTING	AL
3	1	SHAFT EXTENSION	316
4	1	SEAL	
5	1	ADAPTOR	316
6	8	LOCKWASHER	316
7	4	HEX HD CAP SCREW 3/8-16x1	316
8	1	HOUSING GASKET	
9	1	IMPELLER	316
10	1	HOUSING ASSEMBLY	316
11	4	HEX HD CAP SCREW 3/8-16x3/4	316

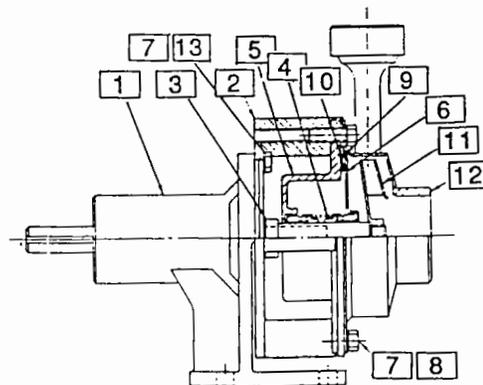


MODEL 2000GH THREADED PORTS

Model	A	B	C	Y	E
1/2 x 3/4	12.25	2	4	2.25	3.5
3/4 x 1	12	1.75	5	2	3.25
1 x 1-1/2	12	1.62	5	2	3.25
1-1/2 x 2	11.75	1.50	5	1.75	3

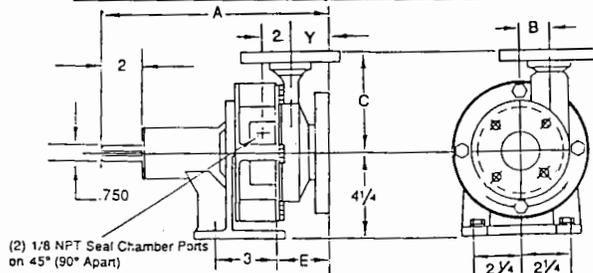


Item	Qty	Description	MTL
1	1	BEARING FRAME	CI
	1	A. SHAFT	STL
	2	B. BEARINGS	STL
	1	C. WAVE WASHER	STL
	1	D. SNAP RING	STL
2	1	EXTENDER CASTING	AL
3	1	SHAFT EXTENSION	316
4	1	SEAL ASSEMBLY	
5	1	SEAL CHAMBER	AL
6	1	ADAPTOR	316
7	8	LOCKWASHER	316
8	4	HEX HD CAP SCREW 3/8-16x1	316
9	1	GASKET (HOUSING)	
10	1	CHAMBER GASKET	
11	1	IMPELLER	316
12	1	HOUSING ASSEMBLY	316
13	4	HEX HD CAP SCREW 3/8-16x3/4	S/S



MODEL 2000GH FLANGED PORTS

Model	A	B	C	Y	E
1/2 x 3/4	12.62	2	4	2.62	3.87
3/4 x 1	11.87	1.75	5	1.87	3.12
1 x 1-1/2	12.25	1.62	5	2.25	3.5
1-1/2 x 2	12.75	1.50	5	2.75	4



SERIES 2000 CORROSION RESISTANT CENTRIFUGAL PUMPS

Install Corcoran Confidence

- Simplicity of Design
- Easy Maintenance
- Compact Size
- Lightweight ("UPS"-able)
- Low Cost
- High Operational Efficiency
- Fast Availability (3 to 5 working days)

The 2000 series corrosion-resistant all purpose pumps of 316L Stainless Steel are ideal for many O.E.M. and chemical processing applications. Our dependable centrifugal pumps are well suited for general corrosion-resistant usage. Whether you are pumping cleaners, caustic materials, salt solutions, chlorinated solvents, photographic chemicals, de-ionized water, fatty acids or phosphoric, citric and lactic acids. . . **Corcoran can pump it!**

Corcoran's 2000 series pumps are available in a wide variety of sizes and materials of construction. This unlimited flexibility allows you to select the exact specifications to fit your needs. And when it comes to service, you can depend on Corcoran to have a complete line of seals and parts in stock ready for immediate delivery.

When you add up the features: Time tested dependability, lightweight construction, easy maintenance, low cost, fast delivery. . . it's no wonder that year after year, the Corcoran 2000 series centrifugal pump continues to be our most popular model. That's why we say, **"When you pump with Corcoran, you pump with confidence."**

MATERIALS OF CONSTRUCTION

- 316 Stainless Steel (standard)
- Carpenter 20Cb-3
- Monel
- Hastelloy C-276
- Hastelloy B-2
- Zirconium
- Titanium

MECHANICAL SEAL & GASKET

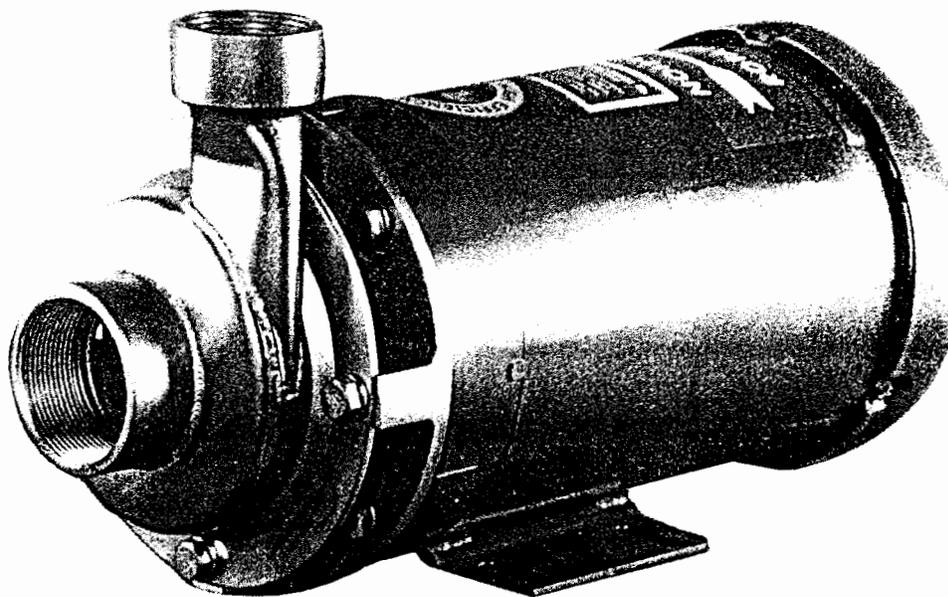
- Viton
- Teflon
- EPT
- Buna-N
- Kalrez

CONSTRUCTION OF STANDARD STAINLESS STEEL PUMPS

- Alloys: 316L Stainless Steel
- Seals: Viton or EPT Elastomers
- Ceramic and Carbon faces
- 316 L Stainless Steel metal parts
- Gaskets: Teflon, Viton or EPT

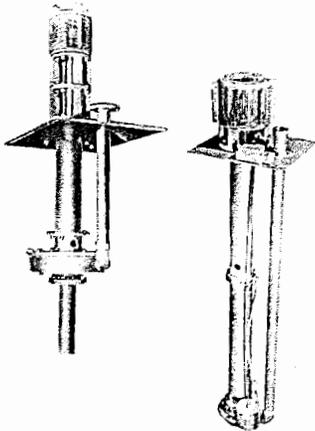
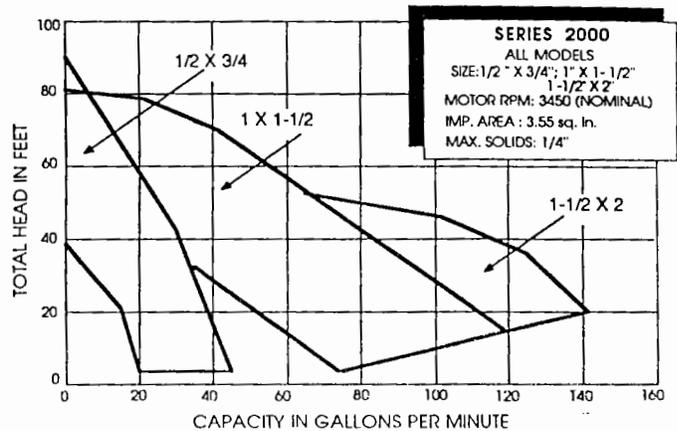
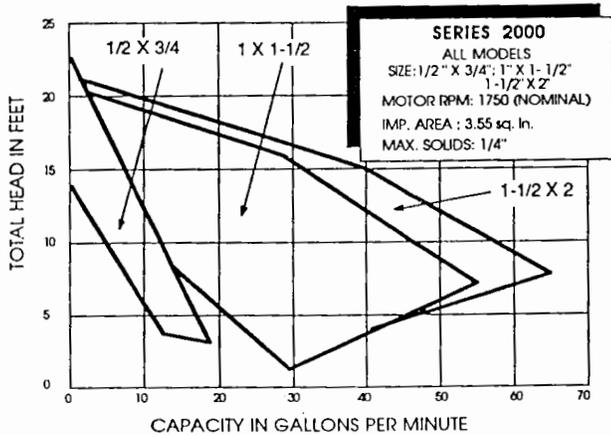
PORT SELECTION

- FNPT (threaded)
- ASA Flanged
- Hose
- Sanitary Fittings



SERIES 2000

CORROSION RESISTANT CENTRIFUGAL PUMPS



VERTICAL CENTRIFUGAL PUMPS

Corcoran supplies a wide selection of pumps with vertical extended shafts in two basic styles: Model VE pumps provided with submerged bearings and Model VEC (vertical cantilever shaft pumps) with all bearings above the mounting plate and no rubbing parts in the fluid being pumped.

Model VEC pumps are particularly desirable for fluids with suspended abrasive solids. C-flanged motor mounting is standard. VEC type pumps may also be supplied with a special chair mounting.

Both models may be provided with either bottom or top suction. The top suction avoids pumping residues collected at the bottom of the tank, and in VE model creates a suction rather than a discharge head at the steady bearings, helping to protect the bearing from abrasive materials and preventing material from moving along the shaft. The bottom suction, on the other hand, is ideal if it is desirable to empty the tank completely.

Corcoran specializes in adapting to your specific requirements. Call the factory for information on unpublished modifications

Install Corcoran Confidence



R.S.
CORCORAN
COMPANY

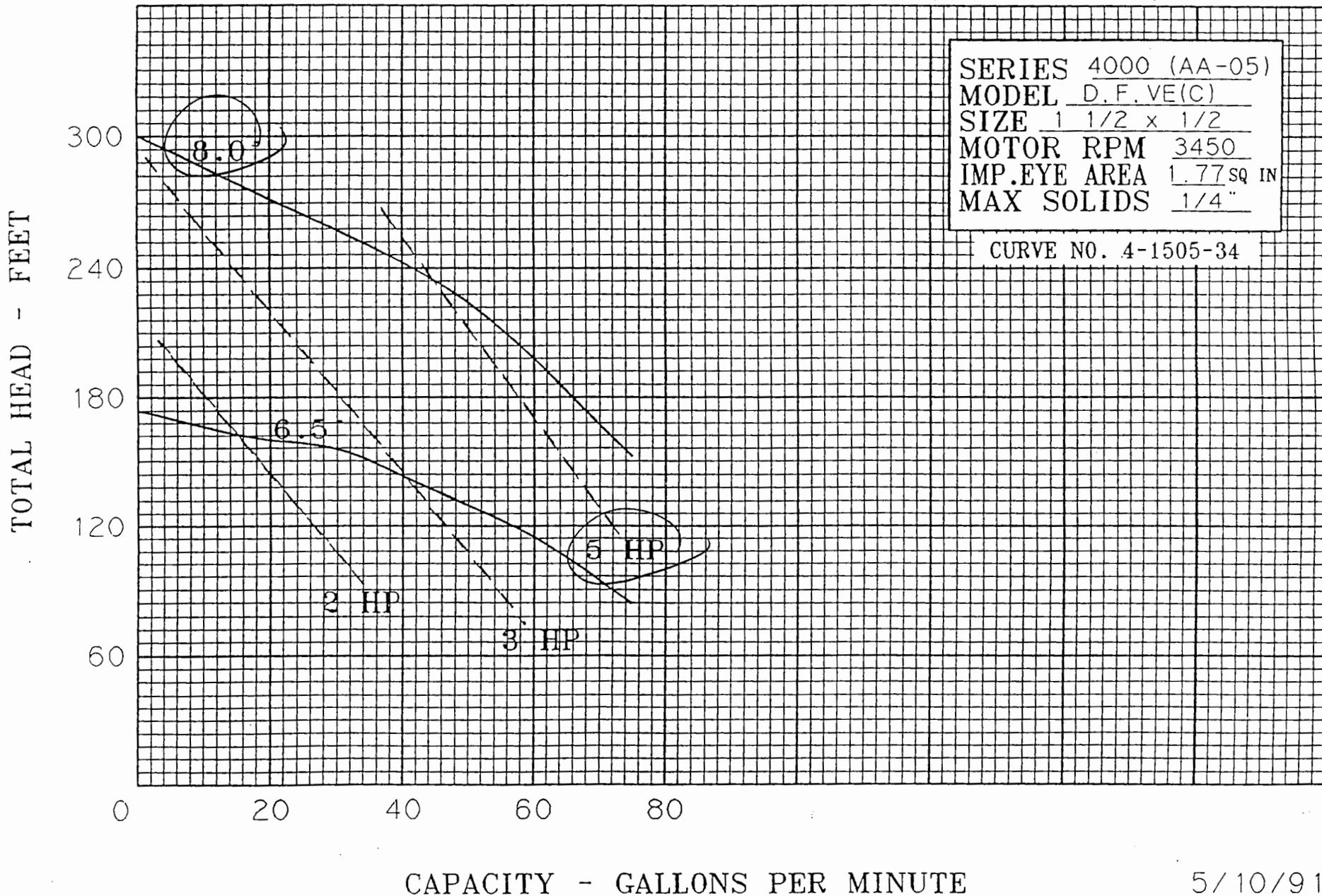
P.O. BOX 429 • 500 N. VINE
NEW LENOX, IL 60451-0429

(800) 637-1067 • (815) 485-2156

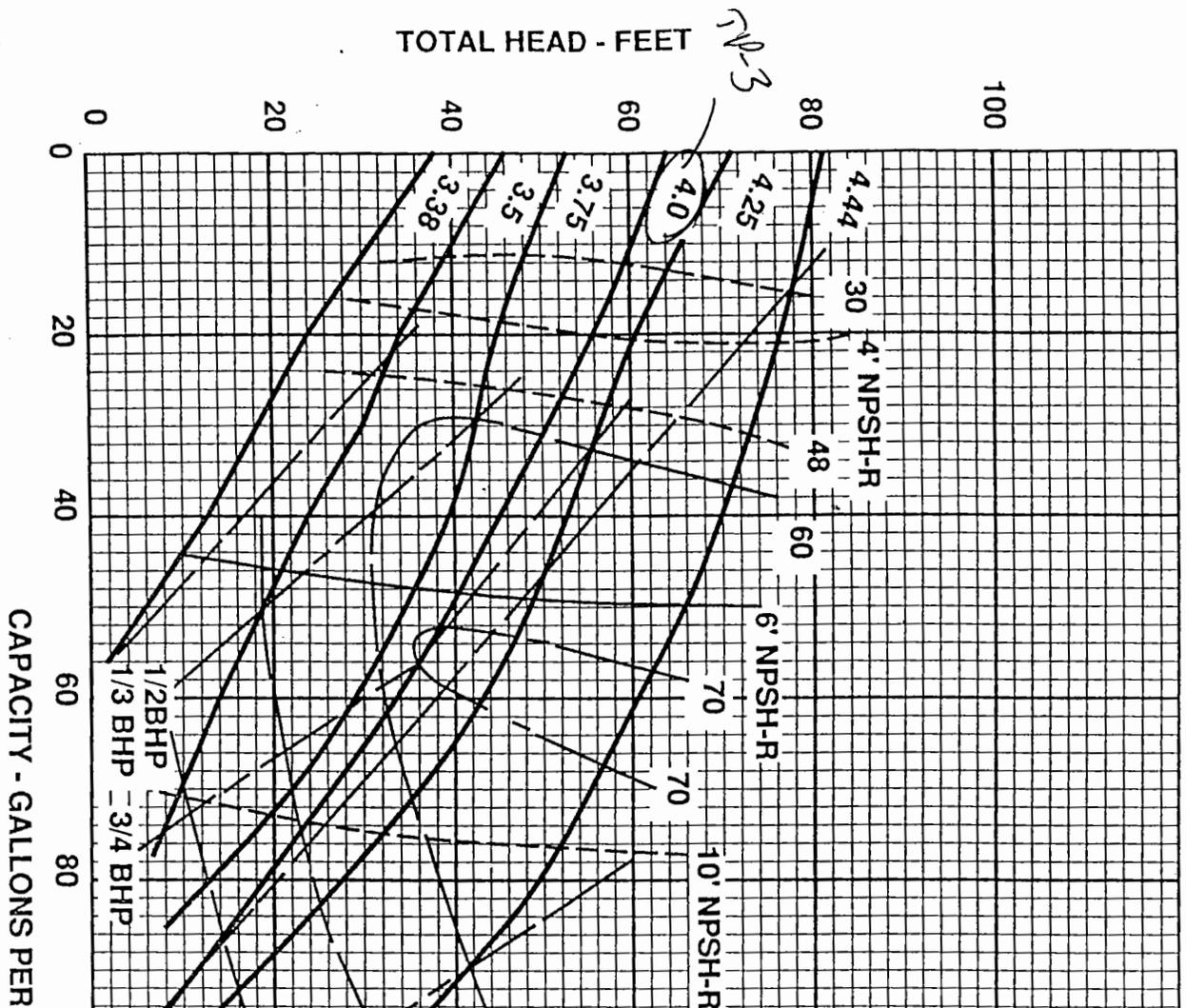
Facsimile (815) 485-5840

TP-2

R. S. CORCORAN CO., NEW LENOX, IL 60451



5/10/91



6

+GF+ SIGNET 8512 Flow Transmitter

Features

- Flow rate, permanent & resettable totalizer and loop mA display
- Powered and non-powered sensor applications
- Complete software setup and operation
- Splashproof enclosure
- Mounting kits accommodate integral, pipe, panel, or wall mounting

Applications

- Remote flow measurement
- Effluent totalization
- Water distribution systems
- Filtration systems
- Water and wastewater treatment systems
- Computer and data acquisition interface

Description

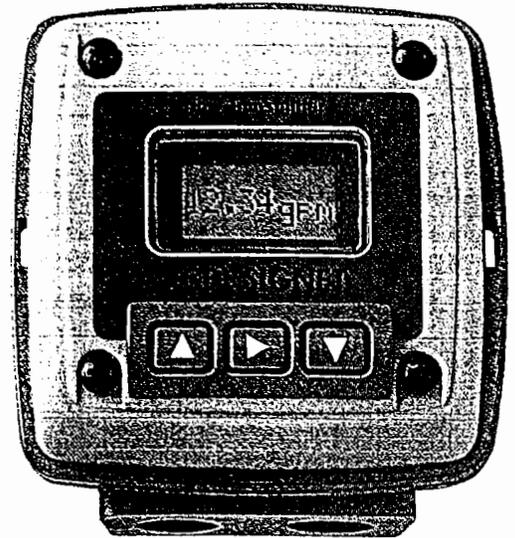
The +GF+ SIGNET 8512 Flow Transmitter converts the signal from all +GF+ SIGNET flow sensors into a 4 to 20 mA signal for long distance transmission. Four possible mounting configurations provide installation flexibility. State-of-the-art electronic design ensures long-term reliability, signal stability, and simple push-button programming. The 8512 can be spanned for virtually any flow range or engineering unit.

Compatibility

All +GF+ SIGNET flow sensors.

Technical Data

Loop Power:	17 to 30 VDC
Max. Loop Impedance:	300Ω @ 24 VDC, 600Ω @ 30 VDC
Electronics Operating Temp:	5 to 158 °F
Operating Range:	0.5 to 500 Hz, scaleable from 0.01 to 9999 engineering units
Current Output:	4 to 20 mA
Sensor Pulse Output:	Open collector, optically isolated, max. current sink 10 mA @ 30 VDC
Sensor Power:	2-wire: 1.5mA @ 4.7-5.0 VDC 3-wire: 20mA @ 5 VDC max.
Accuracy:	Loop: ±0.1% of reading Display: ±0.03% of reading
Update Rate:	Loop: 100ms Display: 1 sec Totalizer: 0 to 99999999 K-factor range: 0.001 to 99999
Relative Humidity:	0 to 95% non-condensing
Materials:	Enclosure: Glass-filled polypropylene, NEMA 4X/IP65 Enclosure Gasket: Silicon rubber Keypad: Silicon rubber Window: Polycarbonate
Immunity:	EN50082-2
Emissions:	EN55011
Quality Standards:	CE

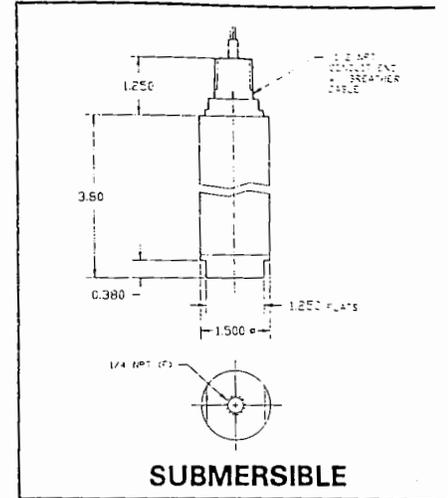
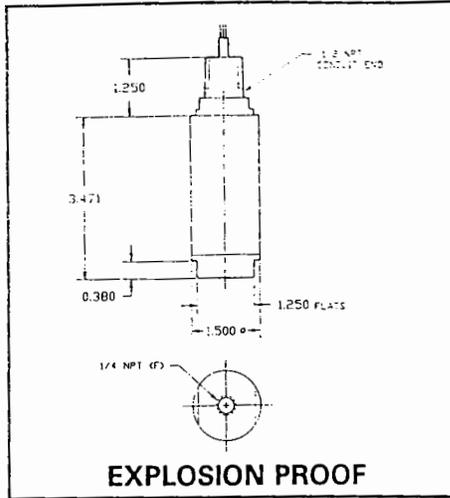
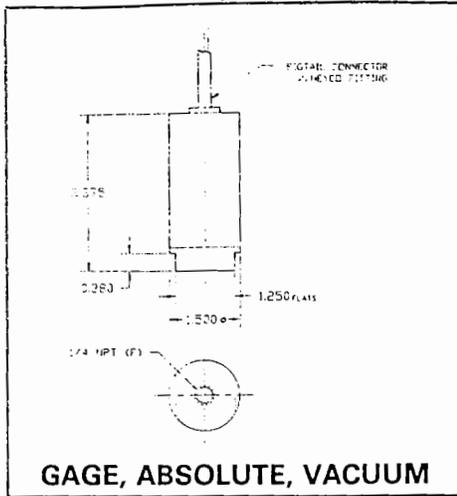


Ordering Information

	Part No.	Description
Basic Unit:	3-8512	8512 Flow Transmitter
Accessories:	3-8010	Universal mounting kit (0.5 in. NPT ports)
	3-8010-D	Universal mounting kit (PG-13.5 DIN ports)
	3-8011	Integral mounting kit (0.5 in. NPT ports)*
	3-8011-D	Integral mounting kit (PG-13.5 DIN ports)*

*Integral mounting kit to be used with 8510-XX or 8512-XX integral sensors.

OUTLINES



SPECIFICATIONS*

Full Scale Pressure Ranges	See ordering guide See pressure type for limitations
Pressure Type	
→ Gage	0-5 thru 0-299 psi standard
Sealed Gage, non-hermetic	0-300 thru 0-20,000 psi standard
	0-100 thru 0-299 psi optional
Sealed Gage, hermetic	0-5 thru 0-20,000 psi optional
Vacuum	0-5 thru 0-15 psi
Absolute	0-5 thru 0-20,000 psi
Elevated (suppressed zero)	Range to be not less than 1/5 of the full scale pressure
Compound	15 psiv to any gage pressure
Wetted Material**	316 & 15-5 PH stainless steel
Gage pressure reference vent	Clean dry gas only
Accuracy (Static error band includes non-linearity, hysteresis, non-repeatability)	
→ Series A	± 1.0% FSO (RSS)
Series B	± 0.5% FSO (RSS)
Series C	± 0.2% FSO (RSS)
Series D	± 0.1% FSO (RSS)
Resolution	Infinite (0.01% FSO practical minimum)
Temperature Limits**	
Compensated	0-180°F
Operating	-20° F to +190° F
Storage	-65° F to +250° F
Temperature Compensation**	
Zero	Less than ± 2% FSO/100° F at full scale pressure range and/or upper range limit
Span	Less than ± 2% FSO/100° F at full scale pressure range and/or upper range limit
Electricals	
Input Impedance	
Model 111	350 ohm nominal, full bridge
	654 ohm nominal, 1/2 bridge
	Consult factory if important
Input Current	
Model 211	35 mA nominal
Turndown	
Model 311 option GR	5:1 (3:1 for lowest range)
Load Impedance	
Model 111	50,000 ohms minimum, for less than 0.1% FSO attenuation
Model 311	1200 ohms maximum at 37 Vdc and 600 ohms maximum at 24 Vdc
Output Current	
Model 211	2.0 mA maximum for less than 0.1% FSO attenuation
Zero Balance**	
Model 111	0.0 mv/v ± 5% FSO at 70° F & 10 Vdc excitation

Model 211	0.0 Vdc ± 5% FSO at 70° F & 24 Vdc excitation
→ Model 311	4.0 mA ± 5% FSO at 70° F & 24 Vdc excitation
Range Calibration Signal**	Resistance value provided on calibration card for 100% FSO
Model 111, 211	Greater than 1000 megohms at 50 Vdc and 70° F
Insulation Resistance	
Mechanicals	
Proof Pressure**	
Gage, Sealed Gage, Absolute	2 times full scale pressure range (or URL) or 22500 psi, whichever is less
Vacuum	0 psia in vacuum and 2 times full scale pressure range in gage
Burst Pressure	
Gage, Sealed Gage, Absolute	5 times full scale pressure range in gage (or URL) or 23000 psi, whichever is less
Vacuum	5 times full scale pressure range in gage
Pressure Response**	Less than 5 ms to 90%
Weight	
Gage, Sealed Gage, Vacuum, Absolute	10 oz. nominal
Connections	
Pressure	1/4" NPT (F)
Electrical**	
Cable	
Model 111, 211	Belden 9536, 6 conductor, 24" long
Model 311	Belden 8723, 4 conductor, 24" long
Color Code	

		111	211	311
A/1	Red	+ Excit.	+ Excit.	+ Excit./Signal
B/2	Green	+ Signal	+ Signal	NC
C/3	White	- Signal	NC	NC
D/4	Black	- Excit.	- Excit./Signal	- Excit./Signal
E/5	Blue	NC Option GH	NC Option GH	NC Option GH
F/6	Brown	NC Option GH	NC Option GH	NC Option GH
	Shield	Open	Open	Open

Enclosure Materials	316 stainless steel
Mounting	Pressure port
Identification	Etched stainless steel nameplate welded to body

* Unless otherwise stated, these specifications are the standards to which the units are normally constructed. Upgrades or alterations may be easily and readily accomplished by the standard option code (pg. 4) or by discussion with the factory. We invite your inquiry.

** See modifications on ordering guide.

Use Following Codes To Identify Desired Item.

MODEL	SERIES	RANGE	PRESSURE TYPE	OPTIONS
311 •	- A •	- RB •	- 2 •	- •/•/•

EXAMPLE
311-C-PZ-2-CA/GJ

Only shaded codes and options are available with explosion proof ratings.

PRESSURE RANGE

MODEL (Signal)	psi		bar		Model 311 Opt. GR Only
	111 - 3 mv/v 211 - 5 Vdc → 311 - 4-20 mA	PJ - 5 PL - 7.5 PN - 10 PP - 15 PQ - 3-15 PR - 20 PS - 3-27 PO - 25 PT - 30 PV - 50 PX - 75 PZ - 100 → RB - 150 RD - 200 RE - 250	RF - 300 RH - 500 RJ - 600 RK - 750 RM - 1000 RO - 1500 RR - 2000 RS - 2500 RT - 3000 RV - 5000 RX - 7500 RZ - 10,000 SB - 15,000 SD - 20,000 SZ - Other	UJ - 1 UK - 1.5 UL - 2 UM - 3 UN - 5 UP - 7.5 UQ - 10 UR - 15 US - 20 UT - 30 UV - 50	

Miscellaneous

TA - 760 mm HG
TC - 30 in HG

PRESSURE TYPE

3 - Absolute	7 - Sealed Gage (non-hermetic)	2 - Gage ←
4 - Vacuum	8 - Elevated (suppressed zero)	9 - Other
6 - Sealed Gage (hermetic)		10 - Compound (vacuum & gage pressure)

OPTIONS

AA - None

Alternate Connector or Cable

Note: Explosion proof rated models are only provided with 1/2" NPT (M) conduit thread, (option CF).

CA - Bendix PTIH-10-6P (Mate PT06E-10-6S [SR] not supplied), or equal
CB - Bendix CF3102E-14S-6P (Mate CF3106E-14S-6S not supplied), or equal
CC - Bendix PC02E-12-8P (Mate PC06A-12-8S [SR] not supplied), or equal
CD - Cannon WK6-32S (Mate WK6-21C not supplied)
CE - Terminal Block
CF - 1/2" NPT male thread with 24" potted leads
CG - MS3102R-14S-6S (Mate MS3106F-14S-6P not supplied)
CH - Vented cable, 8' long (NEMA 4 termination)
CJ - DIN 43650 (includes mate) (Hirschmann type)
CK - Lumberg RSF-3/12 mm
CL - 1/2" NPT MALE THREAD W/24" vented cable (for ranges less than 299 psi)
CM - Bendix PTIH-8-4P, or equal
CN - Bendix MS3102A-14S-5P, or equal
CO - Junction Box (thermocouple type) with terminal block
CP - Cannon WK4-32S
CQ - Cannon WKA7-32S
CR - 30" cable with armored jacket
CT - 24" Teflon jacket cable (high temperature)
CU - 1/2" NPT(F) conduit thread with 24" pigtail
CZ - Other

GENERAL

GA - Standardized output to $\pm 0.5\%$ FSO.
GB - Alternate pressure range, pressure units, or full scale outputs that are non-standard. Set to $\pm 2\%$ FSO.
GC - Special calibration of a standard range (i.e. 20 point).
GD - Pressure overload increased to 10x rated range, or 22,500 psi, whichever is less. May be higher depending on circumstances. Consult factory. Burst pressure becomes 15x rated range or 23,000 psi, whichever is less.
GE - Improved temperature compensation to $\pm 0.5\%$ FSO/100°F for zero and span respectively.
GF - Expanded temperature range, -65 to +250°F (Compensated to $\pm 2\%$ FSO/100°F).
GG - Alternate calibration signal.
GH - Internal calibration resistor, set to $100 \pm 0.5\%$ FSO unless otherwise specified.
GJ - Add zero and span controls. (Approximately $\pm 20\%$ FSO adjustment.)
GK - Inconel pressure cavity.
GL - Cleaning for oxygen service.
GR - 5:1 ranging. (Model 311 only. See pressure code. Includes option GJ, zero/span control. Not available with option GD.)
GS - 0-10 vdc FSO, Model 211. (Requires 16-32 vdc excitation.)

Alternate Pressure Port

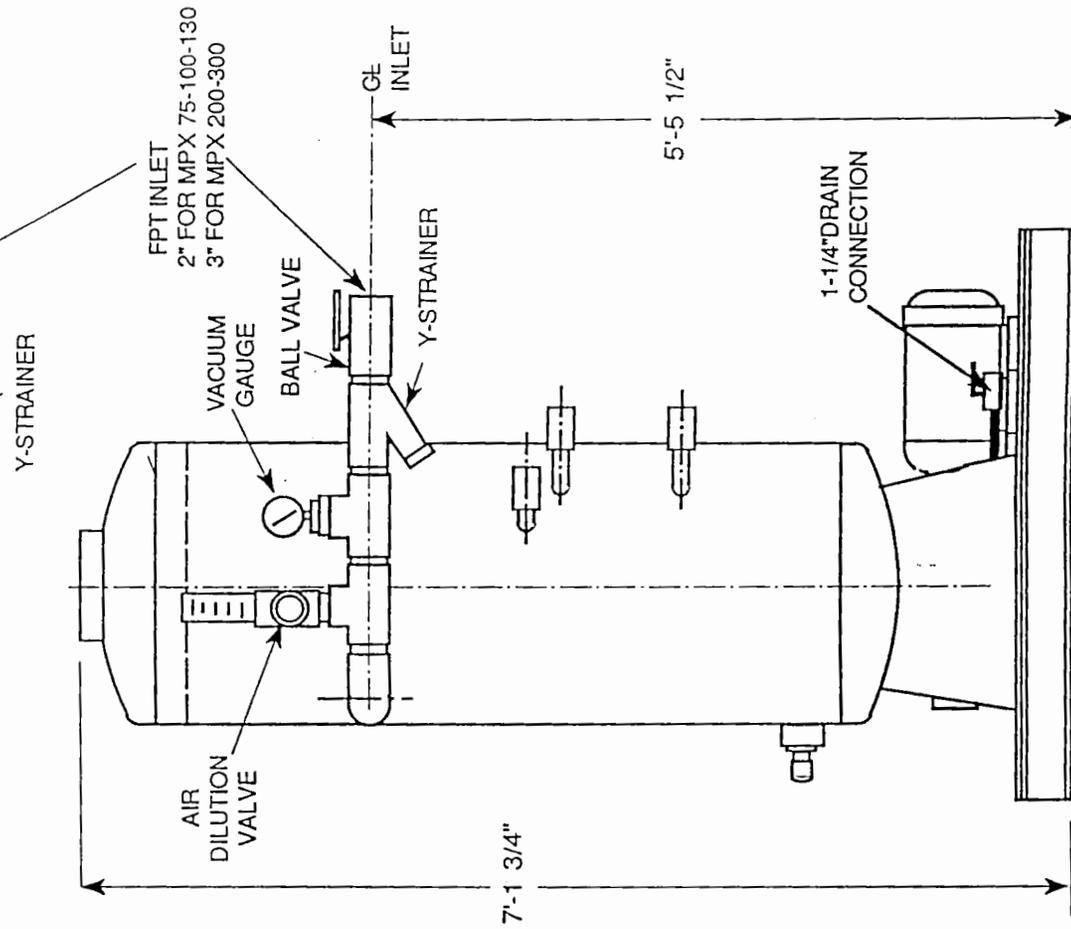
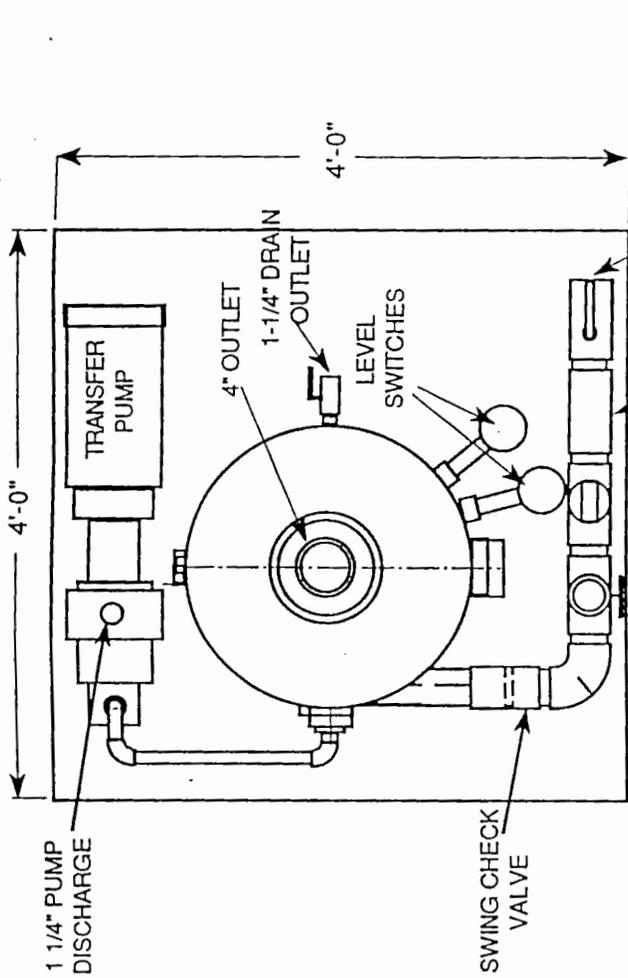
FA - MS33649-4 (1/4 AND-10050, female)
FC - 3/8" NPT(F)
FD - MS33656-4 (7/16-20 UNF-3A, male, for 1/4" tube)
FH - 1/8" NPT(F)
FJ - 1/4" NPT(M)
FL - 1/8" NPT(M)
FM - Autoclave Engineering Type F-250-C (high pressure)
FN - 1/2" NPT(M)
FO - 1/4" BSP(M)
LC - VCR fitting for 1/4" tubing
LG - SAE-4 (F) O-ring seal thread
LH - SAE-6 (M) O-ring seal straight thread (w/o O-ring)
LP - 1/4" BSP(F)
LT - SAE-4(M) O-ring seal straight thread (w/o O-ring)
FE - Bullet nose for cavity protection with submersible option GM
LD - Tapered inlet, sludge level measurement
LJ - Tapered inlet w/standoff plate
FZ - Other
LX & LY - 1-1/2" & 2" tube size Tri-Clover pressure fitting

GY - Type 316 stainless steel pressure cavity. (Option GD not available.)
HE - $\pm 0.5\%$ FSO zero balance.
HK - NEMA 4 rating, non-vented units only.
HL - RFI protection (for unit in proximity to radio transmitter.)
JE - Substitute 5000 ohm strain gages.
JJ - High response (500 microsecond, Model 211).
JK - Barometric pressure, 23-35 Hga.
JS - Internal damping as specified by customer.
JV - Voltage surge protection (lightning resistance), Model 311 & 311X.
MA - 1-5 Vdc FSO.
MD - Add zero and span controls for explosion proof models.
GM - Submersible housing, 8' polyurethane jacket cable, neoprene grommet, and 1/2" NPT(M) conduit fitting.
HR - ± 15 vdc excitation, Model 211.
JH - Remote cable mounted zero and span controls. 3' cable on open side. Cable on closed side as required. Model 311 only.
JN - Die casting hydraulic pressure measurement, model 211 only. Unit provided with full bridge, reduced stress sensor, 1.0 ms response, and 25,000 psi proof pressure.
GZ - Customer special.

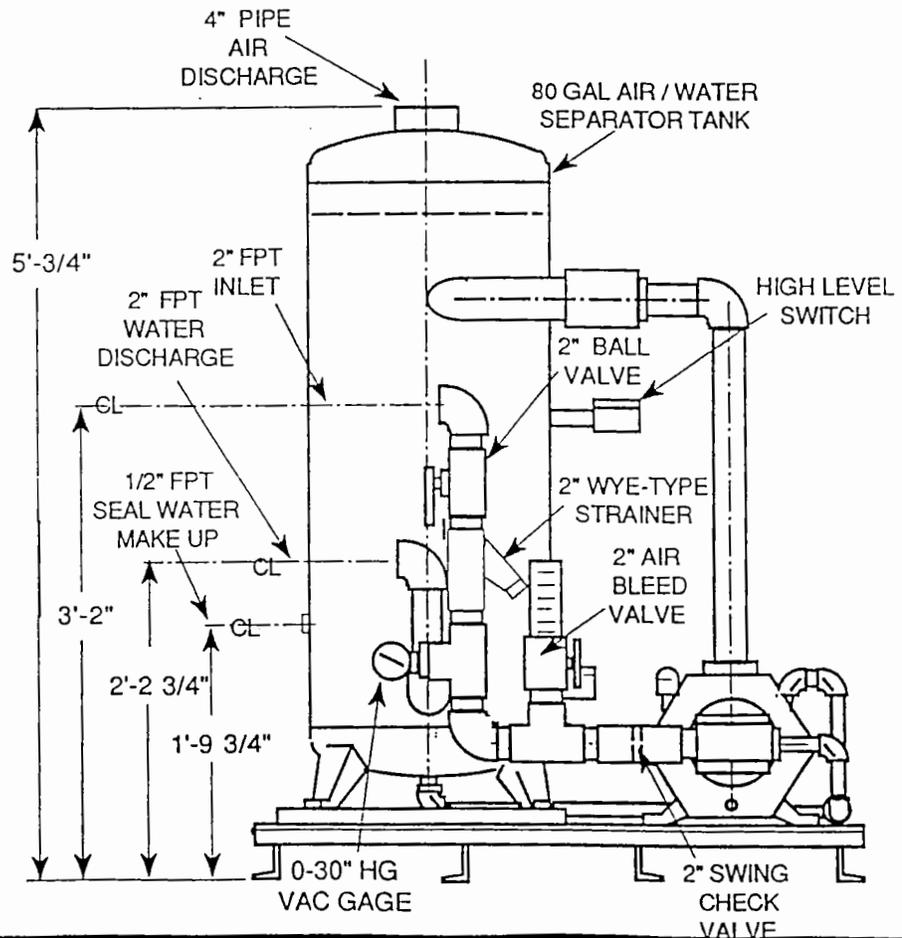
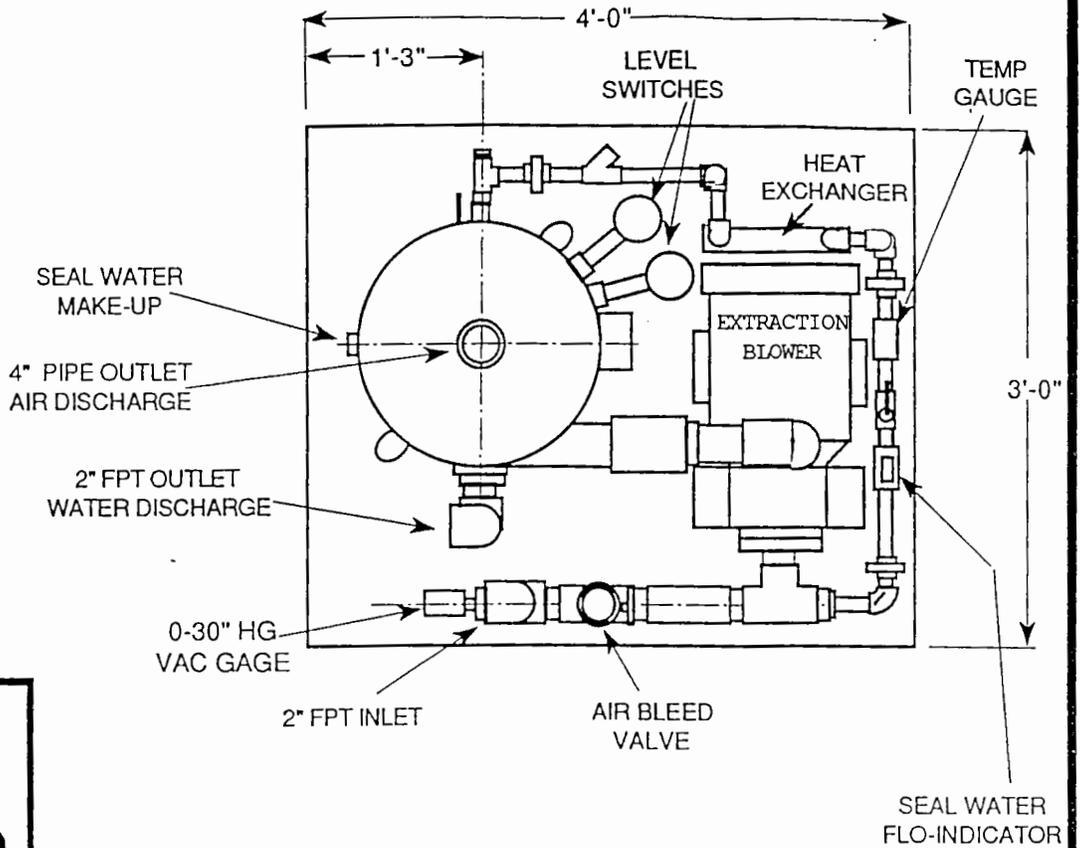
GP:50

NEW YORK, N.Y.

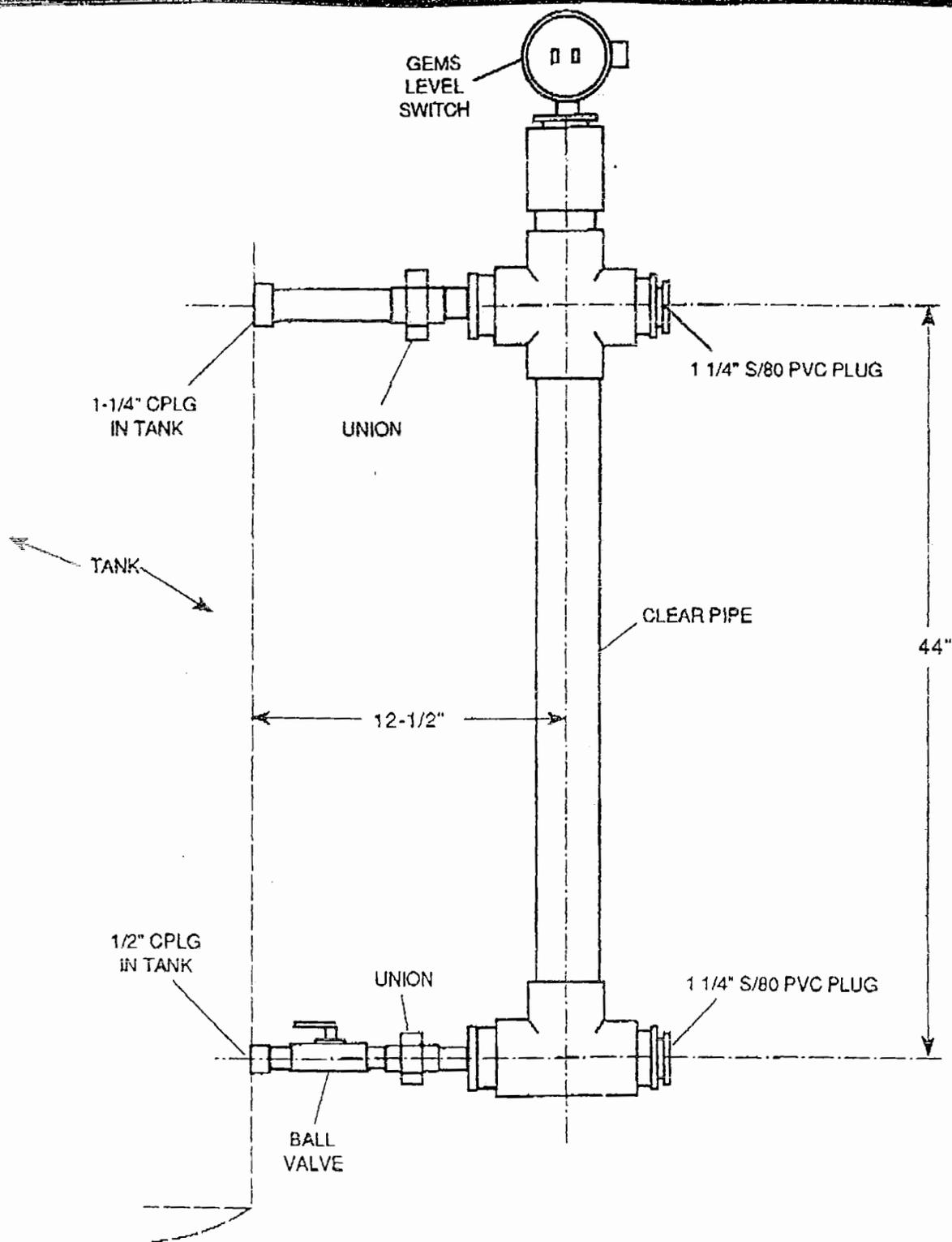
PO Box 805 • 2770 Long Road • Grand Island, NY 14072 • USA
Tel. (716) 773-9300 • FAX (716) 773-5019



CARBTRON [®] CORPORATION		51 RIVERSIDE AVENUE WESTPORT CONN. 06880 (203) 226-5642	
		SCALE ---	FOR ALL MPX MODELS
DATE 9-7-95	Wah	REV 10-17-95	
MULTI-PHASE EXTRACTION SYSTEM FREE PRODUCT SKID			
ARRANGEMENT		S	DWG 2650/1



CARBTRON ®		CORPORATION	
51 RIVERSIDE AVENUE WESTPORT CONN. 06880 (203) 226-5642			
SCALE	---	BY	WH
DATE	9-8-95	REV	3/28/96
MULTI-PHASE EXTRACTION SYSTEM			
MPX-75/100/130 HEAT EXCHANGER GRAVITY DISCHARGE			
ARRANGEMENT			
S	DWG	2640/1	



CARBTRON[®] CORPORATION		51 RIVERSIDE AVENUE WESTPORT CONN. 06880 (203) 226-5642	
SCALE	FOSTER WHEELER - #18804	BY	MTB
DATE 5-9-97	Wah EARL AIR FORCE BASE	REV	
MPX - PRE SEPARATOR SYSTEM FLOAT SWITCH ASSEMBLY			
ASSEMBLY DETAILS		DWG	3266/0



Instruction Bulletin
No. 154474

Series LS-700, 700-EP Multi-Station Level Switches

(Includes LS-700's with Temperature Sensors)

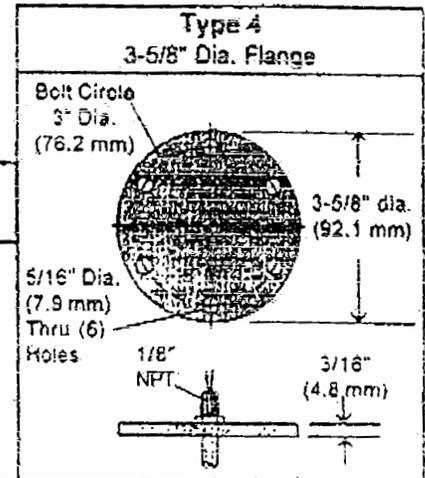
Installation...

Install LS-700 and LS-700-EP Series switches vertically in tank top (mounting up) or in tank bottom (mounting down). Multi-station level switches will operate normally inclined up to 30°.

LS-700 Series Mounting Types...

Each mounting type can be configured with stem lengths (Lo) and float materials indicated in table below.

Type 1 1/8" NPT	Type 2 3/4" NPT	Type 3 1" NPT	Type 5 1-5/16" - 12UNF-2A	Type 6 3/8-24
1-5/16" HEX	1/2" HEX	1-5/16" HEX	1-1/2" HEX Neoprene O-Ring	1/2" HEX



Stem and Mounting Material	Brass or 316 Stainless Steel		
Max. Length	48 Inches (121.9 cm)		
Mounting Position	Vertical ± 30° Inclination		
Float Stops	Brass Units: Beryllium-Copper Grip Rings; Stainless Steel Units: S.S. ARMCO PH-15-7MO Grip Rings		
Pressure Rating, PSI, Max.*	See Float Values Below	50	

*Mounting only. Maximum pressure rating for complete unit will be the lower of this pressure or the selected float pressure (See Float Types, below.)

Float Types...LS-700 Series ONLY (A single float type is selected for use at all actuation points)

Float Material	Buna N		Teflon - Spring Biased	316 Stainless Steel
Compatible Mtg Types	1, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 4, 6
Float Dimensions				
Part Number	39049	138030	133764	60241
Operating Temp.	Water: to 180°F (82.2°C) Oil: -40°F to +250°F (-40°C to +121.1°C)		-40°F to +300°F (-40°C to +148.9°C)	
Pressure, PSI, Max.	250*	250*	1000*	100
Min. Liquid S.G.	.45	.60	.65	.70

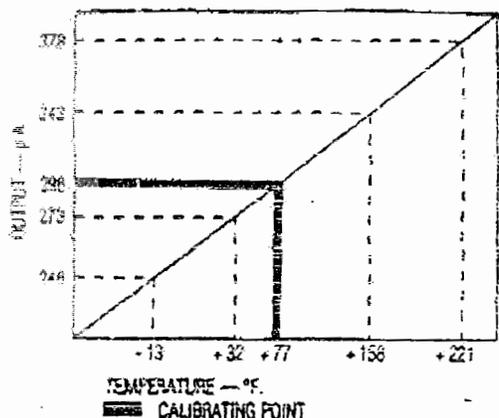
*Derated with Increasing Temperature

More Float Types ➡

Integrated Temperature Sensors

- Figure 1 -

Output Calibration Chart



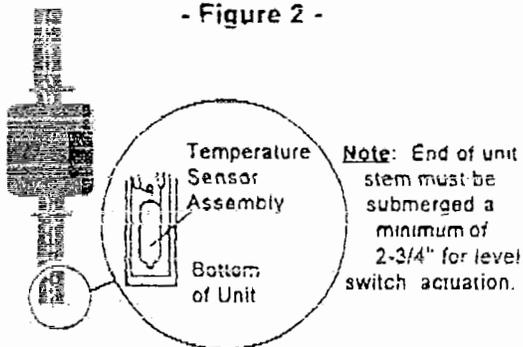
Transducer for Continuous Indication (See Figure 1)

Input: 4-30 VDC
 Output: 298mA @ +77°F
 Current Change: 1mA/1.8°F
 Response Time: 150 Seconds (80% gradient in 60 Sec.)
 Operating Range: -13°F to +221°F
 Accuracy: ±2°F @ 77°F

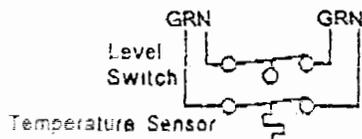
Thermostat for Switch Actuation (See Figure 2)

Switch Ratings: 2.6A/125V (inductive)
 Contact Operation on Increasing Temperature:
 "Opens" when set point reached - or -
 "Closes" when set point reached
 Standard Temperature Set Point (±10°F):
 100°F, 125°F, 150°F, 175°F, 200°F or 225°F

- Figure 2 -



- Typical Wiring Diagram -



Switch Ratings - Maximum Resistive Load

(LS-700 and LS-700-EP Series)

VA	Volts	Amps AC	Amps DC
10 General Use	0-50	.2	.13
	120	.08	N.A.
	240	N.A.	.1
20 Pilot Duty	0-30	.4	.3
	120	.17	.13
	240	.08	.06
50 General Use	0-50	0.5	0.5
	120	.4	.4
	240	.2	.2
100*	120	8**	N.A.
	240	4	N.A.

*Level switch units with 100 VA switches are not U.L. recognized.
 **Limited to 50,000 operations

Important Points!

Product must be maintained and installed in strict accordance with the National Electrical Code and GEMS technical brochure and instruction bulletin. Failure to observe this warning could result in serious injuries or damages.

An appropriate explosion-proof enclosure or intrinsically safe interface device must be used for hazardous area applications involving such things as (but not limited to) ignitable mixtures, combustible dust and flammable materials.

Pressure and temperature limitations shown on individual catalog pages and drawings for the specified level switches must not be exceeded. These pressures and temperatures take into consideration possible system surge pressures/temperatures and their frequencies.

Selection of materials for compatibility with the media is critical to the life and operation of GEMS level switches. Take care in the proper selection of materials of construction; particularly wetted materials.

Life expectancy of switch contacts varies with applications. Contact GEMS if life cycle testing is required.

Ambient temperature changes do affect switch set points, since the specific gravity of a liquid can vary with temperature.

Level switches have been designed to resist shock and vibration; however, shock and vibration should be minimized.

Liquid media containing particulate and/or debris should be filtered to ensure proper operation of GEMS products.

Electrical entries and mounting points may require liquid/vapor sealing if located in an enclosed tank.

Level switches must not be field repaired.

Physical damage sustained by the product may render it unserviceable.

Gems Sensors
 One Cowles Road
 Plainville, CT
 06062-1198

tel 860.747.3000
 fax 860.747.4244



Typical Wiring Diagram

For clarity, only two actuation levels are shown in each group



Number of Actuation Levels and Electrical Specifications

Typically, one float is required for each point at which you need a switch action to occur. The number of actuation levels available depends on the Group Type Wiring selected. (See Below)

LS-700 Series

Group I Wiring: 1 to 5 Actuation Levels
 Group II Wiring: 1 or 3 Actuation Levels
 Switch (SPST, N.O. or N.C.): 20/100 VA
 Lead Wires: #22 AWG, 24" L., Teflon

LS-700-EP Series

Switch (N.O. or N.C.): SPST - 20 VA
 Electrical Termination: Size 50 J-Box; Explosionproof, Watertight, With Terminal Strip
 Approvals: Factory Mutual (FM)

Actuation Level Dimensions

Switch actuation levels shown on are determined as follows: (Actuation Levels Typical)**

- A = Minimum distance to highest actuation level
- B = Minimum distance between actuation levels
- C = Minimum distance between two actuation levels with one float (Note: One float for two levels can only be used when low level is N.C. dry and high level is N.O. dry.)
- D = Minimum distance from end of unit to lowest level

LS-700 Dimensions				
Float P/N	A	B	C	D
39049	9/16"	1-3/4"	1/8" Min.	11/16"
136030	7/8"	2-1/16"		1"
60241	13/16"	1-13/16"		15/16"
141750	1"	2"		1-1/8"
136540	1-9/16"	2-7/16"		1-11/16"
136550	1-5/8"	2-7/16"		1-3/4"
133764	13/16"	1-7/8"		7/8" N.O. 1-3/16" N.C.
LS-700-EP Dimensions				
Float P/N	A	B	C	D
141750	1"	2"		1-1/8"
136540	1-9/16"	2-7/16"		1-11/16"
136550	1-5/8"	2-7/16"	1/8" Min.	1-3/4"
133764	13/16"	1-7/8"		7/8" N.O. 1-3/16" N.C.

Note: A, B and D dimensions are based on a liquid specific gravity of 1.0.

Wiring Color Code

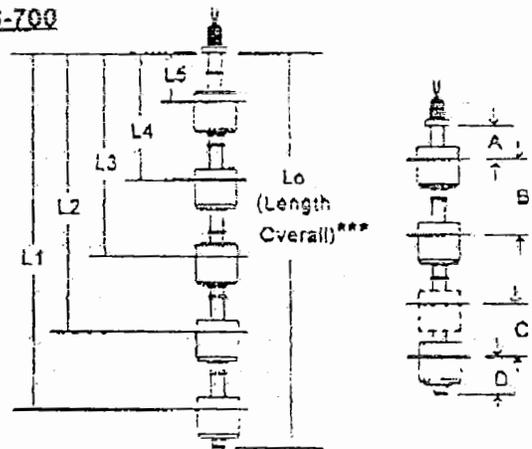
Tinted Area Designates U.L. Recognized Wiring Configurations

SPST Switches			
Wiring	Group I	Group II	
Common Wire	Black	None	
	NO/NC	Sw. Com.	Sw. Com.
L1	Red	Red	Red
L2	Yellow	Yellow	Yellow
L3	Blue	Blue	Blue
L4	Brown		
L5	Orange		

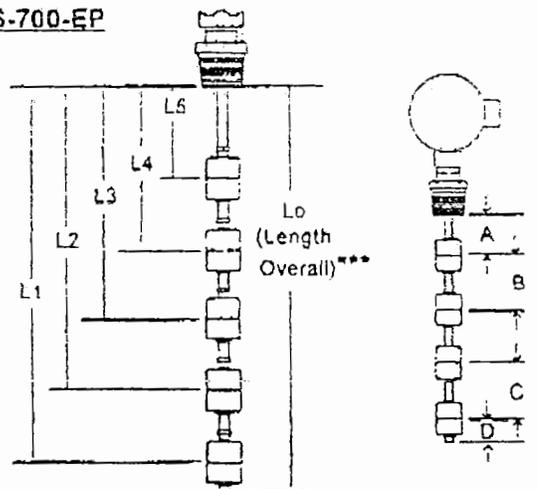
Notes

- Units with 100 VA switches are not U.L. recognized.

LS-700



LS-700-EP



Notes

- ** Actuation Level Distances and Lo (overall unit length) are measured from inner surfaces of mounting plug or flange.
- *** Length Overall (Lo) = L1 + Dimension D. See Mounting Types for Maximum Length values.

Float Types (LS-700 Series - Cont.)

304 Stainless Steel		
1,3,4,5,6	1,2,3,4,5,6	
141750	136540	136550
-40°F to +300°F (-40°C to +148.9°C)		
275	150	400
.85	1.05	1.10

LS-700 - Type 5

Standard Wiring Groups	
Group I	Maximum Number of Levels
Group I	2 (SPST)
Group II	1 (SPST W/3-Pin Connector) 2 (SPST W/4-Pin Connector)
Group III	1 (SPDT)
Switch Options	
SPST, 20 VA / 120-240 VAC	
SPDT, 10 VA / 100 VDC, Max.	

Mounting Types . . . LS-700-EP Series

Each mounting type can be configured with stem lengths (Lo) and float materials indicated in table below.	Type 2 - 3/4" NPT	Type 3 - 1" NPT
Stem and Mounting Material	Brass or 316 Stainless Steel	
Max. Length (Lo)	48 Inches (121.9 cm)	
Mounting Position	Vertical ±30° Inclination	
Float Stops	Brass Units: Beryllium Copper Grip Rings Stainless Steel Units: ARMCO PH-15-7MO Grip Rings	
Pressure Rating, PSI, Max. (Mounting Only*)	See Float Value (Chart Below)	

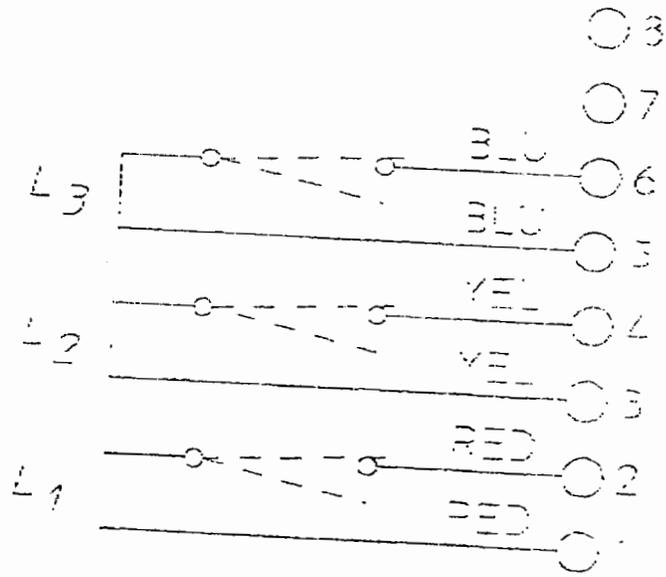
*Maximum pressure rating for complete unit will be the lower of this pressure or the selected float pressure.
(See float types shown on chart below)

Float Types (LS-700-EP Series)

Float Materials	304 Stainless Steel			Telion - Spring Biased
	3	2, 3	2, 3	2, 3
Compatible Mounting Types	3	2, 3	2, 3	2, 3
Float Dimensions				
Part Number	141750	136540	136550	133764
Operating Temperature	-40°F to +300°F (-40°C to +148.9°C)			
Pressure, PSI, Max.	275	150	400	1000*
Min. Liquid Specific Gravity	.85	.98	.98	.65

*De-rated with increasing temperature.

TYPICAL WIRING DIAGRAM
(GROUP II WIRING)

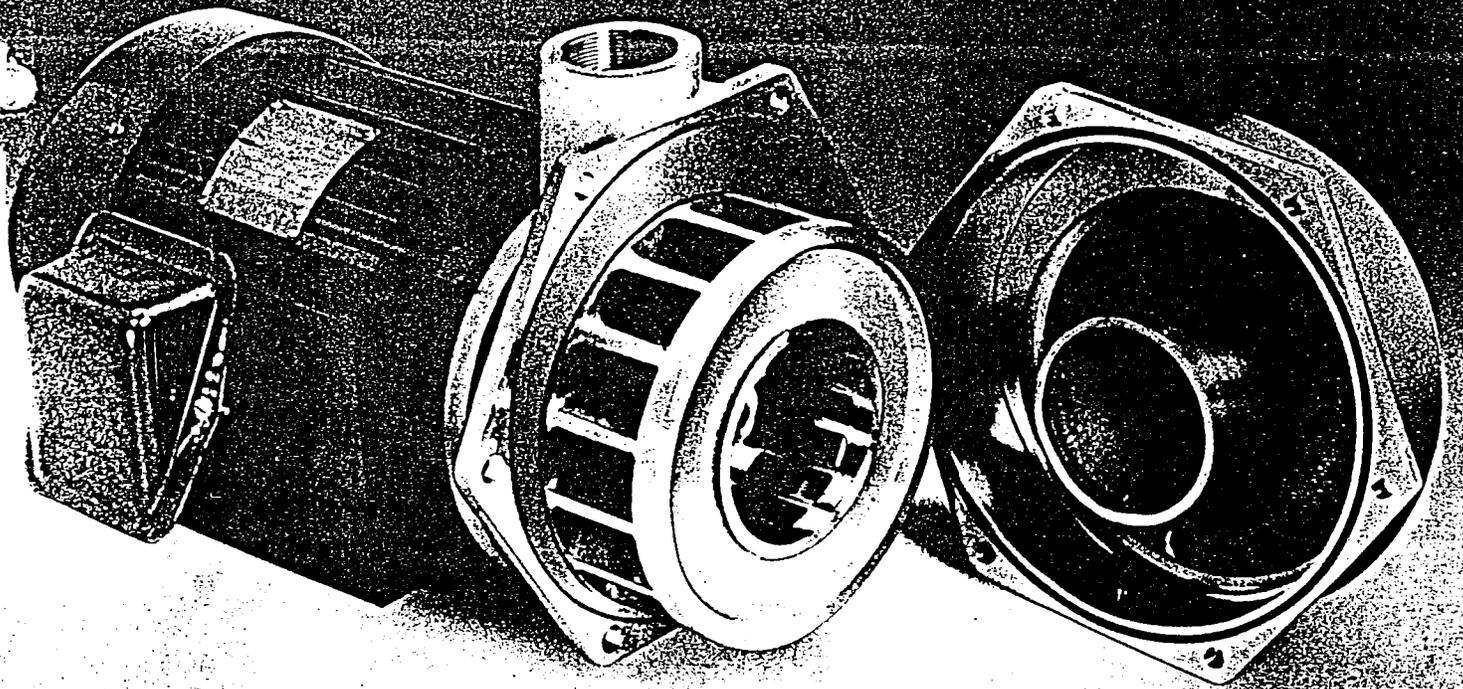


FORM NO 52722

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Fluid-Vac[®]

Liquid Ring Vacuum Pumps

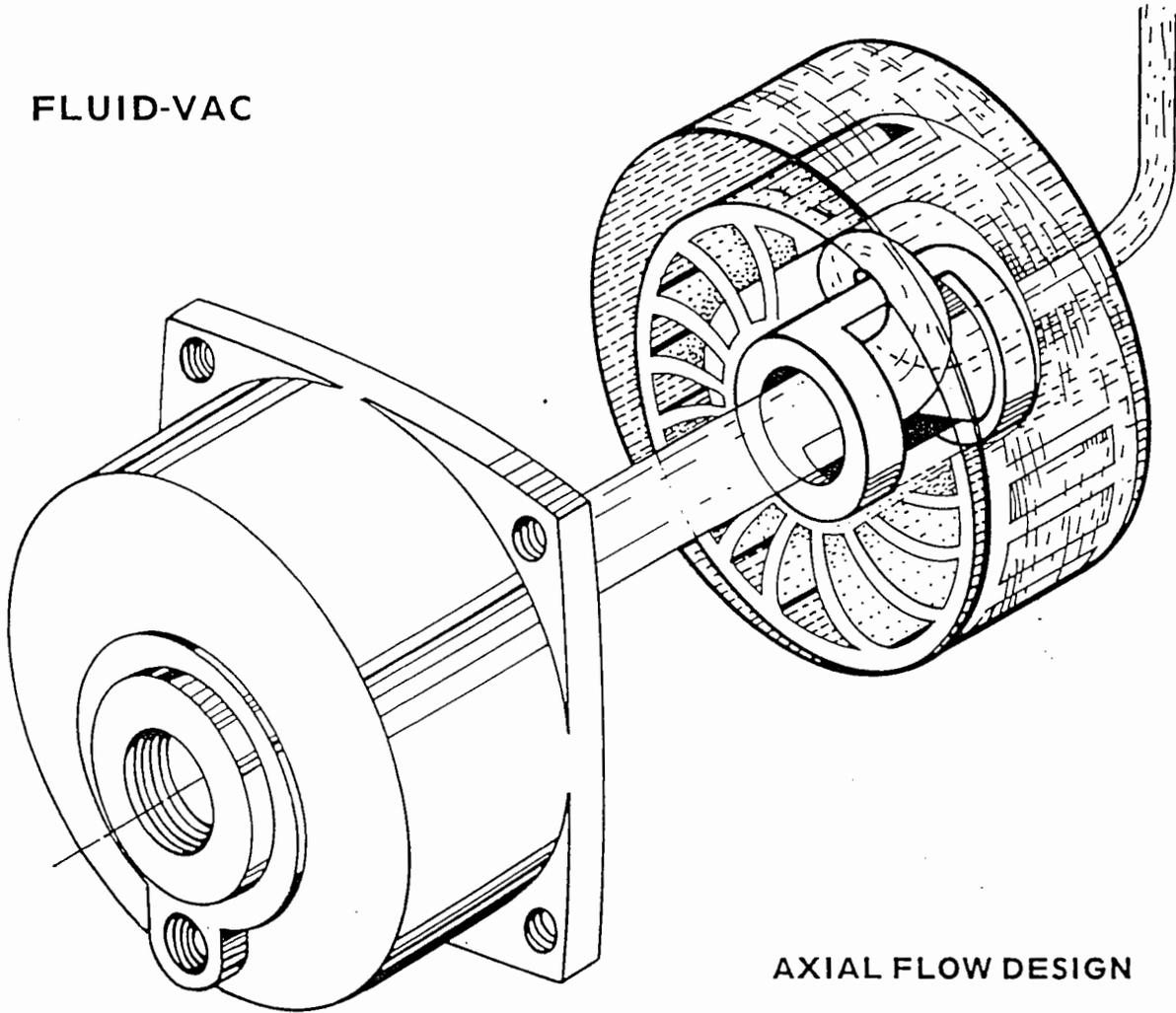


**Installation and
Service Manual**

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FLUID-VAC



AXIAL FLOW DESIGN

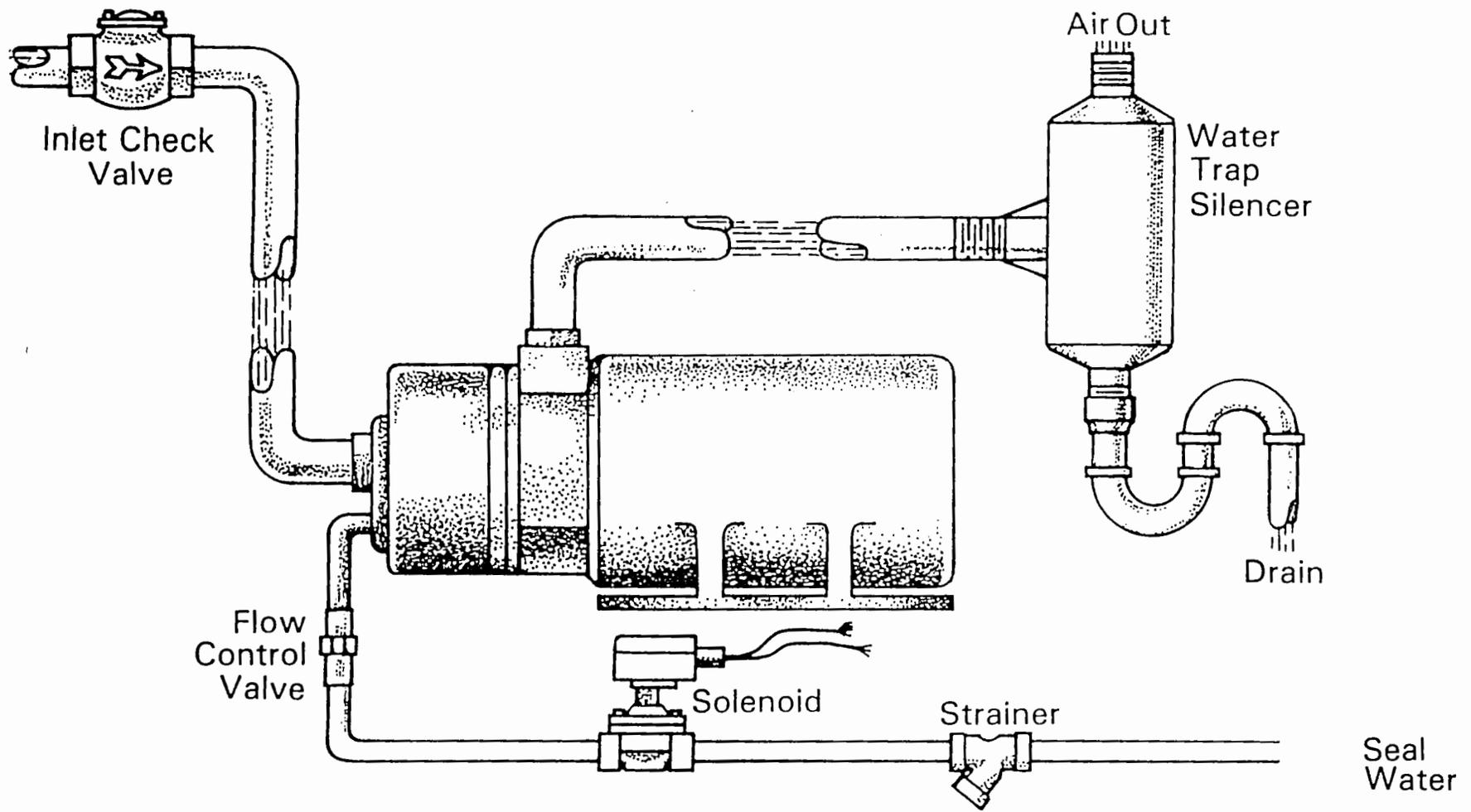
written notice upon discovery of any claimed defect. Material deemed defective must be returned to the factory, transportation charges to and from the factory to the place of origin pre-paid, F.O.B.

Anything herein to the contrary notwithstanding, the Seller will guarantee component parts manufactured by others, including, but not limited to, prime movers, starting equipment, electrical apparatus, and auxiliary fittings only to the same extent of the guarantee made by the manufacturer of such equipment.

1.4 SERVICE and PARTS

Fluid-Vac pumps are 100% designed and manufactured in the United States. All parts are maintained in inventory for immediate shipment from our factory in Stamford, Connecticut. At the back of this manual is a list of parts and recommendations for spares to keep on hand.

The reputation of Atlantic Fluidics is staked on fast service and practical assistance in designing vacuum systems for specific applications. Specializing in the liquid ring field, the company was created by and for ENGINEERS.



PIPING SCHEMATIC

3.2 START-UP

Once the pump is fully piped and wired for operation, be sure no foreign matter may enter and possibly damage the pump. Check for welding shot, slag or other metal bits.

Before starting the pump, turn the motor shaft by hand to be sure it is free to rotate. On TEFC motors, you may turn the rear fan. With ODP motors, the rotor can be turned via the discharge port or the front vents beneath motor.

If a hard rub is experienced, the pump should be checked internally for interference. As long as the shaft can be turned by hand, the pump is operable. A hard rub is indicative of improper alignment, and the pump should be disassembled and realigned.

A final check is to jog the motor, making sure water is introduced into the pump and that rotation is in accordance with the arrow cast on pump face. If no flow of air or vacuum reading is immediately apparent, rewire the motor accordingly. Rotation should be counter clockwise facing the pump inlet.

The pump is now ready for operation.

3.3 STOPPING PUMP

Once the power is shut off, be sure water is stopped from entering the pump. A solenoid valve in the seal water line is recommended to shut off flow simultaneously with cessation of pumping.

An inlet check valve is recommended to prevent vacuum loss or back flow to the system.

3.4 MAINTENANCE

As a general rule, maintenance is not required for Fluid-Vac pumps. Because there are no rubbing parts and with water acting as coolant and lubrication during pumping, wear is minimized. It is recommended that the motor bearings be greased every four years. For further information refer to the Trouble-Shooting Chapter of this manual.

To prevent foreign matter from entering the pump, a strainer is recommended for the seal water line and the usual precautions taken in the pump inlet piping.

4.0 Trouble shooting

4.1 PUMP WILL NOT TURN ON START-UP

- (a) Check wiring and power to pump.
- (b) Remove pump cover to check for anything that may be binding the rotor. Be sure that the rotor turns freely by hand. (Sec. 3.2)
- (c) On cast iron pumps, check for internal rust if pump has been left idle for a long period. Rust can build up to the point where internal clearances are closed. Remove rust and reassemble.
- (d) In areas where there is hard water being fed into the pump, check for scale deposits that may hinder rotation. Scale should be removed by acidizing, but refer to the factory for recommended procedures.

- (e) If the motor fails to turn, be sure it isn't a motor problem. Burn-out may occur if a three-phase motor is single phased.

4.2 NO PUMPING ON START-UP

- (a) Check pump rotations. It may be rotating in reverse. Rewire motor to correct.
- (b) Check seal water. Water must be fed continuously into the pump.

5.1 DISASSEMBLY OF PUMP

The pump may be disassembled while bolted to the baseplate by removing suction and seal water piping and working from cover to motor. Most repair work will not require full disassembly, but please refer to the exploded pump diagram in following steps:

(a) Shut off all valves controlling flow of fluids to and from the pump casing. Disconnect external piping.

(b) Remove bolts connecting cover to casing. The cover and port cylinder assembly will slide straight outward. The port cylinder is dismantled from cover by removing three socket head cap screws.

(c) Remove hex head lock screw and washer from motor shaft. Use a bearing puller to remove rotor without damage to casing. Be sure to protect the threaded shaft bore.

(d) Slide shims, mechanical seal, sleeve bushing and O-Ring off shaft.

(e) Unbolt casing from motor face.

(f) Save any and all shims from shaft and casing assemblies for proper realignment.

5.2 ASSEMBLY OF PUMP

Before commencing assembly of the pump, carefully inspect all parts for signs of unusual wear, abrasion and corrosion. O-Rings should be checked for cracks or brittleness and the carbon face of the mechanical seal examined for scratches.

Replace all parts as needed and proceed as follows:

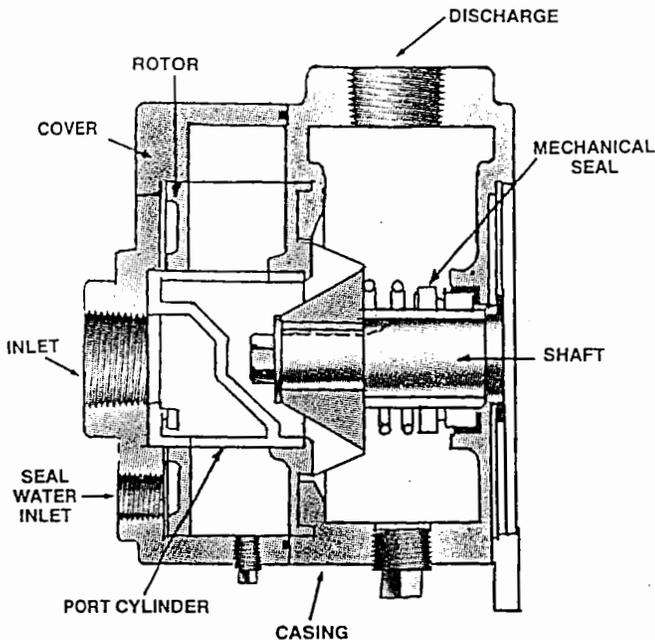
STEP ONE: Casing, Sleeve and Seal Assembly

The mechanical seal is composed of a seat (#8a), seal (#8b), and spring (#8c). The seat is a ceramic ring with a rubber boot that is pressed firmly into the rear of casing. Lubricant is recommended for ease in inserting rubber boot in the seal housing bore. **BE VERY CAREFUL NOT TO SCRATCH THE CERAMIC FACE DURING HANDLING AND INSERTION.**

Once the seal seat is in place, mount casing (#1) on the motor face using the original shims for alignment. The larger pump casings are mounted on four studs extending from motor face, while the smaller casings (Models A10, 15, 20) are secured by four hex head bolts.

Next slip the small O-Ring (#11) over shaft till it touches the shaft shoulder and place the sleeve/bushing (#9) on top so that its chamfered end presses against O-Ring.

To complete the assembly, lubricate the sleeve so that the rest of the mechanical seal (#8b) can be pressed on with the carbon face in flat sliding contact with the ceramic seat. Again, **AVOID SCRATCHING OR TOUCHING THE CARBON FACE.** Proper tension between the seal faces is provided by the spring – leading to Step 2.



Parts List for Models A10 through A200

Ref. No.	Part		
1	Casing	12	O-Ring, Cover
2	Rotor	13	Lock Bolt
3	Port Cylinder	14	Washer
4	Cover	15	Key
5	Gasket (Port Cylinder)	16	Slinger
6	Cap Screws (Port Cylinder)(3)	17	Drain Plug, Cover
7	Motor	18	Drain Plug, Casing
8	Mechanical Seal Assembly	19	Cover Bolts
	a) Seat b) Seal c) Spring		(4) A10-20 (6) A75-200
9	Shaft Sleeve	20	Casing Bolts (4)
10	Shims (set)	20a	Casing Nuts (4) A75-200 only
11	O-Ring, Shaft		

Parts recommended to keep on hand

#3	Port Cylinder
#5	Gasket (Port Cylinder)
#8	Mechanical Seal Assembly
#10	Shims (Set)
#11	O-Ring, Shaft
#12	O-Ring, Cover
#13	Lock Bolt

Contact:

PARTS DEPARTMENT
 Atlantic Fluidics, Inc.
 21 South Street
 South Norwalk, CT 06854
 (203) 853-7315
 FAX (203) 866-8218

Parts can be ordered directly from our Norwalk factory for immediate shipment. All parts are MADE IN AMERICA.

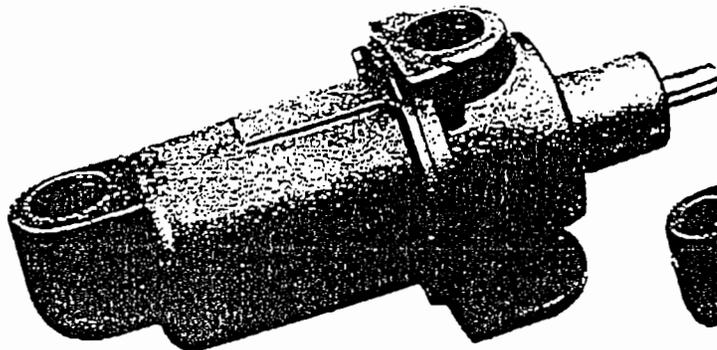
We will be happy to assist you with any questions which might arise and for advice on your application.



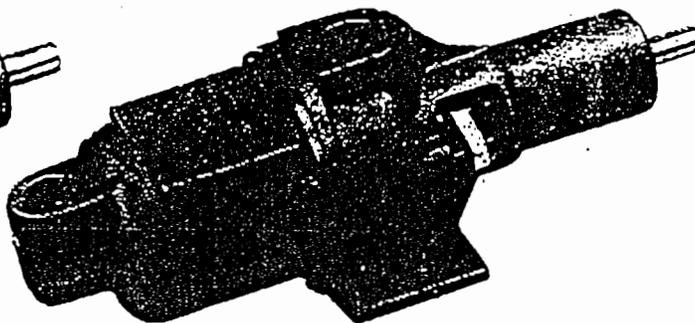
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SP PUMPS
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 Date: October 15, 1993

SERVICE MANUAL
MOYNO® SP PUMPS
300 SERIES

331, 332, 333, 344, 356 AND 367 MODELS



Mechanical Seal Models



Packing Gland Models

DESIGN FEATURES	MODELS					
	33101 34401 33201 35801 33301 36701	33104 34404 33204 35604 33304	33108 33308 33208 34408	34411 35611	35613	
Housing:	Cast Iron	AISI 316 SS	Nylon	Cast Iron	AISI 316 SS	
Pump Rotor:	Chrome plated 416 SS	Chrome plated 316 SS	Chrome plated 416 SS	Chrome plated 416 SS	Chrome plated 316 SS	
Pump Stator:	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	
Shaft:	416 SS	316 SS	416 SS	416 SS	316 SS	
Flexible Joint:	Carbon steel/ NBR	316 SS/ NBR	Carbon steel/ NBR	Carbon steel/ NBR	316 SS/ NBR	
Bearings:	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)	
Mechanical Seal:	Carbon-ceramic	Carbon-ceramic	Carbon-ceramic	---	---	
Packing:	---	---	---	Braided PTFE	Braided PTFE	

Note: Alternate elastomers available. Refer to Repair/Conversion kit numbers, page 8.

INSTALLATION

Mounting Position. Pump may be mounted in any position. When mounting vertically, it is necessary to keep bearings above seals to prevent possible seal leakage into bearings.

Pre-Wetting. Prior to connecting pump, wet pump elements and mechanical seal or packing by adding fluid to be pumped into suction and discharge ports. Turn shaft over several times in a clockwise direction to work fluid into elements.

Piping. Piping to pump should be self-supporting to avoid excessive strain on pump housings. See Table 1 for suction and discharge port sizes of each pump model. Use pipe "dope" or tape to facilitate disassembly and to provide seal.

Drive. On belt driven units, adjust belt tension to point of non-slip. Do not overtighten.

On direct drive units, coupling components should be aligned and spaced at least 1/16" apart.

Pump rotation must be clockwise when facing shaft to prevent damage to pump. Check direction of rotation before startup.

Water Flush of Packing (356 Models Only). The packing may be either grease lubricated through a grease fitting in the stuffing box or have plumbing connected to the housing to allow a water flush.

Maximum speed is 1750 rpm.

When the material being pumped is abrasive in nature, it may be advantageous to flush the packing to prevent leakage under packing and excessive shaft wear.

Clean water can be injected through a 1/8" NPT tapped hole that normally houses the grease fitting for lubricating the packing. The water can be permitted to leak axially along the shaft in either direction or can be removed from the second tapped hole in the stuffing box. In both cases, the discharge from the stuffing box should be throttled slightly to maintain 10-15 PSI higher pressure in the stuffing box than is present in the discharge housing.

Table 1. Pump Data

Pump Models	331	332	333	344	356	367
Suction Port (NPT)	3/4"	3/4"	3/4"	3/4"	1-1/2"	2"
Discharge Port (NPT)	3/4"	3/4"	3/4"	3/4"	1-1/4"	2"
Discharge Pressure (psig)	150	100	50	40	50	50

*08 versions = 1" NPT

Table 2. Temperature Limits

Elastomer	Temperature Limits
*NBR	10°-160°F
*EPDM	10°-210°F
*FPM	10°-240°F

*NBR = Nitrile

*EPDM = Ethylene-Propylene-Diene Terpolymer

*FPM = Fluoroelastomer

OPERATION

Self-Priming. With wetted pumping elements, the pump is capable of 25 feet of suction lift when operating at 1750 rpm with pipe size equal to port size.

DO NOT RUN DRY. Unit depends on liquid pumped for lubrication. For proper lubrication, flow rate should be at least 10% of rated capacity.

Pressure and Temperature Limits. See Table 1 for maximum discharge pressure of each model. Unit is suitable for service at temperatures shown in Table 2.

Storage. Always drain pump for extended storage periods by removing suction housing bolts and loosening suction housing.

TROUBLE SHOOTING

WARNING: Before making adjustments, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

Failure To Pump.

1. Belt or coupling slip: Adjust belt tension or tighten set screw on coupling.
2. Stator torn; possibly excessive pressure: Replace stator, check pressure at discharge port.
3. Wrong rotation: Rotation must be clockwise when facing shaft.

4. Threads in rotor or on shaft stripped: Replace part. Check for proper rotation.

5. Excessive suction lift or vacuum.

Pump Overloads.

1. Excessive discharge pressure: Check discharge pressure for maximum rating given in Table 1. Check for obstruction in discharge pipe.
2. Fluid viscosity too high: Limit fluid viscosity to 20,000 CP or 100,000 SSU.

Viscosity CP	Limit RPM
1-300	1750
300-1,000	1200
1,000-2,000	700
2,000-5,000	350
5,000-10,000	180
10,000-20,000	100

3. Insufficient motor HP: Check HP requirement.

Noisy Operation.

1. Starved suction: Check fluid supply, length of suction line, and obstructions in pipe.
2. Bearings worn: Replace parts; check alignment, belt tension, pressure at discharge port.
3. Broken flexible joint: Replace part, check pressure at discharge port.
4. Insufficient mounting: Mount to be secure to firm base. Vibration induced noise can be reduced by using mount pads and short sections of hose on suction and discharge ports.

Mechanical Seal Leakage (Mechanical Seal Models Only).

1. Leakage at startup: If leakage is slight, allow pump to run several hours to let faces run in.
2. Persistent seal leakage: Faces may be cracked from freezing or thermal shock. Replace seal.

Packing Leakage (Packing Models Only).

1. Leakage at startup: Adjust packing as outlined in maintenance instructions.

Note: Slight leakage is necessary for lubrication of packing.

2. Persistent leakage: Packing rings and/or shaft may be worn. Replace parts as required.

Pump Will Not Prime.

1. Air leak on suction side: Check pipe connections.

MAINTENANCE

General. These pumps have been designed for a minimum of maintenance, the extent of which is routine lubrication and adjustment of packing. The pump is one of the easiest to work on in that the main elements are very accessible and require few tools to disassemble.

Packing Lubrication (356 Models Only). The zerk fitting on the side of the suction housing leads to the lantern ring halves in the mid-section of the packings. At least once a week, inject a small quantity of good quality grease, such as MPG-2 Multi Purpose Grease (Du Bols Chemical), or equivalent, into the zerk fitting to lubricate the packings.

Note: For Model 34411, lubricate packing by applying a liberal amount of grease during assembly.

Packing Adjustment (Packing Models Only). Packing gland attaching nuts should be evenly adjusted so they are little more than finger tight. Over-tightening of the packing gland may result in premature packing failure and possible damage to the shaft and gland.

When the packing is new, frequent minor adjustments are recommended for the first few hours of operation in order to compress and seat the packing. Be sure to allow slight leakage for lubrication of packing.

When excessive leakage can no longer be regulated by tightening the gland nuts, remove and replace the packings in accordance with the DISASSEMBLY and REASSEMBLY instructions. The entire pump need not be disassembled to replace the packings.

Bearing Lubrication. The prelubricated, fully sealed bearings do not require additional lubrication.

PUMP DISASSEMBLY

WARNING: Before disassembling pump, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

To Disassemble Mechanical Seal Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) holding suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning counter-clockwise (RH thread). Use 3/16 inch diameter punch to remove rotor pin (45) on Model 36701.
4. Flexible joint (24) can be removed from shaft (26) by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn counter-clockwise. Use 3/16 inch diameter punch to remove shaft pin (46) on Model 36701.
5. Carefully slide mechanical seal (69) off shaft (26). Carefully pry seal seat out of pump body (1). If any parts of mechanical seal are worn or broken, the complete seal assembly should be replaced. Seal components are matched parts and are not interchangeable.
6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads. The bearings may be pressed off the shaft.

To Disassemble Packing Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) which hold suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning in a counter-clockwise direction (RH thread).
4. Flexible joint (24) can be removed by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn in a counter-clockwise direction.
5. The packing (42) can be removed without removing the shaft (26) using the following procedure:
 - a. Remove gland bolts (47).
 - b. Slide gland (41) away from packing (42).
 - c. Pull out packing (42) (and lantern ring halves (57) on 356 Models) using a packing removing tool.

Note: Packing can be removed after shaft has been removed by pushing out from pump side of pump body after gland (41) has been detached.

6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads.
7. To disassemble shaft assembly, remove snap ring (66A) from shaft (26) and press bearings (29) and bearing spacer (33) off the shaft.

PUMP ASSEMBLY

To Assemble Mechanical Seal Models:

1. Press bearings (29) on shaft (26), and locate slinger ring (77) near bearing on threaded end of shaft.

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

2. Press shaft assembly into pump body (1) securing with snap ring (66).
3. Install mechanical seal (69) using the following procedure:
 - a. Clean and oil sealing faces using a clean light oil (not grease).

Caution: Do not use oil on EPDM parts. Substitute glycerin or soap and water.

- b. Oil the outer surface of the seal seat, and push the assembly into the bore in the pump body (1), seating it firmly and squarely.
 - c. After cleaning and oiling the shaft, slide the seal body along the shaft until it meets the seal seat.
 - d. Install seal spring and spring retainer on shaft.
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread). On 356 Models, install seal spacer (69A) and washer (116) before threading flexible joint onto shaft in a clockwise direction. On Model 36701, use shaft pin (46) to pin flexible joint (24) to shaft.
 5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread). On Model 36701, pin rotor (22) to joint using rotor pin (45).
 6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
 7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
 8. Proceed as in installation instructions.

To Assemble Packing Models:

1. Press bearings (29), with bearing spacer (33) in between, on shaft (26) and secure in place using snap ring (66A).

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

Page 4

2. Install packing (42) before installing shaft assembly using the following procedure:
 - a. Lubricate each individual ring of packing with a grease that is insoluble in the fluid being pumped.
 - b. Individually assemble each ring of packing loosely in the packing chamber of the pump body (1). Stagger splits on rings. (Four rings, 3/16 inch square required on Model 34411; four rings, 1/4 inch square and two lantern ring halves (57) assembled between two rings on 356 Models).
 - c. Loosely install packing gland (41) on pump body (1) using gland bolts (47).
3. Press shaft assembly into pump body (1) positioning slinger ring (77) between packing gland (41) and bearing end of pump body. Secure the shaft assembly with snap ring (66).
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread).
5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread).
6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
8. Proceed as in installation instructions.

Note: Adjust newly installed packing as described in maintenance procedure.

WARNING: Replace belt or coupling guards before re-connecting power.

PARTS LIST — 331, 332, 333, AND 344 MODELS

Item No.	Description	Mechanical Seal Models			Packing Gland Models	
		33101 33201 33301 34401	33104 33204 33304 34404	33108 33208 33308 34408	34411	
1	Pump Body	330-1065-002	330-1910-002		340-1000-001	
1A	Discharge Housing			340-2362-000		
1B	Bearing Housing			330-4587-000		
1C	Pump Base			340-2369-000		
2	Suction Housing	330-1064-002	330-1911-002	330-4536-000	330-1064-002	
*21	Stator	See Stator section below.				
*22	Rotor	See Rotor section below with circled numbers for each series.				
		①	②	①	①	
24	Joint	Carbon Steel/NBR 320-1511-000	316 SS/NBR 320-3759-000	Carbon Steel/NBR 320-1511-000		
26	Drive Shaft	320-1499-000	320-2938-000	320-1499-000	320-2448-000	
29	Bearing (2 req.)	630-0502-031				
33	Bearing Spacer					320-1900-000
41	Packing Gland					320-0101-004
*42	Packing					340-3386-005
47	Gland Bolt					619-1520-161
66	Snap Ring	320-1506-000				
66A	Snap Ring					320-4182-000
*69	Mechanical Seal	320-2424-000				
77	Slinger Ring	320-6382-000				320-6384-000
100	Pipe Plug (3 req.)				610-0120-021	
112	Screws (8 req.)	619-1430-103	320-5968-000	619-0860-081	619-1430-103	
112C	Screws (4 req.)				619-0890-281	
135	Stator Ring (331-332 only)	320-7812-000				
215	Lock Washer (8 req.)	320-6464-000				

* Recommended spare parts.

STATORS		Models			
		331	332	333	344
21	Standard Stator, NBR All Models	340-3501-120	340-3502-120	340-3503-120	340-3504-120
21	EPDM Stator	340-3501-320	340-3502-320	340-3503-320	340-3504-320
21	FPM Stator	340-3501-520	340-3502-520	340-3503-520	340-3504-520
ROTORS					
22	① 416SS — All Models	320-2729-000	330-0906-000	320-1394-000	320-1841-000
22	② 316SS — All Models	320-2933-000	320-2942-000	320-2938-000	320-2934-000

See page 8 for Repair/Conversion Kits

PARTS LIST — 356 AND 367 MODELS

Item No.	Description	Mechanical Seal Models		Packing Gland Models		Mechanical Seal Model
		35601	35604	35611	35613	36701
1	Pump Body	Cast Iron 340-0636-000	316SS 340-1550-000	Cast Iron 350-0420-000	316SS 350-0491-000	Cast Iron 350-0423-000
2	Suction Housing	350-0280-000	350-0489-000	350-0280-000	350-0489-000	350-0302-000
*21	Stator	NBR 340-3505-120		NBR 340-3505-120		NBR 340-3506-120
*22	Rotor	416SS 320-2304-000	316SS 320-4431-000	416SS 320-2304-000	316SS 320-4431-000	416SS 330-2042-000
24	Flex Joint	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1749-000
26	Drive Shaft	320-1759-000	320-4430-000	320-2765-000	320-4435-000	330-1805-000
29	Bearing (2 req.)	630-0552-051				630-0552-061
33	Bearing Spacer	320-2764-000				
41	Packing Gland			320-0003-004	320-0003-007	
*42	Packing	340-3396-008				
45	Rotor Pin					320-4439-002
48	Shaft Pin					320-4439-001
47	Gland Bolt	619-1530-241				
57	Lantern Ring Half™	320-6585-000				
66	Snap Ring	320-1758-000				320-2794-000
66A	Snap Ring	320-3533-000				
*69	Mechanical Seal	320-3945-000				320-1750-000
69A	Seal Spacer	320-4434-000				
77	Slinger Ring	320-6383-000	320-6385-000		320-6385-000	
112	Screws (6 req.)	619-1530-161				619-1530-161
115	Zerk Fitting	320-2503-001				
116	Washer	320-4434-000				
135	Stator Spacer	330-7594-000				
202	Shaft Key					611-0040-240
215	Lock Washer (6 req.)	623-0010-411				
261	Pipe Plug	610-0120-011	610-0420-010	610-0120-011	610-0420-010	610-0120-011

*Recommended spare parts.

**2 Required

See page 8 for Repair/Conversion Kits

REPAIR/CONVERSION KIT NUMBERS

ELASTOMER REPAIR/CONVERSION KITS

Item No.	Description	331 Models			332 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9026-000	311-9025-000	311-9054-000	311-9027-000	311-9038-000	311-9055-000
21	• Stator	340-3501-120	340-3501-320	340-3501-520	340-3502-120	340-3502-320	340-3502-520
24	• Joint	320-1511-000†	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-500	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
Item No.	Description	333 Models			344 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9029-000	311-9028-000	311-9056-000	311-9031-000	311-9030-000	311-9057-000
21	• Stator	340-3503-120	340-3503-320	340-3503-520	340-3504-120	340-3504-320	340-3504-520
24	• Joint	320-1511-000†	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000

†316SS/with appropriate elastomer.

‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for 331-344 Models is available as 320-3759-000.

Item No.	Description	356 Models			367 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No. (Mech. Seal Models)	311-9033-000	311-9032-000	311-9058-000	311-9060-000	311-9036-000	311-9124-000
21	• Stator	340-3505-120	340-3505-320	340-3505-520	340-3506-120	340-3506-320	340-3506-520
24	• Flex Joint	320-1583-000‡	320-6369-000†	320-4671-000†	320-1749-000‡	320-6378-000‡	320-6515-000‡
69	• Seal	320-3945-000	320-6380-000	320-6510-000	320-1750-000	320-6390-000	320-6517-000
45	• Rotor Pins				320-4439-002	320-4439-002	320-4439-002
46	• Shaft Pin				320-4439-001	320-4439-001	320-4439-001
—	Kit No. (Packing Gland Models)	311-9035-000	311-9034-000	311-9059-000			
21	• Stator	340-3505-120	340-3505-320	340-3505-520			
24	• Joint	320-1583-000‡	320-6369-000†	320-4671-000†			

†316SS/with appropriate elastomer.

‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for Model 35604 and 35613 pumps is available as 320-4427-000.

ABRASION RESISTANT SEALS

Elastomer	Models		
	331-344	356	36701
NBR	3206460000	3206505000	3206511000
EPDM	3206502000	3206506000	3206512000
FPM	3206503000	3206507000	3206513000

NBR = Nitrile

EPDM = Ethylene-Propylene-Diene Terpolymer

FPM = Fluoroelastomer

OIL WATER SEPARATOR

Operation

The separator shall be a special purpose prefabricated parallel corrugated plate gravity displacement type oil/water separator designed to remove free and dispersed non-emulsified oil and settleable solids, in accordance with API 421. The separator shall be comprised of a tank containing an inlet compartment, sludge chamber and clean water outlet chamber.

INLET COMPARTMENT

The inlet chamber will be comprised of a non-clog diffuser pipe to distribute the flow across the width of the separator chamber. The inlet compartment shall be of sufficient volume to effectively reduce influent suspended solids, dissipate energy and begin separation. A sludge baffle will be provided to prevent settleable solids and sediment from entering the separation chamber.

SEPARATION CHAMBER

The separation chamber will contain parallel corrugated plates for enhanced oil/water separation. The plates will be spaced for optimum removal of free oil and settleable solids, and the corrugations will have a 60 degree angle with respect to the horizontal. Flow through the plate pack will be in a cross-flow configuration. This allows the oil to collect and coalesce in the high points of the corrugations while the solids collect at the low points. This also allows oil to rise without interfering with the falling solids, reducing the possibility of clogging. Plates shall be enclosed in a stainless steel frame to facilitate installation and removal.

SLUDGE CHAMBER (Option)

The sludge chamber can be located under the separation chamber and will provide an adequate volume for the settling of any solids. The angle of repose of the sludge chamber is 45 degrees to ensure easy and complete removal of the solids through outlet flanges provided on each side of the separator.

OIL COLLECTION

The oil will be collected at the end of the separation chamber by a fixed weir trough or rotatable skimmer. Either collection method will provide for automatic decant of the separated oil through gravity outlet(s) on the side(s) of the separator. The type of oil collector depends upon the application.

INTEGRAL OIL STORAGE COMPARTMENT (Option)

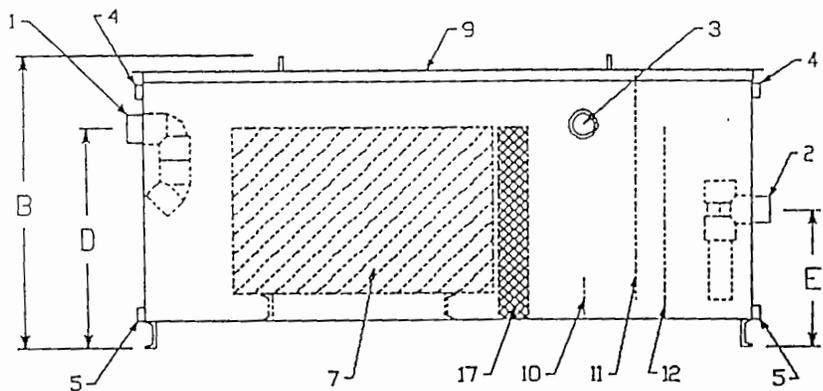
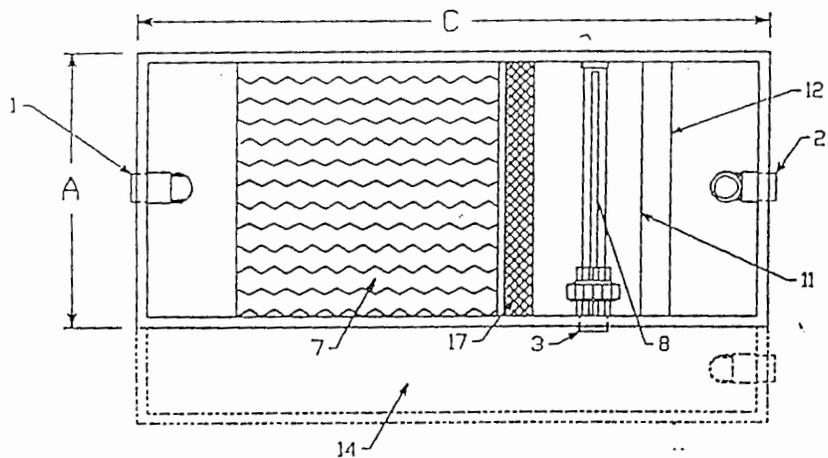
An integral oil storage compartment can be provided for storing separated oil. The compartment adjacent to the coalescing compartment would collect and store the oil discharged from the oil collector.

CLEAN WATER CHAMBER

The water will pass under the oil retention baffle and over the adjustable effluent weir, which maintains the liquid level throughout the separator, and exit through the outlet provided at the end of the separator.

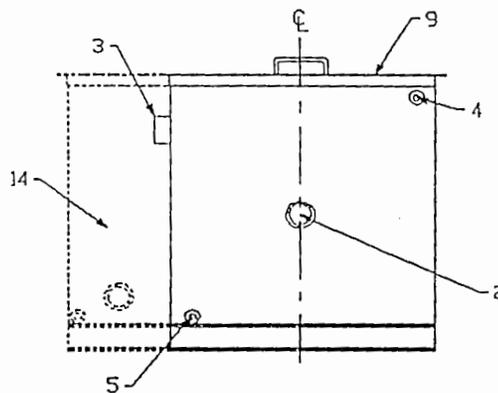
COVERS

The separator is provided with a vapor tight cover that can easily be removed for service and maintenance.



NOTES:

- 1) CONSTRUCTION: 1/8" OR 1/4" A36 CARBON STEEL
- 2) COVER GASKET: NEOPRENE
- 3) HARDWARE: 18-8 STAINLESS STEEL
- 4) PVC PIPE & FITTINGS: GRAY SCHEDULE 80.
- 5) INTERIOR COATING: EPOXY PAINT.
- 6) EXTERIOR COATING: EPOXY PAINT.
- 7) TANKS CONSTRUCTED IN ACCORDANCE WITH API STANDARDS 620 & 650.
- 8) ALL CONNECTIONS 4" AND SMALLER ARE NPT COUPLINGS. ALL CONNECTIONS 6" AND LARGER ARE FLAT FACE FLANGES WITH ANSI 150# DRILLING
- 9) ANCHOR BOLTS TO BE 1/2" DIA MINIMUM WITH 6" EMBEDMENT AND 2" PROJECTION
- 10) OPTIONAL OIL RESEVOIR IS A SEPARATE COMPARTMENT ON THE SIDE AS SHOWN. CAPACITIES RANGE FROM 100 TO 400 GAL. RESERVOIR CAN BE FITTED FOR PUMP CONTROL AND/OR HIGH LEVEL ALARMS.



ITEM	QTY	STANDARD EQUIPMENT
1	1	INLET NOZZLE (SEE SCHEDULE)
2	1	OUTLET NOZZLE (SEE SCHEDULE)
3	1	OIL OUTLET (SEE SCHEDULE)
4	2	VENT (SEE SCHEDULE)
5	2	DRAIN (SEE SCHEDULE)
6	1	LEVEL SENSOR PORT (SEE SCHEDULE)
7	A/R	PARALLEL PLATE MEDIA
8	1	OIL SKIMMER
9	A/R	VAPOR TIGHT COVER
10	1	SLUDGE BAFFLE
11	1	OIL STOP VEIR
12	A/R	EFFLUENT OVERFLOW VEIR
13	4	LIFTING LUG
OPTIONAL EQUIPMENT		
14	1	OIL RESERVOIR (SEE NOTE 10)
15	A/R	LEVEL CONTROLS - NEMA ENCLOSURE
16	A/R	IMMERSION HEATER(S)
17	A/R	POLISHING MEDIA
18	A/R	INFLUENT / EFFLUENT PUMPS
19	1	OIL PUMP
CUSTOMER SUPPLIED EQUIPMENT		
20	1	CEMENT PAD
21	A/R	ANCHOR BOLTS
22	A/R	EXTERNAL PIPING
23	A/R	VENT PIPING

PERFORMANCE

SIZING OF OIL/WATER SEPARATOR TANK TO BE DETERMINED BY HYDROQUIP BASED ON REMOVING NON-HULIFIED FREE AND DISPERSED OIL AND SOME SETTLEABLE SOLIDS.

ANALYSIS MUST INDICATE THAT AT THE CALCULATED OVERFLOW RATE, THE OIL/WATER SEPARATOR WILL BE EQUIPPED WITH THE REQUIRED PROJECTED PLATE AREA TO REALIZE THE SPECIFIED PERFORMANCE UNDER LAMINAR FLOW CONDITIONS. CALCULATIONS TAKE INTO ACCOUNT FLOW RATE, FLUID TEMPERATURE RANGE, INFLUENT CONCENTRATIONS AND SPECIFIC GRAVITIES OF OIL AND SOLIDS TO BE REMOVED. ACCEPTABLE DISCHARGE LIMITS, POTENTIAL SURGE FLOWS, PARTICLE CHARACTERISTICS, AND PH.

THE AG MODEL WILL EFFICIENTLY REMOVE 100% OF ALL 20 MICRON AND LARGER PARTICLES AND PRODUCE AN EFFLUENT OF 10 mg/l AS MEASURED BY API METHOD 481.

MODEL	SCHEDULE					ITEM NO.					SLUDGE CAP. (GAL)	SHIP WEIGHT (LBS)	OPER. WEIGHT (LBS)
	A D.A. WIDTH	B D.A. HEIGHT	C D.A. LENGTH	D INLET HEIGHT	E OUTLET HEIGHT	1 INLET DIA	2 OUTLET DIA	3 OIL DIA	4 VENT DIA	5 DRAIN DIA			
AGS-1	15"	30"	51"	20"	12"	1"	1"	1"	1"	1"	3	288	1307
AGS-2	27"	30"	51"	20"	12"	2"	2"	2"	1"	1"	5	428	2466
AGS-3	40"	30"	52"	20"	12"	2"	2"	2"	1"	1"	8	567	3625
AG-1	15"	42"	87"	32"	20"	2"	2"	2"	1"	1"	12	539	1559
AG-2	27"	42"	87"	32"	20"	3"	3"	3"	1"	1"	24	771	2810
AG-3	40"	42"	88"	32"	20"	4"	4"	3"	1"	1"	36	1003	4061
AG-4	52"	42"	88"	32"	20"	6"	6"	4"	2"	2"	48	2253	6312

B	AGS-1	AGS-2	AGS-3	AGS-4	AG-1	AG-2	AG-3	AG-4	
A	AGS-1	AGS-2	AGS-3	AGS-4	AG-1	AG-2	AG-3	AG-4	
REV.	DESCRIPTION							DATE	DWT.
TITLE: OIL/WATER SEPARATOR MODELS AGS / AG								DRN BY: DPH	
								CHKD BY: MHT	
PROJECT:								DATE: 1/6/96	
REV:								SCALE: 1:0.5	
THIS DRAWING IS PROPERTY OF BISCO ENVIRONMENTAL AND SHALL NOT BE COPIED, LOANED OR REPRODUCED WITHOUT WRITTEN PERMISSION. PENALTIES - NON-PAID REPRODUCIBLE.									
								REV: 0	

→ 30 Micron Sizing

		Maximum Flowrate (gpm)											
		1/2" Media				3/4" Media				1-1/8" Media			
Spec.Gravity		0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95
M O D E L	AGS-1	6	3	2	1	4	2	-	-	2	1	-	-
	AGS-2	13	6	4	2	9	4	3	1	5	2	1	-
	AGS-3	19	9	6	3	13	6	4	2	8	4	2	1
	AG-1	39	19	13	6	27	13	9	4	17	8	5	2
	AG-2	78	39	26	13	54	27	18	9	35	17	11	5
	AG-3	118	59	39	19	82	41	27	13	53	26	17	8
	AG-4	157	78	52	26	109	54	36	18	70	35	23	11
	HP-0	78	39	26	13	54	27	18	9	35	17	11	5
	HP-1	157	78	52	26	109	54	36	18	70	35	23	11
	HP-2	210	105	70	35	146	73	48	24	94	47	31	15
HP-3	315	157	105	52	219	109	73	36	141	70	47	23	
HP-4	420	209	140	70	292	146	97	49	188	94	63	31	
HP-5	525	262	175	88	365	182	122	61	235	118	78	39	
HP-6	630	315	210	105	438	219	146	73	282	141	94	47	
HP-7	735	368	245	123	511	256	171	85	328	165	110	55	
HP-8	840	420	280	141	584	292	195	98	375	189	126	63	
HP-9	945	473	316	158	657	329	219	110	421	212	141	71	
HP-10	1,050	525	351	176	730	365	244	122	468	236	157	79	

Assumptions: Temp. Range = 40-75°F

Removal = 30 microns

Act. Safety Factor = 1.50 minimum

Using Brentwood specific surface area

		Maximum Flowrate (gpm)											
		1/2" Media				3/4" Media				1-1/8" Media			
Spec. Gravity		0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95	0.7	0.85	0.9	0.95
M O D E L	AGS-1	25	12	8	4	15	8	5	2	11	5	3	1
	AGS-2	50	25	17	8	31	16	10	5	23	11	7	3
	AGS-3	75	38	25	13	47	24	16	8	35	17	11	5
	AG-1	55	55	51	26	37	37	32	16	24	24	23	11
	AG-2	110	110	103	52	74	74	64	32	48	48	46	22
	AG-3	165	165	155	78	111	111	96	48	72	72	69	33
	AG-4	220	220	207	104	148	148	128	64	96	96	92	44
	HP-0	110	110	103	52	74	74	64	32	48	48	48	22
	HP-1	168	168	155	78	114	114	96	48	75	75	75	35
	HP-2	220	220	220	138	148	148	148	84	96	96	96	62
HP-3	330	330	330	207	222	222	222	126	144	144	144	93	
HP-4	440	440	440	276	296	296	296	168	192	192	192	124	
HP-5	550	550	550	345	370	370	370	210	240	240	240	155	
HP-6	660	660	660	414	444	444	444	252	288	288	288	186	
HP-7	770	770	770	483	518	518	518	294	336	336	336	217	
HP-8	880	880	880	552	592	592	592	336	384	384	384	248	
HP-9	990	990	990	621	666	666	666	378	432	432	432	279	
HP-10	1,100	1,100	1,100	690	740	740	740	420	480	480	480	310	

Assumptions: Temp. Range = 40-75°F

Removal = 60 microns

Act. Safety Factor = 1.50 minimum

Using Munters specific surface area

BISCO
Environmental

60 STERGIS WAY, DEDHAM, MA 02026
TEL: 800-225-8006 • FAX: (617) 461-1152

Site: **NWIRP , AG-4**

Given the following data:

Q = 20 flowrate (gpm)
T = 35 fluid temperature (°F)
Psg = 0.9 oil specific gravity
S = 0.75 media spacing (in.)
SP = 48 media specific surface area (sq.ft./cu.ft.)
M = 60 micron removal size (microns)

determine the media pack size needed to meet the effluent quality requirements. For a rectangular model separator, the tank requirements are:

L = 3 media length (ft.)
H = 2 media height (ft.)
Lt = 4 tank length (ft.)

First, determine the rate of rise of the oil particles according to Stokes Law:

$$Vr = C1 * (Wsg - Psg) * (M / 10000)^2 / Wv = 0.024 \text{ ft./min.}$$

where:

C1 = Combination of conversion factors = 107.2
Wsg = Water specific gravity at given low temperature = 1.00
Wv = Water viscosity at given temperature = 0.0164 poise.

Next calculate the surface area needed to accomplish separation based on the above Vr:

$$Amin = Q / Vr / C2 = 112.5 \text{ sq.ft.}$$

where:

C2 = Conversion factor (7.48 gal./cu.ft.).

Now determine the minimum volume of media required for this separation:

$$Vmin = Amin / SP = 2.3 \text{ cu.ft.}$$

Given the following media pack width, determine the operating characteristics of the pack:

W = 4 media width (ft.)

Media Pack Characteristics

Actual Coalescing Area	1152	sq.ft.
Actual Settling Area	288	sq.ft.
Actual Media Volume	24	cu.ft.
Fluid Velocity in Pack	0.33	ft./min.
Specific flowrate	0.0174	gpm/sq.ft.
Detention Time in Pack	9.0	min.
Actual Safety Factor	10.2	
Reynolds No. (Low Temp.)	38	
Reynolds No. (High Temp.)	67	

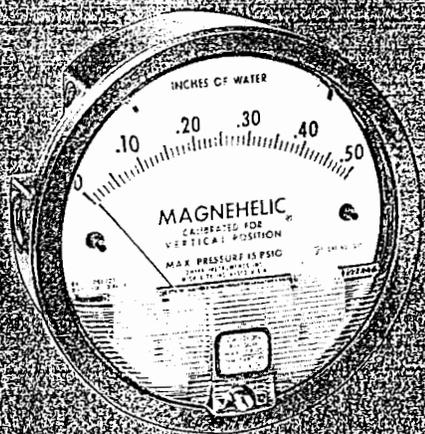
Since the Reynolds Number is less than 500, the flow in the pack is laminar. Therefore Stokes Law applies and optimal separation will be achieved.



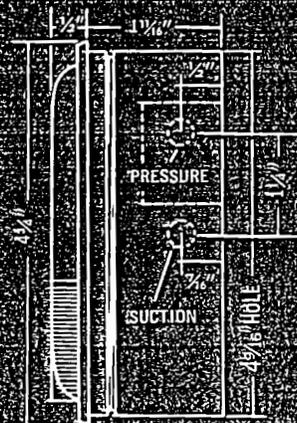
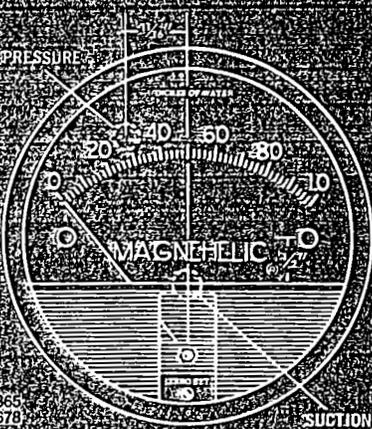
SERIES 2000

Magnehelic® Differential Pressure Gages

Indicate low air or gas pressures—positive, negative or differential. Accurate within 2%. 81 Ranges.



Patent Nos. 4,030,365
5,012,678

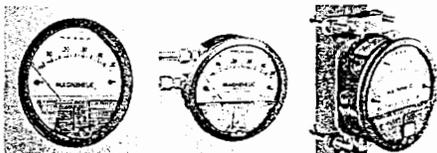


Standard Magnehelic® Pressure Gage has a large, easy-to-read 1" dial.

Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy — guaranteed within 2% of full scale — and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures — either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

Widely used to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.



Flush... Surface... or Pipe Mounted

PHYSICAL DATA

- Ambient temperature range: 20° to 140° F.*
- Rated total pressure: -20" Hg. to 15 psig.†
- Overpressure: Relief plug opens at approximately 25 psig.
- Connections: 1/8" NPT female high and low pressure taps, duplicated — one pair side and one pair back.
- Housing: Die cast aluminum. Case and aluminum parts Iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.
- Accuracy: Plus or minus 2% of full scale (3% on -0 and 4% on -00 ranges), throughout range at 70°F.
- Standard accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)
- Weight: 1 lb. 2 oz.

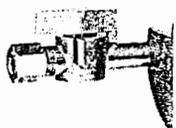
*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at left.

OPTIONS AND ACCESSORIES

- Transparent overlays**
Furnished in red and green to highlight and emphasize critical pressures.
- Adjustable signal flag**
Integral with plastic gage cover; has external reset screw. Available for most ranges except those with medium or high pressure construction. Can be ordered with gage or separately.
- LED Setpoint Indicator**
Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12 - 24 VDC. Requires MP or HP style cover and bezel.



Mounting. A single case size is used for most ranges of Magnehelic gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1 1/4" - 2" pipe. Although calibrated for vertical position, many ranges above 1 inch may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic gages ideal for both stationary and portable applications. A 4 3/16" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.



Vent valves

In applications where pressure is continuous and the Magnehelic gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.



HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4 3/16" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz. (Installation of the A-321 safety relief valve on standard Magnehelic gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).



Portable units

Combine carrying case with any Magnehelic gage of standard range (not high pressure). Includes 9 ft. of 3/16" I.D. rubber tubing, stand-hang bracket, and terminal tube with holder.



Air filter gage accessory package

Adapts any standard Magnehelic for use as an air filter gage. Includes aluminum surface-mounting bracket with screws, two 5 ft. lengths of 1/4" aluminum tubing, two static pressure taps and two molded plastic vent valves, integral compression fittings on both tips and valves.

quality design and construction features

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

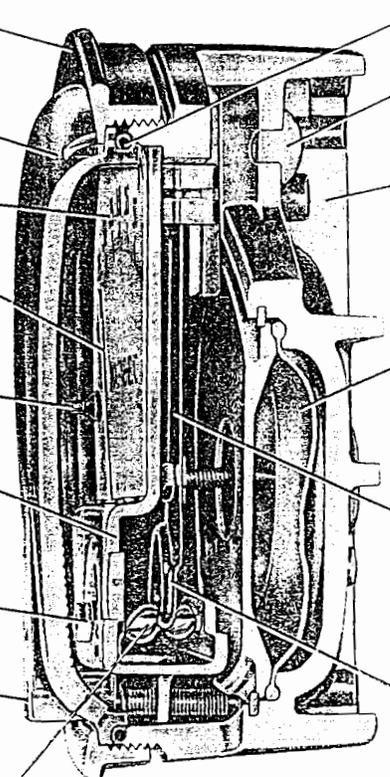
Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Sapphire bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "O" ring seal provides pressure tightness.



"O" ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on 15 PSIG rated models. Opens at approximately 25 PSIG.

Die cast aluminum case is precision made Iridite-dipped to withstand 168 hour salt spray test. Exterior finished in baked dark gray hammerloid. One case size used for all standard pressure ranges, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded "O" ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Alnico magnet mounted at one end of range spring rotates helix without mechanical linkages.

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled

bearings, it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

SERIES 2000 MAGNEHELIC® – MODELS AND RANGES

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Model Number	Range, Inches of Water	Minor Div.	Model Number	Range, Zero Center Inches of Water	Minor Div.	Dual Scale Air Velocity Units			Model Number	Range, CM of Water	Minor Div.	Model Number	Range Pascals	Minor Div.
						Model Number	Range, Inches of Water	Range, Air Velocity F.P.M.						
2000-001	0-0.25	.005	2300-01	25-0-25	.01	2000-00AV1	0-0.25	300-2000	2000-15CM	0-15	.50	2000-60 Pa†	0-60	2.0
2000-015	0-0.50	.01	2301	5-0-5	.02	2000-0AV1	0-0.50	500-2800	2000-20CM	0-20	.50	2000-125 Pa†	0-125	5.0
2001	0-1.0	.02	2302	1-0-1	.05	2001AV	0-1.0	500-4000	2000-25CM	0-25	.50	2000-250 Pa	0-250	5.0
2002	0-2.0	.05	2304	2-0-2	.10	2002AV	0-2.0	1000-5600	2000-50CM	0-50	1.0	2000-500 Pa	0-500	10.0
2003	0-3.0	.10	2310	5-0-5	.20	2010AV	0-10	2000-12500	2000-80CM	0-80	2.0	2000-750 Pa	0-750	25.0
2004	0-4.0	.10	2320	10-0-10	.50	For use with pitot tube.			2000-100CM	0-100	2.0	Zero Center Ranges		
2005	0-5.0	.10	2330	15-0-15	1.0	Model Number	Range, PSI	Minor Div.	2000-150CM	0-150	5.0	2300-250 Pa	125-0-125	5.0
2006	0-6.0	.20				Model Number	Range, MM of Water	Minor Div.	2000-200CM	0-200	5.0	2300-500 Pa	250-0-250	10.0
2008	0-8.0	.20				2000-6MM†	0-6	.20	2000-250CM	0-250	5.0	Model Number	Range Kilopascals	Minor Div.
2010	0-10	.20				2000-10MM†	0-10	.20	2000-300CM	0-300	10.0	2000-1 kPa	0-1	.02
2015	0-15	.50	2201	0-1	.02	2000-25MM	0-25	.50	Zero Center Ranges			2000-1.5 kPa	0-1.5	.05
2020	0-20	.50	2202	0-2	.05	2000-50MM	0-50	1.0	2300-4CM	2-0-2	10	2000-2 kPa	0-2	.05
2025	0-25	.50	2203	0-3	.10	2000-80MM	0-80	2.0	2300-10CM	5-0-5	20	2000-3 kPa	0-3	.10
2030	0-30	1.0	2204	0-4	.10	2000-100MM	0-100	2.0	2300-30CM	15-0-15	1.0	2000-4 kPa	0-4	.10
2040	0-40	1.0	2205	0-5	.10	Zero Center Range			†These ranges calibrated for vertical scale position			2000-5 kPa	0-5	.10
2050	0-50	1.0	2210	0-10	.20	2300-20MM†	10-0-10	50				2000-8 kPa	0-8	.20
2060	0-60	2.0	2215	0-15	.50							2000-10 kPa	0-10	.20
2080	0-80	2.0	2220*	0-20	.50							2000-15 kPa	0-15	.50
2100	0-100	2.0	2230**	0-30	1.0							2000-20 kPa	0-20	.50
2150	0-150	5.0	*MP option standard **HP option standard									2000-25 kPa	0-25	.50
Suggested Specifications						Special Purpose Ranges						Zero Center Ranges		
A differential pressure gage for measuring (state purpose) shall be installed. Gage shall be the diaphragm-actuated dial type 4 3/4" O.D., with white dial, black figures and graduations and pointer zero adjustment. Gage shall be Dwyer Instruments, Inc., Magnehelic®, Catalog No. _____ reading to _____ " water column, in _____ divisions.						Scale No. 2401 Scale No. 2402 Square Root Blank Scale Specify Range Specify Range						2300-1 kPa 0-5.0 .5 2300-3 kPa 1.5-0-1.5 .10		

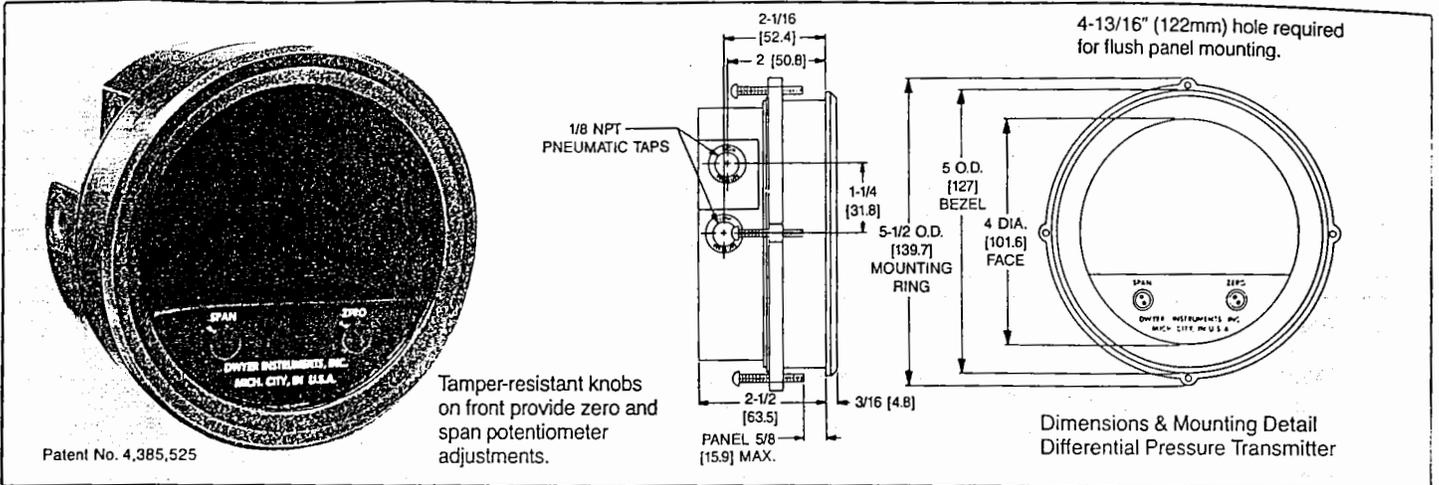


Series 603A

Differential Pressure Transmitters

4-20 mA signal. Two, three or four wire operation.

Ranges from 0.1" water column. Accurate within $\pm 2\%$ of span.



Patent No. 4,385,525

Tamper-resistant knobs on front provide zero and span potentiometer adjustments.

Dimensions & Mounting Detail Differential Pressure Transmitter

Dwyer Series 603A Differential Pressure Transmitters combine ultra low ranges, low cost, high accuracy and rugged construction - ideal for a wide range of HVAC and industrial applications. Utilizing a strain gage transducer in conjunction with the proven mechanical design of the famous Dwyer Magnehelic® Differential Pressure Gages, these transmitters provide a standard 4-20 mA analog output signal in ranges as low as 0.1" w.c. The two/three/four wire model 603A is powered by 13-35 VDC (2, 3, or 4-wire) or 18-26 VAC (4-wire) loop current. All electronics components are mounted on a tough, durable fiberglass reinforced epoxy circuit board. These rugged units can tolerate repeated over-pressure up to the maximum pressure limit without damage or the need for recalibration. Accuracy is $\pm 2\%$ of span (as stocked) in normal ambient temperatures.

The transmitter can be surface mounted or flush mounted in a 4^{13/16}" (122 mm) diameter panel hole. Hardware is included for either option. Duplicate 1/8" NPTF pressure connections on side and back ease installation. Based on its unique combination of price and performance, The Series 603A transmitter is ideal for use in commercial and industrial energy management systems. Typical applications include control of variable speed fans and blowers as well as the positioning of system dampers. Continuous data on air velocities in ducts and air filter pressure drops can be fed to the controlling computer.

SPECIFICATIONS

GENERAL

Maximum Pressure: 35 PSIG (2.46 kg/cm²)

Media Compatibility: Air and non-combustible, non-corrosive gases

ELECTRICAL

Power Supply: 13-35 VDC - 2, 3 or 4 wire, 18-26 VAC - 4 wire

Connections: 4 screw terminal block

Output Signal: 4-20 mA DC (limited at 38 mA DC)

Loop Resistance: DC; 0-1100 ohms, AC; 0-1130 ohms

Warm-up Time: 10 minutes

Current Consumption: DC; 38 mA max., AC; 76 mA max.

MECHANICAL

Weight: 1 lb., 10 oz. (.74 kg)

Span and Zero Adjustments: External potentiometers

Pressure Connections: 1/8" NPT female

Materials: Die cast aluminum case, silicone diaphragm, acrylic cover

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC

Full Span Output: 20 mA DC

Accuracy: (Includes linearity, hysteresis and repeatability) $\pm 2\%$ of full span output

Stability: 1% F.S./year

ENVIRONMENTAL

Operating Temperature: 20-120°F (-6.7 to 49°C), dry air

Thermal Error: $\pm 1\%/50^\circ\text{F}$ typical

STANDARD ACCESSORIES

Mounting ring, snap ring, (4) 6-32 \times 1/4" round head machine screws, (3) 6-32 \times 5/16" round head machine screws, (2) adapters, 3/16" I.D. tubing \times 1/8" NPT pipe plugs and adjustment key for span and zero.



Optional 3^{1/2} digit LCD readout is available for Series 603A, 630A and 632A transmitters. 1/2" liquid crystal display reads 0-100(%) of full span pressure. Plus or minus indication included. To order, add suffix LCD to model number. Example: 603A-4-LCD. For direct readings in PSI, in. w.c., metric units, etc., specify with order. Example: 603A-4-LCD reading directly in pressure units, 0-5.0 in. w.c.

SERIES 603A TRANSMITTER MODELS & RANGES (2-3-4 WIRE)

MODEL NUMBER	RANGES IN INCHES OF WATER		
	AS STOCKED	MIN. RANGE	MAX. RANGE
603A-1	0-0.25	0-10	0-40
603A-2	0-0.50	0-35	0-2.0
603A-3	0-2.0	0-1.5	0-6.0
603A-4	0-5.0	0-4.0	0-25
603A-5	0-25	0-20	0-100
603A-6	0-100	0-50	0-250
603A-11	.25-0-.25		
603A-12	1-0-1		
603A-13	5-0-5		
603A-14	10-0-10		
RANGES IN PSI			
603A-7	0-20	0-5	0-25
603A-8	3-15		

Suggested Specifications -

Series 603A, 604A, 630A, 632A, 634A, 634E

Differential pressure transmitters shall be diaphragm (Bourdon tube, 603A-7, 603A-8, 632A, 634A, 634E only) operated with sensing element motion restrained by a calibrated spring affixed with a silicon strain gage transducer. Electrical signal shall be internally conditioned to a (two wire, 634E) (two, three or four wire, 603A, 604A, 630A, 632A, 634A) 4-20 mA control loop output. Protected, field adjustable zero and span controls shall be provided. Transmitters shall be Dwyer Instruments Model No. 6 _____ for the required operating ranges.

Series 604D, 605, 7116

Differential pressure (single pressure, 7116) indicating transmitters shall be diaphragm (Bourdon tube, 7116) operated with a silicon strain gage transducer. Electrical signal shall be internally conditioned to a (two wire, 605) (two, three or four wire, 604D, 7116) 4-20 mA output signal. Transmitter shall have local pointer indication of sensed pressure with white dial, black figures and graduations (and pointer zero adjust, 604D, 605 only). Zero and span controls shall be provided. Transmitters shall be Dwyer Instruments, Inc. Model No. _____ for the required operating range.



Series DS-200 and DS-300 Flow Sensors

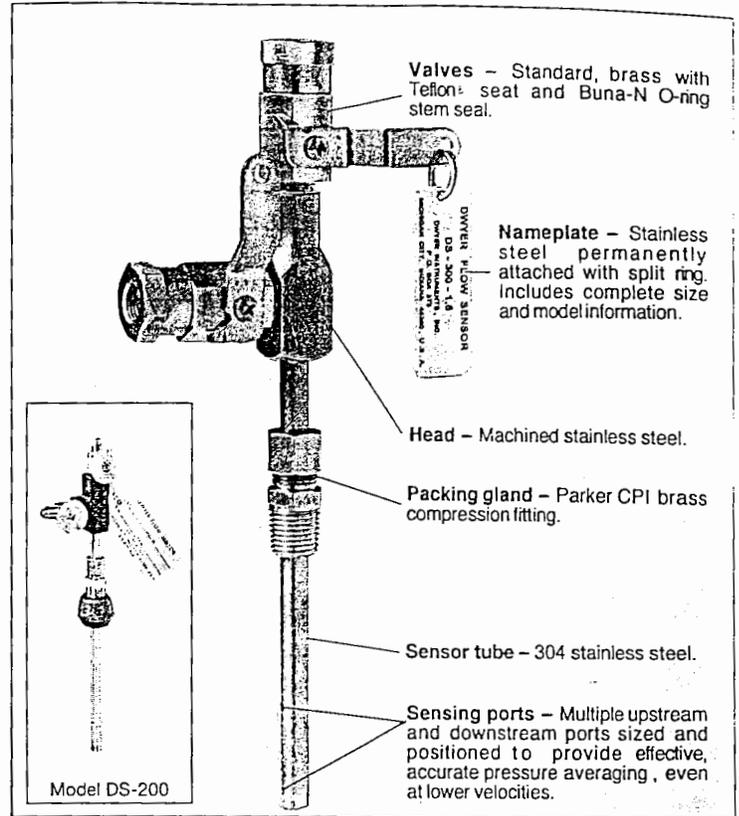
For use with the Dwyer Capsuhelic® differential pressure gage to measure high flow rates of air or water in pipes.

The Dwyer flow sensor is an averaging pitot tube providing accurate and convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

Dwyer Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8" NPT female connections. Accessories include adapters with 1/4" SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1" to 10". If replacing a DS-200 flow sensor or using an A-160 thredolet with a DS-300, an optional 1/4" x 3/8" bushing, P/N A-161 is required.

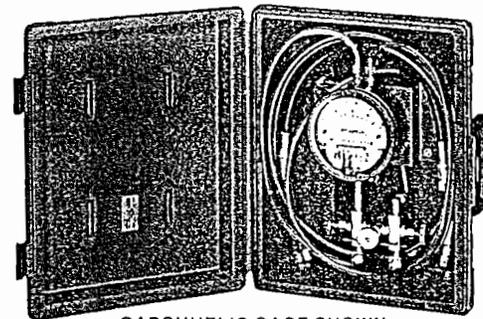
DS-200 models are also available in ten insertion lengths from 1" - 10". Operation is similar to DS-300 units. Basic differences are the multi-turn shut-off valves, 3/8" NPT mounting and installed 1/4" SAE 45° flared pressure connections.



Model A-471 Portable Kit

The Dwyer Series 4000 Capsuhelic® differential pressure gage is ideally suited for use as a read-out device with the DS-300 Flow Sensors. The gage may be used on system pressures of up to 500 PSIG even when the flow sensor differential pressure to be read is less than 0.5" w.c. With accuracy of ± 3% of full scale, the Capsuhelic® gage can be used in ambient temperatures from 32°F to 200°F. Zero and range adjustments are made from outside the gage. The standard gage with a die cast aluminum housing can be used with the flow sensor for air or oil applications. For water flow measurements, the optional forged brass housing should be specified.

The Capsuhelic gage may be panel or surface mounted and permanently plumbed to the flow sensor if desired. The optional A-610 pipe mounting bracket allows the gage to be easily attached to any 1 1/4" - 2" horizontal or vertical pipe.



CAPSULHELIC GAGE SHOWN
INSTALLED IN A-471 PORTABLE KIT

For portable operation, the A-471 Capsuhelic Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings. See Bulletin A-30 for complete information on the Capsuhelic gage.

HOW TO ORDER

Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2" pipe would be a Model No. DS-300-2".

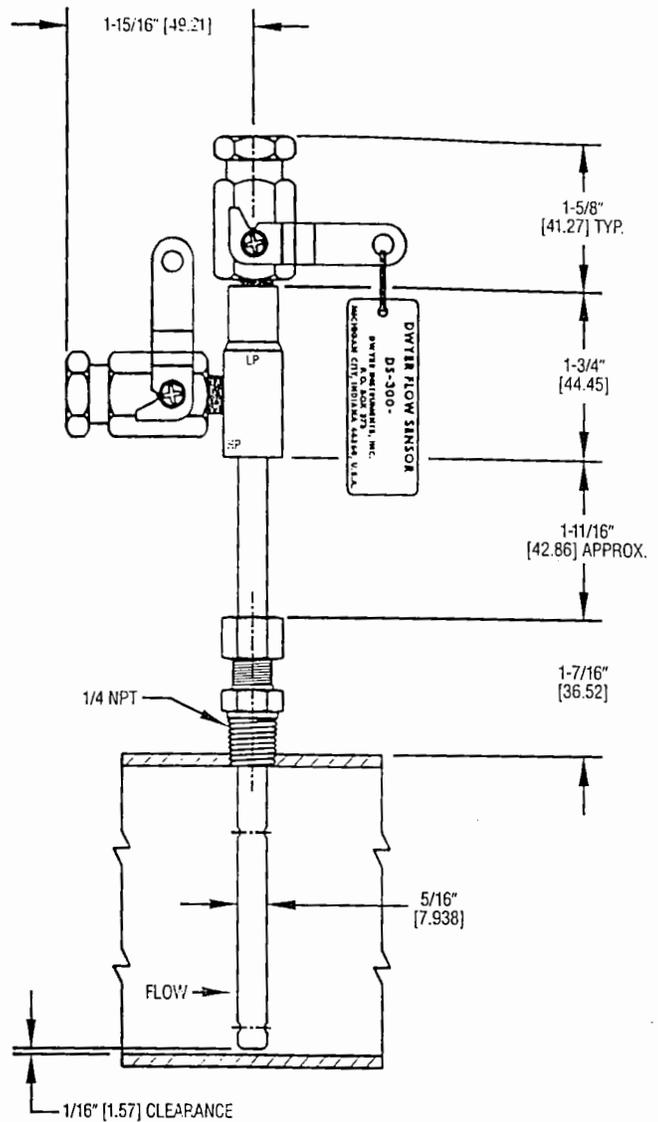
Options and Accessories

- Less Valves (DS-300)** - To order, add suffix -LV. Example: DS-300-2"-LV
- A-160 Thredolet** - 3/8" NPT, forged steel, 3000 psi
- A-161 Bushing** - 1/4" x 3/8" brass bushing

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions. Bulletin F-50. It also includes complete flow conversion charts for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer Capsuhelic gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic gage to provide an easily identified reference point for the proper flow.

Capsuhelic gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Refer to Bulletin A-30 in the Dwyer catalog for model numbers and ordering information for the various standard range Capsuhelic pressure gages.



FULL RANGE FLOWS BY PIPE SIZE (APPROXIMATE)

GAGE RANGE (in. W.C.)	MEDIA @ 70° F.	FULL RANGE FLOWS BY PIPE SIZE (APPROXIMATE)											
		1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	
2	WATER (GPM)	4.8	8.3	11.5	20.5	30	49	86	205	350	560		
	AIR @ 14.7 PSIA (SCFM)	19.0	33.0	42.0	65.0	113	183	330	760	1340	2130		
	AIR @ 100 PSIG (SCFM)	50.0	90.5	120.0	210.0	325	510	920	2050	3600	6000		
5	WATER (GPM)	17.7	31.0	41.0	73.0	107	178	338	820	1360	2190		
	AIR @ 14.7 PSIA (SCFM)	30.0	51.0	66.0	118.0	178	289	510	1200	2150	3400		
	AIR @ 100 PSIG (SCFM)	83.0	142.0	190.0	340.0	610	820	1600	3300	5700	10000		
10	WATER (GPM)	11.0	19.0	25.5	45.5	67	110	195	450	800	1260		
	AIR @ 14.7 PSIA (SCFM)	41.0	72.0	93.0	163.0	250	410	725	1690	3040	4860		
	AIR @ 100 PSIG (SCFM)	120.0	205.0	275.0	470.0	740	1100	2000	4600	8100	15000		
25	WATER (GPM)	18.0	32.0	40.5	72.0	108	173	310	720	1250	2000		
	AIR @ 14.7 PSIA (SCFM)	63.0	112.0	155.0	255.0	390	640	1130	2630	4860	7700		
	AIR @ 100 PSIG (SCFM)	185.0	325.0	430.0	760.0	1200	1800	3300	7200	13000	22000		
50	WATER (GPM)	25.0	44.0	57.5	100.0	152	247	435	1000	1800	2800		
	AIR @ 14.7 PSIA (SCFM)	90.0	161.0	205.0	360.0	560	900	1600	3700	6400	10000		
	AIR @ 100 PSIG (SCFM)	260.0	460.0	620.0	1050.0	1700	2600	4600	10000	18500	28000		
100	WATER (GPM)	36.5	62.0	82.0	142.0	220	350	620	1500	2600	4000		
	AIR @ 14.7 PSIA (SCFM)	135.0	230.0	300.0	505.0	800	1290	2290	5000	8800	13500		
	AIR @ 100 PSIG (SCFM)	370.0	660.0	870.0	1500.0	2300	3600	6500	15000	26000	40000		

DESIGNING YOUR SYSTEM WITH THE EOS RESEARCH PROCONTROL SERIES II

The purpose of this application note is to demonstrate the functionality of the EOS Research ProControl Series II controller/remote monitoring system, and the ease with which you can incorporate it into your project design.

What Does it Do?

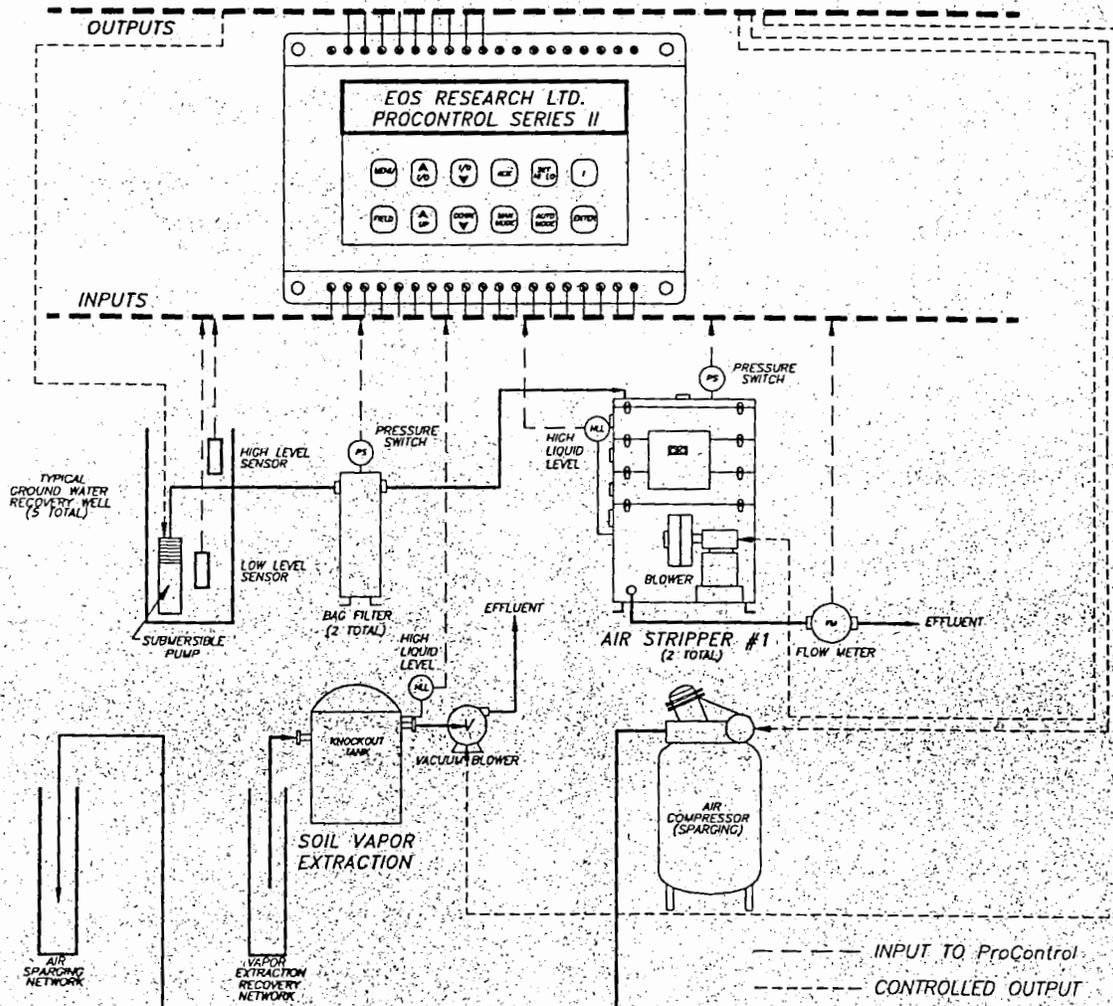
The ProControl Series II is an innovative cost and labor-saving device which performs multiple tasks for your stand-alone operation.

- **Stand-alone Control:** The ProControl is a sophisticated programmable logic controller that will efficiently supervise and control your operation. It can interface with up to 54 electrical devices (float switches, pressure transducers, pH transmitters, flow meters, pumps, blowers, etc.), and execute numerous control functions simultaneously. Automatic shutdown routines can be programmed in to protect your operation during alarm conditions. It is extremely versatile in terms of the control algorithms it can execute.
- **Remote Control and Monitoring:** The ProControl gives you a window into your operation from any remote location, using PROVIEW™, the easy-to-use Windows™-based software supplied with the system. You communicate with the ProControl over a modem link, which allows you to view all of your system's operating conditions, while also providing the same access to control functions that you would have were you at the site (e.g., turning pumps on and off, adjusting alarm setpoints, etc.). No other telemonitoring device gives you the ProControl's level of remote control capability.
- **Fax and Pager Reporting:** The ProControl will *keep you informed*. It will send you periodic fax status reports of your project operations on a schedule specified by you, and will alert you immediately by fax or pager if an alarm condition warrants attention. No longer do you have to assume what's happening at your remote operation.....the ProControl will tell you exactly.
- **Datalogging:** The ProControl is your information manager. It is a powerful datalogger that automatically records all operating conditions in its battery-backed memory. You can access your logged data remotely at any time, and download it to your office computer for further processing. The datalogging capability is an invaluable tool for reporting purposes, troubleshooting, and trend graphing.

What Do You Get?

Although it is available in a variety of configurations, the typical ProControl Series II is configured as a small, high-quality NEMA 4 electrical enclosure which houses a small computer, fax modem, power supply, and terminal blocks for wiring access. The computer has a keypad and LCD display for accessing control functions. The separate power supply provides 24-volt DC power for your analog sensors, while the ProControl computer itself provides 5-volt DC power for digital switches or sensors. EOS Research's own operating software for the ProControl, *customized to your operating specs*, is standard with the unit. The ProControl comes ready to wire to. Once you supply power, it is ready to run with *no further programming necessary*. You also get a plain-English User's Manual which runs you through its easy-to-use functions, and which shows you how to connect with your operation from your office computer.

EOS RESEARCH PROCONTROL SERIES II Service Station Remediation

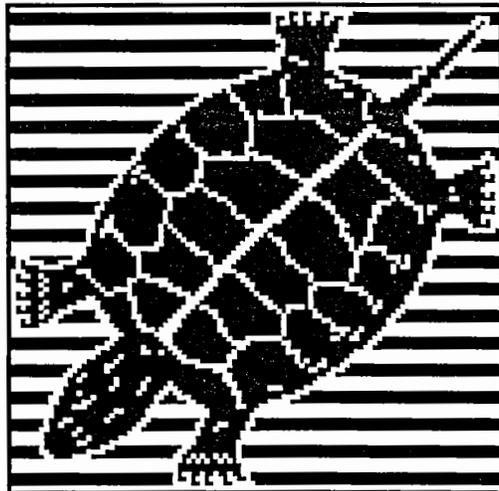


At this service station remediation in Connecticut, contaminated ground water is being pumped from five recovery wells, with treatment by two shallow-tray air stripping units. The aquifer at the site is also being sparged, with a soil vapor extraction system employed for contaminated vapor recovery. The ProControl Series II serves as the central control, datalogging, and telemetry device for the entire operation. The Series II constantly monitors water levels in wells, pressures on bag filters and air strippers, liquid flow rates, and other status inputs. The Series II also controls the cycling of well pumps, senses alarm conditions to initiate a programmed shut-down when indicated, and electronically logs all input states, flows (instantaneous rates and totals), motor cycle times, etc. The entire system can be started or shut down from the office, individual well pumps and other equipment can be turned on and off remotely, and data collected by the ProControl can be graphed or extracted from any location. Numerous safeguards are built into the operating program (for instance, well pumps cannot be turned on unless the air stripper blowers register appropriate pressures). Fax reports are sent by the ProControl on a daily basis, and when alarm conditions are registered.

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PROCONTROL SERIES II PROVIEW

Demonstration System User's Guide



To reach us:

Voice: 603.431.2371

FAX: 603.431.2562

Demo: 603.431.4996

email: procontrol@eos.mv.com

INTRODUCTION

In order to demonstrate the capabilities of the ProControl Series II controller/remote monitoring system, EOS Research has established a demonstration control system that you can call up via modem. Our demonstration system gives you a chance to experience "live" the powerful features, convenience, and ease of use that put the ProControl in a class by itself among environmental control systems.

The ProControl Series II is an innovative cost and labor-saving device which performs multiple tasks for your stand-alone operation. These include:

- **Stand-Alone Control:** The ProControl is a sophisticated programmable logic controller that will efficiently supervise and control your operation. It can interface with dozens of input/output devices (float switches, pH sensors, flow meters, pumps, etc.), and execute numerous control functions simultaneously.
- **Remote Control and Monitoring:** The ProControl gives you a window into your operation from any remote location, using the easy-to-use Windows-based ProView software supplied with the system. View all of your system's operating conditions, and have complete access to the same control functions you can exercise at the site.
- **Fax and Pager Reporting:** The ProControl will keep you informed. It will send you periodic fax status reports of your operations on a schedule specified by you, and will alert you immediately by fax and/or pager if an alarm condition warrants attention.
- **Datalogging:** The ProControl is your information manager. It is a powerful datalogger that automatically records all operating conditions in its battery-backed memory. You can access your logged data remotely at any time, and download it to your office computer for further processing.

We have assembled a demonstration system which contains the basic elements of a typical control application for the ProControl: a ground water remediation system which contains ground water pumping, water treatment, and soil vapor extraction components.

THE DEMONSTRATION SYSTEM

The ProControl Series II Demonstration System controls a ground water remediation setup which includes ground water pumping from two wells, water treatment by air stripping and pH adjustment, and soil vapor extraction (SVE). Figure 1 provides a simple process diagram for the operation. The ProControl unit at the site interfaces with a series of input/output (I/O) devices to maintain proper control of the operation. Two different types of process control are utilized. Simple On/Off control is used to control a well pump, a transfer pump, an air stripper blower and the soil vapor extraction blower. PID (Proportional-Integral-Derivative) control is used to vary the speed or rate of an output (in this case, a chemical metering pump and a variable-speed submersible well pump) to maintain an input at a constant level (process pH or drawdown level in a recovery well).

The ProControl unit interfaces with the following hardware, grouped by I/O type:

Discrete Inputs (On/Off)

1. High Water Level Sensor in GW Recovery Well #1
2. Low Water Level Sensor in GW Recovery Well #1
3. Air Stripper High Water Level Sensor
4. Air Stripper Low Water Level Sensor
5. Air Stripper Low Pressure Sensor
6. Floor Sump High Level Sensor
7. Building Door Closure Sensor

Analog Inputs (continuously variable)

1. Flow Meter for Recovery Well #1
2. Flow Meter for Recovery Well #2
3. Water Level Sensor (pressure transducer) in Recovery Well #2
4. pH Transmitter in Discharge Tank
5. Vacuum Transmitter for SVE unit

Discrete Outputs (On/Off)

1. Groundwater Recovery Well Pump #1
2. Groundwater Recovery Well Pump #2
3. Air Stripper Blower
4. Transfer Pump
5. Soil Vapor Extraction Blower
6. Sodium Hydroxide (NaOH) Metering Pump
7. High Sump Level Alarm Lamp
8. SVE Low Vacuum Alarm Lamp
9. Air Stripper Low Pressure Alarm Lamp
10. pH Alarm Lamp

Analog Outputs (continuously variable)

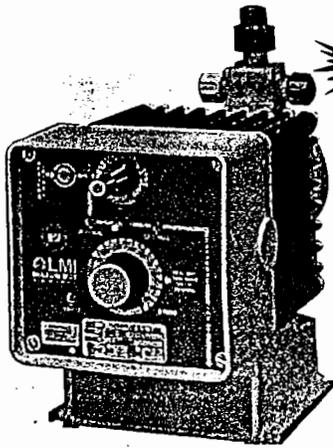
1. Variable Speed Drive for Groundwater Recovery Well #2
2. Variable Rate for NaOH Metering Pump

Ground water is pumped from Well #1 by on/off cycling between high (pump on) and low (pump off) level sensors in the well. Ground water is pumped from Well #2 under a PID control scheme, which varies the rate of the variable-speed pump in this well to maintain a constant drawdown. The flow rate from each well is measured and logged. Water then enters the air stripper for removal of contaminants, and is pumped out of the air stripper sump under level sensor control. The pH of the water is then adjusted in a neutralization tank prior to discharge. A variety of other monitoring points are also included.

These functions are being continuously controlled by the ProControl unit at the site. You use the ProView software supplied to observe the operation from a remote location, change the way it runs, download logged data, and perform other tasks.

WATER TREATMENT

Chemical Metering Pump



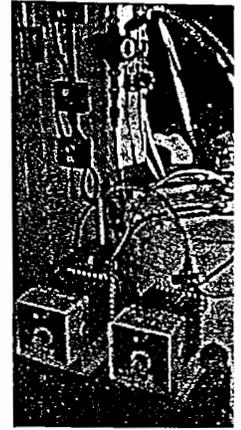
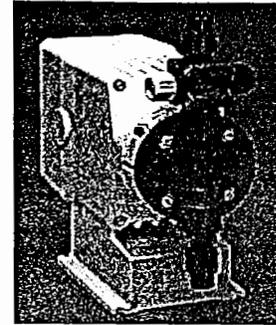
Series B & C

NEW SIZES



Series A

LMI
LIQUID METRONICS DIVISION
MILTON ROY



LMI pump control

LMI Electronic Pumps

Series A1, B1, C1 (formerly D1)

- Dual Manual Control for Stroke Length and Stroke Speed

Series A7, B7, C7 (formerly D7)

- Dual Manual Control and External Control
- External Control pacing by flow meter contactor or our optional 4-20mA signal Conversion Units

These famous bright yellow units are all very similar except for the two different control methods shown above and the performance ratings shown in the tables on the right. LMI pumps boast over 15 years of field experience in rough municipal and industrial environments. These models feature a 100:1 turndown ratio for excellent metering accuracy over a very wide range of feed rates. It is best to select a pump which will normally not operate at more than 60%-80% of its maximum design rating shown below. Since these are all electronic pumps, there is no oil bath and therefore no possible mechanical leakage. But take note, with most all feed pumps, only tighten the tubing connectors by hand and never use pipe tape or dope. This is the most frequent cause for leaks and messy clean-up jobs. Please also wear appropriate clothing, face shields, and gloves.

All these pumps come complete with two 8' sections of tubing (suction & discharge), foot valve and strainer assembly, injection check valve, 4-way anti-siphon pressure relief valve (ASPR) which allows you to drain discharges lines back into the feed tank for easy pump servicing. The ASPR option is standard with us. The last digit of these pumps becomes an S. (There is no ASPR on the HV Series used for polymers.) The anti-siphon pressure relief valve adds about 20 psi of back pressure, so please size your pump accordingly. These pumps all fit the LMI tanks and brackets listed in this section. If you need specific dimensions please call. We also stock wet-end repair kits which include the diaphragm, seal rings, valve balls and anti-siphon spring. It is a good idea to keep at least one of these kits on hand in your shop. The **SIZE** column refers to discharge tubing: 1=1/4"OD; 2=3/8"OD; 3=1/2"OD; 4=3/4"NPT pipe connection.

PVDF(Kynar) or PVC/Teflon/Ceramic wet end suitable for (NOT hydrofluosilicic), alkalis, chlorine, caustic, or potassium permanganate. Viscosity up to 500cps. Discharge tubing: 1" Size 2 = 3/8", Size 3 = 1/2".

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-152S	14	250	60800	\$373.60	SP-U8	61002
A1 MANUAL	A151-192S	24	110	60802	379.20	SP-U7	61004
A7 EXTERNAL	A741-152S	14	250	60804	415.20	SP-U8	61002
A7 EXTERNAL	A751-192S	24	110	60806	420.80	SP-U7	61004
B1 MANUAL	B111-192S	38	150	60808	542.40	SP-U7	61004
B1 MANUAL	B121-192S	60	100	60810	542.40	SP-U7	61004
B7 EXTERNAL	B711-192S	38	150	60812	588.00	SP-U7	61004
B7 EXTERNAL	B721-192S	60	100	60814	588.00	SP-U7	61004
C1 MANUAL	C101-94S	31	300	60816	716.00	SP-U1	61006
C1 MANUAL	C121-162S	96	100	60818	710.40	SP-U10	61008
C7 EXTERNAL	C701-94S	31	300	60820	782.40	SP-U1	61006
C7 EXTERNAL	C721-162S	96	100	60822	756.00	SP-U10	61008
C7 EXTERNAL	C771-26S	240	80	60824	931.20	SP-26S	61010

Acrylic/PVDF(Kynar)/Teflon wet end suitable for hydrofluoric acid. Discharge tubing: Size 1 = 1/4", Size 2 = 3/8", Size 3 = 1/2".

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-150FS	14	250	60840	\$396.00	SP-151FS	61030
A1 MANUAL	A151-91FS	24	110	60842	402.40	SP-U3	61032
A7 EXTERNAL	A741-150FS	14	250	60844	437.60	SP-151FS	61030
A7 EXTERNAL	A751-91FS	24	110	60846	444.00	SP-U3	61032
B1 MANUAL	B111-91FS	38	150	60848	565.60	SP-U3	61032
B1 MANUAL	B121-91FS	60	100	60850	565.60	SP-U3	61032
B7 EXTERNAL	B711-91FS	38	150	60852	611.20	SP-U3	61032
B7 EXTERNAL	B721-91FS	60	100	60854	611.20	SP-U3	61032
C1 MANUAL	C121-71FS	96	100	60858	752.00	SP-U4	61034
C7 EXTERNAL	C721-71FS	96	100	60862	797.60	SP-U4	61034
C7 EXTERNAL	C771-20FS	240	80	60864	965.60	SP-20FS	61036

Polypropylene/Teflon/Stainless Steel wet end for polymer flocculants. Viscosity handling capability up to 30,000cp. Discharge tubing: Size 1 = 1/4", Size 2 = 3/8", Size 3 = 1/2".

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-155HV	14	250	60880	\$404.80	SP-155HV	61050
A1 MANUAL	A151-85HV	24	110	60882	408.40	SP-85HV	61052
A7 EXTERNAL	A741-155HV	14	250	60884	446.40	SP-155HV	61050
A7 EXTERNAL	A751-85HV	24	110	60886	450.40	SP-85HV	61052
B1 MANUAL	B111-85HV	38	150	60888	572.00	SP-85HV	61052
B1 MANUAL	B121-85HV	60	100	60890	572.00	SP-85HV	61052
B7 EXTERNAL	B711-85HV	38	150	60892	617.60	SP-85HV	61052
B7 EXTERNAL	B721-85HV	60	100	60894	617.60	SP-85HV	61052
C1 MANUAL	C121-75HV	96	100	60896	740.00	SP-75HV	61054
C7 EXTERNAL	C721-75HV	96	100	60898	785.60	SP-75HV	61054
C7 EXTERNAL	C771-25HV	240	80	60900	924.00	SP-25HV	61056

CALL FOR OTHER LMI PUMPS

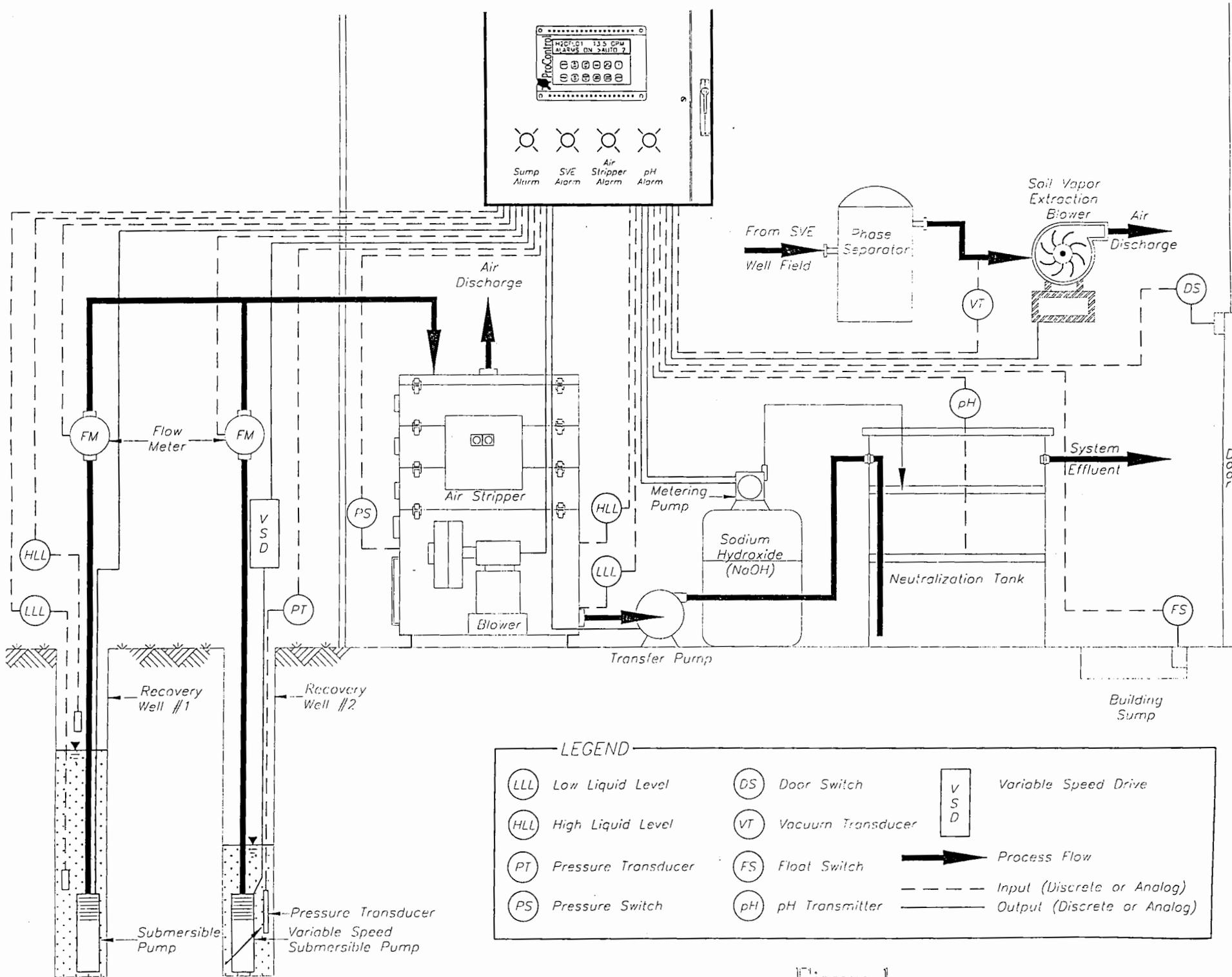
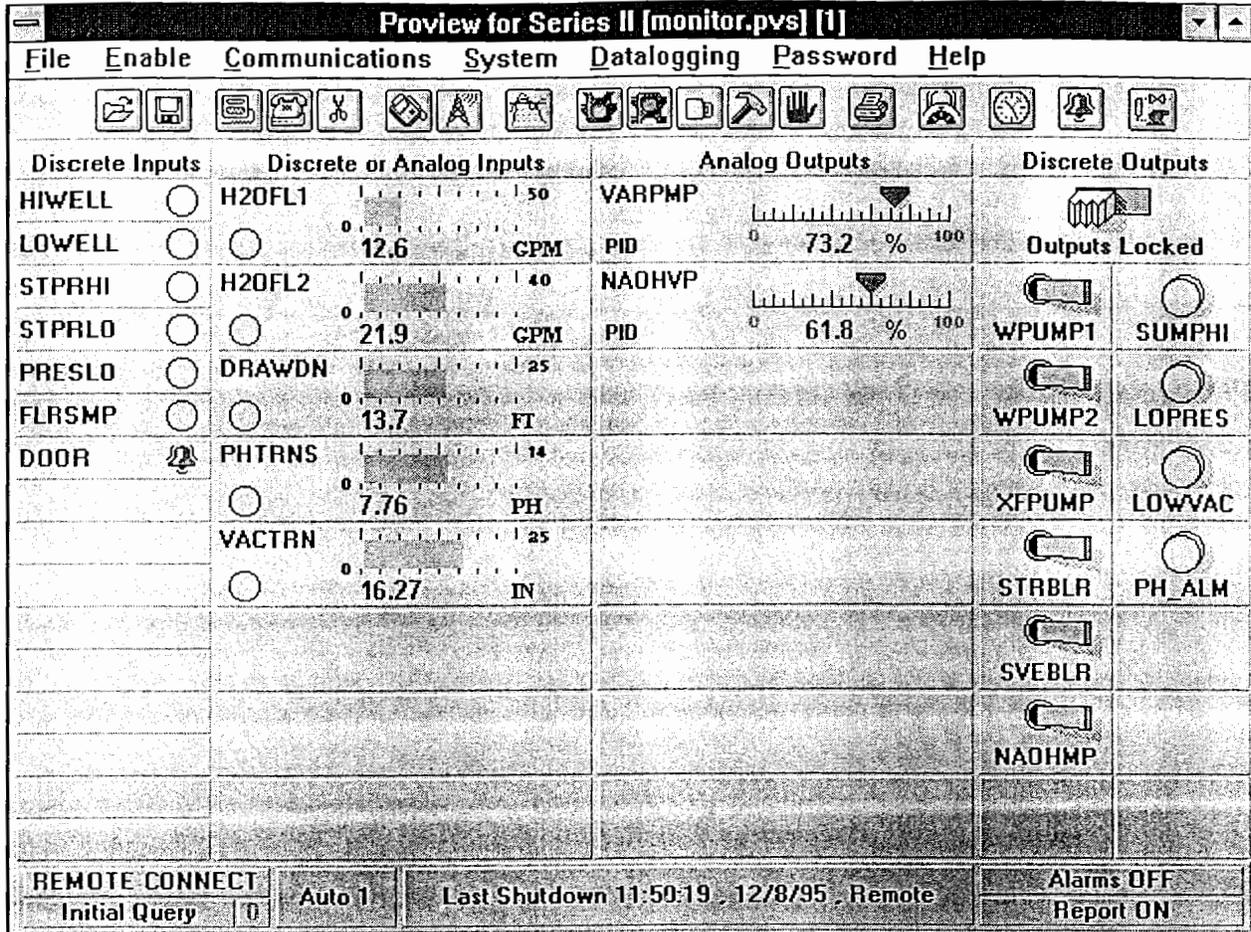


Figure 1

This is essentially a blank template for the site's operations, which will be filled with real-time operating data once you have dialed and connected to the demo control system. Listed below are the primary features shown on the ProView screen:

- Each of the I/O points described on page 2 is displayed on this screen with an abbreviated 6-character name, called a tagname. If you would like a more complete description of the input or output, simply place your mouse pointer over the tagname and the blue bar at the top of the window will show the I/O point's description.
 - The left of the screen contains a set of panels which each contain a discrete input or switch sensor such as the High Water Level Sensor in GW Recovery Well #1, denoted here as HIWELL. The "LED" that appears in each panel provides information about the state of that input. If the "LED" is grey, the input is in its normal state. If the "LED" is green or red the input is in what is termed the *active state*. The normal state is usually OFF while the active state is usually ON.
 - The left center column of the screen contains a set of panels which give information about the analog inputs to the system. A bar graph will accompany a numerical readout of the status of each analog input. The dimensional units of the input are displayed at the right end of the bar graph. The "LEDs" which appear in these panels function in a similar manner to the "LEDs" from the discrete input panels.
 - The right center column of the screen shows the analog outputs. Each panel has a sliding scale in addition to the numerical equivalent of the slider position, expressed as a percentage between 0% and 100%. Beneath the tagname, one of two words will appear: Manual or PID. PID indicates that the ProControl is automatically adjusting the analog output under a PID control algorithm. When in Manual mode, you can drag the slider up and down to change the output level.
 - The right of the screen shows the discrete outputs. The outputs appear as toggle switches or as alarm lights depending on their function. The toggle switch is used where there is a piece of equipment that can be turned on and off. The alarm light is used to provide a strong visual indication of an alarm condition. Once you have connected to the demonstration system, you will be able to monitor and change the state of each output if you'd like.
 - The top of the screen contains a series of buttons which are used to access some of the more commonly used commands. To find out what each button does, simply point your mouse at the button and a small "balloon" will appear stating its function. The picture on the button also gives you an indication of its function (for instance, the hammer button puts the ProControl into Manual mode).
4. To connect to the remote system, click on the button at the top of the screen containing the picture of a telephone. The telephone number of the demo system will appear in the Site Phone Number window. You may need to modify this phone number depending on your area code and your phone system. Be sure to select the correct COM port for your modem at the top of the screen. Once you have done so, press the "Dial Remote Site" button. When you are connected, you will see the words REMOTE CONNECT in the Call Status panel in this window. This may take a minute or so before the remote connection is established. If you do not see these words after about a minute, press the "Hangup Phone Line" button, wait a few seconds, and then repeat this procedure. If you still have trouble, don't hesitate to get in touch with us.
 5. Once connected, click the OK button at the bottom of the window. The screen will fill with real-time operating data, with continuous updates. The following screen is an example:



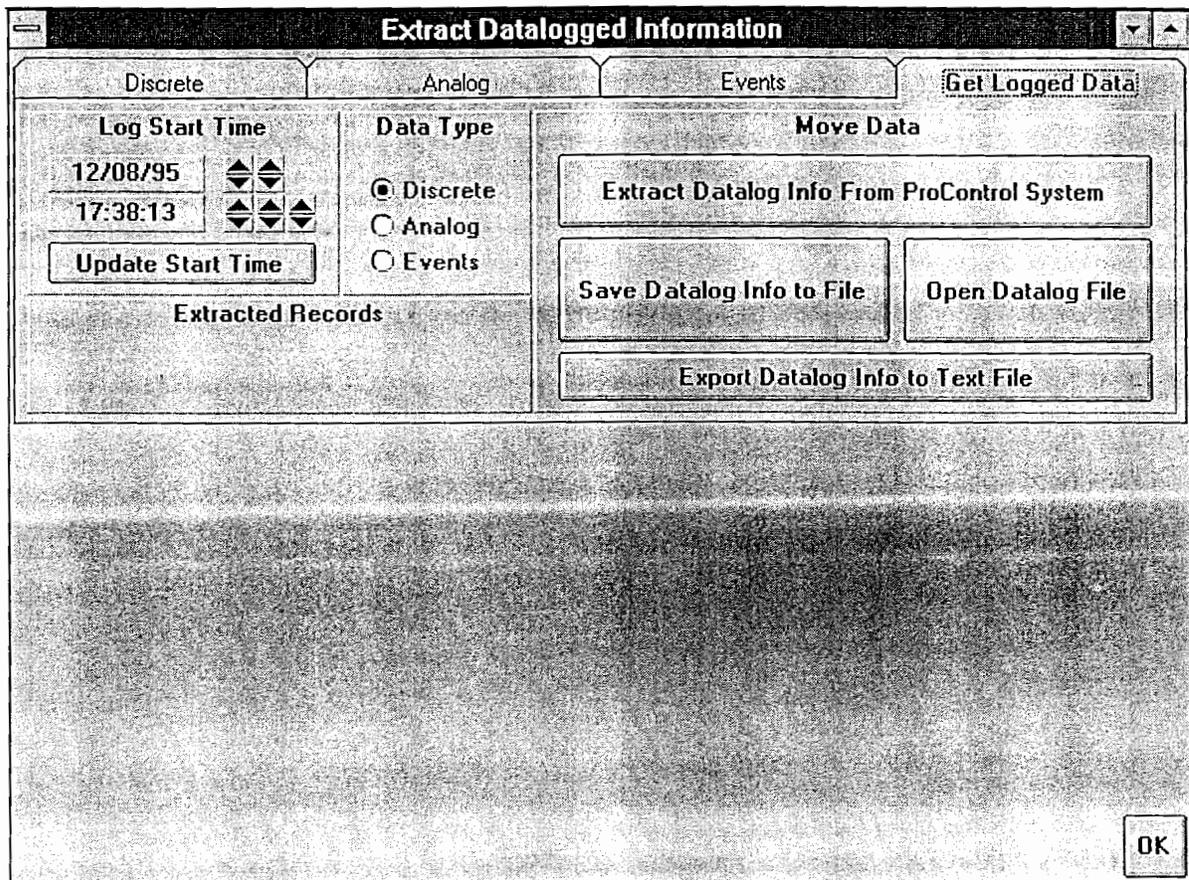
- In the example screen shown above, the DOOR input at the left is in the active state (indicated by the alarm bell) because the building door is open.
- The switched discrete outputs on the right of the screen are ON if they are green in color and angled to the right. If an alarm condition is present, the appropriate alarm lamp would be red in color.
- The bottom of the screen provides some additional information about the system, such as whether the ProControl is currently running automatic control processes (indicated by the presence of "Auto" in the second panel from the left), and what caused the last system shutdown.

Remember, you are looking through a window into the operations being controlled *locally* at the site by the ProControl unit. As you watch the screen, you will see some of the inputs change. For instance, when the HIWELL level sensor in Well #1 is tripped, the pump in this well (WPUMP1) will turn on. The air stripper transfer pump (XFPMP) will cycle on and off between the high (STPRHI) and low (STPRLO) level sensors. You may observe small changes in the flow rates (H2OFL1 and H2OFL2), DRAWDN in Well #2, process pH (PHTRNS) or SVE system vacuum (VACTRN). Disturbances in aquifer conditions will cause the VARPMP output to change in order to keep DRAWDN at a preset value (this is a PID control loop). NAOHVP also works with a PID loop to maintain the pH at a relatively constant level.

DATALOGGING

The datalogging capabilities of the ProControl are among its most useful features. Datalogging helps you understand and optimize the performance of your system.

1. To extract data that is being logged by the ProControl, pull down the **Datalogging** menu and select the **Get Logged Data** tab, if it is not already selected. The following screen will appear:



2. We recommend that you extract analog data so that you can see the graphing functions available to you. In the "Data Type" panel, choose "Analog". In the "Log Start Time" panel, you set the date and time that you want your extracted datalog record to start (ProView will extract all data that has been logged by the ProControl between this time and the present). You can use the up and down arrows to adjust the start time; try going back a few hours or so from the present time; data is being logged at one-minute intervals and can build up very quickly.
3. Once you have selected your date, time, and data type, hit the "Extract Datalog Info From ProControl System" button. A blue bar graph will appear in the "Extracted Records" panel next to the current number of extracted records to keep you up to date on the data extraction process.

SUPREME CORP. SPECIFICATION SHEET

GENERAL REQUIREMENTS

OPERATIONAL DESCRIPTION

The container shall be designed and constructed for the transport of general cargoes of various sizes, densities and packages and be protected for the elements. Containers shall be suitable for transportation in the following modes without any permanent deformation which will render it unsuitable for use.

DESIGN LOADS

- A. 20 ft containers: Evenly distributed load 24,000 kgs (52,910 lbs) including container care.
- B. 40 ft containers: Evenly distributed load 30,480 kgs (67,200 lbs) including container care.

Roof	300 kg	(660 lb)/sq meter-61.48 lbs/sqft
Floor	7,260 kg	(16,000 lb)
Stacking	85 L tons/post	(190,480 lb)
Lifting, top/bottom	2.0 R	
Racking, transverse	15,240 kg	(33,600 lb)
Racking, longitudinal	7,620 kg	(16,800 lb)

HANDLING

The container shall be designed and constructed for handling without any permanent deformation which will render it unsuitable for use for each of the following conditions:

- A. Lifting, laden or empty, from top corner fittings vertically by means of spreaders fitted with hooks, shackles or twist locks.
- B. Lifting, laden or empty, from bottom corner fittings using slings with appropriate terminal fittings at any angle between vertical, and 30 deg. to horizontal.
- C. Lifting full or empty, at a pair of fork lift pockets, with appropriate fork lift truck.
- D. Loading and unloading cargo's from door end by fork lift truck or other cargo handling machines.

WELDING

Welds shall be free of cracks, undercuts, burn-through, spatter, lack of penetration, voids and porosity. Weld size and thickness shall meet acceptable American Welding Society (A.W.S.) and structural standards.

DIMENSIONS AND WEIGHTS

GENERAL

The overall basic dimensions for dry van containers are set by the International Standards Organization (ISO).

DIMENSIONS

20 Foot container (20' X 8' X 8' 6")

External (Minimum)

Length	6,058 mm	+0 - 6 mm (19 ft 10-1/2 in	+ 0 - 1/4 in)
Width	2,438 mm	+0 - 5 mm (8 ft 0 in	+ 0 - 3/16 in)
Height	2,591 mm	+0 - 5 mm (8 ft 6 in	+ 0 - 3/16 in)

Internal (Minimum)

Length	5,900 mm	(19 ft 4 - 1/4 in)
Width	2,348 mm	(7 ft 8 - 1/2 in) 92 1/2"
Height	2,385 mm	(7 ft 9 - 7/8 in)

Door Opening (Minimum)

Width	2,340 mm	(7 ft 8 - 1/8 in) 92 1/8"
Height	2,275 mm	(7 ft 5 - 5/8 in)

Cubic Capacity (Minimum)

33.04 cubic meters (1,166 cubic feet)

40 Foot Container (40' X 8' X 8' 6")

External (Minimum)

Length	12,192 mm	+0 - 10 mm (40 ft	+ 0 - 3/8 in)
Width	2,438 mm	+0 - 5 mm (8 ft 0 in	+ 0 - 3/16 in)
Height	2,592 mm	+0 - 5 mm (8 ft 6 in	+ 0 - 3/16 in)

Internal (Minimum)

Length 12,025 mm (39 ft 5 1/2 in)
Width 2,345 mm (7 ft 8 1/2 in)
Height 2,385 mm (7 ft 9 7/8 in)

Door Opening (Minimum)

Width 2,340 mm (7 ft 8 1/8 in)
Height 2,275 mm (7 ft 5 5/8 in)

Cubic Capacity (Minimum)

67.34 cubic meters (2,377 cubic feet)

40'Foot High Cube container (40' X 8' X 9'6")

External (Minimum)

Length 12,192 mm +0 - 10 mm (40 ft + 0 - 3/8 in)
Width 2,438 mm +0 - 5 mm (8 ft 0 in + 0 - 3/16 in)
Height 2,896 mm +0 - 5 mm (9 ft 6 in + 0 - 3/16 in)

Internal (Minimum)

Length 12,025 mm (39 ft 5 - 1/2 in)
Width 2,348 mm (7 ft 8 - 1/2 in)
Height 2,690 mm (8 ft 9 - 7/8 in)

Door Opening (Minimum)

Width 2,340 mm (7 ft 8 - 1/8 in)
Height 2,578 mm (8 ft 5 - 1/2 in)

Cubic Capacity (Minimum)

75.95 Cubic meters (2,681 cubic feet)

WEIGHTS

20 Foot container (20' X 8' X 8' 6")

Maximum Tare Weight 2,275 Kg (5,015 lbs)
Minimum Payload 21,725 Kg (47,895 lbs)
Maximum Gross Weight 24,000 Kg (52,910 lbs)

MATERIALS

STEEL

All components e.g. corner posts, side panels, crossmembers, etc shall be fabricated of steel. Type of steel to be used shall be as follows:

Cast Steel	Corner fittings
Forged Steel	Door cams and Keepers
Rolled Steel	Headers, side panel, front panels, floor rail, top rail, inner bottom rails, lashing points.
High Tensile Steel	Corner posts, outer bottom rails, sills, headers.
Corten "A" or Equivalent	Roof panels, door panel, door frame, crossmembers, tunnel assembly and fork pocket assemblies.
Stainless Steel	Door gasket retainer, hinge pins, data plate.

PROPERTIES OF STEEL MATERIAL

Y.P. : Yield Point (Kg/sq.mm) T.S. : Tensile Strength (Kg/sqmm)
 C. : Carbon Content (%) E. : Elongation (%)

Material		C.(max)	Y.P.(mim)	T.S.(mim)	E.(min)
Cast Steel	(JIS SCW49)	0.22	28	49	20
Forged Steel	(JIS SF45)	0.6	23	45	19
Rolled Steel	(JIS SS41)	-	25	41	21
High tensile steel	(JIS SM50)	-	29	50	19
High tensile steel	(JIS SM50A)	0.2	33	50	17
Corten "A" or Equivalent	(JIS SPA-H)	0.12	35	49	22
Stainless steel	(JIS SUS304)	0.08	21	53	40

FLOOR

Material : Hardwood Plywood, keruing or apitong, 19 ply min, with one piece top veneer.

FASTENERS

Floor : 8 mm dia self tapping plated screws.
Door : 9 mm dia min. zinc plated hex head bolts with lock nuts.
Gasket : 4.5 mm dia stainless steel self tapping screws or pull type rivets.
Ventilators : 6.0 mm dia, 2024 alloy aluminum huck bolts with aluminum collars.
Data Plate : 4.5 mm dia, stainless steel pull type rivets.

SEALANTS

Cargo area : U.S.D.A. approved chloroprene sealant to be used on interior seams which cargo may contact. Sealant must be compatible with interior coatings.
Other area : Non-hardening butyl rubber or equivalent sealant, used between floor lap joints and other seams which will not come in contact with cargo.

MARKINGS

Decals : Pigmented cast vinyl, color white.
Data Plate : Stainless steel plate with etched on letters.

COATINGS

Primer : Epoxy zinc rich, color gray, 90% min zinc content.
Exterior top : Chlorinated rubber, color R.A.L. 3009. (brown)
Interior coating : FDA compliant, two-pack epoxy, color R.A.L. 7035 (gray)
Undercoat : Tectyl 121.B

GASKETS

Material : EPDM rubber
Geometry : Double lipped "J" section with modified "C" section lower gasket.

VENTS

Material : ABS Plastic or equivalent
Geometry : Labyrinth tuype with mounting gasket.

TUNNEL BOLSTER (40 FT CONTAINERS ONLY)

Geometry : Box shaped member comprised of top plate and "U" shaped lower section
Gauge : 4.5 mm
Assembly : Top and bottom sections continuously welded to form a sub assembly. Sub assembly continuously welded to tunnel and rails.

FLOOR

Assembly : Floor to be installed over crossmembers including fork pockets on 20 ft containers
Thickness : 28 mm
Assembly : The floor planks shall be tightly fitted on the crossmembers. All floor screws shall be counter-sunk below the surface of floor by 1.5 mm minimum. All the seams of each board and all the perimeters of the floor shall be sealed.
Treatment : In accordance with Australian Health Departments regulations. Maximum moisture content shall not be over 12 percent before installation.

FLOOR RAIL

Geometry : Flat bar
Gauge : 4.0 mm minimum
Treatment : Blasted primed and painted in the same manner as the crossmembers.

LASHING

Geometry : Formed from 10 mm dia. bar welded to top and bottom side rails.
Location : 20 ft containers - five rings per top and bottom side rails.
40 ft containers - ten rings per top and bottom side rails.
Features : Rings shall have a pull strength of 1,500 kgs in any direction.
Treatment : Zinc-plated.

FRONT END FRAME

Front end frame shall comprise of a header, sill, corner posts, front panel and corner castings welded together to form an assembly.

Geometry : Single open "L" shaped pressing
Gauge : 6.0 mm
Features : Incorporating minimum two 10.0 mm dia. zinc plated lashing bars per post.

FRONT HEADER

Geometry : One piece open section with one doubler plate at each corner casting.
Gauge : Header - 4.0 mm; Doubler Plates - 3.2 mm

FRONT SILL

Geometry : "G" shaped section iwth three internal reinforcements.
Gauge : Sill: 4.0 mm; Gussets; 3.2 mm
Features : On 40 ft containers the lower portion of the front sill shall be eliminated between the tunnel rails and the lower corner castings. The upper portion of the front sill shall be reinforced at the tunnel and casting area.
On 20 ft containers the lower portion of the front sill shall be modified at the corner castings area to provide a recessed area to eliminate damages to sill from chassis twist locks.

END PANEL

Geometry : Trapezium section corrugated 45.6 mm depth with pitch of 204 mm.
Gauge : 2.0 mm
Assembly : Continuously welded externally to front end frame and internally to corner posts.

REAR END FRAME

Frame shall be compsed of corner posts, sill, header and corner castings which are welded to from an assembly.

CORNER POST

Geometry : Rectangular box section composed of outer and inner sections.
Gauge : 6.0 mm thick modified "C" section outer, and 10.0 mm hot rolled channel section inner.
Assembly : Continuously welded.
Features : Incorporating minimum two 10.0 mm dia. lashing bars per-post. Lashing bars to be zinc plated.

REAR HEADER

Geometry : Rectangular box section fabricated from upper and lower sections with doubler plate at each corner castings.

Gauge : Upper, reinforcements and gussets-3.2 mm lower-4.0mm

Features : One reinforcement gusset welded behind each camkeeper

Assembly : Continuously welded.

REAR SILL

Geometry : Open section

Gauge : Sill and reinforcements - 4.5 mm; Gussets 3.2 mm

Features : One reinforcement gusset welded behind each camkeeper
Internal, upper radius of sill to be 2 mm above level of floor. The lower portion of the sill shall be modified at the corner casting area to provide a recessed area to eliminate damages to the sill from chassis twist locks.

Assembly : Continuously welded.

DOOR AND HARDWARE

Doors shall be constructed with frame members and panel which are welded as a sub assembly.

DOOR

Geometry : Corrugated steel panel welded vertically to rectangular tubes and horizontally to channels. Profile of door panel corrugations must match the profile of side panel corrugations.

Gauge : Panel - 2.0 mm
Vertical tubes - 3.2 mm
Horizontal channels - 3.2 mm

Features : One locking T.I.R. plate to be fitted to outside of right door. Each door capable of swinging 270 degrees. Chloroprene sealant is to be applied to the outer edges of lower gaskets to prevent water ingress. A nylon rope hold back is provided on each door.

HINGE BLADE AND LUG

Geometry : Hinge blades shall be weld-constructed with boss and formed plate. Hinge lugs shall be from pressed plate

Size : Plate : 10 mm thick.

Features : Each door shall be suspended by four hinges with nylon bushes and stainless steel washer placed between the hinge and lug.

Treatment : Electro zinc plated.

VENTILATOR

- Geometry : Small labyrinth type. 2 pcs fro 20 ft containers.
4 pcs for 40 ft container, secured with 6.0 mm
dia huck bolts.
- Installati : At both ends, on diagonally opposite sides of the
container, on 20 ft containers. On each side at
both ends of container on 40 ft containers.
Sealant to applied to the sides and top of each
ventilator.

ROOF

PANEL

- Geometry : 20 mm min depth corrugated panel with 3 or 4
corrugations maximum per panel.
- Gauge : 2.0 mm
- Features : Roof panel shall be cambered 6 mm to 8 mm above at
center to ensure complete water drainage.
- Assembly : Continuously welded.

CORNER PROTECTION (DOUBLER) PLATES

- Geometry : Rectangular plate 450 mm X 450 mm
- Gauge : 3.2 m
- Assembly : Continuously welded to roof panel and corner
castings.

PC-24 WASTEWATER TREATMENT SYSTEM

SYSTEM AC®

The PC-24 wastewater treatment system utilizes Clarion® PM-100 filter media to remove oil, grease and other high-molecular weight dissolved organics from wastewater.

FLOW RATE:

12 gallons (45.4 liters) per minute

MAXIMUM OPERATING PRESSURE:

45 psi

FILTER MEDIA REQUIRED:

300 pounds (136kg) of CLARION® PM-100

SUPPORT BED REQUIRED:

One cubic foot of #2 Anthracite Coal

PC-24 DIMENSIONS:

Outer Diameter: 2 ft. 5 in. (73.6cm)
Height: 3 ft. 11 in. (119.4cm)

PS-24 DIMENSIONS:

Length: 5 ft. 6 in. (167.6cm)
Width: 2 ft. 5 in. (73.6cm)
Height: 4 ft. 7 in. (139.5cm)

PC-24 SHIPPING WEIGHT:

875 pounds (397.2kg); includes 300 lbs. of media

PS-24 SHIPPING WEIGHT:

1,200 pounds (5,44.8kg);
includes 300 lbs. of media

PIPING:

1-1/2 inch service with quick disconnect

TOP LOADING HATCH:

2 ft. 5 in. (73.6cm)

CONSTRUCTION:

Carbon steel painted inside and out with chemical resistant epoxy

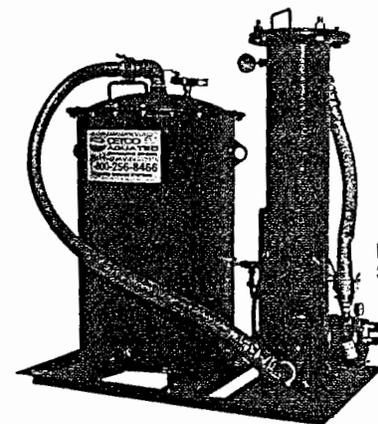
GAUGES & EQUIPMENT:

Air Eliminator Valve
0-60 psi Upper Pressure Gauge
(Optional) 0-60 psi Lower Pressure Gauge

*PS-24 System comes complete with a PC-24 vessel, centrifugal pump, bag filter, piping and PM-100 filter media. The system is skid mounted for ease of use.



PC-24
Vessel



PS-24
System*

Copy of the
... 875-3-37

CETCO

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

INDUSTRIAL SERVICES GROUP

1350 West Shure Drive
Arlington Heights, IL 60004-1440
(847) 392-5800 • Fax (847) 577-5571

800/527-9948

<http://www.cetco.com>

Clarion[®] PM-100

WASTEWATER FILTRATION MEDIA

SYSTEM AC[®]

CLARION PM-100 is a chemically modified clay and anthracite filtration media that reliably removes oil, grease and other high-molecular weight organics from wastewater. Engineered for column operation, CLARION PM-100 is an effective treatment technology. It can also be used as a pre-treatment or post-treatment to many other filtration technologies.

CLARION[®] PM-100 is an excellent pre-treatment for activated carbon, reverse osmosis and desalination systems. For example, by absorbing up to 60% of its weight in oil and grease, CLARION PM-100 will increase the effectiveness of activated carbon by preventing the pore blinding problem associated with oil, grease and other less water-soluble organics. CLARION PM-100 can extend the lifetime of the carbon by factors of 2 to 10 times, while resulting in higher carbon sorption capacity. In general, anytime oil and grease extractable are 1 ppm or greater, PM-100 will be an economic advantage as a pre-treatment for carbon.

As a stand alone media, CLARION PM-100 is the best technology available for treatment of oil contaminated wastestreams and boiler condensate.

CLARION PM-100 is an extremely efficient post-treatment media downstream of equipment such as dissolved and induced air flotation units, API oil separators, corrugated plate separators, granular media oil coalescers, ultrafiltration, air strippers and our own wastewater treatment systems.

ADVANTAGES AND BENEFITS

- **Economical to use.** PM-100's large absorption capacity (up to 60% its weight) for oil and other high molecular weight organics makes it the cost effective oil-removal alternative relative to other filtration materials.
- **Dependable.** PM-100 can accommodate increases in flow rates and contaminant concentration levels caused by accidental spills and plant upsets. When oil is not present, PM-100 is not being expended, thus providing a "fail safe" method to prevent oil contamination.
- **Simple to Apply.** PM-100 is employed in conventional filtration contactors.
- **Non-Hazardous.** Fresh PM-100 is non-hazardous; therefore, the waste classification of the spent material is determined by the constituents removed.

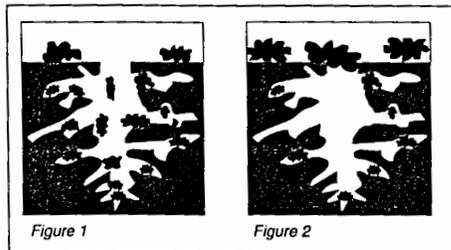


Figure 1 (Left)
Activated carbon surface area sorption.

Figure 2 (Right)
Blinded activated carbon pore resulting in lower organic adsorption.

CLARION PM-100 differs from activated carbon in the mechanism of organic sorption from water. Activated carbon absorbs organics through a surface area related mechanism (Figure 1) which tends to foul activated carbon by blinding the pore structure (Figure 2) and lowering the available surface area for adsorption. CLARION PM-100 technology absorbs organics through a platelets partitioning process (Figure 3) that increases the organic absorption capacity to approximately 60% of its weight.

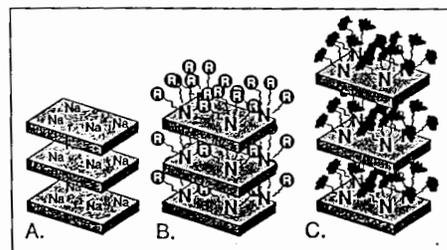


Figure 3
(A.) Clay platelets.

(B.) Clay surface chemically modified to form CLARION.

(C.) CLARION saturated with organic contaminants. Clay platelets expanded.

CLARION PM-100 SYSTEM DESIGN CRITERIA

The design criteria of PM-100 systems is similar to a typical granular activated carbon system. The following design parameters are recommended:

Granular Oil Absorbent	PM-100
Bed Depth	3 feet (min.)
Hydraulic Loading	3-4 gpm/sq. ft. (max)
Contact Time	2-5 minutes
Bed Expansion	20%

SPECIFICATIONS

Particle Size:	16x40 mesh (US sieve)
Moisture	8%
Water Retention, Drained	10%
Density	Shipped 52-54 lb./ft. ³ Backflushed, settled in column 58 lb./ft. ³

Standard Packaging

Packaged in 50 Lb. boxes and 2000 Lb. bulk bags.



COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

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Clarion PM-100

Protection for Activated Carbon Water Treatment Systems

A technical problem in the application of activated carbon water treatment systems is the presence of oil and grease extractable organics. These organics tend to be higher molecular weight, less water-soluble compounds occurring many times as emulsions. Such organic contaminants tend to foul activated carbon by blinding the pore structure of the carbon and lowering the available surface area for adsorption, resulting in loss of capacity.

The PM-100 technology is a unique approach to sorption of organics from water. However, it differs from activated charcoal in the mechanism of sorption. Activated carbon adsorbs organics through a surface area related mechanism. PM-100 operates through a partitioning phenomena that has little relationship to surface area. The effectiveness of PM-100 to absorb organics is directly related to the water solubility of the organic. The partition coefficient for several organics on PM-100 versus the water solubility of the organics is presented in figure 1.

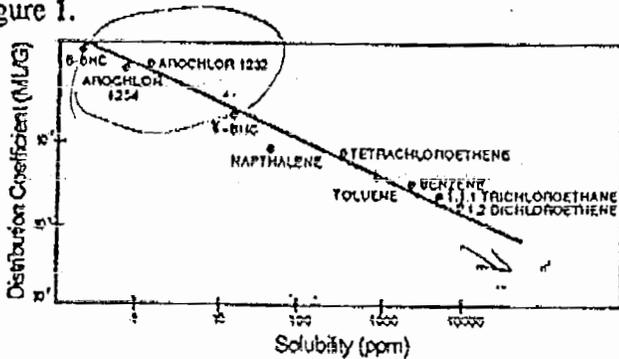


Figure 1.

As can be seen, there is a linear relationship between the partition coefficient and water solubility of the organic. In practical terms this means that any organic that would be extracted in a traditional oil and grease determination will be absorbed strongly by PM-100, but organics that are highly water soluble or that are quite volatile will absorb poorly onto PM-100. The PM-100 will efficiently remove from water, free, mechanical emulsified, and dissolved organics which are sparingly water soluble.

The PM-100 product is specifically designed to solve the blinding problem in activated carbon systems associated with

oil and grease. PM-100 will absorb up to 60% of its weight in oil and grease. In contrast, carbon, will adsorb only 2 to 3% of its own weight. In addition, PM-100 will absorb lightly emulsified oil and grease from solution. When PM-100 is utilized as a pre-treatment to carbon, it removes the oil and grease extractables and allows carbon to remove the water soluble organics more efficiently, and with higher capacity. This effect can be dramatic. The lifetime of carbon can be extended when combined with PM-100 by factors of 2 to 10 times, depending upon oil and grease levels in the waste stream. The PM-100, because of its large capacity, must be changed only a fraction of the times that the carbon is changed. In general, any time the oil and grease extractables are 1 ppm or greater, PM-100 will be of an economic advantage in combination with carbon. The overall cost of combining PM-100 with carbon will be lower than carbon alone. In many cases, this cost reduction factor is 1/2 to 1/4 the cost of carbon alone, depending upon the oil and grease level in the waste.

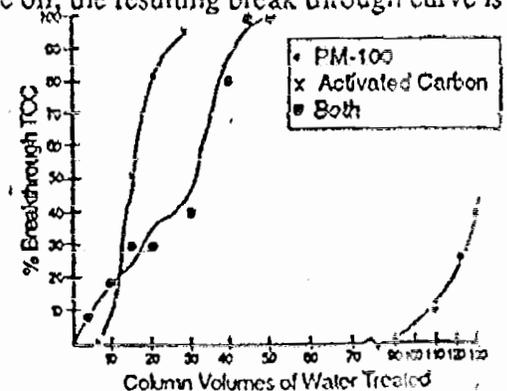
Example of PM-100 Efficacy

The breakthrough curves for the application of PM-100 to a waste water containing 200 ppm oil and grease and 200 ppm toluene is presented in Figure 2.

The first curve is the breakthrough obtained with activated carbon alone. It is obvious that carbon is very inefficient for removing the mix of contaminants.

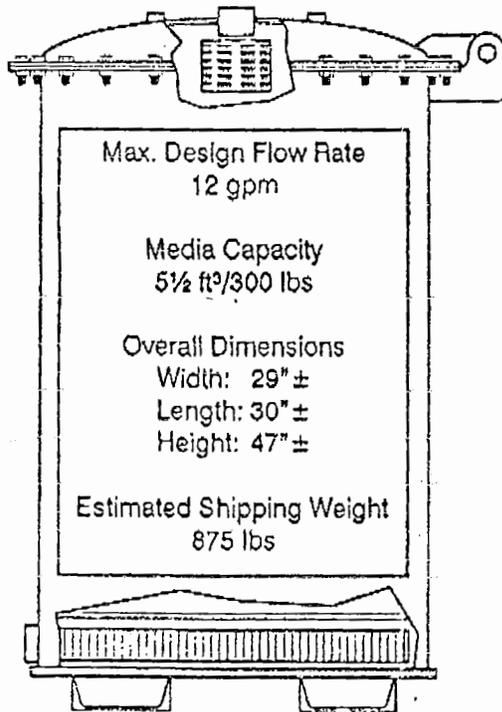
The second curve is the same waste treated with PM-100 alone. The PM-100 performs substantially better than the carbon column. However, when PM-100 is utilized to protect the carbon from the oil, the resulting breakthrough curve is superior in performance as compared to either technology alone.

Figure 2



AQUATEC PC-24 PM100 Pressure Vessel

CETCO Industrial Services Group's **Aquatec PC-24** vessel is designed as a cost effective way to remove oil, grease and high molecular weight hydrocarbons from water streams by using CETCO's organophilic absorption media. Unlike a standard drum adsorber, the **PC-24** is designed for the moderate pressures (up to 75psi) associated with applications using PM100 or similar media.



Important Features

- Durable carbon steel construction.
- Hydrotested to 90 psi for a maximum recommended operating pressure of 75 psi.
- Slotted inlet diffuser allows for backwashing without media loss.
- 1½" fpt Inlet/outlet.
- ½" fpt PRV/vent connection.
- ½" fpt Pressure gauge/sample port connection.
- Forklift guides and lifting lugs to facilitate moving.
- Lower guard to prevent lateral damage.
- Anthracite support bed for maximum utilization of PM100 media.

Available Options

- Stainless Steel Construction
- Influent Pressure Gauge
- Air Eliminator Valve
- Variety of Media
- Kamloc Connections
- Piped Multi Component Systems
- Call for your Custom Configuration

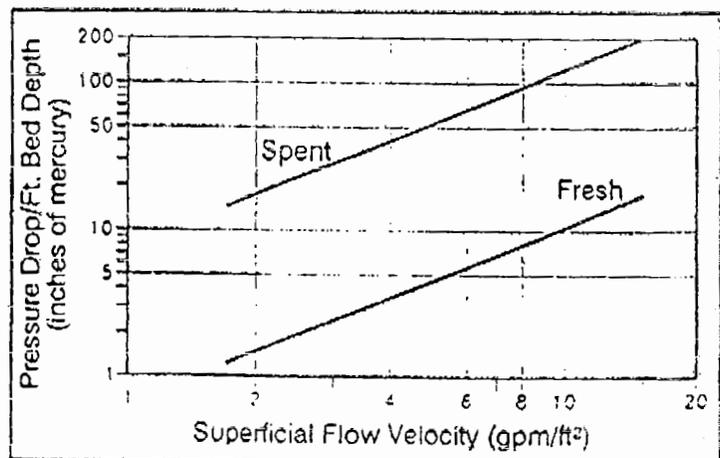
For More Information and Pricing

Call

1-800-527-9948

and Talk to One of Our
Knowledgeable Technical
Support Personnel

Media volume and weight based on PM100 @ 54 lbs/ft³
Design and specifications subject to change without notice.



DISPOSAL OF SPENT CLARION FILTER MEDIA

Once spent, the Clarion absorption media must be disposed of properly. CETCO has determined that disposal by fuel blending offers the least environmental liability and is cost effective. To facilitate this process, CETCO can act as a waste broker to coordinate the disposal arrangements between the customer (generator) and disposal company. In some cases landfilling the waste may be less expensive, however its long term liability far outweighs its cost benefit. Because of this, CETCO will not offer brokerage services for landfill disposal.

Fuel blending is a process in which spent material is processed and used as a supplemental fuel source in the production of cement. The supplemental fuels, as well as fossil fuels (coal, oil, natural gas), are introduced into a cement kiln and burned at temperatures of up to 3,400°F. Virtually all organic compounds are destroyed at these high temperatures.

Fuel blending has several advantages as a disposal option, including; limiting the generators environmental liability, recovering a valuable energy source, and reducing dependency of non-renewable fossil fuels. For disposal of the spent Clarion filter media through a fuel blending program, the following steps should be taken:

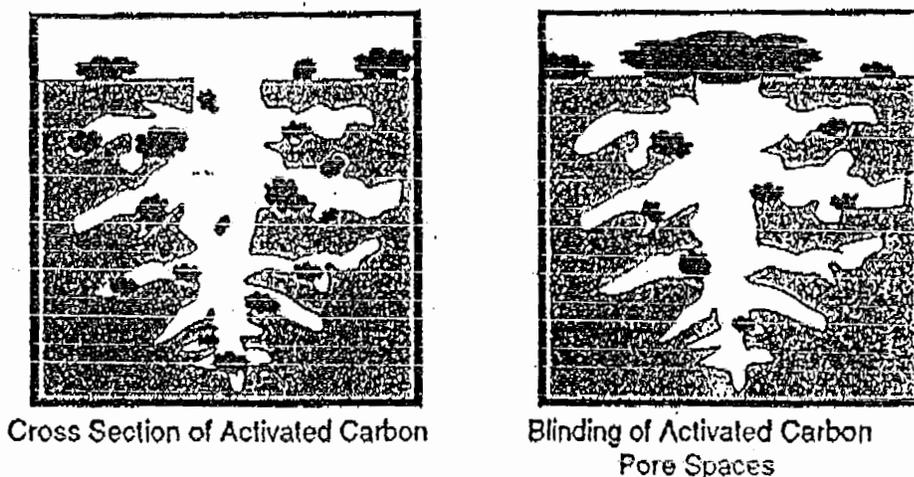
1. The generator should collect a representative sample of the spent Clarion media and place the media in a clean sample container (1 quart is sufficient).
2. The sample should be sent to CETCO, where a representative of CETCO will visually analyze the sample and complete the waste profile form for disposal approval.
3. The completed form will be sent back to the generator to be signed.
4. The sample and waste profile form will be sent to the processing center where the sample will be analyzed for several disposal characteristics (i.e., BTU, total metals, % water, % halogens, etc.).
5. Upon completion of the analysis, CETCO will notify the generator of acceptance status and disposal costs.
6. CETCO will arrange for transportation of the spent material from the generator to the processing facility.
7. Waste material that is in compliance will be introduced into the cement kiln for final disposal. Non-compliance waste material will be returned at the expense of the generator.

Clarion PM-100

Sorption Technology of PM-100

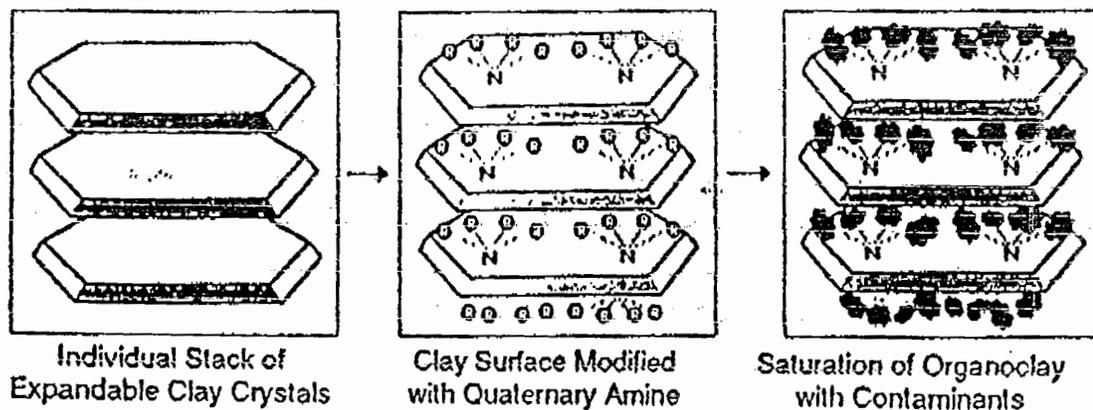
The PM-100 technology is a unique approach to sorption of organics from water. However, it differs from activated carbon in the mechanism of sorption. In Figure 1, activated carbon adsorbs organics through a surface area related mechanism. PM-100 operates through a partitioning phenomenon that has little relationship to surface area. Higher molecular weight organics, such as humic substances, tend to foul activated carbon by blinding the pore structure of carbon and lowering the available surface area for adsorption, resulting in loss of capacity.

Figure 1



As illustrated in Figure 2, the surfaces of the clay platelets in PM-100 are chemically modified, rendering the clay completely hydrophobic. The modified platelets only have an affinity for organics. As the higher molecular weight organics are absorbed, the platelets spread further apart. This phenomenon gives PM-100 a very high absorption capacity relative to activated carbon. PM-100 can also be regenerated with a caustic backwash thereby extending bedlife.

Figure 2





SERVICE TECH, INC.

Activated Carbon Engineering, Sales and Service

Vessel for Clarion Claymedia

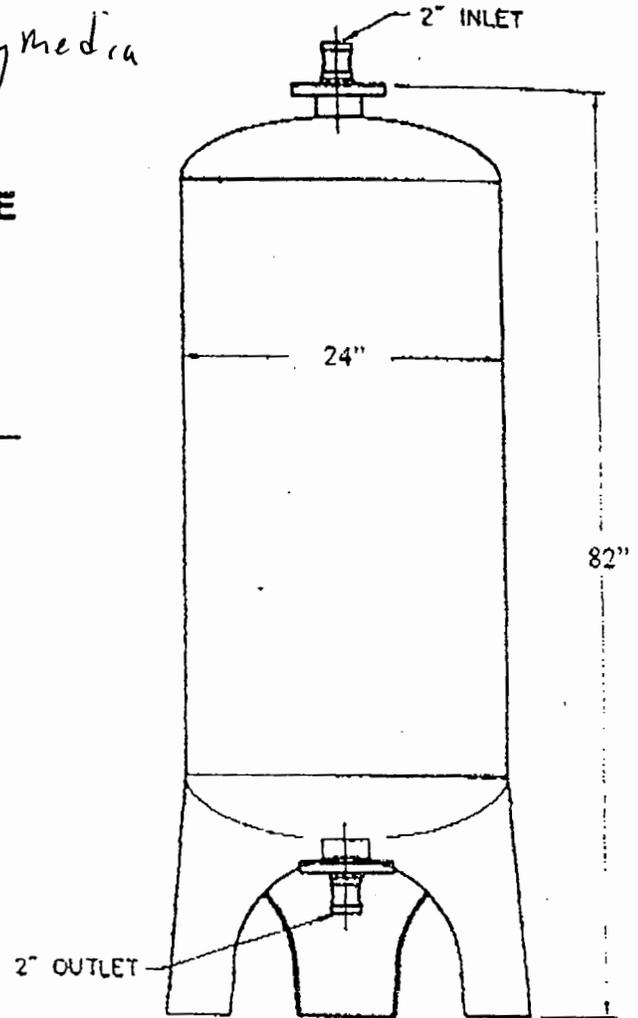
**LIQUIDCLEAN - HPBA 500
500 POUND BETONITE ANTHRACITE
HIGH PRESSURE ABSORBER**

STANDARD FEATURES

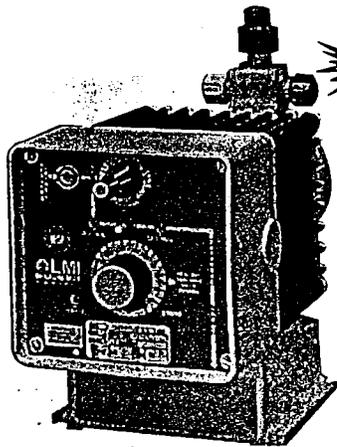
- 500#S of betonite anthracite.
- Standard 2" FNPT couplings for easy installation.
- Heavy duty, corrosion resistant Polyglass composite poly vessel.
- Hub & lateral internal distribution and collection assemblies designed to maximize flow and media utilization.
- High pressure vessel rated to 150 psig operation @ 150F.

SPECIFICATIONS

Max suggested flow - 25 GPM
 Typical flows - 10 to 20 GPM
 Inlet - 2" fnpt
 Outlet - 2" fnpt



WATER TREATMENT

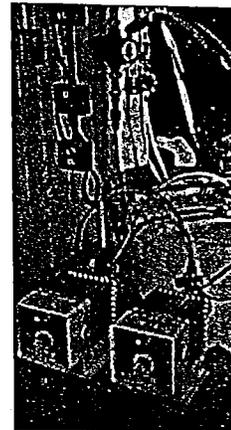
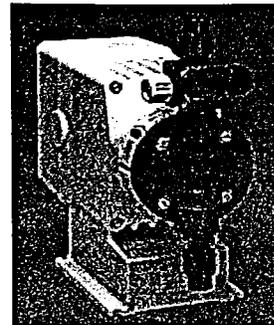


Series B & C

NEW SIZES



Series A



LMI pump contro

LMI Electronic Pumps

Series A1, B1, C1 (formerly D1)

- Dual Manual Control for Stroke Length and Stroke Speed

Series A7, B7, C7 (formerly D7)

- Dual Manual Control and External Control
- External Control pacing by flow meter contactor or our optional 4-20mA signal Conversion Units

These famous bright yellow units are all very similar except for the two different control methods shown above and the performance ratings shown in the tables on the right. LMI pumps boast over 15 years of field experience in rough municipal and industrial environments. These models feature a 100:1 turndown ratio for excellent metering accuracy over a very wide range of feed rates. It is best to select a pump which will normally not operate at more than 60%-80% of its maximum design rating shown below. Since these are all electronic pumps, there is no oil bath and therefore no possible mechanical leakage. But take note, with most all feed pumps, only tighten the tubing connectors by hand and never use pipe tape or dope. This is the most frequent cause for leaks and messy clean-up jobs. Please also wear appropriate clothing, face shields, and gloves.

All these pumps come complete with two 8' sections of tubing (suction & discharge), foot valve and strainer assembly, injection check valve, 4-way anti-siphon pressure relief valve (ASPR) which allows you to drain discharges lines back into the feed tank for easy pump servicing. The ASPR option is standard with us. The last digit of these pumps becomes an S. (There is no ASPR on the HV Series used for polymers.) The anti-siphon pressure relief valve adds about 20 psi of back pressure, so please size your pump accordingly. These pumps all fit the LMI tanks and brackets listed in this section. If you need specific dimensions please call. We also stock wet-end repair kits which include the diaphragm, seal rings, valve balls and anti-siphon spring. It is a good idea to keep at least one of these kits on hand in your shop. The SIZE column refers to discharge tubing: 1=1/4"OD; 2=3/8"OD; 3=1/2"OD; 4=1/4"NPT pipe connection.

PVDF(Kynar) or PVC(Teflon)/Ceramic wet end suitable for (NOT hydrofluosilicic), alkalis, chlorine, caustic, or pota permanganate. Viscosity up to 500cps. Discharge tubing: 1"; Size 2 = 3/8", Size 3 = 1/2".

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-152S	14	250	60800	\$373.60	SP-U8	61002
A1 MANUAL	A151-192S	24	110	60802	379.20	SP-U7	61004
A7 EXTERNAL	A741-152S	14	250	60804	415.20	SP-U8	61002
A7 EXTERNAL	A751-192S	24	110	60806	420.80	SP-U7	61004
B1 MANUAL	B111-192S	38	150	60808	542.40	SP-U7	61004
B1 MANUAL	B121-192S	60	100	60810	542.40	SP-U7	61004
B7 EXTERNAL	B711-192S	38	150	60812	588.00	SP-U7	61004
B7 EXTERNAL	B721-192S	60	100	60814	588.00	SP-U7	61004
C1 MANUAL	C101-94S	31	300	60816	716.00	SP-U1	61006
C1 MANUAL	C121-162S	96	100	60818	710.40	SP-U10	61008
C7 EXTERNAL	C701-94S	31	300	60820	782.40	SP-U1	61006
C7 EXTERNAL	C721-162S	96	100	60822	756.00	SP-U10	61008
C7 EXTERNAL	C771-26S	240	80	60824	931.20	SP-26S	61010

Acrylic/PVDF(Kynar)/Teflon wet end suitable for hydrofl acid. Discharge tubing: Size 1 = 1/4"; Size 2 = 3/8", Size 3 = 1/2"

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-150FS	14	250	60840	\$396.00	SP-151FS	61030
A1 MANUAL	A151-91FS	24	110	60842	402.40	SP-U3	61032
A7 EXTERNAL	A741-150FS	14	250	60844	437.60	SP-151FS	61030
A7 EXTERNAL	A751-91FS	24	110	60846	444.00	SP-U3	61032
B1 MANUAL	B111-91FS	38	150	60848	555.60	SP-U3	61032
B1 MANUAL	B121-91FS	60	100	60850	555.60	SP-U3	61032
B7 EXTERNAL	B711-91FS	38	150	60852	611.20	SP-U3	61032
B7 EXTERNAL	B721-91FS	60	100	60854	611.20	SP-U3	61032
C1 MANUAL	C121-71FS	96	100	60858	752.00	SP-U4	61034
C7 EXTERNAL	C721-71FS	96	100	60862	797.60	SP-U4	61034
C7 EXTERNAL	C771-20FS	240	80	60864	965.60	SP-20FS	61036

Polypropylene/Teflon/Stainless Steel wet end for polymer flocculants. Viscosity handling capability up to 30,000cp Discharge tubing: Size 1 = 1/4"; Size 2 = 3/8", Size 3 = 1/2"

LMI SERIES	PUMP MODEL	GPD	PSI	STOCK#	EACH	REPAIR KIT	STOCK#
A1 MANUAL	A141-155HV	14	250	60880	\$404.80	SP-155HV	61050
A1 MANUAL	A151-85HV	24	110	60882	408.40	SP-85HV	61052
A7 EXTERNAL	A741-155HV	14	250	60884	446.40	SP-155HV	61050
A7 EXTERNAL	A751-85HV	24	110	60886	450.40	SP-85HV	61052
B1 MANUAL	B111-85HV	38	150	60888	572.00	SP-85HV	61052
B1 MANUAL	B121-85HV	60	100	60890	572.00	SP-85HV	61052
B7 EXTERNAL	B711-85HV	38	150	60892	617.60	SP-85HV	61052
B7 EXTERNAL	B721-85HV	60	100	60894	617.60	SP-85HV	61052
C1 MANUAL	C121-75HV	96	100	60896	740.00	SP-75HV	61054
C7 EXTERNAL	C721-75HV	96	100	60898	785.60	SP-75HV	61054
C7 EXTERNAL	C771-25HV	240	80	60900	924.00	SP-25HV	61056



FeREMEDE® DEPOSIT CONTROL AGENT

PRODUCT APPLICATION:

FeREMEDE is a concentrated blend of chelants, sequestering agents and dispersants specifically designed to prevent the precipitation and deposition of metallic oxides and hardness salts, in a wide variety of water handling systems. The product is particularly effective in preventing the deposition of iron, manganese and calcium compounds in groundwater remediation systems utilizing air stripping towers. By maintaining clean packing or trays, FeREMEDE helps to increase water circulation rates, minimize pressure drops, reduce liquid hold-up and improve the mass transfer efficiency of the unit. When used on a continuous basis the product can also help to remove existing deposits from the system, thereby enabling a reduction in traditional chemical and manpower expenses associated with treatment system cleanings.

FeREMEDE is easy to use in that the product is environmentally safe, does not promote microbiological contamination, is active over a broad pH range and is compatible with all other water treatment compounds. The product is also chlorine-stable, does not contribute to foaming problems and is non-corrosive to metal surfaces.

PRODUCT DESCRIPTION:

Appearance: Clear, pale yellow to light brown liquid
Specific Gravity: 1.06 - 1.10 @ 25 degrees C
Density: 8.9 pounds per gallon
pH: Less than 5.0
Freeze Point: Less than 32 degrees F

PRODUCT DOSAGE:

As product feed rates are highly dependent upon makeup water characteristics and system operating conditions, your sales representative should be consulted for specific dosage recommendations. Typically, however, FeREMEDE is dosed to the system at a rate of 25-100 ppm (as product). The recommended feed method is by continuous injection of the product into the system influent line (see Product Application Guidelines on the reverse side of this page for specific product feed recommendations and procedures).

PRODUCT SAFETY:

As with any industrial chemical, FeREMEDE should be handled with appropriate care. Therefore, please have all supervisory personnel and operating employees review the Material Safety Data Sheet (MSDS) to obtain recommended application, storage and disposal procedures before using the product in your application.

PRODUCT PACKAGING:

FeREMEDE is available in 55 and 30 gallon drums, 15 gallon containers, 5 gallon pails and in bulk containers of various sizes.

MATERIAL SAFETY DATA SHEET

IDENTITY - FEREKMEDE

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SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME -

Remede Products, Inc.
280 Callegari Drive
West Haven, CT 06516

TELEPHONE NUMBER FOR INFORMATION - 203/932-3655

EMERGENCY TELEPHONE NUMBER - CHEMTREC (800) 424-9300

DATE PREPARED - May 20, 1991

PREPARED BY -

Technical Manager
Remede Products, Inc.
West Haven, CT 06516

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SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

<u>COMPONENT</u>	<u>OSHA PEL</u>	<u>ACGIH TLV</u>	<u>Other Limits Recommended</u>
Organic acid	NDA	NDA	-
Organic phosphorus compound	NDA	NDA	-
Tetrasodium ethylene- diaminetetraacetic acid	NDA	NDA	-
Sulfonated styrene copolymer	NDA	NDA	-

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N/A = Not Applicable NDA = No Data Available

RM-10[®]

REACTIVE SEPARATING AGENTS

SYSTEM AC[®]

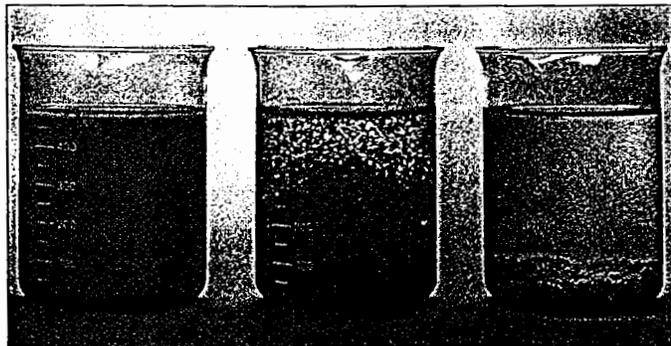
RM-10[®] Reactive Separating Agents

RM-10 Reactive Separating Agents remove emulsified oils, heavy metals, phosphates and suspended solids from wastewater through flocculation, precipitation and pH adjustment. Unlike conventional wastewater treatment systems that require multiple chemical additions throughout the process, RM-10 is applied in a single application. RM-10's proprietary blend of separating agents activate and react in a predetermined sequence to effectively remove wastewater contaminants.

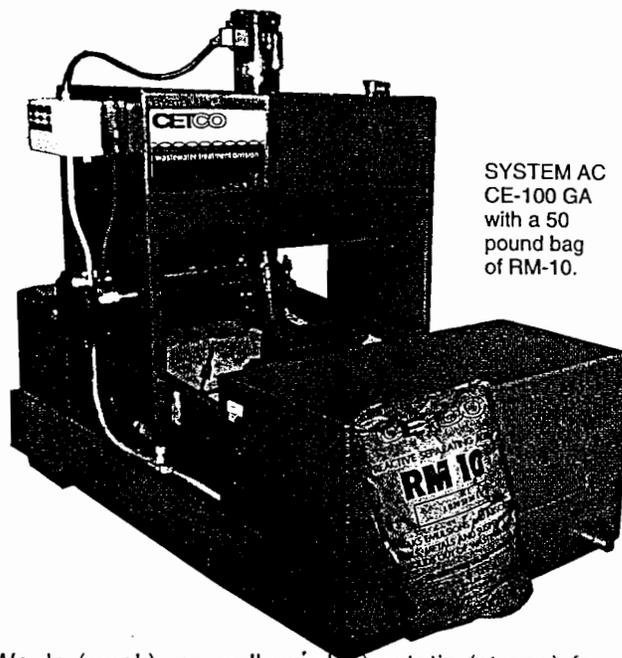
RM-10 is composed of minerals, inorganic and organic acids and bases, and cationic polymers. RM-10 is produced in twenty different dry powder formulations for various wastewater applications. Seven of the formulations are also available in a granular form. Three of the powder formulations are specifically designed to remove ortho, meta, pyro and tri-poly phosphates.

How RM-10 Treatment Works

Wastewater treatment with RM-10 takes only minutes, yet several complex chemical reactions occur. First, the acidic component of the RM-10 causes oily contaminants to coalesce and separate from the wastewater. Next, the polymeric cationic portion of the formulation attracts any remaining oils and larger, more highly charged anions. Finally, the basic component activates, precipitating metallic hydroxides and driving the system to a fully flocculated condition where the cationic polymer molecules (with any adsorbed oil), metallic ions, and positively charged contaminants are attracted to the RM-10's clay particles. Heavy metal cations remaining in solution will exchange with the sodium on the clay and will bond to the clay platelets by electrostatic forces. The fully reacted mass is a complex mixture of encapsulated contaminants and waste solids held together by Van der



Wastewater treated with RM-10 chemistry.



SYSTEM AC
CE-100 GA
with a 50
pound bag
of RM-10.

Waals (weak), as well as electrostatic (strong) forces. The clay particles agglomerate, entrapping and surrounding suspended solids completely. Pozzolanic reactions also occur, forming cementitious particles which settle to the bottom of the vessel. The entire microencapsulation process is completed in just minutes, leaving clear and in most cases sewerable, water.

At this point, the flocculated and solidified waste sludge is often non-leachable. Contaminants are surrounded by a barrier of clay particles and unavailable to external leaching fluids. TCLP test results typically confirm that the treatment process has permanently isolated the contaminants in a "non-leachable" form.

The RM-10 chemicals are used in conjunction with System AC[®], CETCO's own line of wastewater treatment machines. The RM-10 chemicals are packaged in 50 pound water resistant bags, which are palletized and stretchwrapped. Delivery of RM-10 is available from regional warehouses across the United States and Canada.

CETCO

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

INDUSTRIAL SERVICES GROUP

1350 West Shure Drive

Arlington Heights, IL 60004 USA

(847) 392-5800 • Fax (847) 577-5571

800/527-9948

<http://www.cetco.com>

MATERIAL SAFETY DATA SHEET

IDENTITY - **PERMEDR**

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SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME -

Remede Products, Inc.
280 Callegari Drive
West Haven, CT 06516

TELEPHONE NUMBER FOR INFORMATION - 203/932-3655

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Sulfonated styrene copolymer	NDA	NDA	-

N/A = Not Applicable NDA = No Data Available

MATERIAL SAFETY DATA SHEET

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point, (°F):	212 - 220
Specific Gravity, (water=1):	1.06 - 1.10
Vapor Pressure, (mm Hg.):	SIMILAR TO WATER
Melting Point, (°F):	N/A
Vapor Density, (air=1):	SIMILAR TO WATER
Evaporation Rate, (Butyl Acetate = 1):	SIMILAR TO WATER
Solubility in Water:	Complete
Appearance and Odor:	Clear, pale yellow liquid with slight odor.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point, (Method Used): Non-flammable/aqueous solution.

Flammable Limits: N/A

LEL: N/A

UEL: N/A

Extinguishing Media:

N/A

Special Fire Fighting Procedures:

Firefighters should wear self-contained breathing apparatus and body covering protective clothing.

Unusual Fire and Explosion Hazards:

None

MATERIAL SAFETY DATA SHEET

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SECTION V - REACTIVITY DATA

Stability:

Stable X Unstable

Conditions to Avoid: NONE

Incompatibility (Materials to Avoid):

Quaternary amines, acids, sulfides and strong oxidizers.

Hazardous Decomposition or Byproducts:

Carbon dioxide, carbon monoxide and sulfur oxides.

Hazardous Polymerization:

May Occur Will Not Occur X

Conditions to Avoid: NONE

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SECTION VI - HEALTH HAZARD DATA

Route(s) of Entry:

Inhalation? YES Skin? YES Ingestion? YES

Health Hazards (Acute and Chronic):

Mild irritant. May be harmful or fatal if swallowed.

Carcinogenicity:

NTP? NO IARC Monographs? NO OSHA Regulated? NO

MATERIAL SAFETY DATA SHEET

Signs and Symptoms of Exposure:

Eye and skin irritant. Material may cause burns on exposed tissues, with corneal injury which may result in permanent impairment of vision, or even blindness.

Medical Conditions Generally Aggravated by Exposure:

Skin conditions

Emergency and First Aid Procedures:

Ingestion:

NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. If available, give several glasses of milk. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

Inhalation:

Remove person to fresh air. If breathing has stopped, resuscitate and give oxygen if readily available. Seek medical attention immediately.

Eye Contact:

Immediately flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire surface. Washing eyes within 1 minute is essential to achieve maximum effectiveness. Seek medical attention immediately.

Skin Contact:

Immediately wash contaminated areas with plenty of water. Remove contaminated clothing and footwear and wash clothing before reuse. Discard footwear which cannot be decontaminated. Seek medical attention immediately.

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MATERIAL SAFETY DATA SHEET

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SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE:

Steps To Be Taken in Case Material is Released or Spilled:

Wear protective equipment outlined below. Absorb with inert ingredient such as sand or vermiculite, shovel into closable container for disposal. Thoroughly flush residual with water.

Waste Disposal Method:

By methods consistent with applicable federal, state and local regulations.

Precautions to be Taken in Handling and Storing:

Wear recommended protective equipment when handling. Store in a cool, dry and well ventilated area.

Other Precautions:

None

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SECTION VIII - CONTROL MEASURES:

Respiratory Protection:

Not normally required.

Ventilation:

Local Exhaust -	NONE
Mechanical -	NONE
Special -	NONE
Other -	General Dilution

MATERIAL SAFETY DATA SHEET

Protective Gloves :

RUBBER or NEOPRENE gloves.

Eye Protection:

Safety goggles or full face shield.

Other Protective Equipment:

Protective clothing or rubber apron.

Work/Hygienic Practices:

Wash hands thoroughly after handling.

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All information, recommendations and suggestions appearing herein concerning our product are based upon tests and data believed to be reliable. However, it is the user's responsibility to determine the safety, toxicity, and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by Remede Products, Inc. as to the effects of such use, the results to be obtained, or the safety and toxicity of the product, nor does Remede Products, Inc. assume any liability arising out of use, by others, of the product referred to herein. The information herein is not to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations.