

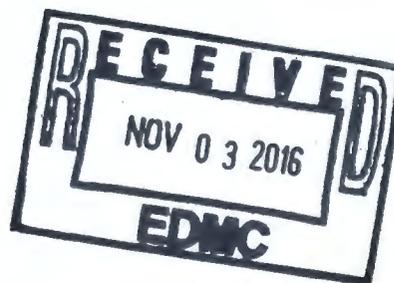
OPERATION AND MAINTENANCE MANUAL FOR THE 200 WEST AREA EVAPORATIVE SEWER LAGOON

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728



P.O. Box 650
Richland, Washington 99352



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OPERATION AND MAINTENANCE MANUAL FOR THE 200 WEST AREA EVAPORATIVE SEWER LAGOON

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Mission Support Alliance

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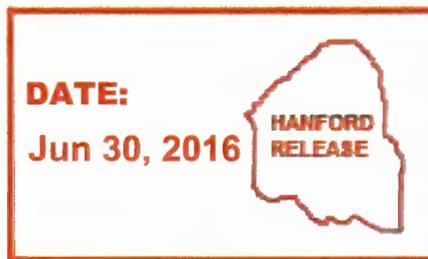


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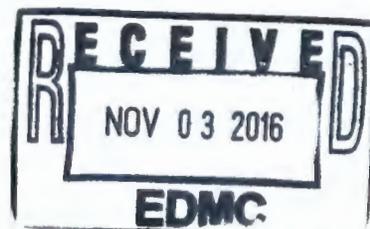
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ABBREVIATIONS AND ACRONYMS

ADF	average design flow
AADF	annual average design flow
BOD or BOD ₅	(Five-Day) biological oxygen demand (at 20 degrees C)
CFM	cubic feet per minute
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	State of Washington, Department of Ecology
EPA	U.S. Environmental Protection Agency
ESS	Environmental Site Services
gpd	gallons per day
gpm	gallons per minute
HDPE	high density polyethylene
hp	horsepower
HLAN	Hanford local area network
HVAC	heating, ventilation, and air conditioning
ISF	intermittent sand filter
LSU	Lime Stabilization Unit
LTS	Lagoon Treatment System
mg/L	milligrams per liter
MSA	Mission Support Alliance, LLC
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
NH ₃	ammonia
NO ₃	nitrate
NOC	Notice of Construction
O&M	Operation and Maintenance
OSS	on-site sewage system
PFD	personal floatation device
plant	200 West Area Evaporative Sewer Lagoon System
POC	point of contact
PPE	personal protective equipment
PQL	Practical Quantification Limits
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control

TAP	toxic air pollutants
TDS	total dissolved solids
TSS	total suspended solids
WAC	Washington Administrative Code
°C	degrees Celsius
°F	degrees Fahrenheit

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1.0 INTRODUCTION

This Operation and Maintenance (O&M) manual provides the principal reference source for the manager or operator of the 200 West Area Evaporative Sewer Lagoon System (herein referred to as the 'plant') and, thereby, helps to operate and maintain the plant facilities to achieve compliance with the regulations governing domestic waste treatment facilities and Washington State Waste Discharge Permit ST-0045514 and Air Emissions Notice of Construction (NOC) Order DE12NWP-001. This O&M manual provides information related to (1) the lagoon treatment system (i.e. gravity and pump system associated with the use of the aeration, settling, and evaporative lagoons and sand filters) and (2) the sludge processing facility (i.e. systems associated with lime stabilization and dewatering of sludge). It includes an explanation of all the basic equipment functions, capabilities, and their effect on other units, and the factors that affect their operation. This O&M manual emphasizes the principles of plant management, troubleshooting, and preventive maintenance, and recognizes that the plant's success over the long run depends on effective operation and sound management.

The plant was designed as part of comprehensive strategy to provide wastewater service to the Hanford site. The wastewater management plan in this report is aimed at achieving the following goals by Mission Support Alliance, LLC (MSA):

- Develop a centralized waste treatment system which will provide safe, reliable, and cost effective sewer service for the Hanford Site.
- Reduce the footprint of the utility infrastructures.
- Plan and develop replacement or rehabilitation of the existing onsite wastewater system in the 200W Area and focus on the services needed for the future mission with the core corridor in the Central Plateau of the Hanford Site.

The plant is located near 27th Street and Route 3 near the 200 West Area of the Hanford Site (Figure 1-1). The plant is designed to treat domestic wastewater by separation of sludge from the effluent by means of physical, chemical, and biological treatment processes. Aerated lagoons and settling lagoons have been built to stabilize the wastes by an aerobic biological process. Upon separation, solids (sludge) will be stabilized by lime and dewatered prior to disposal. Effluent will be stored in evaporative lagoons that utilize evaporation as a means of disposal. Domestic wastewater and solids from the existing on-site sewage systems (i.e. septic tanks, holding tanks)

will be transported by trucks initially and possibly by a sewer collection system connected to the plant in the future. The plant has been designed to treat an average influent flow of 55,000 gallons per day (gpd). This O&M manual will provide details of the processes, controls, and monitoring necessary to achieve compliance with the environmental requirements.

Responsible individuals are listed below:

**Table 1-1
Responsible Individuals**

Name	Position Title	Phone Number
Douglas Chapin	Program Manager Water and Sewer for DOE-RL	(509) 373-9396
Jon Kon	Manager of MSA Water & Sewer Utilities	(509) 373-5366
Sam Camp	Shift Operations Manager MSA Water & Sewer Utilities	(509) 373-0175
Daniel Saucedo	MSA Director of Public Works	(509) 373-3990
Jarrold Szabo	Supervisor Wastewater & Sewer Utilities	(509) 373-5669
Kevin Anderson	Wastewater Operator IV Certification # 6982	(509) 440-4858
Johnathan Berger	Wastewater Operator II Certification # 7028	(509) 440-4858
Carly Nelson	Environmental Compliance Officer	(509) 373-6945
Stacey Callison	Water and Sewer Utilities Design Authority	(509) 373-6578

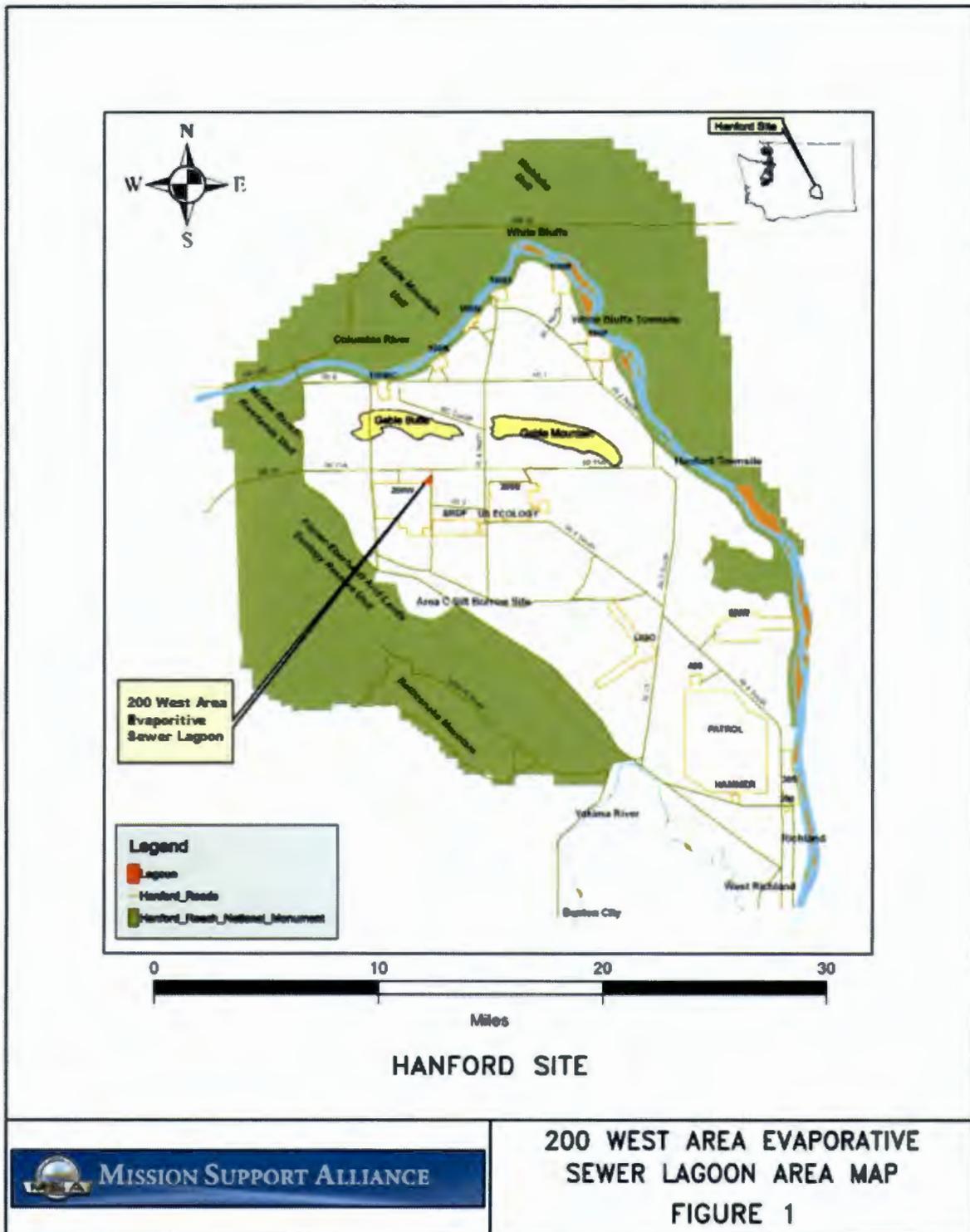


Figure 1-1
200 West Area Evaporative Sewer Lagoon Area Map

1.1 SYSTEM MANAGEMENT

The plant, owned by the U.S. Department of Energy, Richland Operations Office (DOE-RL), was constructed in 2011 and 2012. In 2012, it was permitted for use by the State of Washington, Department of Ecology under NOC Order DE12NWP-001 and State Waste Discharge Permit ST-0045514 as a Class I treatment plant.

Mission Support Alliance, LLC (MSA), or the current Mission Support Contract (MSC) holder, operates and maintains the system on DOE-RL's behalf; MSA will be used to refer to the current MSC holder throughout this document. MSA performs the day-to-day operation of the system. Responsible personnel are required to maintain Ecology Group I wastewater operator certification as required by Permit Condition S5.A of Permit ST-0045514. Wastewater operators are responsible for the continued operation of the plant, and ensuring that permit requirements are upheld. Certified wastewater operators are responsible for field testing and sampling of the influent and effluent. MSA Maintenance Services is responsible for the maintenance of the plant. Section 5.2 describes the responsibilities related to the sampling.

System, operations, and maintenance record retention includes calibration and maintenance records, original recordings for continuous monitoring instrumentation, copies of reports required by Permit ST-0045514, records of data used to complete the permit application, and sludge monitoring records. These records are kept for at least 3 years.

2.0 SYSTEM DESCRIPTION (WASTEWATER MANAGEMENT SYSTEM)

2.1 DEFINITIONS

Influent – Wastewater which enters a Wastewater Treatment Plant.

Effluent – Treated wastewater which is exiting a Wastewater Treatment Plant.

Biological Oxygen Demand – The amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.

Detention Time – The average period of time wastewater stays in a treatment system.

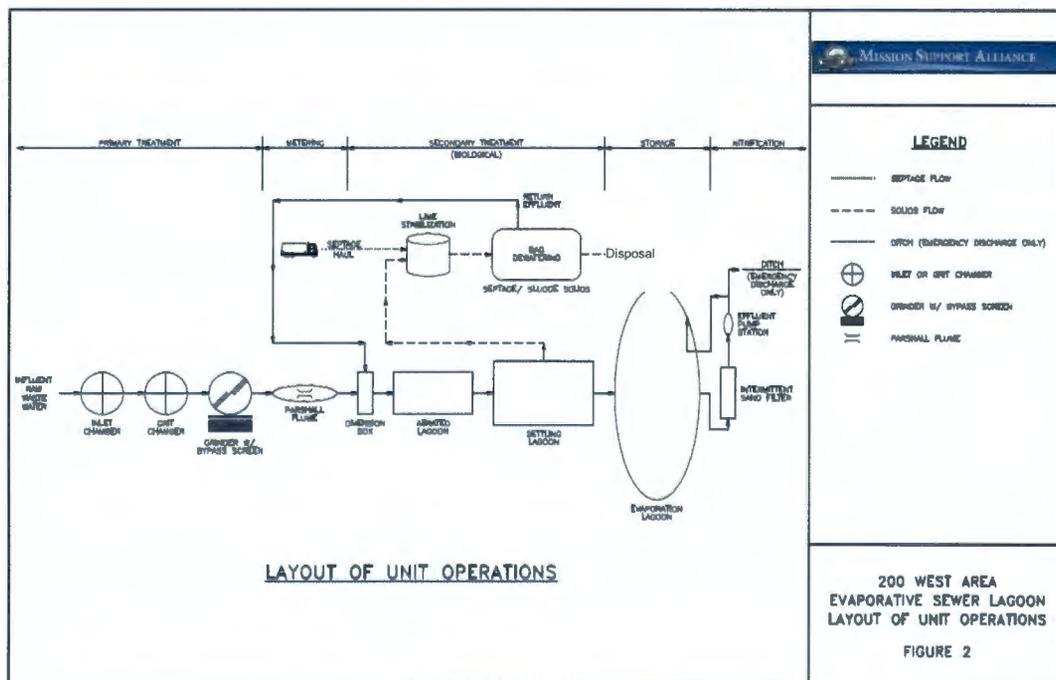
Sludge – solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sludge does not include grit and screenings generated during preliminary treatment of domestic sewage in a treatment works (WAC 173-308-080).

Domestic Wastewater – water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments or other places, together with the groundwater infiltration or surface waters that may be present (WAC 173-240-020). Wastewater is classified as domestic, and the term “domestic wastewater” and “wastewater” are used interchangeably in this document.

2.2 WASTEWATER TREATMENT & DISPOSAL

The plant consists of a Preliminary Treatment System, Lagoon Treatment System (LTS), Evaporative Lagoons, Intermittent Sand Filters (ISF), and Sludge Processing Facility (Figure 2-1). The LTS was designed to handle the higher load volume expected in the future of 55,000 gpd. It was designed to lower the expected amount of 105 milligrams per liter (mg/L) total suspended solids (TSS) and biological oxygen demand (BOD) to the State of Washington-recommended level of 65 mg/L, or approximately 40 percent removal in the effluent.

Initially, wastewater will be transported by trucks from the OSS or various holding tanks. This may be directly discharged into the LTS for treatment and sludge solids from the LTS may be stabilized at the Sludge Processing Facility. Residual solids will be dewatered prior to disposal. As-built drawings of the LTS are available online through the Hanford Document Control System.



**Figure 2-1
200 West Area Evaporative Sewer Lagoon Layout Of Unit Operations**

2.2.1 Preliminary Treatment System

The first stage of the treatment is the preliminary treatment system, which consists of the truck unloading station, inlet chamber, grit chamber, grinder chamber, flume metering manhole, and diversion box. The truck unloading station consists of a valved 4-inch diameter pipe for trucks to attach their discharge hose. The inlet chamber is simply a concrete vault used to move flow down the line. The grit chamber consists of a 6-foot diameter manhole with a formed sump in the bottom. The channel grinder is a 12-inch wide unit that macerates solids. A manually raked bar rack with approximately 1-inch clear space between the bars is mounted in a parallel channel to

be used when the grinder is off-line. The influent flow meter is a Palmer-Bowles flume with an 8-inch throat that is outfitted with an ultrasonic level detector to measure the liquid level and convert it into the flow rate passing through the flume. The last stop is the diversion box, which separates flow into the two lagoon trains using two slide gates. With the various units in the preliminary treatment system, debris is macerated and some solids are removed from the wastewater to protect the downstream treatment processes.

2.2.2 Lagoon Treatment System

The LTS is designed as a two-train system, and each train is designed to handle the maximum influent flow and to receive flow from the existing OSS and/or the future collection system planned at the 200 West Area. The designs for the system include unit operations necessary to achieve effluent quality of BOD and TSS in a cost-effective and reliable method, and afford simplicity in its operation. The LTS is designed with treatment options that are reliable yet operationally simple and stable with little need for frequent control of the process. All lagoons in the project are double-lined with high density polyethylene (HDPE) membranes 60-mil thick, and provide a watertight containment with minimum potential for migration of contaminants to facilitate ease of maintenance. The bottom liner is separated from the top liner by a leak-detection layer fitted with leak-detection pumps. The hydraulic design will accommodate variations in the hauled flows in the interim, and accommodate future flows from the sewer system, along with seasonal fluctuations.

The lagoons are paired, so Aerated Lagoon 1 is piped to Settling Lagoon 1, and Aerated Lagoon 2 is piped to Settling Lagoon 2. The flow split to each pair of lagoons is controlled by slide gates in the diversion box. The aerated lagoons are designed as a complete mix system where the solids are kept in suspension with aeration through the detention time, until biological stabilization is nearly complete. The aerated lagoons are a flow-through aeration basin without the recycle of solids. The effluent should contain about one-third to one-half the concentration of the influent BOD. Mechanical aerators provide most of the dissolved oxygen required for biomass and to mix lagoon contents. Turbulence levels would be high enough to ensure nearly uniform dissolved oxygen and suspended solids concentrations throughout the lagoons.

The average design flow (ADF) for the LTS is 55,000 gpd for the treatment of wastewater, which was determined after considering the planning period for 2010 through 2020. Each lagoon train was designed to handle the ADF. The hydraulic retention time of the aerated lagoon is 4.1 days at the design ADF for each lagoon. Treated effluent flows over the weir to the settling lagoon. Settling lagoons are designed for solids sedimentation, stabilization, and sludge storage within the basin itself. The settling lagoons are aerated to maintain an aerobic water column and aerobic layer at the top of sludge deposits on the floor of basin, which in turn, minimizes the feedback of reduced compounds from the sludge to water column, reduces odors, and reduces re-suspension of solids. However, the intensity will be low enough to permit the influent waste solids to settle as sludge. The hydraulic retention time of the settling lagoons is 4.1 days at the design ADF for each lagoon. The treated effluent flows over the weir to the evaporative lagoons.

**Table 2-1
Lagoon Treatment System Design Summary**

Aerated Lagoons	
Number of Lagoons	2 (redundant)
Volume, each	30,149 cubic feet
Hydraulic Detention Time at AADF, each	4.1 days
Water Depth	8.5 feet
Aerators, each	2 at 5HP, each
Leak Detection Pump	
Number of Pumps	1, per each Aeration and Settling Lagoon
Design Flow, each	25 gpm
Design Discharge Head, each	55 feet
Pump Motor	0.5 HP
Settling Lagoons	
Number of Lagoons	2 (redundant)
Volume, each	30,149 cubic feet
Hydraulic Detention Time at AADF, each	4.1 days
Water Depth	7 to 8 feet
Cells, each	3
Aerators, each	2 at 1 HP, each

Notes:
gpm = Gallons per Minute, HP = horsepower

2.2.3 Evaporative Lagoons

The evaporative lagoon consists of two cells (east and west cells) and is sized to provide a large enough surface area to enhance evaporative loss of effluents and flexibility in operation. The cells are double lined with HDPE membranes and designed to receive the effluent for storage and disposal by evaporation. The bottom liner is separated by a leak detection layer fitted with leak detection pumps. Aerators are installed to enhance algae control and reduce stagnation. If further control of algae is needed, water in the lagoons can be passed through the ISFs and filtered effluent can be returned back to the east or west cell.

The lagoon pump station at the divider wall of the cells is capable of exchanging water between the east and west lagoons, and delivering water to the ISFs, according to the position of the valves in the discharge box.

**Table 2-2
Evaporative Lagoons Design Summary**

Evaporative Lagoons	
Number of Lagoon Cells	2
Surface Area at Bottom of Freeboard, Lagoon 1 (West)	9.34 acres
Lagoon 2 (East)	4.65 acres
Maximum Water Depth, Lagoon 1 (West)	7 feet
Lagoon 2 (East)	7 feet
Aerators, Lagoon 1 (West)	3 at 25 HP
Lagoon 2 (East)	2 at 25 HP
Leak Detection Pump	
Number of Pumps	2, West 1, East
Design Flow, each	25 gpm
Design Discharge Head, each	55 feet
Pump Motor	0.5 HP
Lagoon Pump Station	
Number of Pumps	2 (1 duty, 1 standby)
Design Flow, each	100 gpm
Design Discharge Head, each	29 feet
Pump Motor	5 HP

Notes:

gpm = Gallons per Minute, HP = horsepower

The evaporative lagoons and other lagoons are designed to serve as a zero discharge system to the soil column except in emergency situations. Discharge from the evaporative lagoons will be avoided, except, in emergency situations when release of water becomes necessary to prevent impacts to human health, safety, and avoid damages due to failure of liner or potential overflow situations. Refer to Section 3.3.5 for the procedure to discharge to the surface ditch if an emergency arises.

2.2.4 Intermittent Sand Filters

The ISF pump station consists of two sand filters lined with a double-geomembrane liner and filled with sand over a gravel layer. Each filter is 80 feet by 40 feet with both a 6-inch and 8-inch polyvinyl chloride (PVC) underdrain to collect the effluent before discharging in emergency situations or returning it to the lagoons to help control algae. Effluent from the evaporative lagoons may be intermittently dosed to the ISFs by operating the Lagoon Pump Station. Together, the ISFs remove suspended solids and achieve nitrification before returning flow to the evaporative lagoons, which helps to control the algae level and improves the water quality.

If, in extremely wet years, the evaporative lagoons reach the high water level, emergency discharges may be necessary. Such discharges must be filtered through the ISFs prior to disposal in accordance with the State of Washington Waste Discharge Permit ST-0045514. The filtered effluent from the ISF is collected in the wet well for the sand filter pump station. The pumps in this station discharge the flow either to the evaporation lagoons or to the point of discharge, according to the position of the valves in the discharge box. The emergency discharge pipe has been capped to ensure that no accidental effluent will be released.

Table 2-3
Intermittent Sand Filters Design Summary

Sand Filter Pump Station	
Number of Pumps	2 (1 duty, 1 standby)
Design Flow, each	100 gpm
Design Discharge Head, each	24 feet

Sand Filter Pump Station	
Pump Motor	5 HP

Notes:

gpm = Gallons per Minute, HP = horsepower

2.3 SOLIDS TREATMENT AND DISPOSAL

Solids Treatment and Disposal, which occurs at the Sludge Processing Facility, will be handled through the MSA work control process at the time that solids treatment and disposal is necessary. The following description will be used in the planning process.

2.3.1 Solids Delivery

Sludge shall be stabilized with lime and dewatered prior to disposal. Sludge (solids separated from wastewater) in the aeration, settling, and evaporative lagoons shall be pumped out and trucked or pipe transferred to the Sludge Processing Facility. Trucked sludge will be off-loaded at a valve located on the outside of the building and flowed through a grinder and progressive cavity pump to the mixing tanks associated with the Lime Stabilization Unit (LSU).

**Table 2-4
Waste Solids Delivery Design Summary**

Sludge Feed Pump and Sludge Mixing Pumps	
Number of Pumps	1
Design Flow, each	100 gpm
Design Discharge Head, each	31 feet
Pump Motor	10 HP

Notes:

gpm = Gallons per Minute, HP = horsepower

2.3.2 Lime Stabilization Unit

Sludge shall be stabilized adequately (See Section 3.2.2) with lime to immobilize metallic ions, reduce odors, kill pathogens, and improve dewaterability prior to disposal. The LSU is designed with a liquid lime feed system, sludge mixing pump, static mixer, mixing tank, level instrumentation and pH instrumentation. Upon stabilization, the supernatant will be pumped off and sent to the head works of the LTS. The solids will be pumped to dewatering unit at the dewatering pad.

**Table 2-5
Lime Stabilization Unit Design Summary**

Lime Addition Pump	
Number of Pumps	1
Design Flow, each	0-10 gpm
Design Discharge Head, each	138 feet
Pump Motor	13 CFM
Supernatant Pump	
Number of Pumps	1
Design Flow, each	10 gpm
Design Discharge Head, each	85 feet
Pump Motor	13 CFM

Notes:

gpm = gallons per minute, CFM = cubic feet per minute

2.3.3 Dewatering Pad

Sludge will be pumped to geotextile bag on the dewatering pad. A polymer will be mixed with the sludge to promote dewatering. The polymer mixing skid with a water tote, polymer tote, static mixer, and polymer water pump skid, and other controls are located at the dewatering pad. Prior to discharge into the geotextile bags, polymer feed will be injected into the sludge pipeline from the LSU. The dewatered sludge is accumulated in the geotextile bags and the filtrate from the dewatered unit will be pumped to the diversion box located upstream of the plant. Bags will be transported to the Mixed Waste Disposal Trenches to dispose of the solids.

**Table 2-6
Dewatering Pad Design Summary**

Polymer Water Pump Skid	
Number of Pumps	1
Design Flow, each	10 gpm
Design Discharge Head, each	138 feet
Pump Motor	1.0 HP

Notes:

gpm = Gallons per Minute, HP = horsepower

2.4 CHEMICAL STORAGE, HANDLING AND FEEDING

Chemical feed systems for sludge stabilization waste and dewatering solids are located at the Sludge Processing Facility and Dewatering Pad. The chemical feed system consists of liquid lime and polymer transfer lines. Major components of the system also include chemical storage, calibrated feeding, and feed monitoring during the treatment process.

Liquid lime feed for stabilization includes an air-operated diaphragm pump, valves, lime solution tote with agitator, and other accessories compatible with pumping up to 50 percent solution of lime at a capacity of 0-10 gpm at 138 feet of total dynamic head. The polymer pump is assembled in a skid containing a polymer preparation system. The pump skid includes, but is not limited to, a polymer pump, mixing chamber, valves, flow meter, motors, and electric control panels.

2.5 COMPRESSED AIR SYSTEM

Compressed air will be used to power the liquid addition pump and supernatant pump. Air is provided to two air hose stations. The compressed air system consists of an air compressor with a reservoir tank, an air dryer, a pressure control valve, instrumentation, piping, and two hose reels.

For all compressed air system equipment and component manuals including installation, service, maintenance, and spare parts, see Appendix J. For information regarding either Supernatant Pump or Lime Addition Pump, see Appendix D.

Table 2-7
Compressed Air System Design Summary

Design Summary – Air Compressor	
Number of Compressors	1
Design Flow, each	13 CFM
Tank Size	80 Gal
Motor	7.5 HP

Notes:

CFM = cubic feet per minute, gpm = gallons per minute, HP = horsepower

2.6 WATER SYSTEM

The water system at the plant consists of a 3,000 gallon water storage tank which feeds the utility sink and three utility hose stations. The hose stations will be used to wash down the lime agitator and the mixing tanks post mixing. The safety shower has its own tank which holds approximately 140 gallons of water and should be checked and disinfected prior to Solids Handling campaign. For day to day lagoon operation a portable eye wash unit is in service in the bio-Solids Handling facility and has required routine maintenance completed.

Table 2-8. Water System Design Summary

Design Summary – Water Pump	
Number of Pumps	1
Design Flow, each	30 gpm
Design Discharge Head, each	125 feet
Pump Motor	1.5 HP

Notes:
gpm = gallons per minute, HP = horsepower

2.7 HVAC

The heating, ventilation, and air conditioning (HVAC) system for the Sludge Processing Facility, serves the process area, Electrical Room and Storage Room. The ventilation system will be used to keep lime and polymer areas cool and keep the pipes from freezing. The major components of the system are described below:

- Heating – The process area’s heating requirement is supplied by five electric unit heaters attached to the building’s steel structure around the process area’s perimeter. Each unit heater is controlled by an internal factory-installed thermostat device.
- Ventilation – Ventilation is provided by a sidewall exhaust fan mounted above the roll-up door in the north wall. Air is drawn into the space through two louver assemblies, complete with gravity backdraft dampers, mounted in the opposite building wall. The ventilation fan is controlled by wall-mounted thermostat.
- Air Conditioning – The electrical room’s additional cooling needs are met by a duct-free split system mounted on its north wall. This system consists of an outdoor condensing unit and an indoor, wall-mounted, fan coil unit connected by refrigerant lines. The system is controlled by a wall-mounted thermostat.

For all HVAC equipment and component manuals including installation and service, see Appendix K. For information about maintenance, see Appendix A.

3.0 SYSTEM OPERATION

3.1 START-UP PROCEDURE

These procedures should be used when the facility first opens up or after a shut down.

3.1.1 Preliminary Treatment

All chambers should be checked to ensure that no pipes are obstructed prior to starting the system. There should be flow to the system before turning on the grinder. Also, the flow meter should be turned on and set to the correct operating parameters (See Appendix L, Attachment L-1). At least one of the slide gates in the diversion box should also be open, so as not to cause a back-up within the system. At start-up, it is recommended that only one lagoon train be used until a more constant and larger flow is present. However, this is up to the wastewater operator's discretion. The grinder can then be turned on using the steps in Section 3.2.1 or Appendix G, Attachment G-1.

3.1.2 Lagoon Treatment System

The settling basins should be filled with raw water so that the aerators can be turned online using the motor starters to reduce odors once the water level in the lagoons reaches its maximum. After the aerators have been turned on, water flowing through the aerators should be visible from the shore. If not, turn off the aerators and follow the troubleshooting steps in Appendix H.

3.1.3 Evaporation Lagoon

The evaporation lagoons processes are dependent on the environment and require no wastewater operator interface. Therefore, no action is required at start up except ensuring that appropriate valves are opened to allow flow into the lagoon. Also, a minimum water level should be maintained at all times. The water should completely cover the bottom of the lagoon up to the slope on the shallowest end. If at least 5 feet of liquid depth is present in the evaporative lagoons, and the aerators have been deemed necessary (i.e. algae growth, promote evaporation), turn on the aerators in the same way as for the LTS.

3.1.4 Intermittent Sand Filters

As the ISF are used only sporadically, no start up procedures are necessary.

3.1.5 Lime Stabilization Unit

Start-up will be covered through the work control process. In addition, wastewater operators should ensure that lime slurry is in stock, so operation can begin when necessary. See Section 3.2.2 for operation of the Lime Stabilization Unit.

3.1.6 Dewatering Pad

The Dewatering process will also be handled through the MSA work control process. Ensure that prior to starting up the Solids Processing Facility, the geotextile bags and polymer are available and ready for use. Polymer should be ordered prior to the first dewatering. A sample of lime treated sludge should be sent to the manufacturer (See Appendix B for the shipping form) for analysis and determination of the appropriate polymer selection. Hook up the hoses to the bags. As unit does not operate continuously, no other operation is needed at the start-up of the facility. See Section 3.2.2 for the operation of the dewatering pad.

3.2 NORMAL OPERATING PROCEDURES

3.2.1 Wastewater

Preliminary Treatment

The grit chamber has no mechanical parts. Occasionally, the grit that settles in the bottom of the chamber will need to be removed. A vacuum truck will be used to remove the solids. Any personnel who enter the grit chamber must follow the protocol for confined space entry.

Flow through these systems is maintained by gravity. The truck unloading station uses quick release couplings, the activation of which merely involves using the appropriate hose and ensuring that it is connected securely prior to dumping. When operating in "auto" mode, the grinder pump will automatically activate during dumping. The grinder pump will shut off once

dumping is complete. When operating in “manual” mode, a wastewater operator must be present to ensure that the grinder pump is activated during the dumping. Once the dumping has been completed with the grinder in manual mode, the wastewater operator will turn the grinder pump off.

Manual operations for the channel grinder consist of the five steps listed below:

- Verify that there are no obstructions such as scrap metals, etc. in the cutting chamber.
- Check to see whether the correct indicator lights are illuminated. With the unit off, the amber "Power On" light and the green “Power Off” should both be illuminated.
- Turn the motor switch to the “ON” position.
- On the control panel, place the three position H-O-A switch in the Hand or Auto mode to begin the starting sequence. Once the motor begins the starting sequence, the green "OFF" light should go out and the red “RUN” pilot light should illuminate.
- See Appendix G for more information.

The flume metering manhole uses an Ultrasonic Flow Meter to measure the flow through the flume. Once the meter has been programmed (see Section 2 in the *4210 Ultrasonic Flow Meter Installation and Operation Guide* in Appendix L, Attachment L-1) and turned on, no further operation is required. The meter should remain on at all times. The monitoring system is capable of collecting data which can be printed out or downloaded to a laptop computer. This flow meter provides the reporting information related to the permitted design flow of the system.

At the diversion box there are two sluice/slide gates used to control the amount of flow in the LTS. If gates have not been used for some time, thoroughly clean stem threads and lubricate before use (see Appendix F, Attachment F-2 for details). To open or lift gates, turn hand wheel in the direction noted on the wheel and raise the gate to the level desired. To close the gate, simply turn the hand wheel in the reverse direction, until flow has stopped.

Lagoon Treatment System

System Operation for Performance

Because of the simplicity of this treatment plant design, there are few opportunities for the wastewater operator to control the plant’s performance. One of the most critical operational

decisions is whether to run one or two of the paired trains of lagoons. This decision needs to be based on the experience gained over time in operating the plant. Generally, the main cause of poor performance by a lagoon treatment system is the build-up of algae. The presence of algae will result in higher concentrations of TSS and BOD in the effluent, as compared to a system with minimal levels of algae. One way to reduce algae formation is to operate with only one of the two paired trains on-line. This will increase the turbidity in the lagoon and reduce the ability of algae to reproduce. Operating the aerators is another way to reduce the ability of algae to reproduce. Of course, the amount of wastewater being treated will affect the need to operate one or both of the paired trains of lagoons. As more flow is being treated, having both lagoons on-line may improve the treatment performance. Temperature is another parameter affecting the need to operate one or both of the paired trains of lagoons. In winter, when temperatures are cold and biological activity slows down, having both lagoons on-line may improve the treatment performance. The wastewater operator should consider these factors in selecting how many paired trains of lagoons to have on-line.

When there is low flow, such as when the facility first opens, it is recommended that only one lagoon train (i.e., one aeration and settling lagoon) be operational. However, it is the wastewater operator's decision when to open the second train, as they are both capable of handling maximum loading capacity.

Aeration Lagoons

Aerations lagoons will need to be kept to their designed water level at all times. The aerators should remain in operation any time influent is present in the lagoon in order to keep the contents from becoming anaerobic. Operation responsibilities include ensuring that aerators have power and a sufficient volume of liquid is flowing through them. Raw water may be supplied from the HDPE makeup water line as necessary. Aerators should be turned off any time the volume of liquid in the lagoon is less than 2.5 feet.

Settling Lagoons

Although the water levels in the settling lagoons are not required to be kept to their operational water level, it is recommended that the water remain high so the aerators do not remix the settled

solids. The aerators need a minimum of 2.5 feet of water so they will not rest on the liner. Raw water may be supplied from the HDPE makeup water line as necessary. Aerators in the settling lagoons should be operated most of the time to maintain an aerobic layer that reduces odor and algae growth. When conditions are favorable to keep odors at bay and reduce re-suspension of solids in the settling lagoon, the wastewater operator may choose to turn off the aerators.

Removing solids from the settling lagoons is important to achieving good performance from the treatment plant. If the solids blanket in the settling lagoons becomes too deep, then solids will carry over from the lagoon into the effluent. In this case, removing the solids will restore the performance of the lagoon system.

Evaporative Lagoons

The evaporative lagoon requires no daily operation. However, a minimum water level should be maintained at all times. Water should be added directly to the evaporative lagoons when necessary. This is to ensure linear stability and prevent liner uplift. Raw water may be supplied from the HDPE makeup water line as necessary. A liquid depth of 5 feet in the lagoon is sufficient to start the aerators. The aerators assist in controlling algae growth and help promote evaporation. It is the wastewater operator's decision on when and how long to turn on the aerators. The wastewater operator should also analyze the lagoon levels to determine whether an overflow situation is imminent. See Figure 3-1 and Table 3-1 to assist in this decision.

Intermittent Sand Filters (ISF)

The ISFs are to be used in emergency discharge situations (See Section 3.3) or to remove excess algae from the evaporative lagoons. See Section 3.3.5 for how to operate the pumps. Use of the ISFs is one of the few process control decisions the wastewater operator must make for this treatment plant. If the contents of the evaporation lagoons contain excessive levels of solids or algae, then operation of the ISFs should be initiated and the filtered flow returned to the evaporation lagoons. By operating the ISFs, the solids will be trapped on the surface of the filters and removed from the lagoons. Effluent from the evaporation lagoons should run through both sand filters in several intervals throughout the day for a maximum of 36,730 gpd for each sand

filter or a total of 73,460 gpd. In order to not exceed the 36,730 gpd limit, the effluent pump from the evaporative lagoon pump vault should not be run for more than 6 hours per day through each sand filter. The wastewater operator will need to rake the sand on the top of the filters from time-to-time to keep them free of weeds. If the filters are used regularly, then it may be necessary to rake the sand on the top of the filters to break up any crust that forms over the sand. After extended use, it will be necessary to scrape the top layer off of the filters to remove the solids that have collected. If some of the sand is removed during scraping, this will need to be replaced with fresh filter sand. Solids scraped from the filter should be disposed of as directed by the Environmental Compliance Officer (ECO).

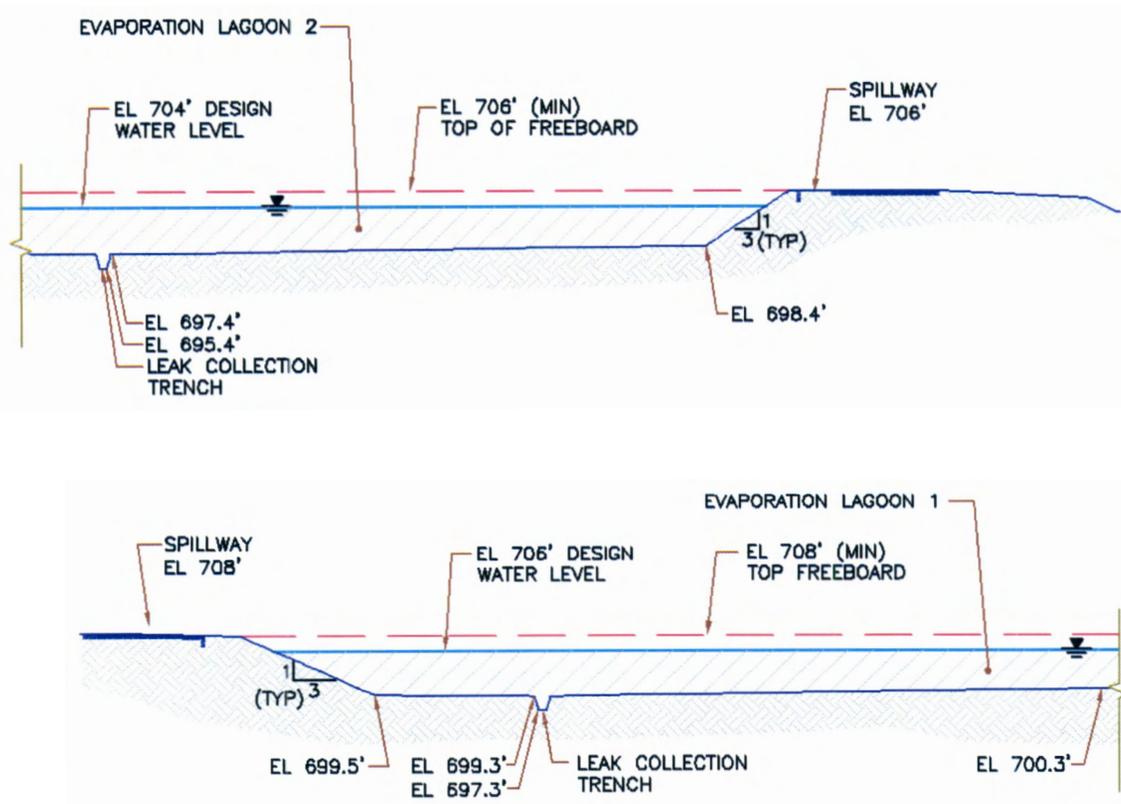


Figure 3-1
Cross Sections of the Evaporative Lagoons

**Table 3-1
Evaporation Lagoon Volume Levels**

Evaporation Lagoon 1 (west)				Evaporation Lagoon 2 (east)				Combined Lagoons		
Elevation (feet)	Area ¹ (square feet)	Volume (cubic feet)	Volume (gallons)	Elevation (feet)	Area ¹ (square feet)	Volume (cubic feet)	Volume (gallons)	Area ¹ (square feet)	Volume (cubic feet)	Volume (gallons)
699 ²	~ 0	~ 0	~ 0	697 ³	~ 0	~ 0	~ 0	~ 0	~ 0	~ 0
700	46,966	23,483	175,653	698	30,357	15,179	113,535	77,323	38,662	289,188
701	158,653	126,293	944,668	699	88,838	74,776	559,324	247,491	201,069	1,503,992
702	295,891	353,565	2,644,662	700	149,850	194,120	1,452,018	445,741	547,685	4,096,680
703	383,301	693,161	5,184,841	701	181,447	359,769	2,691,068	564,748	1,052,929	7,875,909
704	391,031	1,080,327	8,080,842	702	186,614	543,799	4,067,617	577,645	1,624,126	12,148,459
705	398,817	1,475,251	11,034,874	703	191,835	733,024	5,483,016	590,652	2,208,274	16,517,890
706 ⁴	406,654	1,877,986	14,047,335	704 ⁴	202,452	930,167	6,957,649	609,106	2,808,153	21,004,984
707	414,553	2,288,590	17,118,649	705	207,838	1,135,312	8,492,134	622,391	3,423,902	25,610,783
708 ⁵	422,507	2,707,120	20,249,254	706 ⁵	213,290	1,345,876	10,067,152	635,797	4,052,996	30,316,406

Notes:

¹ The area is the area at the water surface at the elevation indicated.

² Low point of West Lagoon

³ Low point of East Lagoon

⁴ Design water line elevation, bottom of 2 ft. freeboard.

⁵ Maximum water elevation, top of 2 ft freeboard (spillway).

Source: Water Balance Model Report by Robert Yager.

3.2.2 Solids Processing

Solids Treatment and Disposal will be handled through the work control process at the time that solids treatment and disposal is necessary. The following description will be used in the planning process.

Solids Delivery

Sludge can be delivered to the Sludge Processing Facility two ways: the truck unloading station and the flump connections. The truck unloading station should be used to unload sludge from the vacuum service trucks. The truck unloading station uses quick release couplings, which merely involve using the correct hose and ensuring that it is connected securely. Sludge from the lagoon system will be processed as necessary when it is removed from the settling lagoon or the evaporative lagoon. Sludge may come through the truck unloading station or the flump connections, located near the settling lagoons. If a flump is used, a pump with a capacity for approximately 300 gpm at 1190 feet will need to be utilized. A wastewater operator shall be present at the Sludge Processing Facility for this operation to ensure that following steps are followed:

- Determine which mixing tank will be used.
- Ensure that valve STS-V-015 is open and valves STS-V-018 and STS-V-027 are closed. Also, ensure that all drain valves (STS-V-012, -014, -019, -028, -024, -033, -021,-030) are closed.
- Align valves along pipe runs STS-SL-203/204 as noted below:
 - Transfer to Mixing Tank 1; Open valve STS-V-016 and Close valve STS-V-015.
 - Transfer to Mixing Tank 2; Open valve STS-V-015 and Close valve STS-V-016.
- Connect the hose from the truck to the quick-disconnect coupling outside of the building, and open valve STS-V-011.
- Manually start the grinder (STS-GRD-001), which is also interlocked to the sludge feed pump (STS-P-001). Manually start STS-P-001 to begin transfer of sludge to the selected mixing tank. Monitor the water level gauge as pumping proceeds.
- Manually stop the grinder/sludge feed pump once septic tanker truck is emptied. Do not allow the pump to run dry for more than two or three minutes.
- Close valves STS-V-015 and STS-V-011.

Lime Stabilization

Lime stabilization should begin once the tanks are full or if the wastewater operator decides lime stabilization is necessary, sooner. Safety information regarding the dangers of working with and around lime is provided in Appendix O, the Material Safety and Data Sheets (MSDS), Attachment O-1. Proper procedures for lime stabilization are indicated below:

- Place the vendor-supplied lime totes in the containment dike, place the lime tote agitator apparatus on top of tank, and manually start the agitator to mix lime solution. Hook-up the flexible hose connection to the tote. Ensure that valves STS-V-075, STS-V-077 are open, drain valve STS-V-074 is closed, and sample port valve STS-V-078 is closed.
- Open valve for pH probe insertion and insert pH probe per procedure. The pH probes are designed to last up to 1 year. If the probe cannot be calibrated prior to use, it should be disposed of in a waste receptacle.
- Align valves for mixing sludge in pipe runs STS-SL-209/210 or 206/207 as noted below:
 - If mixing sludge in Mixing Tank 1: Open valves STS-V-018, STS-V-022, STS-V-023 and close valve STS-V-025, STS-V-021, and STS-V-019.
 - If mixing sludge in Mixing Tank 2: Open valves STS-V-027, STS-V-031, STS-V-032 and close valve STS-V-034, STS-V-030, and STS-V-028.
- Manually start sludge mixing pump (STS-P-002) if using Mixing Tank 1 or manually start sludge mixing pump (STS-P-003) if using Mixing Tank 2.
- Prepare to add lime to static mixer by the following procedure:
 - If adding lime solution to Mixing Tank 1, open STS-V-079 and STS-V-112 and close STS-V-080.
 - If adding lime solution to Mixing Tank 2, open STS-V-080 and STS-V-113 and close STS-V-079.
- Ensure that air valve AIR-V-110 is closed. Connect air-operated lime addition pump (STS-P-004) to the air line, ensure that the air compressor is operating and has pressure, and open air valve AIR-V-110 and AIR-V-108 to start pumping lime to the static mixer.
- Monitor pH of the circulated sludge until a pH of 12 is reached. Record the time it takes the batch to reach a pH of 12 or above on the Lime Stabilization Batch Form (Appendix B).
- Stop or slow the addition of lime by adjusting air valve AIR-V-110. Monitor pH reading to ensure that a pH of 12 is held for at least 30 minutes. If the pH reading falls below 12, then open air valve AIR-V-110 to add additional lime. If pH holds at or above a pH of 12 for at least 30 minutes, then turn off sludge mixing pump.
- Record the time the batch mixing is stopped.
- Turn off the lime addition pump, air compressor, and agitator, and close the remaining valves. Rinse the agitator off with the hose RWS-H-010 before storing it. Open RWS-V-090

to allow flow to the hose and turn on raw water pump (RWS-SKD-001). Turn off pump and close valve when finished.

- Remove the pH sensor from pipe and clean with water prior to storing. The sensor will be stored in tap water or 4 pH buffer solution if storing overnight or if longer stored with a protective cap containing potassium chloride (KCl) solution.

It is important to let the sludge settle and decant the water, so that a large amount of high pH wastewater does not enter the aeration basin and disrupt the biological processes taking place. However, the operator decides whether the sludge is allowed time to settle and water is decanted. An alternative is to close the valve SWS-V-006 at the dewatering pad and dilute the water before allowing the wastewater to flow to the lagoon system. Use the following procedure to decant sludge:

- Allow lime-mixed sludge to settle, typically overnight. Open the top inspection port of tank and measure the depth of water above the lime-stabilized sludge that has risen to the top. Utilize the top of the inspection port as a reference to document the measured depth.
- Prepare to utilize the supernatant pump (SWS-P-001). Ensure that valves STS-V-073 and STS-V-071 are opened.
- Ensure that air valve AIR-V-106 is closed and AIR-V-104 is open. Connect the air-operated supernatant pump to the air line. Insert the suction hose of the supernatant pump (SWS-P-001) through the inspection port to a depth that is slightly less than measured above to ensure that only water is pumped via the supernatant pump. Slowly open air valve AIR-V-106 and pump-off the supernatant to the underground HDPE pipe through the collection manhole, and ultimately to the evaporative lagoon. Close air valve AIR-V-106 when water has been decanted and slowly remove the suction hose from tank.
- Once water has been decanted from the lime-stabilized sludge, prepare to receive the sludge at the Dewatering Station by preparing the polymer feed system and filter bags.

Dewatering

Once sludge has set and been decanted, remaining sludge will be pumped to the dewatering pad. Two wastewater operators are required: one to run the pump in the Sludge Processing Facility and one at the dewatering pad. The following procedures should be followed:

- Ensure that a filter bag is connected to at least one of the flexible hoses (STS-H-004 or STS-H-018) and ensure that line STS-SL-208 is connected to the static mixer via flexible connection STS-H-003. Open valves STS-V-036 and STS-V-039, and close drain valve STS-V-040. Open either valve STS-V-038 or STS-V-117 as required to feed the filter bag.

- Prepare polymer feed system by connecting a water tote to the polymer water pump skid using the flexible connection RWS-H-008. Connect a polymer tote to the polymer mixing skid using the flexible connection STS-H-007, and connect the polymer addition system to line STS-P-801 via flexible connection STS-H-005.

Note: polymer has a 1-year shelf-life.

- Open water valve RWS-V-121 and open polymer valves STS-V-092 and STS-V-094. Ensure that drain valve STS-V-093 is closed.

Note: Ensure that the de-watering sump pump (SWS-P-002) is operable. The wastewater operator may wish to close valve SWS-V-006 if the pH reading is required prior to sending lime treated water to the aeration lagoons.

- Once the dewatering station is arranged as noted above, then the transfer process can be prepared for transfer of lime-treated sludge.
- Align valves along pipe runs STS-SL-209/211/208 or STS-SL-206/208 as noted below:
 - To transfer from Mixing Tank 1: Valve STS-V-018 should already be opened. Close valve STS-V-022 and open valve STS-V-025 and STS-V-026.
 - To transfer from Mixing Tank 2: Valve STS-V-027 should already be open. Close valve STS-031 and open valve STS-V-034 and STS-V-035.
- Manually start sludge mixing pump either STS-P-002 (for Mixing Tank 1 transfer) or STS-P-003 (for Mixing Tank 2 transfer), whichever pump was used to previously mix the sludge) to transfer lime-treated sludge to dewatering station and manually start polymer mixing skid pump to inject polymer into the static mixer.
- Monitor the discharge of the treated-sludge at the dewatering facility and check to ensure that the drained water does not overflow the containment dike. Monitor the level gauge associated with the tank being pumped and turn-off sludge mixing pump once the tank is emptied. At this point, the process is now complete. Sludge should dewater and room will be left to fill next time.
- Once the geotextile bag is sufficiently full, wastewater operator should arrange for the bag to be disposed of properly.

Cleaning

After all sludge has been removed, clean the mixing tanks and lime-addition piping. The following procedure should be followed:

- Attach the raw water hose from Hose Utility Station #1 to valve STS-V-012.
- Open up valve STS-V-011, STS-V-012, STS-V-015.
 - If transferring to Mixing Tank 1, open STS-V-016 and close STS-V-017.
 - If transferring to Mixing Tank 2, open STS-V-017 and close STS-V-016.

- Start the grinder (STS-GRD-001)/sludge feed pump (STS-P-001), and raw water pump (RWS-SKD-001) to start flow through the system. Allow water to flow until mixing tank is full.
- Manually stop the grinder/sludge feed pump, and raw water pump.
- Shut valves STS-V-011 and STS-V-012
- Ensure that valve STS-V-036 at the dewatering pad is open.
- Attached the portable water tank to hose STS-H-0012 to rinse out lime-addition piping.
- Prepare to rinse out lime addition system by following the procedure below:
 - If rinsing out Mixing Tank 1, open STS-V-079 and STS-V-112 and close STS-V-080.
 - If rinsing out Mixing Tank 2, open STS-V-080 and STS-V-113 and close STS-V-079.
- Start rinsing out the mixing tank piping by following the below procedures;
 - Mixing Tank 1: Open valves STS-V-018, STS-V-022, and STS-V-023. Close STS-V-025 and clean out valves STS-V-019, STS-V-021, and STS-V-024.
 - Mixing Tank 2: Open valves STS-V-027, -031, and -032 and close STS-V-034 and clean out valves STS-V-028, STS-V-030 and STS-V-033.
- Start the sludge mixing pump (STS-P-002 for Mixing Tank 1 or STS-P-003 for Mixing Tank 2).
- Ensure that air valve AIR-V-110 is closed. Connect air-operated lime addition pump (STS-P-004) to the air line; ensure that the air compressor is operating and has pressure prior to operating the pump. Open air valve AIR-V-110 and AIR-V-108 to start pumping the water through the system.
- Allow water to flow through mixing tank piping and lime addition piping for a minimum of five minutes.
- Open valves to allow flow to head to the dewatering pad.
 - For Mixing Tank 1: Open valves STS-V-025 and -026 and close STS-V-025 and -035.
 - For Mixing Tank 2: Open valves STS-V-034 and -035 and close STS-V-026 and -031.
- Shut down the water flowing through the lime-addition system. Close the valves associated with the system.
- Turn off sludge mixing pump once there is no longer water in the tank.
- Shut all valves and re-attach hose STS-H-003 at the dewatering pad to prepare for the next dewatering process.
- Polymer skid pump, chamber and associated piping should be flushed after each use.

3.2.3 Electrical System

Normal operation for the electrical system consists of using switches and electricity to power motors and pumps. If a problem arises, the electrical system should be inspected and/or repaired by a qualified electrician.

3.2.4 Alarm System

Alarm systems are located in the building to warn when there is high sludge level in the mixing tanks or the raw water tank. All flow to these tanks should be shut off at this point. Then the alarms must be shut off manually using the labeled button.

3.3 EMERGENCY OPERATIONS AND RESPONSES

3.3.1 Power Outage

A power outage should not stop the flow of influent in the system since the LTS is driven by gravity. However, the grinder and aerators will be stopped in the event of a power outage. If this is a localized event, the bypass through the bar gate should be utilized to keep the influent from backing up. The flow meter has battery backup, so it should continue to run through the power outage. The battery will last for up to 7 days, so should be used as little as possible.

With the aerators off, the system will be less effective and may result in unacceptable odors. As no mixing occurs in the aeration basin, flocculation will not result. Therefore, more solids may pass into the settling basin and evaporation basin. This should not be a problem, as long as the power is restored within a short-period of time. As for the odor, if the power is out longer than 24 hours, temporary power should be brought in to return the system to normal operation.

If the power goes out while sludge is being lime-stabilized, the mixing process will need to start over again until a pH of 12 has been held for 30 minutes or more. Pumps should be turned off until power returns. If a power outage occurs while the polymer is being mixed, the pumps should be shut off and operations can resume once power is restored.

3.3.2 Earthquakes

After an earthquake, all systems should be checked for leaks and damage. The liquid levels in each of the lagoons should be checked for several days afterward along with the leak detection pumps to detect whether the liners have been damaged. If a leak is detected, the lagoon should be emptied and repaired by a knowledgeable contractor.

3.3.3 Collection System Leak

If a leak is detected within the preliminary treatment system piping or a secondary liner, the flow should be stopped to that part of the system and diverted if possible. If one of the lagoons is determined to have a leak, then the other train or evaporative lagoon should be used. The affected portion of the system should be emptied and then repaired by a knowledgeable contractor.

3.3.4 Evaporation Lagoon Overtopping

To prevent evaporative lagoon overtopping, an emergency discharge should take place when the water depth is less than 2 feet from the spillway, as this is the limit of the freeboard depth. If the evaporation lagoon does overtop, a report in accordance with Permit ST-0045514 will be filed with the Department of Ecology. After an overtopping event occurs, the earth around the lagoons will be checked for erosion or other signs of damage, and emergency clean-up will be implemented.

3.3.5 Emergency Discharge to Ditch

An emergency situation occurs when release of water becomes necessary to prevent impacts to human health, to alleviate safety risks, to avoid damages due to liner failure, and/or to prevent potential overflow situations. A potential overflow of the evaporative lagoons is considered anything over the freeboard depth, which is 2 feet below the spillway (Figure 3-1).

If an emergency discharge is determined necessary, the following procedures apply:

- Contact Department of Ecology for sampling requirements

- Remove Discharge Cap
- Open up the valves to allow flow into the Lagoon Pump Station and then onward to the ISF.
- Start the pump once it is submerged.
- Before turning on the pumps at the Sand Filter Pump Station, ensure that the valves are open for the direction to send the flow to the ditch and that there is water in the manholes.
- Watch the initial flow onto the filter to verify that the flow evenly covers the filter. When releasing to the ditch, measure the effluent flow from the evaporation lagoon to the ditch.
- Measure discharge flow using portable flow meter or best management practice.
- Make appropriate notifications according to State Waste Discharge Permit ST-0045514

4.0 MONITORING AND REPORTING

4.1 FLOW MONITORING

Monitoring of the wastewater influent and wastewater effluent is required under Permit ST-0045514. Discharge flow of domestic wastewater to the double-lined evaporation lagoons is limited to 55,000 gpd. The wastewater influent flow meter is located in the flow metering manhole (Figure 4-1) and the specifications are located in Appendix L, Attachment L-1.

In case of an emergency, measure the flow from the evaporative lagoon(s) at the location noted in Figure 4-3. This pipe has been capped to ensure that no accidental effluent will be released unless in an emergency.

4.2 EVAPORATIVE LAGOON DEPTH, SLUDGE MONITORING, AND LEAKED WATER MONITORING

The evaporative lagoon water depth will be measured monthly and the sludge depth will be measured once per permit cycle per Permit ST-0045514. A measuring device will be used to estimate the lagoon water depth at a constant location (Figures 4-1 and 4-2). Calculations should be used to convert the slope measurement to a vertical depth measurement. Calculations are found in Figures 4-4 and 4-5. A sludge measurement device will be used to estimate the lagoon sludge depth at a location accessible by the operator. Sludge measurements should be taken in the same general area of the lagoon each time measurements are taken (See Figure 4-2).

The leakage between the primary and secondary liners will be monitored for each of the lagoons. A baseline leakage volume was established at startup, as some minor collection of leakage between the two liners is expected. Any leakage between the liners flows to a centralized sump and is pumped back into the same lagoon via a slopesider sump pump. Each sump pump has a flow meter. This system essentially reduces the head on the secondary liner to a minimum, so as to not allow any head to promote flow through any potential opening in the secondary liner. Volume of leaked water which is pumped out of each lagoon will be recorded to monitor leak rates. Once the total recovered leakage reaches the action rates shown in Table 4-1, the

wastewater operator will be required to document the need for necessary repairs to the primary liner.

**Table 4-1
Action Leak Rates for Each Lagoon**

Location	Action Leak Rate (gallons/acre/day)	Linear Surface Area (acre)	Action Leak Rate (gallons/day)
Aeration Lagoons	250	0.23	60
Settling Lagoons	250	0.19	50
Evaporation Lagoon 1 (West)	500	12.04	6020
Evaporation Lagoon 2 (East)	500	5.49	2800

4.3 SAMPLING AND ANALYSIS

Per Non-Radioactive Air Emissions Notice of Construction Approval Order Conditions and Restrictions DE12NWP-001, a baseline assessment was conducted within 90 days of commencement of operations of the facility for each of the three applicable Toxic Air Pollutants (TAP) listed in Table 4-2 (ammonia, chloroform, and 1,4-dichlorobenzene). Sampling and analysis for Table 4-2 pollutants in the influent stream will be in accordance with an EPA approved method from 40 CFR Part 136. Refer to Section 5.0 of this O&M Manual for the complete Sampling and Analysis Plan.

**Table 4-2
200 Area Lagoon Sampling Requirements for Air Emissions**

Parameter	Units	Minimum Sampling Frequency	Concentration
(1) Wastewater Influent			
Sample the wastewater entering the Truck Unloading Chamber or Inlet Chamber, when system is online, excluding any side-stream returns from inside the plant.			
Ammonia	mg/L	Annual	52,400
Chloroform	µg/L	Annual	12,400,000
1,4-dichlorobenzene	µg/L	Annual	2,650,00

All laboratory analyses will be done at a state-certified analytical laboratory. The required parameters and frequency of measurement are shown in Table 4-3 for Permit No. ST0045514.

Locations of sampling are shown in Figure 4-1 and Figure 4-3. In emergency discharge situations, it is also required to sample the effluent for pH, BOD₅, and total suspended solids (TSS) (Figure 4-3). Testing and reporting requirements regarding the parameters, format, and frequency of measurement are specified by the Department of Ecology as part of Permit ST-0045514 for wastewater. Refer to Section 5.0 of this O&M Manual for an example Sampling and Analysis Plan.

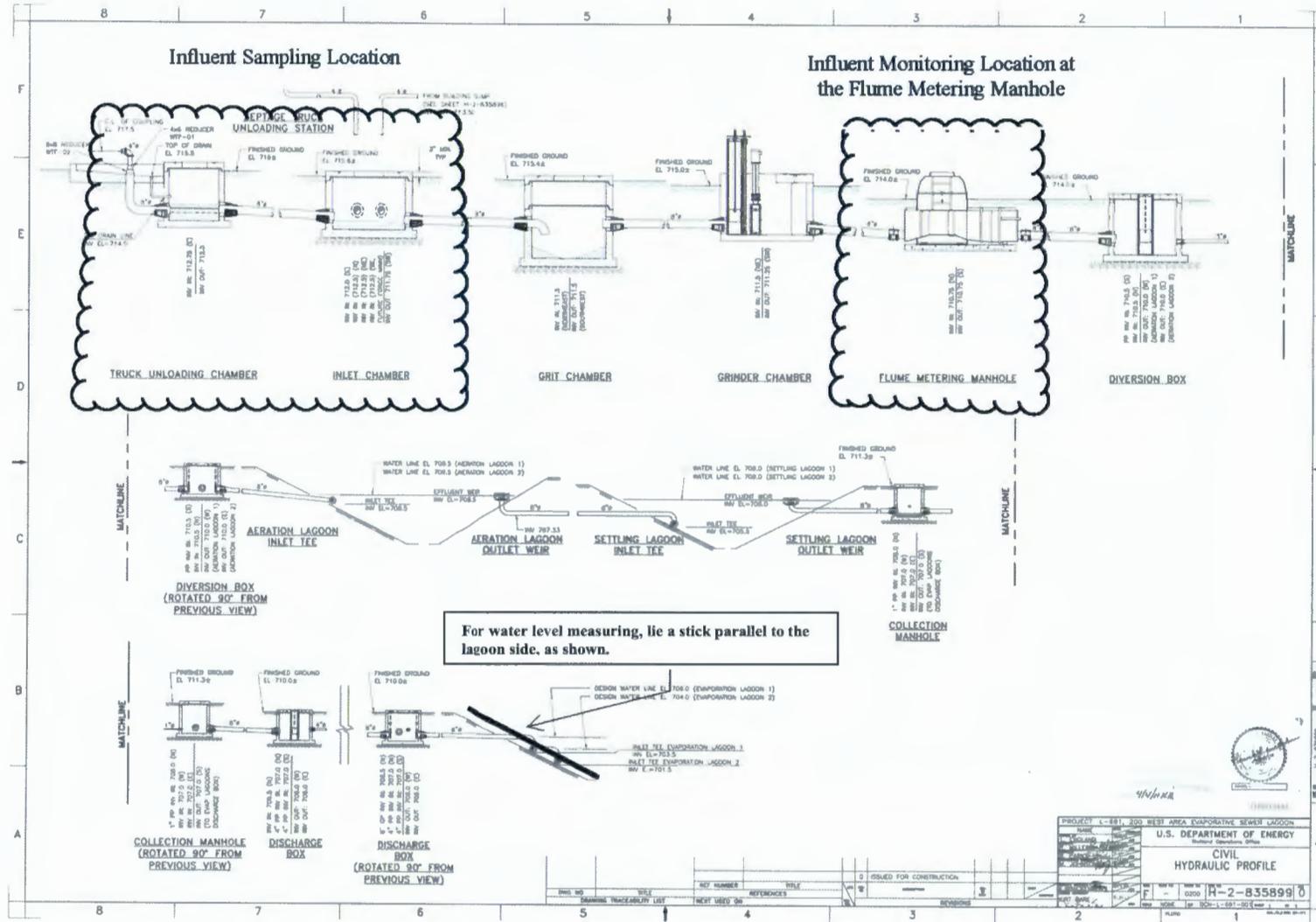


Figure 4-1
Influent Monitoring Location Measuring

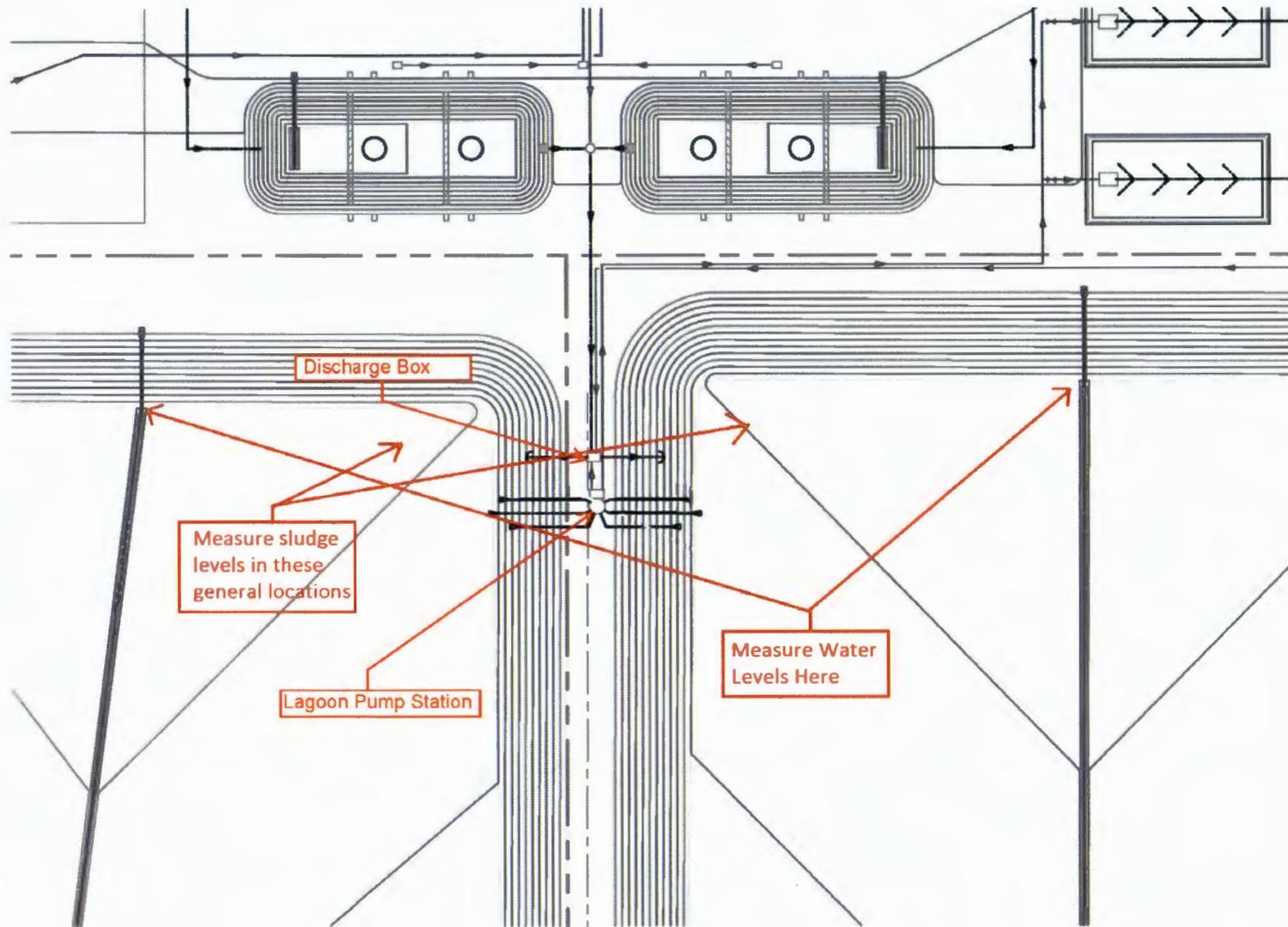


Figure 4-2
Water and Sludge Measuring Locations Plan View

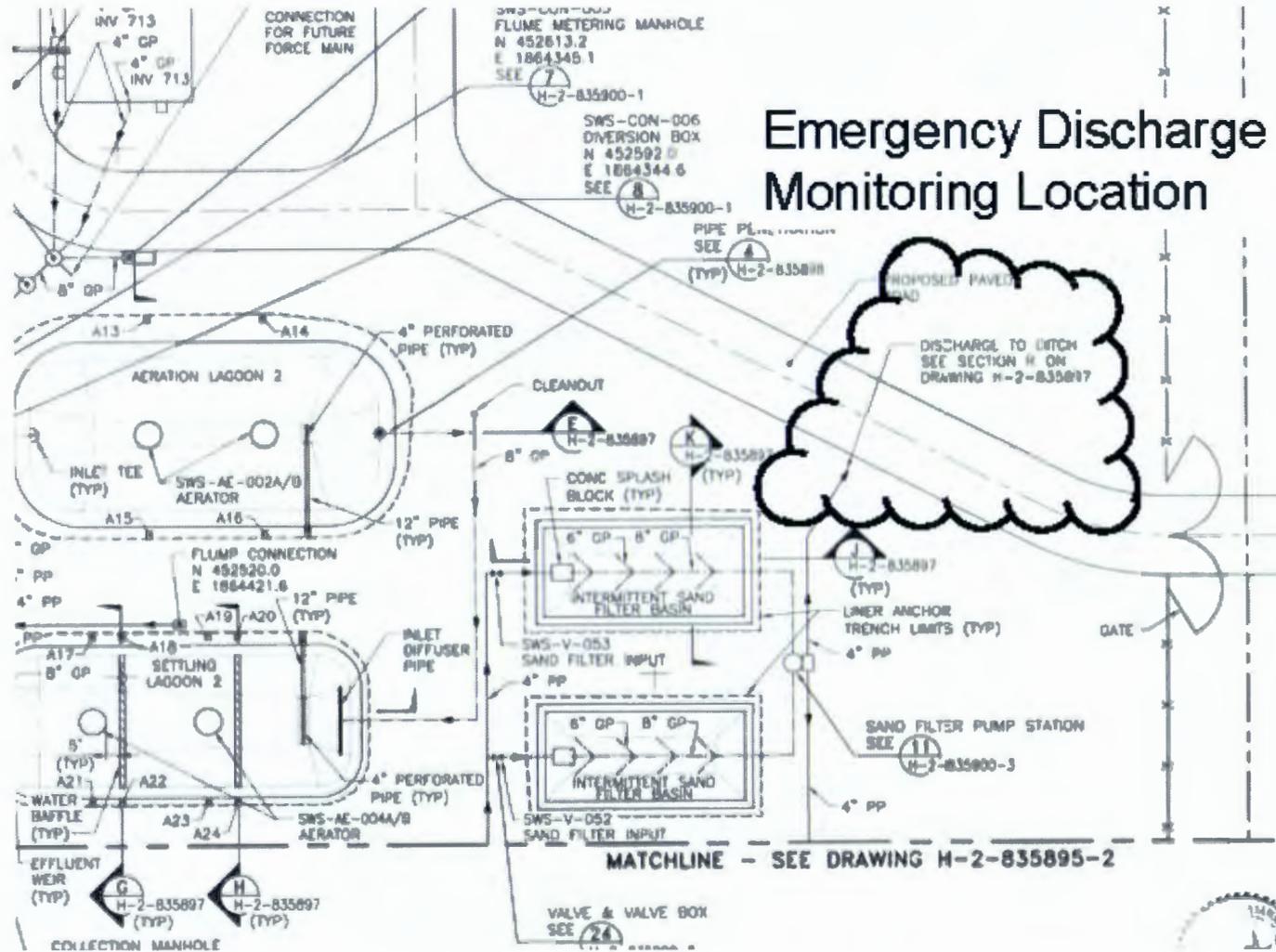
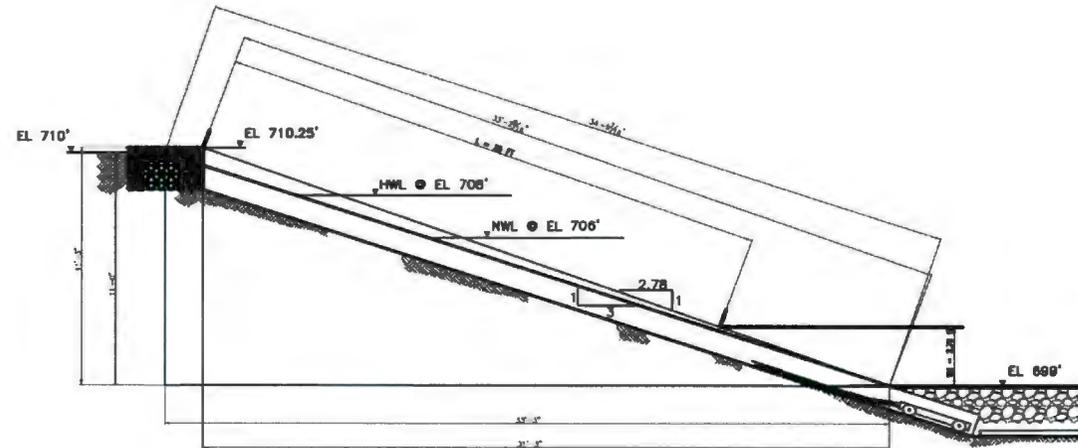


Figure 4-3
Emergency Discharge Monitoring Location



EVAPORATIVE LAGOON NO. 1

$$\text{DEPTH OF WATER} = [\text{TOP BANK EL} - \text{BOTTOM LAGOON EL}] - 0.3387 * L$$

$$Dw = [11.25'] - 0.3387 * L$$

Example: Given L = 25 ft

$$Dw = 11.25 - 0.3387 (25) = 2.78 \text{ ft}$$

Figure 4-4
Water Depth Calculation for Evaporative Lagoon No. 1

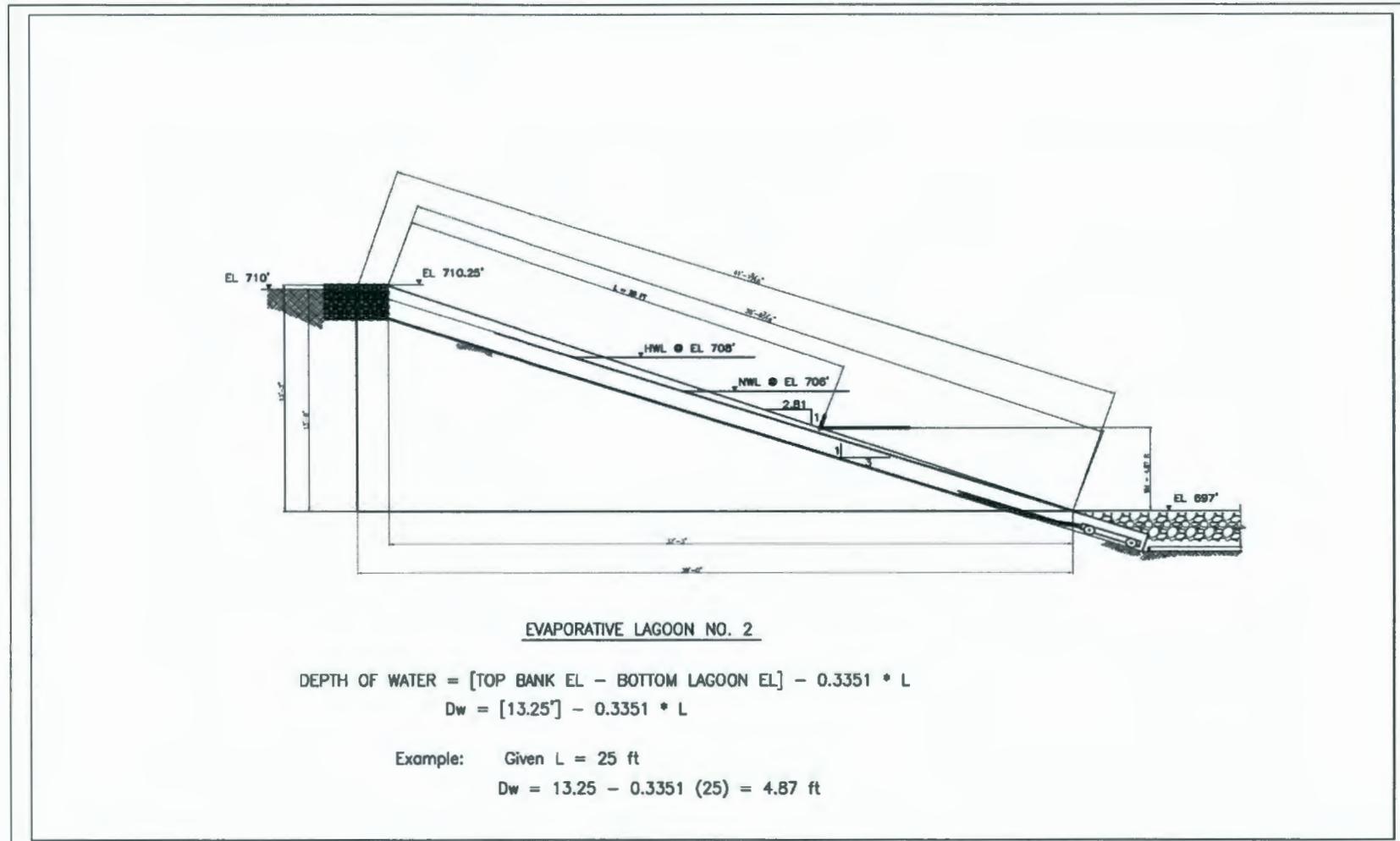


Figure 4-5
Water Depth Calculation for Evaporative Lagoon No. 2

**Table 4-3
200 Area Lagoon Sampling Requirements for Wastewater Permit**

Parameter	Units	Sample Location	Minimum Sampling Frequency	Sample Type
(1) Wastewater Influent				
Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.				
Flow	55,000 gpd	Flume Metering Manhole	Continuous ^a	Metered/Recorded
Biochemical Oxygen Demand (BOD ₅)	mg/L	Truck Unloading Chamber	4/year ^b	8-Hour Composite ^c
BOD ₅	lbs/day ^d	NA	4/year ^b	Calculated ^e
Total Suspended Solids (TSS)	mg/L	Truck Unloading Chamber	4/year ^b	8-Hour Composite ^c
TSS	lbs/day ^d	NA	4/year ^b	Calculated ^e
(2) Final Wastewater Effluent				
Final Wastewater Effluent means wastewater which is exiting, or has exited, the last treatment process or operation.				
Evaporative Lagoon Water Depth	0.1 ft	Each Lagoon	Monthly	Measured
Evaporative Lagoon Sludge Depth	0.1 inches	Each Lagoon	1/Permit Cycle	Measured
Leaked Water ^f	Yes/No	Each Lagoon	Daily, if present	Measured
Volume of Leaked Water	gallons/day	Each Lagoon	Weekly, or as measured when pumped	Measured

Notes:

- a Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Flow must be measured hourly during influent flows when continuous monitoring is not possible.
 - b 4/Year means 4 times per year in the specified months (February, May, August, and November). The Permittee must report data on the monthly discharge monitoring report.
 - c 8-hour composite means a manual composite collected over an 8 hour period. The composite shall be composed of at least four separate grab samples of equal volume, collected at two to three hour intervals during a normal work day which is at least 8 hours long. All attempts should be made to keep sample timing and methodology consistent over all sample events.
 - d lbs/day = Concentration (mg/L) x Flow (in MGD) x 8.34
 - e Calculated means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day
 - f If leaked water is observed report yes, if not report no.
- gpd = gallons per day
mg/l = milligrams per liter

4.4 REPORTING

Any notifications and submittals required under NOC Order DE12NWP-001 (air permit) are to be submitted to the State of Washington, Department of Ecology at:

Washington State Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, WA 99354

Results of wastewater sampling conducted pursuant to the NOC Order DE12NWP-001 shall be submitted to Ecology within 90 days of completion of validated laboratory analysis results of such assessment.

Wastewater operation reports for the facility are to be submitted to State of Washington, Department of Ecology at:

Water Quality Permit Coordinator
Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, WA 99354

Or for electronic reporting submit to the below web page.
<https://fortress.wa.gov/ecy/publications/summarypages/1110013.html>

Table 4-4 presents a condensed list of reports required to be sent to the Department of Ecology, and the schedule at which they should be sent. See Permit ST-0045514 and DE12NWP-001, Revision 1 for complete set of applicable reports.

**Table 4-4
Monitoring and Reporting Requirements**

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Flow/Discharge Monitoring Report	Quarterly	15 October 2012
S3.A	Lagoon Sludge Depth	1/permit cycle	30 June 2017
S3.E	Reporting Permit Violations	As necessary	
S4.E	Wasteload Assessment	1/permit cycle	30 June 2017
S5.G	Operations and Maintenance Manual	1/permit cycle	1 September 2012
S5.G	Operations and Maintenance Manual Update or Review Confirmation Letter	Annually	1 September
S7	Application for Permit renewal	1/permit cycle	30 April 2017

5.0 FIELD SAMPLING AND ANALYSIS PLAN

5.1 PURPOSE

This Field Sampling and Analysis Plan will be used for sampling the 200 West Area Evaporative Sewer Lagoon in support of Permit ST-0045514 and NOC Order DE12NWP-001, Revision 1. An analysis from the sampling is used to show compliance with Permit ST-0045514 and NOC Order DE12NWP-001, Revision 1.

5.2 RESPONSIBILITIES

Members of MSA Environmental Site Services (ESS) Organization in coordination with the Water and Sewer Utilities Organization will conduct sampling and shared recordkeeping. This includes scheduling sampling events, collecting samples, completing chain-of-custody forms, and shipment/delivery of the samples to the analytical laboratory.

MSA Water and Sewer Utilities will be responsible for all interfaces with the offsite analytical laboratory, all data validation activities, recordkeeping associated with sample test results, and filling out the Flow/Discharge Monitoring Reports provided to the Department of Ecology.

MSA Water and Sewer Utilities will be responsible for providing access to lagoon area (i.e., unlocking the gate), assisting with sampling activities (e.g., operation of discharge box valves to control flow, physically collecting samples and delivery to an accredited analytical laboratory), and recordkeeping associated with the field sampling logbook , shipping, and chain of custody forms.

An accredited laboratory will perform sample analyses. The laboratory must be accredited by the State of Washington, Department of Ecology to perform all the analyses required by Permit ST-0045514.

5.3 TRAINING REQUIREMENTS

The ESS and MSA Water and Sewer Utilities personnel responsible for performing/overseeing sampling activities at the 200 West Area Evaporative Sewer Lagoon will be trained to sample in accordance with the sampling protocol outlined in Section 5.4 below.

5.4 SAMPLING REQUIREMENTS

5.4.1 Minimum- Required Sampling Equipment

The following serves as a checklist of the minimum-required sampling equipment used for this activity (See sample form in Appendix B):

- Chain of custody form (form # BC-6000-828)
- Field sampling logbook
- Sample containers
- Container labels
- Latex gloves
- Paper towels or shop towels for wiping down containers
- Substantial footwear
- Cellular phone or radio
- Sealable plastic bags
- Ice chest with ice
- Field pH meter (if needed)

5.4.2 Sample Collection & Handling Requirements

Samples should be representative of influent to the aeration lagoon during normal sampling. All samples are to be collected in clean plastic sample containers provided by the accredited laboratory. The normal sample is collected from the flow via a ladle then placed into the container until the container is full.

Normal Sampling

Permit ST-0045514 requires the sample to be taken prior to any treatment and excluding any side-stream returns, which is considered to be at the truck unloading chamber. Quarterly (see Table 4-3 for specific months), a 1-liter container is used to collect influent for the TSS and BOD analyses. Sample containers are filled and rinsed in the effluent stream three times prior to sample collection.

The influent will also be collected (See figure 4-1) for air sample to assess pollutant concentration for ammonia (use a 500ml bottle), chloroform (use a 40ml bottle), and dichlorobenzene (bottle size 40ml bottle) in accordance with NOC Order DE12NWP-001. These samples and analyses are required to be completed annually and submitted to the Department of Ecology, if results exceed table 2 values of the NOC Order.

Emergency Discharge Sampling

Complete sampling per the Department of Ecology's sampling requirement upon notification of an emergency see section 3.3.5 above, under the direction of the responsible party/management.

5.4.3 Management of Waste Generated by Sampling Activities

The analytical laboratory will dispose of any used and unused excess sample material remaining after analysis through standard disposal practices for wastewater effluent. Nothing inherent in these samples requires special disposal practices.

Other debris managed as part of the sampling process, such as used latex gloves, rags, and paper towels are disposed of as sanitary waste.

5.4.4 Quality Assurance/Quality Control Requirements

The field sampling logbook documents all pertinent information related to sampling activity. All entries in the logbook will be completed in ink, including the date and the signature of the person completing the logbook entry.

The temperatures of sample and ambient air will be recorded in field sampling logbook and include a description for each day of sampling a notation of any observed conditions that could affect sample results (e.g., evidence of algae, operation of aerators in aeration and settling lagoons, visible solids in sample).

Sample containers are packaged in a plastic bag and placed in an ice chest packed with ice to facilitate the preservation requirement that sample be maintained at 4 degrees Celsius (± 2 °C) prior to analysis. This also facilitates cooling of the sampling during delivery to the laboratory. At the laboratory, the sample will be maintained at a temperature of 4 °C (± 2 °C) prior to analysis.

5.4.5 Sample Labeling & Chain-of-Custody

Sample labels will include the time and date of sampling. Sample labels will be applied to all sample containers. Label information is recorded using waterproof ink. Labels will be firmly affixed to the appropriate sample container(s). The following information will be included on each sample label:

- Name of collector
- Date and time of collection
- Place of collection
- Description of material being sampled (i.e., sewage)
- Unique sample identification number corresponding to sample identification number on chain-of-custody
- Specific analysis required
- Preservation requirements (i.e., cool to 4 degrees Celsius)

All samples are recorded on a chain-of-custody form. The primary purpose of the chain-of-custody form is to create a written record to trace the possession and handling of the sample from the moment of collection through analysis and eventual disposal. The sample remains in the custody of the sampler through transfer to the analytical laboratory. A sample is in someone's custody under any of the following conditions:

- The sample is in one's actual possession.
- The sample is within view, after being in one's physical possession.
- The sample is in a locked area to prevent unauthorized personnel from tampering with it.
- The sample is in a secured area, restricted to authorized personnel only.

The following information is recorded on the chain-of-custody:

- Name and address of analytical laboratory doing the analysis
- Name, address, phone number, and fax number of client contact person
- Billing information
- Required turnaround time
- Project name for future reference to help identify the sampling event, including names of all personnel involved in sampling
- List of unique sample identification numbers, description (i.e., size and type) of sampling container tied to each number, date and time sample was added to each container, and specific analysis requested for each
- Preservation and holding time requirements, as appropriate
- Under the comments section, any project-specific information that might be useful to laboratory in running analysis, such as detection limit requirements, process knowledge, etc.

At the time of turnover to laboratory, the sampler signs and dates chain-of-custody. The laboratory representative also signs and dates chain-of-custody to indicate when the laboratory took possession of sample. The laboratory representative makes a copy of the chain-of-custody for retention. The original chain-of-custody will remain with sample throughout analytical process.

5.5 SAMPLE ANALYSIS & REPORTING REQUIREMENT

5.5.1 Analytical Techniques & Requirements

Permit ST-0045514 calls for the analytical methods listed in Table 5-1. Alternate methods are allowed provided the practical quantitation limits (PQLs) given in Table 5-1 are achieved.

**Table 5-1
Analytical Methods**

Parameter	EPA Method	PQL	Units
BOD ₅	405.1	4	mg/L
TSS	160.2	1.0	mg/L

5.5.2 Holding Time & Preservation Requirements

Table 5-2 lists the holding time and preservation requirements, per the respective analytical methods called out in Permit ST-0045514. The laboratory will notify the MSA Point of Contact (POC) immediately if a holding time is exceeded and a new sample will be taken.

**Table 5-2
Holding Time and Preservation Requirements**

Parameter	Preservation	Holding Time
BOD ₅	cool to 4 degrees C	48 hours
TSS	cool to 4 degrees C	7 days

Note:

* pH is analyzed in field to meet requirement of being analyzed immediately. In addition, immediately upon receipt at laboratory, pH is analyzed again for verification of field results. Sample should be delivered to laboratory as soon as possible following sampling, preferably within the hour.

5.5.3 Detection Limits

The minimum analytical detection limits are the PQL values given in Table 5-1.

5.5.4 Quality Assurance/Quality Control Requirements

The analytical laboratory shall follow quality assurance/quality control (QA/QC) requirements mandated in each of the respective methods. This includes the running of duplicates, laboratory control samples, and blanks. QA/QC data will be provided as part of a data package.

5.5.5 Data Reporting/Validation Procedures

The laboratory pH is taken upon receipt of sample at laboratory and results are reported immediately to the MSA point of contact. As soon as all results are available, the laboratory prepares a written report to document results and submits it to the MSA POC. Upon receipt of sample results, the MSA POC reviews results against influent limitations (see Table 5-3, which is taken from Permit ST-0045514 and NOC Order DE12NWP-001). This includes verification of holding time requirements, and as appropriate, review of laboratory QA/QC data to verify validity of results. In the event of any exceedance of the influent limitations listed in Table 5-3, the laboratory will provide written notification to the MSA POC as soon as possible. Any exceedance of the influent limits will also be reported to ESS and MSA Water Utilities management immediately so notification can be made to U.S. Department of Energy (DOE) and the Department of Ecology, as appropriate. In the event of a permit limit exceedance, the MSA POC will arrange to re-sample the influent for the affected constituent as soon as possible.

If any questions concerning the results arise, the MSA POC will contact the laboratory for further information and/or clarification. If questions concerning the test results or the quality control samples persist, the remaining sample portions may need to be run for verification of previous information.

**Table 5-3
Influent Regulation Limits**

Parameter	Limits
Influent BOD ₅	105 lb/day
Ammonia	52,400 mg/L
Chloroform	12,400,000 µg/L
1,4-dichlorobenzene	2,650,000 µg/L

Notes:

Influent Regulation Limits are established by Permit ST-0045514
and NOC Order DE12NWP-001, Revision 1

lb/day = pounds per day; mg/L = milligrams per liter,

µg/L = micrograms per liter

5.6 DOCUMENTATION & RECORD RETENTION

The following documentation will be maintained for a minimum of 5 years:

- Chain-of-custody records
- Field sampling logbook
- Sample test results
- Shipping records (if applicable)
- Quality control information
- Copy of laboratory contract(s)

6.0 LAGOON TREATMENT SYSTEM MAINTENANCE

6.1 MAINTENANCE OVERVIEW

Most of the problems associated with sewage lagoon treatment can be avoided by proper maintenance. Maintenance should be carried out in a manner that prevents emergencies or unscheduled shutdowns. Information related to the weirs, sluices, and the flowmeter is shown in Appendix F and Appendix L. A schedule of required maintenance activities can be seen in Table 6-1.

Table 6-1
Lagoon System Preventative Maintenance Schedule

Maintenance	Daily	Quarterly	Semi-Annual	Annual
Grounds Inspection	X			
Check for Leaked Water	X			
Run Lagoon Pump Station		X		
Run Sand Filter Pump Station		X		
Flow Meter Back-Up Batteries			X	
Physical Plant inspection			X	
Flume Flow Meter Calibration				X
Leak Detection Flow Meters Calibration				X

The maintenance program should start with the following rules:

- Observe required safety practices.
- Keep the treatment system clean and orderly.
- Have a systematic plan for daily operation.
- Maintain a routine schedule for inspection and maintenance.
- Keep records of inspection and maintenance.

Three basic categories of maintenance programs – performance, physical, and safety – are recommended in the subsections below.

6.1.1 Performance-Related Maintenance

It is important to have an adequate stock of spare parts or to make arrangements with suppliers so that spare parts are available upon request. In an effort to best utilize the available budget, a minimum of spare parts for lagoon equipment are kept on hand (Appendix A). Instead, a procurement process has been designed to acquire the necessary spare parts on an as-needed basis. See Appendix A for the name and numbers of local suppliers. While a part is being acquired, the corresponding lagoon train should be closed down and flow routed through the other lagoon train.

Maintenance activities performed on all equipment will be established by the Maintenance Management Program, using input from the manufacturer's maintenance recommendations, state waste discharge permit requirements, and/or design authority recommendations. The proper tools for maintenance and a storage place with a locking device should be maintained at the site.

Aeration Lagoon

The aeration lagoons should be cleaned when determined by the wastewater operator. This is accomplished by emptying the lagoon being cleaned and diverting flow to the other lagoon train. Sludge will be treated at the Sludge Processing Facility or processed offsite as necessary.

Settling Lagoon

When sludge in the settling lagoon has built up to two feet, the corresponding lagoon train should be shut down so the sludge can be removed and processed. During this period, the influent wastewater should be diverted into the other lagoon train. The settling lagoon level should be lowered to its minimum level prior to sludge removal, to allow solids to re-settle.

Sludge at the settling lagoon will be measured annually, in the same general location for each measurement cycle. No deviation from this technique will be allowed until desludging has occurred or a new technology has been proven to be more accurate. If a new technique is approved, it must be used consistently until the lagoon is desludged before a different technique

will again be considered. Changes in measurement technique between desludging may be considered after discussion with regulators.

Aerators, Weirs, and Sluices

Information related to the flumes and sluice ways are shown in Appendix F; aerators are discussed in Appendix H.

Operation of all aerator-moving mechanisms should be observed to determine whether they are aligned properly, moving at a constant speed, and producing no unusual vibration or sound. The presence of aerated water coming from the aerators should be visible at the surface.

Maintenance Records

Maintenance of the plant will be managed through a computerized maintenance management system (CMMS) that has the capability of recalling maintenance items at predetermined intervals, tracking maintenance due and completed maintenance items, recalling previous maintenance items, assigning equipment numbers, and recording and developing work packages.

An equipment service record form for each piece of equipment is maintained in the CMMS database. Periodic inspections, cleaning, replacement of worn parts, and other important data are recorded. The database indicates regular servicing of the equipment. All preventive maintenance activities that are due on regular intervals will be retained and retrieved automatically based on the predetermined maintenance schedule. All completed preventive maintenance activities will be retained in the Hanford site records management system per procedure MSC-RDRM-210 "Records Management Program" and available for retrieval for a period of 3 years. The lagoon supervisor will be able to access copies of equipment maintenance and repairs through the site records management system when required. A review of the maintenance records will enable the wastewater operator to evaluate the equipment and determine which repair parts should be ordered and which ones should be kept in stock, and future preventive maintenance operations can be scheduled for a certain date.

6.1.2 Physical Plant Maintenance

Maintenance of the physical plant requires regular inspection to determine deficiencies and deterioration. Corrections to the damaged berms, animal burrowing damage, road deterioration, and liner damage are construction repairs. Liner repair information is shown in Section 6.2. Access to the three lagoons must be possible at all times, and roads must be maintained as all-weather roads. All lagoons should be kept completely clear of all rooted vegetation; the absence of rooted vegetation will be confirmed during health and safety inspections.

6.1.3 Safety

There are health hazards associated with coming into contact with the wastewater and the pathogenic organisms, and of falling into the wastewater and possible drowning. Periodic inspections and prompt repair of the fence around the facility is a major safety measure. A buddy-system or fall protection should be used when measuring the lagoon depth or working near the edge of the lagoons. These safety measures should be implemented within 4 feet from the edge of the basin per the Automated Job Hazard Analysis for working at the Lagoon (reference AJHA#SIU1694).

No other special tools, equipment, or supplies are required. For safety information, see Section 9.5, Occupational Health.

6.2 LINERS

During operation of the sewage treatment lagoons, daily inspections for leaked water in each lagoon will be performed. If leaked water is present, the leak detection pump, or other appropriate pumping method, should be used to pump water out of the sump. The flow from each pump will be recorded and charted if water is present (Appendix B). The charts will provide a baseline leakage quantity and a leak history for a particular lagoon such that when the leakage increases by a substantial amount, it is an indication of a new hole or tear in the liner that should be repaired.

Daily pumped volumes below an action leak rate, as described below, are considered acceptable and will not require any repair action. By limiting the depth of water within the sump to a minimal level, the amount of water that could leak through the secondary liner would be negligible. Action Leakage Rates have been established and are presented in Table 6-2.

**Table 6-2
Action Leak Rates for Each Lagoon**

Location	Area (ft)	Area (acre)	Leak Rate (gpd)
Aeration Lagoons	9940	0.23	60
Settling Lagoons	8160	0.19	50
Evaporation Lagoon 1 (West)	524404	12.04	6020
Evaporation Lagoon 2 (East)	239183	5.49	2800

Once the total recovered leakage reaches these action rates, the wastewater operator will be required to document the need for making necessary repairs to the primary liner. Liner repairs are not mandated until the volume is at or above the action leak rate. However, the wastewater operator may determine that a repair is still necessary despite a lower action leak rate.

Several methods exist for performing a repair to an HDPE liner:

- Patching is used to repair large holes, tears, and destructive sample locations. All patches shall extend at least 6 inches beyond the defect and all corners of patches shall be rounded.
- Grinding and Welding can be used to repair sections of extruded seams.
- Spot Welding or seaming will be used to repair small tears, pinholes, or other minor localized flaws.
- Capping is used to repair lengths of failed extruded areas.
- A bad seam can be removed and replaced with a strip of new material.

All repairs shall be non-destructively tested using air pressure testing, air pressure/soap testing, or vacuum testing. Repair test results shall be logged in the corresponding repair work package or contractor submittals.

If a large repair is to occur, and/or a liner is to be replaced at the end of its service life (36 years), then a plan that includes all requirements associated with *Repair/Replacement Details &*

Specifications, Construction Methods, and Required Quality Control/Assurance Plans will be submitted for approval.

6.3 OTHER LAGOON INSPECTION AND MAINTENANCE ITEMS:

Besides equipment maintenance, a few other items require maintenance for proper plant operation. The procedures for maintaining embankments, trash and scum control measures, weed and insect control are described below.

Embankments – Check embankment slopes for erosion or sliding, check liner anchor trenches, and check all batten bar installations for potential leaks. Ensure that the embankments are maintained to support treatment plant integrity. The embankments shall be inspected routinely and unwanted vegetation will be eliminated as required. Care is taken to prevent weeds and debris from blowing or falling into the lagoons. The lagoon embankments will be inspected for evidence of burrowing rodents, leakage, or erosion. Burrowing rodents can severely damage side slopes, create water leaks, and damage equipment. If burrowing rodents are evident, contact MSA Biological Controls.

Trash and Scum Control – Trash and scum accumulation is a common characteristic of lagoons and is usually greatest in spring when growth of water weeds and vigorous biological activity resumes. Ordinarily, wind action dissipates scum accumulation and causes it to settle. However, in the absence of wind, other methods of removal may need to be considered. If scum is not broken up, it could dry on the surface of the water and become crusted. Blue-green algae are apt to become established on the scum crust. The formation of blue-green algae can give off disagreeable odors, and may cut off a significant amount of sunlight into the lagoon. When this happens, production of oxygen by algae inside the lagoon will be reduced, which may result in other odor problems. Methods for breaking up the scum include agitation with the aerators or moving the water through the ISFs. Scum is most easily broken up when it is attended to promptly.

Insect Control - If mosquitoes or other similar insect problems arise, it will be necessary to eliminate their breeding areas within and around lagoons. This can be done by spraying the area

with mosquito control chemicals and eliminating standing water outside of lagoon areas. If insects become a problem contact Biological Controls.

Weed Control – If weeds or other similar plant growth problems arise in the evaporation lagoons, it will be necessary to eliminate their presence with the use of approved herbicides. If weeds become a problem, contact Biological Controls.

7.0 BUILDING MAINTENANCE & CLEANING

7.1 BUILDING STRUCTURE

Facility personnel will inspect the building structure and roof/wall panel systems on a routine basis for any deterioration to or missing building fasteners, degradation of paint finishes, and pitting/cracking of concrete slab. Repairs will be made as required to correct any problem.

7.2 GUTTERS, DOWNSPOUTS, & SPLASH-BLOCKS

Facility personnel will inspect the facility gutters, downspouts, and splash-blocks on a routine basis to ensure that they are free flowing and clear of any debris.

7.3 CLEANING LOGS

The facility will be inspected and cleaned on a regular basis to ensure that dust, dirt, waste material, and operational debris is removed. Waste material will be removed routinely as necessary.

7.4 MAINTENANCE

Certain operational components of the building will be inspected on a routine basis to ensure that they are in proper working order.

- **Back-up Power Batteries:**

Batteries providing back-up power for the exit signage, smoke detectors, and safety/eyewash units will be inspected, tested, and replaced as recommended by the equipment manual, or as determined by the MSA Maintenance Management Program and the Design Authority.

- **Door Hardware:**

Door locks, closers, operators, etc. will be maintained as recommended by manufacturer, or as determined by the MSA Maintenance Management Program and the Design Authority, to ensure that they are in proper working order.

- **Fire Extinguishers:**

Fire extinguishers will be inspected, tested, tagged, and maintained on a yearly basis as recommended by the manufacturer, or as determined by the MSA Maintenance Management Program and the Design Authority, to ensure that they are in proper working order.

7.5 EGRESS ROUTES – TRIP & OVERHEAD HAZARDS

Material will be stored properly and kept out of walkway paths and off of stair treads, landings, and elevated platforms so that egress routes are free of trip hazards and objects will not fall from above.

7.6 EXTERIOR WALKWAYS

During winter months, exterior walkways and paths will be maintained to ensure that they are free from ice build-up and slip hazards. An ice melting product, shovel, and broom will be stored/maintained in close proximity to building entrances.

7.7 PESTS, RODENTS, & NESTING BIRDS

The facility will be inspected on a regular basis for insect nests (ants, bees, wasps, hornets, etc.), rodents, and nesting birds. Lagoon management will be informed of any issue and arrange for pest control, removal, or re-location.

7.8 BUILDING UTILITIES

The raw water tank, safety shower tank, and HVAC should also be maintained. The raw water tank should be filled as needed and water level checked quarterly. Leaks should be noted and repaired as needed. The safety shower tank water should be replaced semiannually. HVAC filters should be checked and replaced as necessary.

8.0 SHIPPING/RECEIVING & INVENTORY CONTROL

All transportation to and from the plant will comply with Hanford Site Procedure MSC-PRO-TRANS-37561, *Department of Transportation Federal Motor Carrier Safety Management Plan*. Lime and Polymer MSDS sheets will be followed when shipping and receiving to ensure safe practices. Records for lime, polymer, and influent truck loads will be kept in the office.

See Appendix B for an inventory form.

9.0 OCCUPATIONAL HEALTH AND SAFETY

9.1 EQUIPMENT AND CONTROL

All lock out and tag out procedures will be followed. Electrical equipment should be maintained in accordance with the provisions of the National Electrical Code. All standard and posted building safety rules should be followed.

9.2 NOXIOUS GASES & OXYGEN DEFICIENCY

The wastewater operator should be thoroughly familiar with the characteristics, sources, and means of testing for common gases associated with conveyance and treatment of wastewater (ammonia, carbon dioxide, hydrogen sulfide, methane, nitrogen, etc.).

Tests should be made with gas indicators for oxygen deficiency and the presence of dangerous gas before entering a below-surface work area. If evidence of flammable or toxic gases exists, the structure should be purged by forcing fresh air into the enclosure with a blower and flexible hose before it is entered. It is safer to suspect and test for gas in all potential gas-producing or possible accumulation areas. If it becomes necessary to enter an area where a gas or oxygen deficiency is present, a supplied air respirator will be worn.

9.3 SAFETY TRAINING

As deemed necessary by facility supervision, personnel responsible for the operation and maintenance of the plant should attend a safety training course developed for wastewater operators. The training should include, at a minimum, the following topics:

- Hazards at the conveyance and treatment system
- Health and industrial hygiene
- Personal protective equipment (PPE)
- Housekeeping
- Materials handling and storage
- Fire prevention and control
- First-Aid and cardiopulmonary resuscitation (CPR)

- Accident reporting
- Accident investigation

9.4 SAFETY & PROTECTIVE EQUIPMENT

Safety training should include instruction on the use of the following safety and protective equipment as needed:

- Protective clothing, including safety goggles, face shields, hard hats, gloves, rubber boots, safety shoes, and rain gear
- Fresh air blower and flexible hose for ventilation of lift station and other enclosed areas
- Testing equipment used to identify oxygen deficiencies and explosive, toxic, and combustible gases
- Hydrogen sulfide detector
- Carbon monoxide detector
- First-Aid kits
- Barricades, traffic cones, warning signs, and flashers
- Fire extinguishers
- Safety harness and life lines
- Life jackets and life lines

9.5 OCCUPATIONAL HEALTH

Wastewater and by-products are potential hazards to treatment plant personnel. Hazards include waterborne diseases and the danger from tetanus. The following guides should be observed whenever working around wastewater:

- All immunizations shall be administered as recommended by medical authorities for wastewater operators.
- Hands and fingers shall be kept away from the nose, mouth, eyes, and ears.
- Hands should be washed thoroughly with soap and hot water before eating, smoking, and after work.
- Fingernails shall be kept short and foreign material should be removed from the nails with a stiff, soapy brush.

- Gloves should be worn when handling wastewater, screenings, sludge, or for other work when a wastewater operator comes into direct contact with untreated wastewater or sludge. Contaminated gloves should be handled properly.
- Gloves shall always be worn when hands are chapped or burned, or when the skin is broken for any cause.
- All cuts and scratches must be reported and receive First-Aid treatment.
- Fresh work clothes shall not be stored in a locker with used work clothes. Clothes should be cleaned after each use.
- Contaminated clothes shall be removed before entering lunchrooms or other food service facility.
- A shower should be taken after each workday.

9.6 EMERGENCY RESPONSE

Emergencies at the lagoon fall under two categories.

- Natural Disasters
- Operational Emergencies

Natural disasters involve events such as earthquakes, fire, high winds, blizzards, prolonged freezing temperatures, and prolonged high temperatures. In the event of such conditions, every effort will be taken to ensure that effluent treatment levels are not degraded. If treatment levels cannot be maintained at satisfactory levels during the event, effluent discharge will be stopped if at all possible until the event has passed and effluent quality has improved. In cases where effluent discharge is necessary, or unavoidable, written notification will be made to the Department of Ecology describing the event and remedial actions.

Operational emergencies would typically involve mechanical failures, power failure, liner failure, or personnel accident or injury, and will typically not be catastrophic in nature. Most operational emergencies can be corrected prior to effluent quality degradation. Stopping effluent discharge until effluent quality has recovered will be the primary course of action. In the event of a liner failure, the lagoon levels will be lowered to a point lower than the point of failure if at all possible, and effluent quality will be monitored for signs of degradation. Temporary isolation of the affected lagoon may be necessary until appropriate repairs can be performed. All operations personnel will carry a reliable source of two-way communication while working inside the

lagoon fence line, and emergency life rings or personal floatation devices (PFDs) will be maintained in good condition at all times. In the case of an emergency requiring immediate emergency response, personnel will contact Hanford Patrol either by use of an emergency channel-equipped radio, through the filter plant operator at 373-3800, or by dialing 373-0911 from a cell phone to summon emergency services. Lagoon management will be notified as soon as possible after an operational emergency occurs.

9.7 MATERIAL SAFETY DATA SHEETS

When chemicals are present, MSDSs shall be kept either in a 3-ring binder (in plastic sleeve inserts) in a centralized area near the main building entry or with the Field Work Supervisor overseeing the job. MSDS's are also available on HLAN and are immediately accessible to the facility personnel. All facility personnel shall be familiar with and trained in the use of the chemicals used and stored within the facility. The MSDSs on file will be reviewed and updated on a yearly basis.

9.8 SPILL CLEANUP

In the event of a spill or leak within the building, management shall be notified as soon as possible after the event occurs. Management shall direct the cleanup utilizing the proper materials, equipment, and protective equipment as required by the MSDS for the type of material released.

9.9 EMERGENCY EVACUATION

In the event of a spill or leak within the building that poses an imminent threat, personnel shall evacuate the facility as quickly as possible to an up wind location and notify management. Facility personnel will be trained in advance to know which facility systems to be shut down (if any), so long as it is possible to shut those systems down without potential risk or injury. Shutdown procedures and routes to the assembly point will be clearly posted in a centralized building location.

9.10 FORK-TRUCK OPERATION & TRAINING

Only approved personnel with the proper training shall be allowed to operate facility forklifts or pallet jacks. When not in use, equipment will be stored and secured in a designated area within the facility.

9.11 TRUCK OPERATION

Only approved personnel with the proper training shall be allowed to operate facility trucks that transport material prior to treatment. Truck operators will utilize appropriate equipment and methods to unload and hook-up hose, chock tires at an inclined grade, and signal, and generally obey site traffic signage and traffic control measures.

Truck operators shall ensure that valves are closed and that unloading hoses are disconnected and properly secured prior to pull away. They will also use appropriate PPE during unloading operations such as gloves, footwear, coveralls, and masks.

9.12 SAFETY SHOWERS

In the event of human contact with a chemical, the safety shower and/or eye wash should be used as quickly as possible. All personal entering the site should be shown the location of, trained in the operation of, and explained what necessitates the use of the safety shower and eyewash.

9.13 ELECTRICAL CORDS, PANELS, & DEVICES

Only qualified electrical workers will perform maintenance on electrical equipment. Safe operation and maintenance of all electrical equipment will follow requirements of National Fire Protection Act (NFPA) 70E-2009. Arc-Flash boundaries and appropriate PPE will be listed on applicable equipment. Unless specific permission is provided, no work will be performed on energized electrical circuits or equipment operating at more than 50 volts. See specific equipment operation manuals for additional instructions and pre-cautions.

10.0 REFERENCES

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- MSA. MSC-PRO-EI-15333. "Environmental Event Notification (Including Spills and Releases and Agency Notifications)." Section 5.56 of the *Environmental Protection Processes*.
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- WAC 173-240. 2000 (July). "Submission of plans and reports for construction of wastewater facilities," *Washington Administrative Code*, Olympia, Washington
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- Water Environment Federation. 2007. *Operation of Municipal Wastewater Treatment Plants*. Manual of Practice No. 11, Volumes I, II and III. Washington, D.C.
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APPENDIX A
Maintenance and Spare Parts Lists

Pumps and Pump Skid Maintenance Schedule and References											
Item	Location	Equipment Number	Manufacturer	Model Number	Maintenance Manual Pages	Maintenance Schedule	Maintenance Type	Supplier	Phone	Address	
Leak Detection Pumps	Aeration Lagoon	LDS-P-001A	Gunnco	Sidesloper P2K25.3	Attachment D-3	As Needed	Replace rotor	GunnCo Pump & Control, Inc.	770-889-7114	515 Industrial Way Cumming, GA, 330040	
		LDS-P-001B									
		Settling Lagoon									LDS-P-001C
	Evaporation Lagoon	LDS-P-001D									
		LDS-P-001E									
		LDS-P-001F									
		LDS-P-001G									
Effluent Pump	Lagoon Pump Station	SWS-P-007A/B	Tsurumi	80SFQ23.7	Attachment D-6	Daily	Measure the operating current and power voltage	Cascade Machinery & Electric, Inc.	206-762-0500	PO Box 3575 Seattle, WA, 98124	
	Sand Filter Pump Station	SWS-P-08A/B				Monthly	Measure the insulation resistance				
							Semi-yearly				Inspect the lifting chain or rope
							Yearly				Inspect oil
							Biennial				Change oil and mechanical sela
							Once every two to five years				Overhaul
Raw Water Pump	Biosolids Building	RWS-SKD-001	Goulds	2AB22HMIF2EO	Attachment D-2	Annual	Inspect Pump to ensure working properly	Beckwith & Kuffel	206-767-6700 800-767-6700 Web: www.b-k.com	PO Box 81186 5930 First Avenue South Seattle, WA 98108	
Sludge Feed Pump	Biosolids Building	STS-P-001	Seepex	BN52-6LS	Attachment D-4	Biennial	Nord Gearboxes - Lubricate according to manufactures specifications (Attachment D-4 Section 10 Gearboxes pg 7)	Seepex Inc.	937-864-7150	511 Speedway Drive Enon, Ohio, 45323	
Sludge Mixing Pump		STS-P-002									
		STS-P-003									
Lime Addition Pump	Biosolids Building	STS-P-004	Wilden	PX-200	Attachment D-7	Annual	Inspect Pump to ensure working properly	Wilden Pump & Engineering, LLC	909-422-1730	22069 Van Buren Street Grand Terrace, CA 92313-5607	
Polymer Mixing Skid		STS-SKD-001	Water Solve	WSLP 2400 F10PV	Attachment D-5						
Polymer Water Pump Skid	Biosolids Building	STS-SKD-002	Goulds	1AB2LB1035	Attachment D-1	Annual	Inspect Pump to ensure working properly	Beckwith & Kuffel	206-767-6700 800-767-6700 Web: www.b-k.com	PO Box 81186 5930 First Avenue South Seattle, WA 98108	
Supernatant Pump	Biosolids Building	SWS-P-001	Wilden	PX-1	Attachment D-8	Annual	Inspect Pump to ensure working properly				
Dewater Sump Pump	Dewatering Pad	SWS-P-002	Tsurumi	80SFQ23.7	Attachment D-6	Daily	Measure the operating current and power voltage	Cascade Machinery & Electric, Inc.	206-762-0500	PO Box 3575 Seattle, WA, 98124	
						Monthly	Measure the insulation resistance				
						Semi-yearly	Inspect the lifting chain or rope				
						Yearly	Inspect oil				
						Biennial	Change oil and mechanical sela				
						Once every two to five years	Overhaul				

HVAC Maintenance Schedule and Reference						
Item	Equipment Number	Manufacturer	Model Number	Maintenance Schedule	Maintenance Type	
Outdoor Condensing Unit	STS-AC-001	Carrier	38HDF018	Before Summer	Clean Coils by vacuuming or long bristle brush.	
Indoor Fan Coil Unit	STS-AC-002	Carrier	40QNCO1824	Monthly	Inspect coils and clean as required (min annually).	
				Monthly	Clean air filters. Replace if worn or torn.	
				Quarterly	Clean Ionizer with a brush. Clean Drain Pipe. Clean Outdoor Coil from Outside.	
				Annual	Change Remote Control Batteries. Clean fan wheel, drain pans, and outdoor coil from inside. Check electric connection tightening and fan tightening.	
Sidewall Exhaust Fan	STS-EF-001	Greenheck	SBE-2H48-20	Quarterly	Belts - ensure belts are not loose or tight	
				Semiannual	Bearings - Lubricate fittings using a high-quality lithium based grease.	
					Check bolts and screws for tightness. Clean fan.	
Louver		American Warming and Ventilating	LE-21	Annual	Clean Louvers.	
Backdraft Damper		American Warming and Ventilating	BD-33HD	Annual	Clean Damper and check motor for damage.	
Unit Heater	STS-HTR-001	Indeeco	240-U1050U-T	Note:	Contains built-in thermostat, dust shield, mounting brackets	
	STS-HTR-002					Volts 480; KW 5; pH 3; Amps 6.22
	STS-HTR-003			Annual	Check tightness of all visible bolts and nuts (including motor mounting)	
	STS-HTR-004			Annual	Check motor, fan, discharge openings, intake openings, heating elements, and control compartment for cleanliness\	
	STS-HTR-005			Annual	Check motor and fan for smooth operation. Replace motor if excessive bearing play is detected.	

Note: Supplier: Total Energy Management
 Phone: 509-946-4500
 Address: 1975 Butler Loop Rd.
 Richland, WA, 99352

Electrical Maintained Schedule and References										
Item	Location	Equipment Number	Related Equipment Number	Manufacturer	Model Number	Maintenance Schedule	Maintenance Type	Supplier	Phone	Address
Motors Starter/Motors	Aeration Lagoon	MSTR-002	LDS-P-001A	Siemens	NEMA 1 Combo	Monthly	Inspect and clean contactor, tighten up loose connections	Sun River Electric Service, Inc	509-627-5400	9312 W 10th Ave Kennewick, WA, 99336
	Settling Lagoons	MSTR-004	LDS-P-001C							
	Evaporation Lagoon	MSTR-030	LDS-P-001E							
	Aeration Lagoon	MSTR-011	SWS-AE-001A	Baldor	Reliance	Quarterly	Inspect motor, clean and clear vents, use a megger for winding insulation and record readings, ensure all electrical connection are tight	Baldor	425-952-5000	550 Kirkland Way Ste 205 Kirkland, WA, 98033
	Aeration Lagoon	MSTR-012	SWS-AE-001B							
	Settling Lagoons	MSTR-015	SWS-AE-003A							
	Settling Lagoons	MSTR-016	SWS-AE-004A							
	Grinder						Relubricate as shown in Table 3-1			
	Evaporation Lagoon	MSTR-021	SWS-AE-005A							
	Evaporation Lagoon	MSTR-022	SWS-AE-005B							
	Sand Filter Effluent Pump	MSTR-009	SWS-P-008A	Siemens	NEMA 12 Combo	Monthly	Inspect and clean contactor, tighten up loose connections	Sun River Electric Service, Inc	509-627-5400	9312 W 10th Ave Kennewick, WA, 99336
	Lagoon Pump	MSTR-007	SWS-P-007A							
Lighting	Roadway Lighting			Lithonia Lighting	CHMD			Outdoor	770-922-9000	One Lithonia Way Conyers, GA, 30012
	Emergency Lighting				ELM2	Annual	Check battery and change if needed	Emergency	800-334-8694 770-981-8141	
	Florescent Lighting				FGB	As Needed	Replace Light bulb	Industrial	770-922-9000	
	Florescent Lighting				L/LA	As Needed	Replace Light bulb	General Purpose	800-858-7763	
	Exit Signs				LHQM			Emergency	800-334-8694 770-981-8141	
	Wall Packs				TWP	As Needed	Replace Light bulb	Outdoor	770-922-9000	
	Surface Commercial Lighting				WS	As Needed	Replace Light bulb	Fluorescent	800-858-7763	
	Contactors					ABB	A30		ABB Inc		800-385-1221
Transformers	Dry Type			Siemens	Speedfax			Siemens Industry, Inc.		
Panelboards				Siemens	P4	Annual	Inspect Panelboard, clean out dirt and dust if necessary. Don't use a blower or compressed air. Dirt and dash should be kept out of circuits.	Siemens Industry, Inc. Building Technologies Division	800-241-4453	5400 Triangle Parkway Norcross, GA, 30092
							Check Conductor and Connections for discoloration or flaking. This is a sign of a loose or contaminate connections. Replace when needed.			
Unit Substation				Square D	Mini Power-Zone			Schneider Electric	509-535-3685	104 S Freya, Suite 117 Spokane, WA, 99202
Surge Arresters				Cooper Power Systems	UltraSIL polymer-housed Evolution					
Grinder Controller	Grinder			Franklin Miler				Franklin-Miller	973-535-9200 ext 115 for spare parts and customer service	60 Okner Parkway Livingston, NJ, 07039

Maintenance Schedule and References										
Item	Location	Equipment Number	Manufacturer	Model Number	Maintenance Manual Pages	Maintenance Schedule	Maintenance Type	Supplier	Phone	Address
Liners	Aeration Lagoon		Northwest Linings and Geotextile Products, Inc.		Attachment E	As Needed	Repair	Agru America, Inc.		500 Garrison Rd Georgetown, SC, 29440
	Settling Lagoon									
	Evaporation Lagoon									
Aerators	Aeration Lagoon	SWS-AE-001A/B	Environmental Equipment Engineering	FA 1805	Attachment H	Depends on use	Inspection; clean and dry, nuts and bolts tight, megger to check insulation resistance if long storage or unusual operating conditions, air chamber clear, squirrel cage rotors check by checking for localized heating'	Environmental Equipment Engineering	804-730-1280	PO Box 389 Mechanicsville, VA, 23111
		SWS-AE-002A/B								
	Settling Lagoon	SWS-AE-003A/B		FA 1801						
		SWS-AE-004A/B								
	Evaporation Lagoon	SWS-AE-005A/B/C		FA 1225				CA, WA, OR JBI Water & Wastewater Equipment	925-426-9033	5266 Forest Hill Dr Pleasanton, CA, 94588
		SWS-AE-006A/B								
Grinder	Open Channel Grinder	SWS-GRD-002	Franklin-Miller	TM 8512	Attachment G-1	Weekly	Inspection - cutters for wear, check reducer for excessive vibration or noise, leakage of lubricant, motor for excessive vibration or noise	Franklin-Miller	973-535-9200 ext 115 for spare parts and customer service	60 Okner Parkway Livingston, NJ, 07039
						Quarterly	Lubricate gears			
						Quarterly	Inspect Fasteners, tighten as necessary			
						Annual	Seal inspection			
Macerator (Grinder)	Flanged Grinder	STS-GRD-001	Seepex	I 110	Attachment G-2	Quarterly	Inspect macerator.	Seepex Inc.	937-864-7150	511 Speedway Drive Enon, Ohio, 45323
Flume	Flume Metering Box		Plasti-Fab	8" Palmer-Bowlus Flume	Attachment F-1	As Needed	Wash with industrial detergent and water to remove oil and sludge build-ups	Plasti-Fab	503-692-5460	9665 S. W Tualatin-Sherwood Rd PO Box 100 Tualatin, OR 97068
Flow Meter	Flume Metering Box		Teledyne Isco	4210	Attachment L-1	Quarterly	Wipe of case, inspect case seal and clean if necessary,	Whitney Equipment Company, Inc.	425-486-9499 800-255-2580	21222 30th Dr SE Suite 110 Bothell, WA, 98021
							Inspect cable connections			
							Change printer paper and ink ribbon as needed			
							No lubrication or disassembly required			
						Semi-annual	Check battery, change if needed			
							Update flow metering software			
Leak Detection Pumps Flow Meter	Leak Detection Pumps		SeaMetrics	FT400-Series	Attachment L-2	Annual	Calibrate Sensor	Valin Corporation (Stocking Distributor)	425-282-6030	830 SW 34th St, Suite E Renton, WA, 98057
						As Needed	Replace rotor and sensor			
pH/ORP Sensor			TUPH	Model 396R	Attachment M	As Needed	Remove oil deposit with mild non-abrasive detergent	Emerson Process Management	949-757-8500	2400 Barranca Parkway Irvine, CA, 92606
							Remove scale deposits, soak electrodes for 30 to 60 min in a 5% hydrochloric acid solution			
						Always	Keep at room temperature to keep life expectancy long			
						For ORP As Needed	Polish electrodes with moistened baking soda			

Item	Location	Equipment Number	Manufacturer	Model Number	Maintenance Manual Pages	Maintenance Schedule	Maintenance Type	Supplier	Phone	Address
Air compressor	Sludge Processing Facility	AIR-CMP-001	Atlas Copco	KV 7.5 PV 803	Attachment J	Daily	Drain tank of moisture after use. Leave drain cock open if not in use.	Atlas Copco Compressors Inc.	413-536-0600	94 N. Elm St., Floor 4 Westfield, MA 01085
							Check oil level at sight glass.			
							Verify the pressure switch unloader is working (listen for a brief hissing sound when compressor shuts off).			
							Check the compressor for loose parts excessive noise or vibration. Tighten any necessary parts.			
						Monthly	(Power off) Check the belts for tension. Adjust if more than 1/2 in of play when depressed.			
							Remove and check air filter. Replace if necessary.			
						Quarterly or 300 hrs	Change oil. A compressor grade 30 wt non-detergent oil should be used.			
						Annual	Inspect Tank for pin holes or other imperfections (Replace if Necessary, DO NOT weld or attempt to repair tank)			
									Clean electrical equipment with an approved cleaning agent	
Tanks	Raw Water Tank	RWS-TK-001	Snyder Industries, Inc.	3000 Gal Tank		Quarterly	Check Water Levels. Replace as Needed.	Snyder Industries, Inc.	402-467-5221	PO Box 4583 Lincoln, NE 68504
	Mixing Tank 1	STS-TK-001				Each Use	Rinse out tanks.			
	Mixing Tank 2	STS-TK-002								
Mixers	Static Mixer 1	STS-MX-001	Koflo	3-10-3-6N-7IF				Koflo	847-516-3700 800-782-8427	309 Cary Point Dr. Cary, IL, 60013
	Static Mixer 2	STS-MX-002								
	Static Mixer, Bag Dewatering	STS-MX-003								
Agitator	Lime Tote Mixer	STS-AG-001	Neptune	RGT-2.0	Attachment I					
Service Sink	Sludge Processing Facility	SS-1	Elkay	Weldbilt Scullery Sink		Monthly	Clean Sink.	Elkay	630-574-8484	222 Camden Ct. Oak Brook, IL, 60523
Tankless Water Heater	Sludge Processing Facility	WH-1	Eemax	SP4208		Notes	Volts 208; kW 4.1; Amps 19.7	Eemax Inc.	800-543-6163 203-267-7890	353 Christian Street Oxford, CT, 06478
Safety Shower		STS-SSEW-001	Hughes Safety Showers LTD	EXP-J-1200	Attachment N	Semiannual	Replace Water and clean shower head.	Hughes Safety Showers LTD	44(0)-181-430-8618	Whitefiel Road, Bredbury, Stockport, Cheshire SK6 2SS, England
Water Hammer Arrestors	Sludge Processing Facility		Zum	Z1700				Zum Industries, LLC	814-455-0921	1801 Pittsburgh Ave. Erie, PA, 16514

Item	Location	Equipment Number	Manufacturer	Model Number	Maintenance Manual Pages	Maintenance Schedule	Maintenance Type	Supplier	Phone	Address
Slide Gates	Diversion Box, Collection Box	SWS-V-001	Plasti-Fab	Slide Gates	Attachment F-2	Semi-Annual	Lubricate stems	Plasti-Fab	503-692-5460	9665 S. W Tualatin-Sherwood Rd PO Box 100 Tualatin, OR 97068
		Monthly				inspect stem for grit and clean and grease as needed or as mentioned above				
		Annual				Inspect thrust nut and seals				
		quarterly				lubricate ball and roller bearings				
Valves	Facility and Lagoon	All (except slide gates)	See Valve	Ball, Check, Knife Gate, Gate		As Needed	Replace.	HD Fowler Company	509-545-0255 866-829-9733	1320 N Oregon Ave Pasco, WA, 99301

Spare Parts List

Item	Location	Manufacturer	Model Number	Spare Parts	Part Catalog Number	Supplier	Phone	Address
Influent Flow Meter	Flume	Teledyne Isco, Inc	4210	Ultrasonic Level Sensor Only. With 25 ft. cable and quick connect to flow meter.	60-31114-012	Teledyne Isco, Inc. Customer Service Department	800-228-4373 402-464-0231	PO Box 82531 Lincoln, NE, 68501
				4200 Series plotter paper roll. 58 ft length.	60-2313-019			
				4200 Series printer ribbon, black.	250-0200-00			
				Dri-Cann Dessicant Pack	099-0012-00			
Lime	Sludge Processing Facility	Mid-Ohio Valley Lime, Inc.	Hydrated Lime Slurry	1 Tote		Mid-Ohio Valley Lime, Inc.	Emergency: 88-847-3090 Info: 88-847-3090	PO Box 734 16360 State Route Seven South Marietta, OH 45750
Geotextile Bags	Dewatering Pad (15' x 30' max)	Blue River Technologies	Geotextile Dewatering	1 Bag		Blue River Technologies	Mike Conwell Work: 765-766-61900 Cell: 765-744-5943	2283 N County Rd 500 E New Castle, IN 47362
		US Fabrics	EcoTubes				Chuck Fedders 800-518-2290 513-2271-6000	
Polymer								

APPENDIX B
Operational Forms

Record of Leak Rates for _____, 20____						
Day of Month	Aeration Lagoon 1	Aeration Lagoon 2	Settling Lagoon 1	Settling Lagoon 2	Evaporative Lagoon 1	Evaporative Lagoon 2
Action Leak Rates (gal/day)	60	60	50	50	6020	2800
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
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21						
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26						
27						
28						
29						
30						
31						

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST										C.O.C. No.	
										Page	of
Collector				Contact/Requestor				Telephone No.		MSIN	FAX
SAF No.				Sample Origin				Purchase Order/Charge Code			
Project Title				Logbook No.				Ice Chest No.		Temp.	
Shipped To (Lab)				Method of Shipment				Bill of Lading/Air Bill No.			
Protocol				Data Turnaround				Offsite Property No.			
Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis				Preservative	
POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS <input type="radio"/> Yes <input type="radio"/> No						SPECIAL INSTRUCTIONS				Hold Time	
Relinquished By		Print	Sign	Date/Time		Received By		Print	Sign	Date/Time	Matrix* S = Soil DS = Drum Solids SE = Sediment DL = Drum Liquids SO = Solid T = Tissue SL = Sludge WI = Wipe W = Water L = Liquid O = Oil V = Vegetation A = Air X = Other
Relinquished By				Date/Time		Received By		Date/Time			
Relinquished By				Date/Time		Received By		Date/Time			
Relinquished By				Date/Time		Received By		Date/Time			
FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)						Disposed By		Date/Time		

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-432 (05/02)



SAMPLE COLLECTION AND SUBMITTAL FORM

(To be submitted prior to testing)

Date _____

Customer Name & Address _____

Contact Person _____ Phone _____

Location and Description of Sample _____

Project Objectives (solids/water separation, clarification, settling, filtrate clarity, etc.) _____

To your knowledge, is the sample designated as hazardous waste per RCRA? yes no

Do you require Watersolve to return all packaging materials yes no (see section VI. C). UPS # _____ Fed Ex # _____

Other Information _____

I. Type of Material/Residual

- Municipal Wastewater
- Municipal Water Treatment
- Industrial/Process
- Lake / Pond / River Sediment (circle one)
- Mine Drainage
- Other- Describe _____

II. Application

- Geotube® Dewatering
- Mechanical Dewatering
- Settling
- Thickening
- Clarification
- Other- Describe _____

III. Solids concentration of sample (percent dry weight) if known _____%

- If dilution is anticipated to be required, please provide sample of water to be used for on-site dilution.
- Testing will include solids determination. This value will be for verification.

(August, 2010)

IV. Sample Size

A. Municipal Wastewater	2-4 gallons
B. Municipal Water Treatment	2-4 gallons
C. Industrial Process	3-5 gallons
D. Pond/Lake/River Sediment	4-5 gallons (and dilution water where required)
E. Other	Please contact lab (616)575-8693

V. Labeling- Label each sample (on the container and on the lid) with the date, name and description. A permanent marker should be used to label the containers.

VI. Packaging

A. Biological Samples (i.e. wastewater biosolids)

1. Place in closed and sealed containers inside a sturdy closable cooler.
2. Containers inside cooler should be sealed with tape to prevent leakage.
3. Provide frozen ice packs to preserve sample during shipping.

B. Other Samples (i.e. sediment)

1. Five-gallon buckets with sealed top, or
2. Smaller containers (sealed) inside a sturdy cooler.

C. Containers, coolers, or other forms of packaging will not be returned to client unless specified on this form. All costs incurred with returned materials will be the client's responsibility, and we ask that a return label or UPS or FedEx number for shipping be included with the original shipment or on this form.

VII. Shipping

- A. Biological Samples- Should be shipped "next day" to arrive Monday-Friday.
- B. Other Samples- Should be shipped based on customer priorities.

VIII. Notes and Considerations

A. Representative Sample- Care should be taken to collect representative samples. In some cases, composite samples should be collected and combined. In other cases, separate grab samples would be more representative.

B. Dangerous/ Hazardous Materials- When testing is requested on dangerous or hazardous materials (per USDOT and/or RCRA Standards), contact WaterSolve LLC prior to shipping. The tested material will be returned to client at client's expense.

C. Water (Filtrate) Clarity- Unless we are told otherwise, water clarity of conditioned residual is important to the potential dewatering or settling application. If there are specific requirements for filtrate (water leaving Geotube® container) clarity, it should be noted. If solids separation is the primary objective, and water clarity is not a primary objective, it should also be noted.

(August, 2010)

Enclose this completed form within a water tight plastic bag or shipping enclosure taped to the outside of the container, or e-mail (RandyW@gowatersolve.com) or fax (616-575-9031) the completed form prior to shipment to Attn: Lab - WaterSolve. Samples should be sent to:

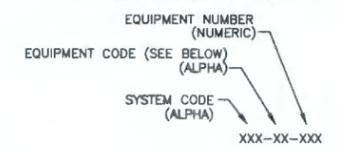
***WaterSolve, LLC
Attn: Laboratory
4964 Starr Street, SE
Grand Rapids, MI 49546***

(August, 2010)

APPENDIX C
Piping & Instrumentation Documents

8 7 6 5 4 3 2 1

EQUIPMENT IDENTIFICATION



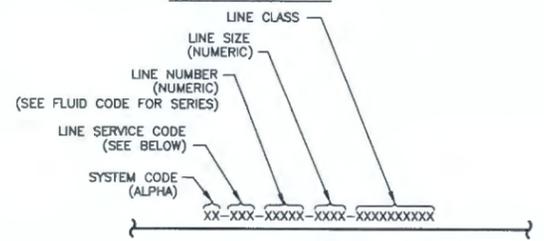
SYSTEM CODES

- AIR - COMPRESSED AIR SYSTEM
- LDS - LEAK DETECTION SYSTEM
- RWS - RAW WATER SYSTEM
- STS - SLUDGE TREATMENT SYSTEM
- SWS - SEPTAGE AND WASTE WATER SYSTEM

EQUIPMENT CODES

- AE - AERATOR
- AG - AGITATOR
- CON - CONTAINER
- CMP - COMPRESSOR
- EW - EYE WASH STATION
- FLT - FILTER
- GRD - GRINDER
- MTR - MOTOR
- MX - MIXER
- P - PUMP
- SSEW - SAFETYSHOWER W/EYE WASH
- TK - TANK

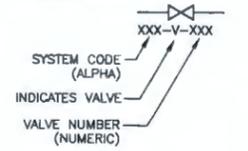
LINE DATA IDENTIFICATION



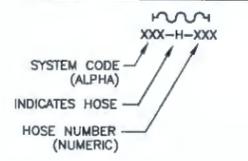
LINE SERVICE CODES

- CA - COMPRESSED AIR (SERIES 900)
- EF - EFFLUENT WATER (SERIES 300)
- LS - LIME SOLUTION (SERIES 600)
- LC - LEACHATE COLLECTION (SERIES 400)
- P - POLYMER (SERIES 800)
- RW - RAW WATER (SERIES 700)
- SL - SLUDGE (SERIES 200)
- SN - SUPERNATANT (SERIES 500)
- WW - WASTE WATER (SERIES 100)

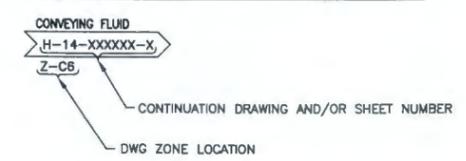
VALVE IDENTIFICATION



HOSE IDENTIFICATION



DRAWING CONTINUATION ARROW

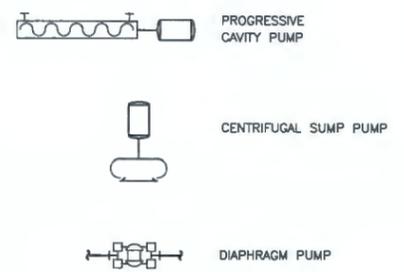


PIPING LINES (P&IDS)

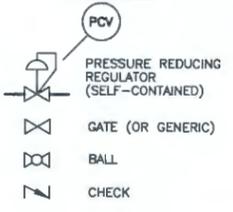
- PRIMARY LINE (AG & UG) (.7 mm [0.028"] THK)
- SECONDARY/UTILITY (AG & UG) (.35 mm [0.014"] THK)
- EXISTING (.35 mm [0.014"] THK)
- FUTURE SYMBOL W/ NOTATION (.35 mm [0.014"] THK)
- VENDOR PACKAGE BOUNDARY (.35 mm [0.014"] THK)

PUMPS

(DRIVERS SHOWN ILLUSTRATE ORIENTATION ONLY)



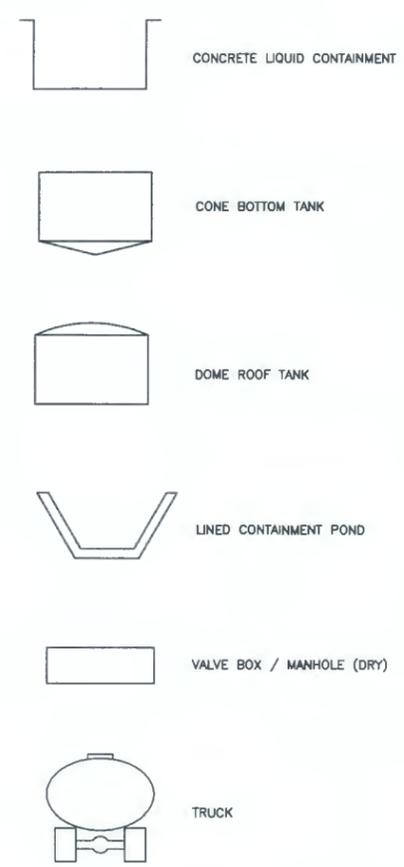
VALVES



P&ID MISC SYMBOLS

- ∅ CAP
- ▷ CONCENTRIC (OR GENERIC) REDUCER
- QUICK CONNECT
- PLUG
- HOSE CONNECTION
- FLANGE
- || BLIND FLANGE

TANKS AND CONTAINMENT



GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

1. FOR GENERAL PIPING REQUIREMENTS, SEE DESIGN SPECIFICATION
2. ALL SINGLE VALVED CONNECTIONS TO ATMOSPHERE IN PROCESS SERVICE WILL BE PLUGGED, CAPPED, OR BLIND FLANGED.
3. ALL VENTS AND DRAINS ARE 3/4" UNLESS OTHERWISE NOTED.
4. DEFINITIONS: GRAVITY FLOW (diagram), ELEVATIONS DOWNSTREAM NEVER EXCEED INLET ELEVATIONS. LINE MAY CONTAIN POCKETS. SLOPED LINE: NO POCKETS PERMITTED.

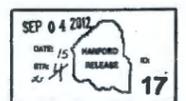
ABBREVIATIONS

(THESE TAKE PRECEDENCE OVER ASME Y14.38 1999)

- ATM - ATMOSPHERE
- B/L - BOUNDARY LIMIT
- BOP - BOTTOM OF PIPE
- CL - CENTERLINE
- CONC - CONCENTRIC
- ECC - ECCENTRIC
- FD - FIELD DETERMINE
- FLG - FLANGE
- FOB - FLAT ON BOTTOM
- FQI - FLOW METER
- FV - FIELD VERIFY
- GR - GRADE
- HC - HOSE CONNECTION
- HP - HIGH POINT
- HS - HAND SWITCH
- LP - LOW POINT
- LT - LEVEL TRANSMITTER
- NC - NORMALLY CLOSED
- NO - NORMALLY OPEN
- PCV - PRESSURE REDUCING REGULATOR
- PSV - PRESSURE RELIEF VALVE
- POE - PLAIN ONE END
- REF - REFERENCE
- SCH - SCHEDULE
- SR - SPRING RETURN
- TBD - TO BE DETERMINED
- THD - THREADED
- TOC - TOP OF CONCRETE
- TOE - THREAD ONE END
- TOS - TOP OF STEEL
- TYP - TYPICAL
- UON - UNLESS OTHERWISE NOTED
- W/ - WITH



THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON INFORMATION FURNISHED BY CONTRACTOR (PER RED-LINE CONSTRUCTION DRAWINGS) AND/OR APPROVED DESIGN CHANGE NOTICES. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THE ENGINEER HAS PROVIDED DRAFTING SERVICES ONLY TO IMPLEMENT THESE CHANGES TO THE ORIGINAL DRAWINGS.

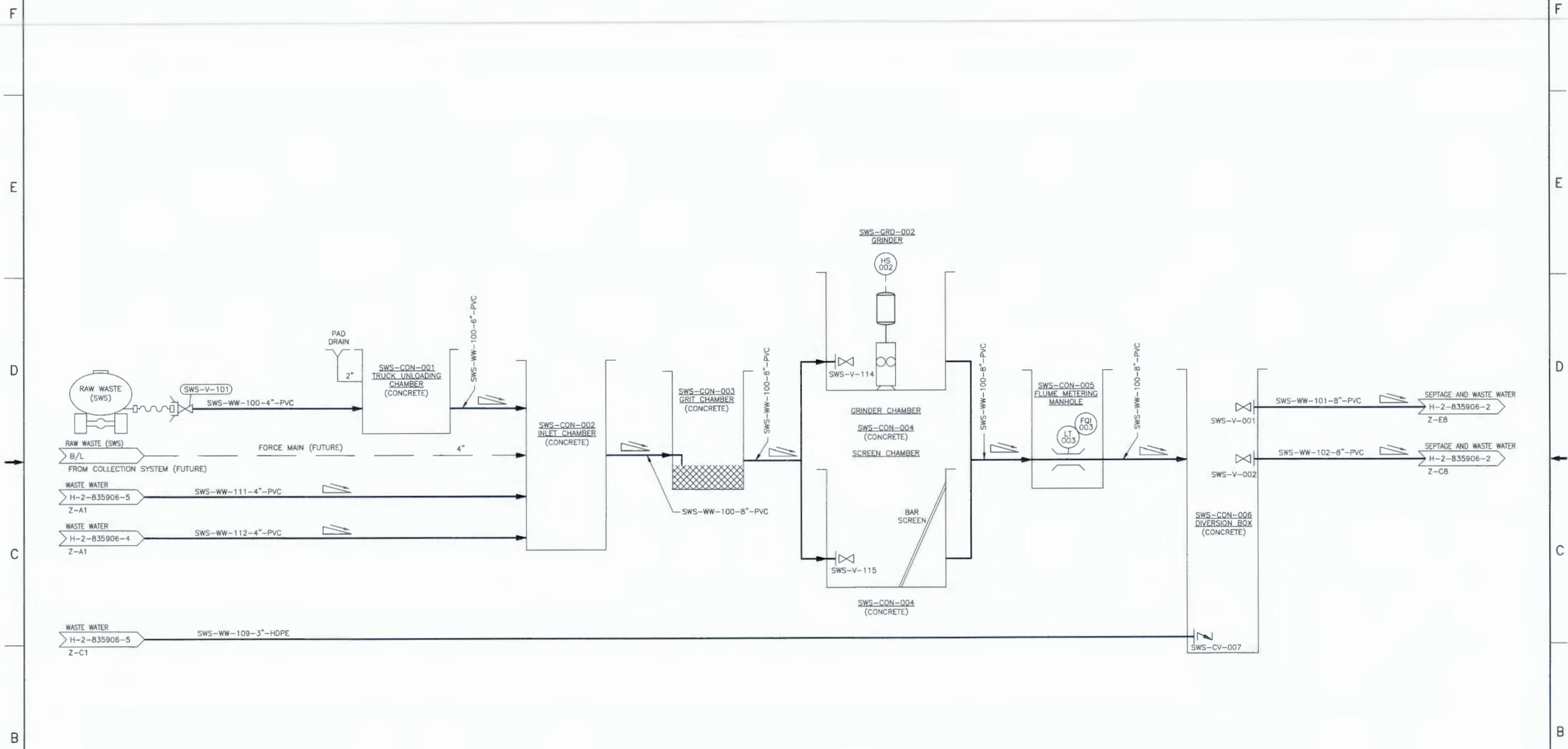


PROJECT: L-691, 200 WEST AREA EVAPORATIVE SEWER LAGOON		U.S. DEPARTMENT OF ENERGY Richland Operations Office	
NAME	DATE	PROCESS PIPING & INSTRUMENTATION DIAGRAM LEGEND	
D. DAVIS	08/21/12	REV	NO
J. ANDEREGG	08/21/12	REV	NO
W. BETHERO	08/21/12	REV	NO
M. JOHNSON	08/21/12	REV	NO
E. BRACKENBURY	08/21/12	REV	NO
KIRTI BARE	08/21/12	REV	NO
NO. 6608	7004	H-2-835905	1
SCALE: NONE	REV: DCN-L-691-001	SHEET: 1	OF: 1

DWG NO	TITLE	REF NUMBER	TITLE	DESCRIPTION	DATE	BY	CHKD	APP'D
	DRAWING TRACEABILITY LIST		NEXT USED ON					

8 7 6 5 4 3 2 1

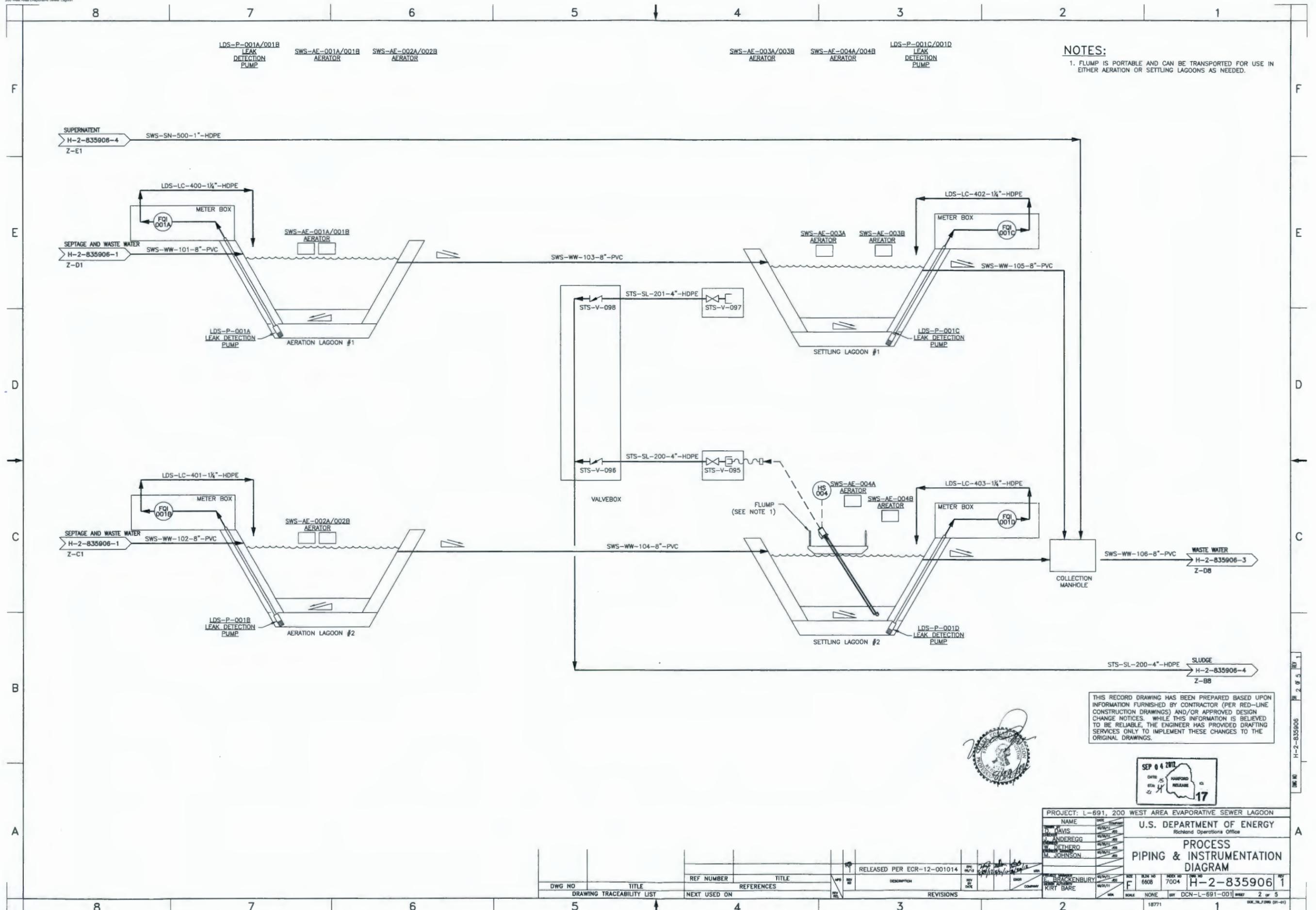
SWS-CON-001 TRUCK UNLOADING CHAMBER SWS-CON-002 INLET CHAMBER SWS-CON-003 GRIT CHAMBER SWS-GRD-002 GRINDER SWS-CON-004 GRINDER CHAMBER SWS-CON-005 FLUME METERING MANHOLE SWS-CON-006 DIVERSION BOX



DATE:
Sep 02, 2015

BLDG NO: 6608	CAUTION NOT COMPLETE WITHOUT CURRENT CHANGE DOCUMENTS FROM DATABASE		ATTENTION DESTROY THIS DOCUMENT BY SHREDDING MAY CONTAIN SENSITIVE INFORMATION	
	NAME H0075995-B MESSINGER	DATE 6/2/2015	U.S. DEPARTMENT OF ENERGY Richland Operations Office	
BLDG NO: 7004	2 REVISED PER ECR-13-001043.		PROCESS PIPING & INSTRUMENTATION DIAGRAM	
	DESIGN AUTHORITY H0017389-GM STEVENS	DATE 6/2/2015	SCALE NONE	SHEET NO. 1

DWG NUMBER	TITLE	REFERENCES	REVISIONS
PROJECT: L-691	200 WEST AREA EVAPORATIVE SEWER LAGOON		
REF NUMBER	TITLE		
NEXT USED ON			



NOTES:
1. FLUMP IS PORTABLE AND CAN BE TRANSPORTED FOR USE IN EITHER AERATION OR SETTLING LAGOONS AS NEEDED.

THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON INFORMATION FURNISHED BY CONTRACTOR (PER RED-LINE CONSTRUCTION DRAWINGS) AND/OR APPROVED DESIGN CHANGE NOTICES. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THE ENGINEER HAS PROVIDED DRAFTING SERVICES ONLY TO IMPLEMENT THESE CHANGES TO THE ORIGINAL DRAWINGS.

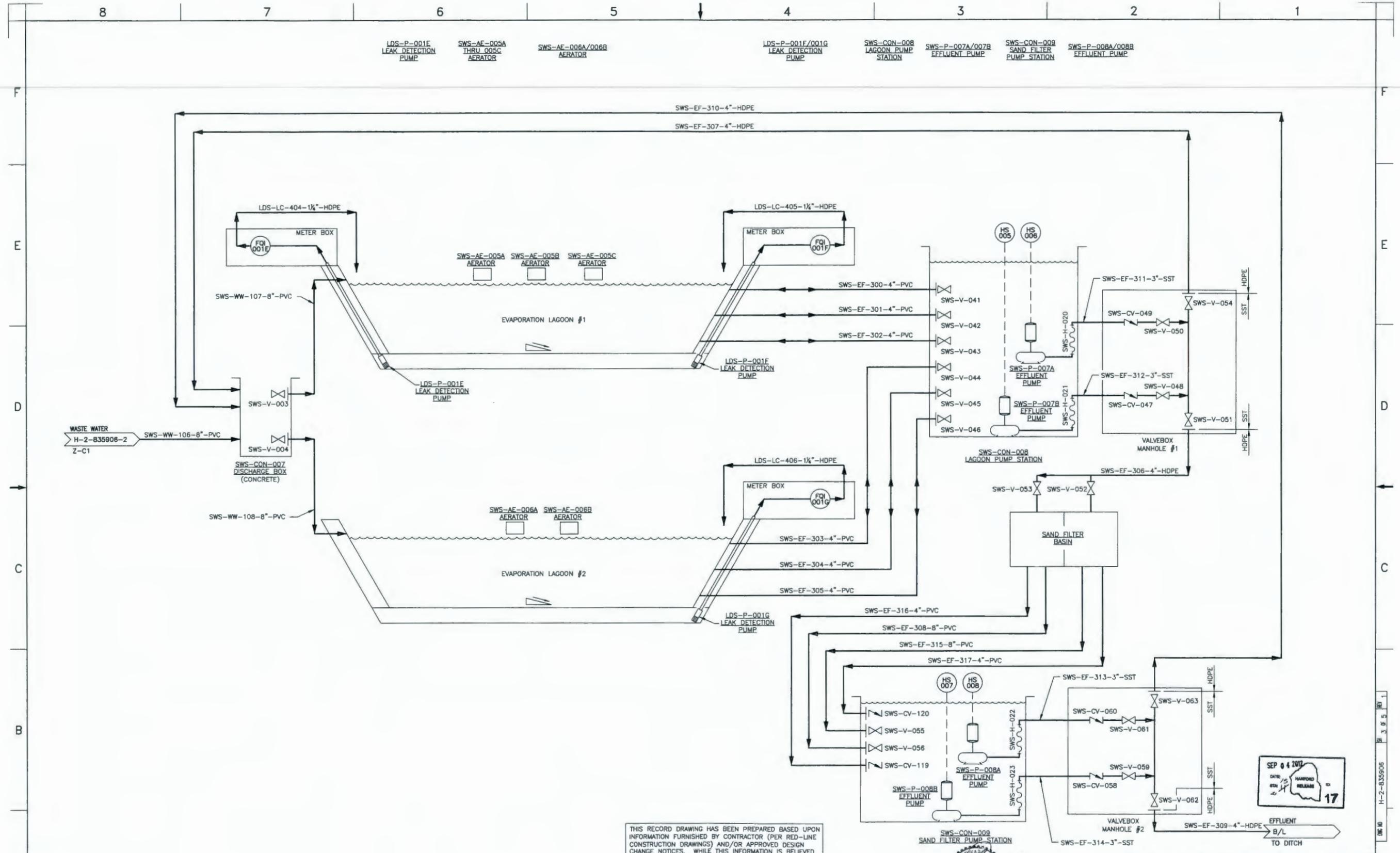


SEP 04 2013
DATE
HARFORD
RELEASE
17

PROJECT: L-691, 200 WEST AREA EVAPORATIVE SEWER LAGOON	
NAME	DATE
D. RAVIS	09/20/13
D. ANDEREGG	09/20/13
W. BETHERO	09/20/13
M. JOHNSON	09/20/13
U.S. DEPARTMENT OF ENERGY Richland Operations Office	
PROCESS PIPING & INSTRUMENTATION DIAGRAM	
DWG NO	REF NO
H-2-835906-1	7004
SCALE	DATE
NONE	DCN-L-691-001
SHEET 2 OF 5	

DWG NO	TITLE	REF NUMBER	TITLE	DESCRIPTION	DATE	BY	CHKD	APP'D

DRAWING TRACEABILITY LIST



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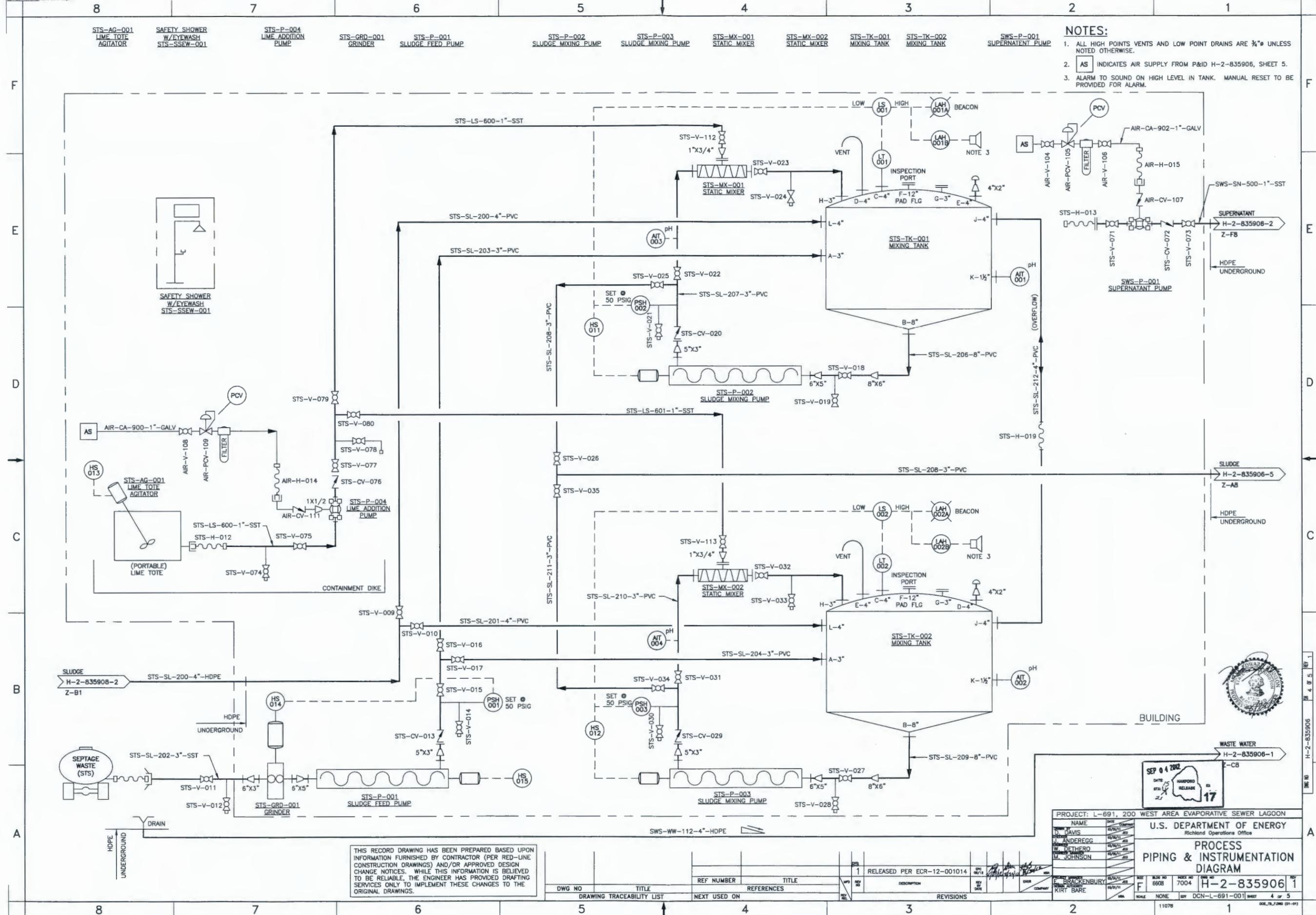
SEP 04 2010
DATE
BY J.S.
REV. 17

PROJECT: L-691, 200 WEST AREA EVAPORATIVE SEWER LAGOON	
NAME	U.S. DEPARTMENT OF ENERGY
BY DAVIS	Richland Operations Office
BY ANDERBERG	
BY BETHERO	
BY JOHNSON	
PROCESS PIPING & INSTRUMENTATION DIAGRAM	
SCALE: NONE	DCN-L-691-001
BLK NO: 6608	TRK NO: 7004
H-2-835906 1	
17177	

DWG NO	TITLE	REF NUMBER	TITLE	DESCRIPTION	REV	DATE	BY	CHK	APP

DRAWING TRACEABILITY LIST

REVISIONS



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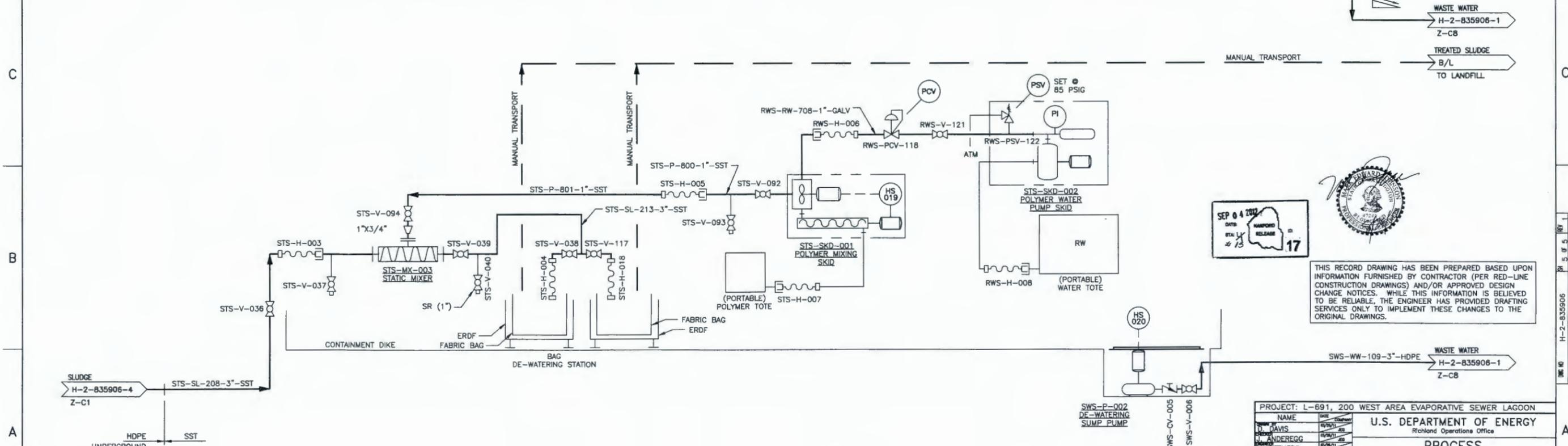
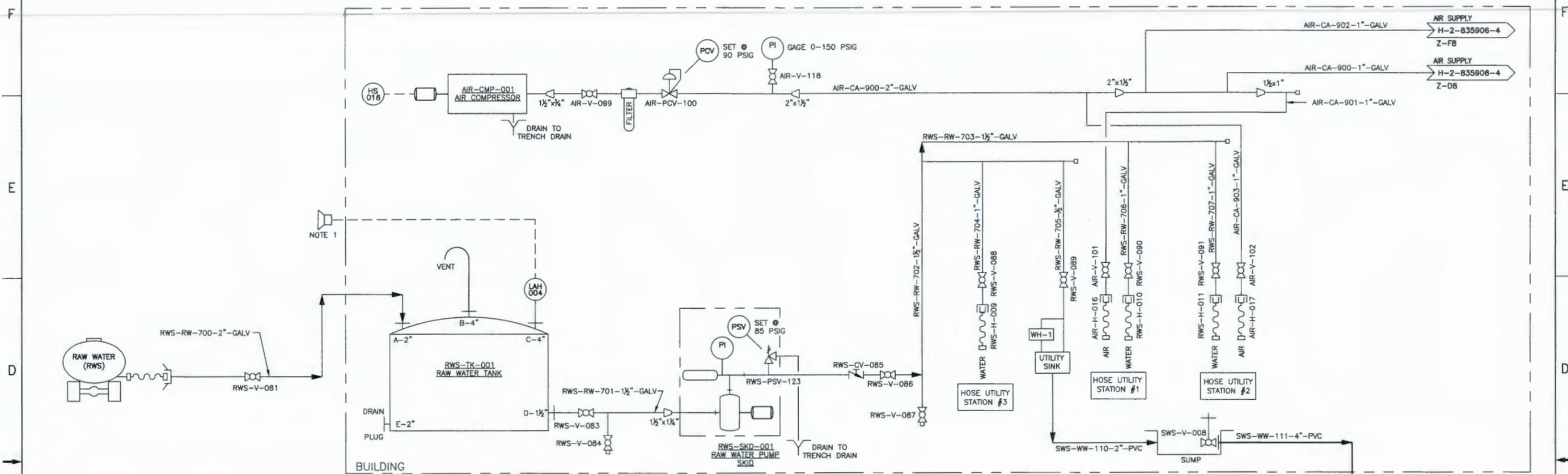
DWG NO	TITLE	REF NUMBER	TITLE	REVISIONS
H-2-835906-1	PROCESS PIPING & INSTRUMENTATION DIAGRAM			

NO	DATE	BY	CHKD	APP'D	DESCRIPTION
1	08/20/01	DAVIS			RELEASED PER ECR-12-001014
2	08/20/01	ANDEREGG			
3	08/20/01	W. DEIBERO			
4	08/20/01	M. JOHNSON			



STS-MX-003 STATIC MIXER RWS-TK-001 RAW WATER TANK STS-CMP-001 AIR COMPRESSOR RWS-SKD-001 RAW WATER PUMP SKID STS-SKD-001 POLYMER MIXING SKID STS-SKD-002 POLYMER WATER PUMP SKID SWS-P-002 DE-WATERING SUMP PUMP

NOTES:
 1. ALARM TO SOUND ON HIGH LEVEL IN TANK. MANUAL RESET TO BE PROVIDED FOR ALARM.



SEP 04 2002
 DATE
 H-2-835906-1
 17

THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON INFORMATION FURNISHED BY CONTRACTOR (PER RED-LINE CONSTRUCTION DRAWINGS) AND/OR APPROVED DESIGN CHANGE NOTICES. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THE ENGINEER HAS PROVIDED DRAFTING SERVICES ONLY TO IMPLEMENT THESE CHANGES TO THE ORIGINAL DRAWINGS.

PROJECT: L-691, 200 WEST AREA EVAPORATIVE SEWER LAGOON	
NAME: D. DAVIS	DATE: 09/20/01
NAME: W. ANDEREGG	DATE: 09/20/01
NAME: W. DETHERO	DATE: 09/20/01
NAME: M. JOHNSON	DATE: 09/20/01
U.S. DEPARTMENT OF ENERGY Richland Operations Office	
PROCESS PIPING & INSTRUMENTATION DIAGRAM	
DWG NO: F	SCALE: NONE
BLK NO: 6608	REV NO: 7004
PROJECT: H-2-835906-1	SHEET: 5 OF 5

DWG NO	TITLE	REFERENCES
1	RELEASED PER ECR-12-001014	

APPENDIX D
Pumps & Pumps Controls

Attachment D-1
Goulds 1AB2LB1035

BEST AVAILABLE COPY



Item #3
STS-SKD-002
Goulds Pump Model
1AB2LB1035
IO&M Manual

PROCUREMENT / CONTRACT SUBMITTAL	
APW <input type="checkbox"/>	AP <input checked="" type="checkbox"/>
A <input checked="" type="checkbox"/> Conforms to the Contract Requirements	
B <input type="checkbox"/> Minor Comments - Approved With Exceptions as Corrected	
<input type="checkbox"/> Re-submittal requested <input type="checkbox"/> Re-submittal not required	
C <input type="checkbox"/> Not Approved - Revise and Resubmit	
Sign: <i>Debra Bore/Kuffman</i>	Date: <i>6/18/12</i>

Goolds Pumps

Residential and Commercial Water Systems

INPUT AND OUTPUT POWER (VOLTAGE AND PHASE)

- All 1AB2 and 2AB2 require single-phase input power
 - All will work on 1Ø, 208-230V input power
 - Some 1AB2's will work on 1Ø, 115V input power
- All controllers output three-phase, 230 Volt power
- All pumps are equipped with three-phase motors

*1AB2 – Controller

- 4.2 Amp, 208-230 V, single phase input
- 1 HP variable speed controller
- Wall mount set • Transducer • Pre-wired
- Pump and tank not included

2AB2 – Controller

- 6.9 Amp, 208-230 V, single phase input
- 2 HP variable speed controller
- Wall mount set • Transducer • Pre-wired
- Pump and tank not included

*1AB2LB1035

- 1 HP controller • Wall mount set
- 1.8 stainless steel jet pump
- Transducer • Discharge tee • V6P tank, pressure gauge
- Controller is pre-wired to the pump. Flows to 15 GPM.

2AB21MC1F2B2

- 2 HP controller • Wall mount set • 208-230 V input
- MCC cast iron / stainless steel pump
- Transducer • V6P (2 gallon) tank and pressure gauge
- Controller is pre-wired. Flows to 27 GPM.

2AB21MC1G2A2

- 2 HP controller • Wall mount kit • 208-230 V input
- MCC cast iron / stainless steel pump
- Transducer • V6P (2 gallon) tank and pressure gauge
- Controller is pre-wired. Flows to 32 GPM.

*1AB21HM1E2D0

- 1 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- V6P (2 gallon) tank and discharge pipe tee
- Controller is pre-wired. Flows to 20 GPM.

*1AB22HM1E2D0

- 1 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- V6P (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 30 GPM

2AB22HM1F2E0

- 2 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- V6P (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 30 GPM.

3AB2LCB1H2D0

- 3 HP controller • Wall mount kit • 208-230 V input
- LCB stainless steel pump • Transducer
- V6P (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 50 GPM.

2AB22MC1G2D2

- 2 HP controller • Wall mount kit • 208-230 V input
- MCC cast iron/stainless steel impeller pump
- Pressure transducer
- V6P (2 gallon) tank, pressure gauge, 1½" bronze discharge tank tee
- Controller and motor are pre-wired. Flows to 80 GPM.

**5AB22MC1J2K2

- 5 HP controller • Wall mount • 208-230 V input
- MCC cast iron/stainless impeller pump
- Pressure transducer
- Pressure gauge, 1½" bronze tank tee
- Controller and motor are pre-wired. Flows to 100 GPM.

**5AB2LCC1J2D0

- 5 HP controller • Wall mount • 208-230 V input
- LCC stainless steel pump • Pressure transducer
- Pressure gauge, 1½" bronze tank tee
- Controller and motor are pre-wired. Flows to 70 GPM.

* 1 HP available in 115 volt models, see price book.

** Tank not included.



INSTRUCTION MANUAL

IM156



MODELS COVERED:

1151AB2 (115V, 4.2A), 1AB2 (230V, 4.2A),
2AB2 (230V, 6.9A)

Aquavar ABII Controller

VARIABLE SPEED PUMP CONTROL

INSTALLATION, OPERATION AND TROUBLESHOOTING MANUAL



Owner's Information

Controller Model Number: _____
Controller Serial Number: _____
Pump Model Number: _____
Pump Serial Number: _____
Motor Model Number: _____
Motor SFA: _____
Tank Serial Number: _____
Installer: _____

Installer Telephone Number: _____
Installation Date: _____
Wire Lengths (Feet)
Service Entrance to Controller: _____
Controller to Motor: _____
Incoming Voltage: _____

Table of Contents

<u>SUBJECT</u>	<u>PAGE</u>
1. Safety Instructions	3
2. System Components	3
3. System Design	4
4. Piping.....	5
5. Mounting the Controller	5
6. Power Supply and Wiring	6
7. Starting the System	6-7
8. Diagrams	8-9
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NOTICE: RECORD THE MODEL NUMBERS AND SERIAL NUMBERS FROM THE PUMP AND CONTROLLER IN THIS INSTRUCTION MANUAL FOR FUTURE REFERENCE. GIVE IT TO THE OWNER OR AFFIX IT TO THE CONTROLLER WHEN FINISHED WITH THE INSTALLATION.

NOTE:

- Use Copper wire only.
- Suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes. Branch circuit protection provided by fuses.
- Suitable for use in a pollution degree 2 micro-environment.
- Motor overload protection provided at 110% of full load current.
- In order to maintain the environmental rating integrity of the enclosure, all openings must be closed by equipment rated 3, 3R, 3S, 4, 4X, 6 or 6P.
- Maximum ambient temperature is 50° C.

1: SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON EQUIPMENT.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE UNIT.



This is a **SAFETY ALERT SYMBOL**. When you see this symbol on the pump, the controller or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Used without a safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

NOTE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS CONTROLLER.

MAINTAIN ALL SAFETY DECALS.

ALL OPERATING INSTRUCTIONS MUST BE READ, UNDERSTOOD, AND FOLLOWED BY THE OPERATING PERSONNEL. GOULDS WATER TECHNOLOGY ACCEPTS NO LIABILITY FOR DAMAGES OR OPERATING DISORDERS WHICH ARE THE RESULT OF NON-COMPLIANCE WITH THE OPERATING INSTRUCTIONS.

1. This manual is intended to assist in the installation, operation and repair of the system and must be kept with the system.
2. Installation and maintenance **MUST** be performed by properly trained and qualified personnel.
3. Review all instructions and warnings prior to performing any work on the system.
4. Any safety decals **MUST** be left on the controller and pump.
5.  The system **MUST** be disconnected from the main power supply before attempting any operation or maintenance on the

electrical or mechanical part of the system. Failure to disconnect electrical power before attempting any operation or maintenance can result in electrical shock, burns or death.

6.  When in operation, the motor and pump could start unexpectedly and cause serious injury.

2: SYSTEM COMPONENTS

Please review the Aquavar ABII components and insure that you have all the parts and are familiar with their names. Be sure to inspect all components Goulds Water Technology supplies for shipping damage.

Aquavar ABII:

1. Pump with Motor
2. Aquavar ABII Controller with Integral Pressure Sensor Cable
3. Pressure Tank (supplied on some models)
4. Pressure Sensor
5. Mounting Kit
6. Tank Tee with Pipe Plug
7. Pressure Gauge

WARNING



Hazardous voltage

DO NOT power the unit or run the pump until all electrical and plumbing connections, especially the pressure sensor connection, are completed. The pump should not be run dry. All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code (CEC) as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury, death, damage to equipment, unsatisfactory performance and may void manufacturer's warranty.



Hazardous Pressure

3: SYSTEM DESIGN

NOTE: Systems **MUST** be designed by qualified technicians only and meet all applicable state and local code requirements.

The following diagrams show a typical system using the Aquavar ABII Constant Pressure System. Connection can be made directly to a water supply or water can be drawn from a supply tank. Diagram #1 shows a typical set up for a supply tank.

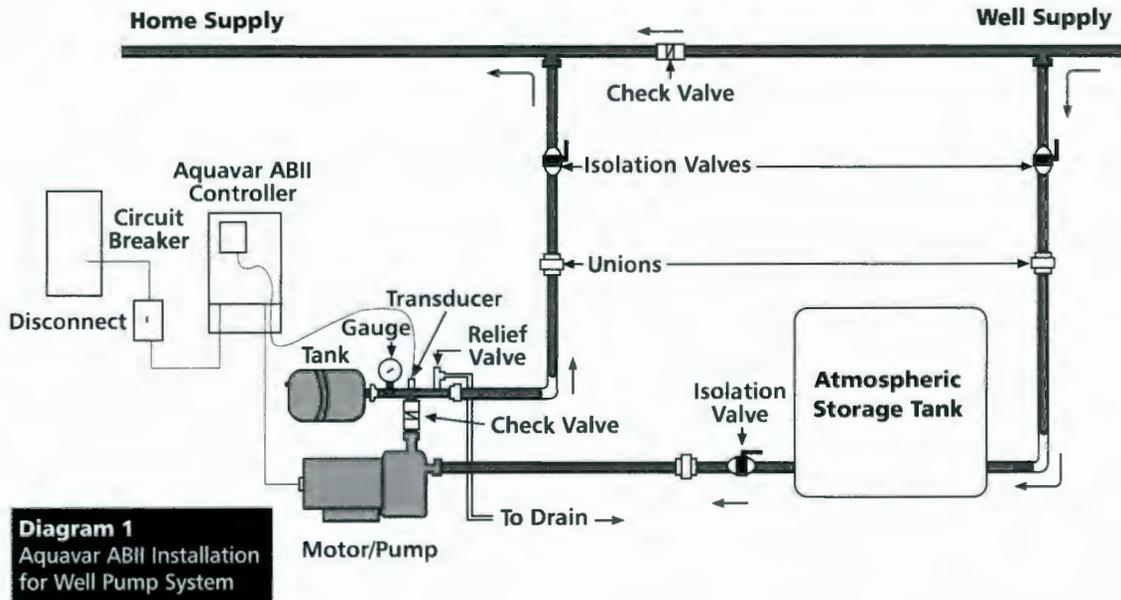
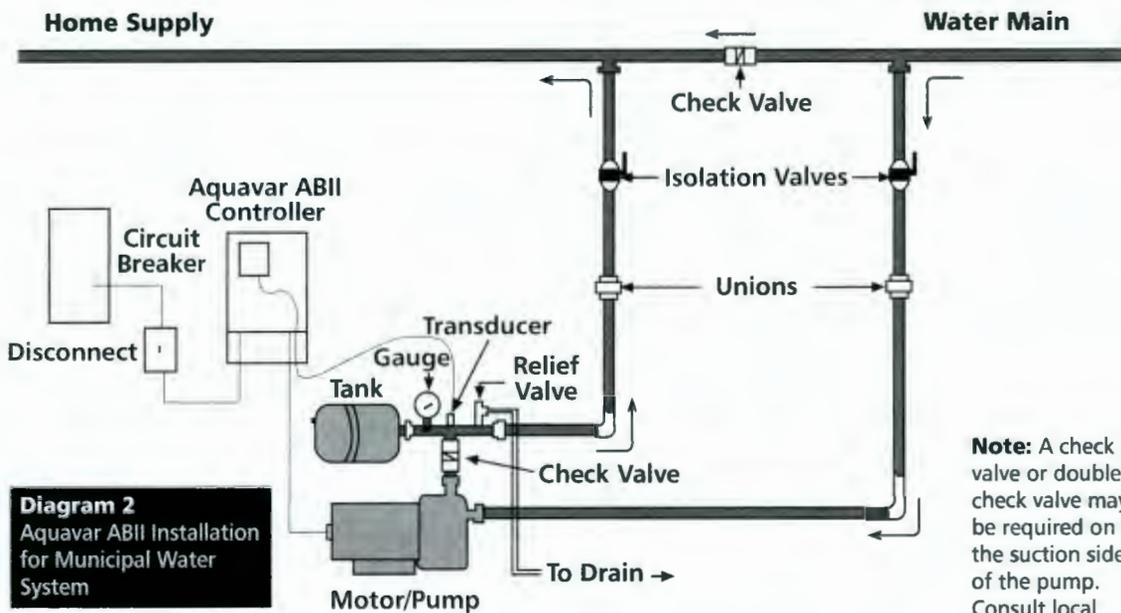


Diagram #2 shows a set-up for municipal water connection. This allows pump maintenance without main line shut-off.



4: PIPING

General

NOTE: All plumbing work must be performed by a qualified technician. Always follow all local, state and provincial codes.

A proper installation requires a pressure relief valve, a 1/4" female N.P.T. threaded fitting (found on tank tee) for the pressure sensor, and properly sized pipe. Piping should be no smaller than the pump discharge and/or suction connections. Piping should be kept as short as possible. Avoid the use of unnecessary fittings to minimize friction losses.

CAUTION **Hazardous Pressure** Some pump and motor combinations supplied with this system can create over 200 PSI. Select pipe and fittings accordingly per your pipe suppliers' recommendation. Consult local codes for piping requirements in your area.

All joints must be airtight. Use Teflon tape or another type of pipe sealant to seal threaded connections. Please be careful when using thread sealant as any excess that gets inside the pipe may plug the pressure sensor.

Galvanized fittings or pipe should never be connected directly to the stainless steel discharge head or casing as galvanic corrosion may occur. Barb type connectors should always be double clamped.

Pressure Tank, Pressure Relief Valve and Discharge Piping

The standard Hydro-Pro tanks have a pre-charge of 38 PSI. You may set the tank pre-charge anywhere between this value and 10 PSI below the system operating pressure. Use the higher tank pre-charge setting if the system drifts over 5 PSI at a constant flow rate. Use only "pre-charged" tanks on this system. Do not use galvanized tanks. Select an area that is always above 34° F (1.1° C) in which to install the tank and pressure relief valve. If this is an area where a water leak or pressure relief valve blow-off may damage property, connect a drain line to the pressure relief valve. Run the drain line from the pressure relief valve to a suitable drain or to an area where water will not damage property. Use the supplied tank tee to connect the discharge pipe to the pressure tank and house plumbing. It is allowable to pump to multiple locations.

WARNING Maximum working pressure of most HydroPro tanks is 125 psi. Check the tank label or instruction manual to verify data.

Installing the Pump

WARNING **Hazardous voltage** **CAUTION** **Hazardous Pressure** **WARNING:** Risk of electric shock - This pump system has not been investigated for use in swimming pool areas.

CAUTION **Hazardous Pressure** Plumb suction and discharge of pump into piping. Locate the pump as near liquid

source as possible. When pumping out of an atmospheric tank locate the pump below the level of the liquid in the tank. All piping must be supported independently of the pump. Be sure that suction and discharge piping are in line with the suction and discharge of the pump. Install a check valve between the discharge of the pump and the pressure sensor and tank. For additional information refer to Installation, Operation and Maintenance Instructions supplied with the pump.

Installing the Pressure Sensor

Install the pressure sensor in the tank tee provided with the unit. The pressure sensor cable supplied with the controller is 120 inches long. Locate the controller so there will be enough cable to properly install the pressure sensor.

CAUTION **Hazardous Pressure** Do not install any shut-off valves, filters or flow/pressure control devices (except for a check valve) between the pressure sensor and the discharge of the pump as this could create a hazardous situation.

Use **ONLY** the pressure sensor provided with the unit. Install the pressure sensor into one of the 1/4" holes on the tank tee provided in the kit. Install the pressure sensor vertically to avoid accumulation of debris in the sensor port. Do not install the tank tee with the 1/4" holes facing down. Align the connector on the end of the pressure sensor cable with the mating connector on the pressure sensor and push it on. The tab will lock it in place. Prevent water from following the cable and entering sensor connector by creating a "drip loop" in the cable.

5: MOUNTING THE CONTROLLER

General

Mount the controller in a well ventilated, shaded area using the supplied mounting kit. The controller must be mounted vertically. Be sure to leave 8 inches of free air space on every side of the unit. The controller must be in an area with an ambient between 34° F (1.1° C) and 104° F (40° C). Model 2AB2 will automatically decrease (derate) the maximum output current of the drive (6.9A) if the ambient temperature exceeds 104° F (40° C). The maximum output current of the drive will be decreased by 0.069A for every degree Fahrenheit above 104° F, or -1%/° F. The maximum output current of the drive will be decreased by 0.12A for every degree Celsius above 40° C, or -1.75%/° C. Model 1AB2 does not require ambient derating and will maintain a maximum output current of 4.2A in high ambient temperatures. If installation is more than 3300 feet above sea level, drive output should also be derated by 2% per 1000 feet above 3300 feet.

NOTE: Do not block the heat sink (fins) and do not set anything on the units.

⚠ WARNING
Hazardous voltage
The controller access cover should always be securely fastened to the control box due to the dangerous voltage/shock hazard inside the unit.

6: POWER SUPPLY AND WIRING

Power Supply

⚠ DANGER
Hazardous voltage
The 1151AB2 Controller requires a single phase power supply of 115 volts +/- 15%. The 1AB2 and 2AB2 Controllers require a single phase power supply of 230 volts +/- 15%. All controllers require a dedicated 20 amp two-pole circuit breaker. A dedicated circuit means no other appliances use the same circuit! The output power from the motor controller is three-phase, variable frequency and variable voltage. Maximum output voltage and frequency are line input voltage and 60 Hz, respectively. Low supply voltage will reduce pump performance.

NOTE: Installation and maintenance MUST be performed by properly trained and qualified personnel. Always follow the National Electric Code or Canadian Electric Code, as well as all local, state and provincial codes when wiring the system.

Wire and Conduit

Do not use wire smaller than 14 AWG. Use of Metal Conduit with Metal Conduit Connectors is recommended for all electrical connections.

Output Power Connections

⚠ DANGER
Hazardous voltage
Connect the motor leads for 230 volt or 208 volt operation using the nameplate as a reference. Connect the output power leads from the controller to the 3 motor leads in the conduit box on the motor. Connect the ground (green) output power lead to the ground screw in the conduit box on the motor. This step is performed in its entirety at the factory for complete systems. See diagram 4 for details.

NOTE: If the pump has more than 50 feet of wire from the controller, consult factory for selection of an output load filter (load reactor).

Connecting Input Power

⚠ DANGER
Hazardous voltage
Connect the single-phase power supply leads and Safety Ground wire from a 20 amp two-pole circuit breaker (in the OFF position) to one side of a 20-amp two-pole disconnect switch. Connect the input power leads supplied with the controller to the other side of the disconnect switch. Be sure to use Metal Conduit with Metal Conduit Connectors for electrical connections.

⚠ DANGER
Hazardous voltage
The controller has a high leakage current to ground. The terminals marked "GND" in the controller must be connected to the safety ground from the electrical service entrance. Failure

to properly ground the controller or motor will create an electrical shock hazard.

NOTE: Do not use GFCI protection with this controller. Nuisance tripping will result.

7: STARTING THE SYSTEM

⚠ DANGER
Hazardous voltage
Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker before servicing.

⚠ DANGER
Hazardous voltage
Once the controller is powered it will remain electrically charged for 5 minutes after power is turned off. Wait 5 minutes after disconnecting power before opening controller access cover as there is a severe shock hazard.

Setting the Motor Overload Switches

⚠ DANGER
Hazardous voltage
When the unit is powered, the Motor Overload Setting Switches are at a high voltage potential. DO NOT touch the Motor Overload Setting Switches while the power is on.

The Motor Overload Setting Switches adjust the level of motor overload current protection needed to protect the motor from damage due to overcurrent conditions. Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Remove controller access cover. On the inside of the access cover is the Motor Overload Setting table. See Diagram 6 for details. This table shows the switch setting for the desired Motor Overload Setting. Read the Service Factor Amps off the motor nameplate. Use the Motor Overload Setting table to match the Service Factor Amps (SF Amps) of the motor to the correct switch setting. See Diagram 5 for details. Set the Motor Overload Switches according to the correct combination on the table. If the Service Factor Amps of the motor do not match any of the Motor Overload Settings, use the next lowest switch setting. See Diagram 3 for details.

NOTE: The Motor Overload Setting Switches are preset at the factory for complete systems.

⚠ CAUTION
Failure to perform this step will result in loss of Motor Overload Protection and will void the Motor Warranty. Nuisance Motor Overload Error tripping or motor damage can occur if these switches are not set properly.

Setting the Pressure

Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Remove controller access cover. Open a faucet in the system and turn the breaker/disconnect switch to the ON position. The pump will start and pressure will increase to the factory preset 50 PSI. After the pressure has stabilized, use the Increase/Decrease Pressure Adjust Pushbuttons on the right-hand side of the controller to adjust the pressure setting.

Push and Hold the Increase or Decrease Pressure Adjust Pushbutton until the desired pressure setting is reached. The new pressure setting is automatically saved. Close the faucet and turn power to controller off. Wait 5 minutes before installing the controller access cover.

NOTE: The maximum allowable pressure setting is 85 psi.

Setting the Application Switches

▲ DANGER Hazardous voltage When the unit is powered, the Application Setting Switches are at a high voltage potential. **DO NOT** touch the Application Setting Switches while the power is on.

The controller has 6 possible Application Settings. These settings are used to adjust the Minimum Speed of the motor and the Ramp Setting, or acceleration and deceleration ramp. This allows the controller to fit a wide range of applications.

Before adjusting the Application Switches, turn the circuit breaker and disconnect switch to the off position. Wait 5 minutes. Remove the controller access cover. On the inside of the access cover is the Application Switch Setting Table. *See Diagram 6 for details.* This table shows the switch setting needed for the desired system response. *See Diagram 3 for details.*

Select a Minimum Speed of 10 Hz if the pressure at the pump's suction is within 20 PSI of the desired pressure setting. Select a Minimum Speed of 30Hz if the pressure at the pump's suction is more than 20 PSI below the desired pressure setting, if pumping from a tank or if drawing a suction lift.

Changing the Ramp Setting changes how fast the controller can change the speed of the motor. A Slow Ramp Setting allows the controller to work better in applications where the average demand for water is low (less than 3GPM or about 1 faucet). A Fast Ramp Setting allows the controller to work better in applications where the demand for water is high because the motor is allowed to change speed faster.

NOTE: The Application Switches are preset at the factory to "0000" or Minimum Speed = 30 Hz, Ramp Setting = Fast.

Motor Rotation Direction

If the pressure or flow seems low, check motor rotation direction. Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Switch any two leads on the controller output (T1, T2, or T3). Turn the circuit breaker and disconnect switch to the on position. Observe pressure and flow. If pressure or flow still seems low check plumbing.

NOTE: It is possible for the pump to maintain constant pressure with a low flow or a high positive suction head even if the pump is rotating backwards. While the pump is running, use an amp probe on one of the output power leads connected to the motor and compare the current draw between the two rotation directions. The lowest current reading indicates the pump is running in the correct direction.

System Status

The controller is always powered. A Solid Green Status Code indicates that the pump is in standby mode (pump not running) or that the line input voltage is low.

▲ DANGER Hazardous voltage Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker and wait 5 minutes before servicing.

A Blinking Green Status Code indicates that the pump is running. A Blinking or Solid Red Light indicates a problem with the controller. Refer to the access cover side panel or Diagram 6 for Status Codes. *See Section 9 for more details.*

8: DIAGRAMS

Motor Overload and Application Switch Setting



When the unit is powered, the Motor Overload and Application Setting Switches are at a high voltage potential. Always turn off the disconnect switch and circuit breaker and wait 5 minutes before touching the Motor Overload or Application Setting Switches.

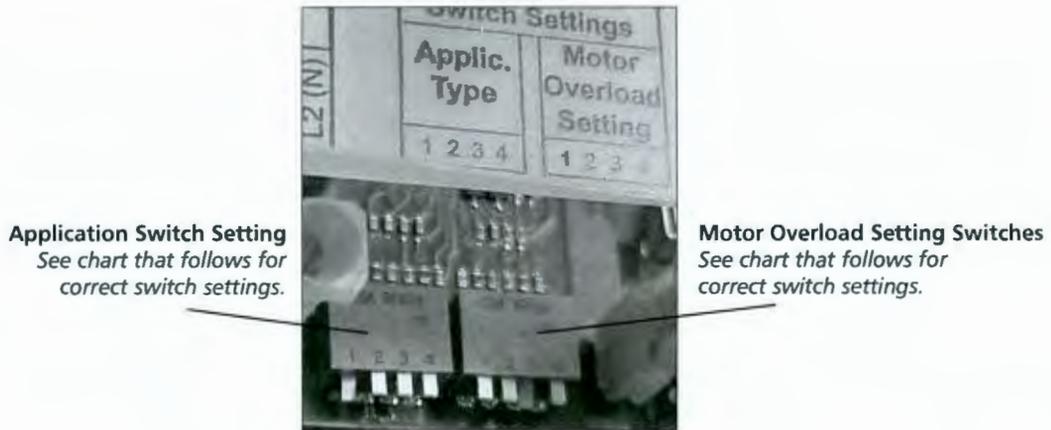
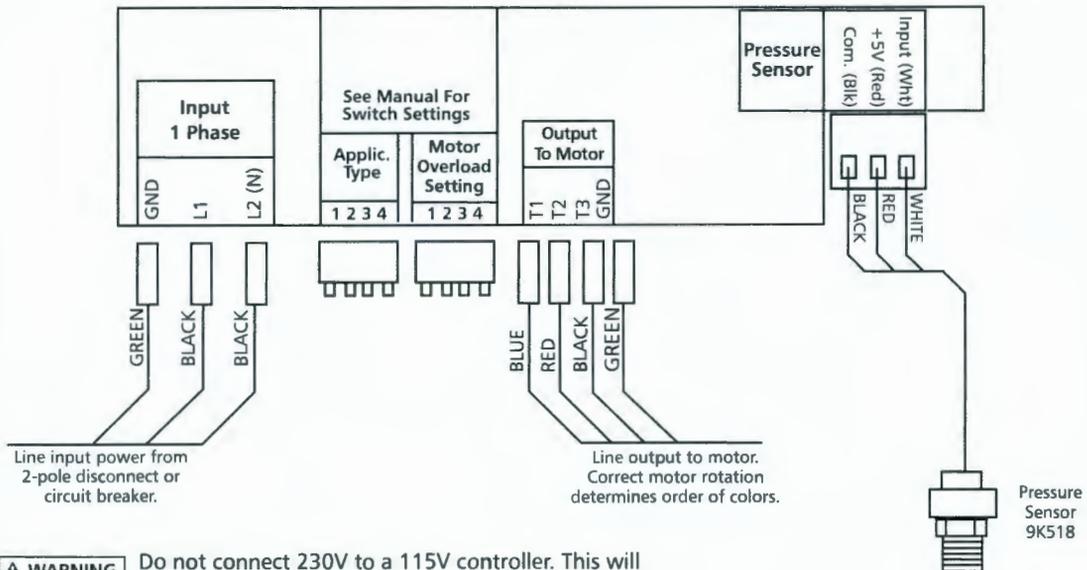


Diagram 3

Aquavar ABII Wiring Diagram

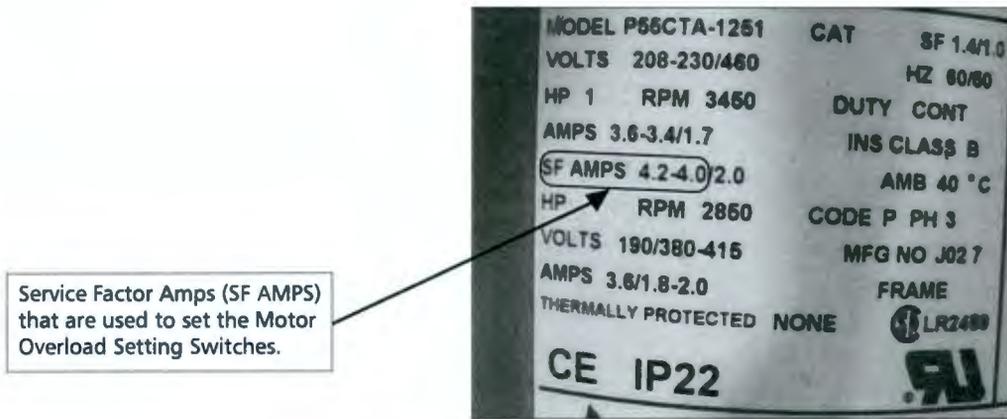


WARNING Do not connect 230V to a 115V controller. This will damage the controller and voids the warranty.

Diagram 4

8: DIAGRAMS (continued)

Typical Motor Nameplate Showing Service Factor Amps (SF AMPS)



In this example, use the 4.2 Amp setting indicated on the Motor Overload Setting Table. This setting is used to account for any voltage fluctuation.

Diagram 5

Labels found on the Controller Access Cover:

Motor Overload Setting		
▲ WARNING Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Motor Overload Setting Switches.		
1 = UP 0 = DOWN		
DIP Switch Setting	Motor Overload Setting (Amps)	
1 2 3 4	1AB2	2AB2
1 1 1 1	2.5	4.6
1 1 1 0	2.8	5.2
1 1 0 1	3.3	5.3
1 0 1 1	3.5	5.8
0 1 1 1	3.8	6.5
0 0 0 0	4.2	6.9

Motor Overload Setting Label

Use this label to choose the correct Motor Overload Switch Setting. This label is found under the controller access cover.

Application Type Switch Setting		
▲ WARNING Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Application Setting Switches.		
1 = UP 0 = DOWN		
DIP Switch Setting	Minimum Speed (Hz)	Ramp Setting
1 2 3 4		
1 1 1 1 *	10	Slow
1 1 1 0 *	10	Medium
1 1 0 1 *	10	Fast
1 0 1 1	30	Slow
0 1 1 1	30	Medium
0 0 0 0	30	Fast
*THESE SETTINGS ARE NOT TO BE USED WITH SUBMERSIBLE PUMPS.		

Diagram 6

Status Code Label

Use this label to diagnose any system errors. This label is found on the side of the controller access cover.

Status Codes*	
Green Light Codes	
Constant	Standby/Low Voltage
Blinking	Pump Running
Red Light Codes	
Constant	Replace Controller
1 Blink	No Water/Loss Of Prime
2 Blinks	Tank Water-Logged
3 Blinks	Pressure Sensor Fault
4 Blinks	Pump or Motor Bound
5 Blinks	Short Circuit
6 Blinks	Ground Fault
7 Blinks	High Temperature
8 Blinks	Over Voltage (>264V)
9 Blinks	Motor Overload
*No Light - No/Very Low Voltage	

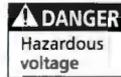
Application Switch Setting Label

Use this label to choose the correct Application Switch Setting. This label is found under the controller access cover.

9: TROUBLESHOOTING

General

The Aquavar ABII is a self-diagnosing controller. If a problem occurs, observe the Status Code Indicator Light on the front of the unit. No Status Code Indicator Light means either no or low input voltage (less than 50 V).



Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker and wait 5 minutes before servicing. High voltage may still remain on controller.

Refer to the status code label on the side of the controller access cover to diagnose system errors. See *Diagram 6* for details.

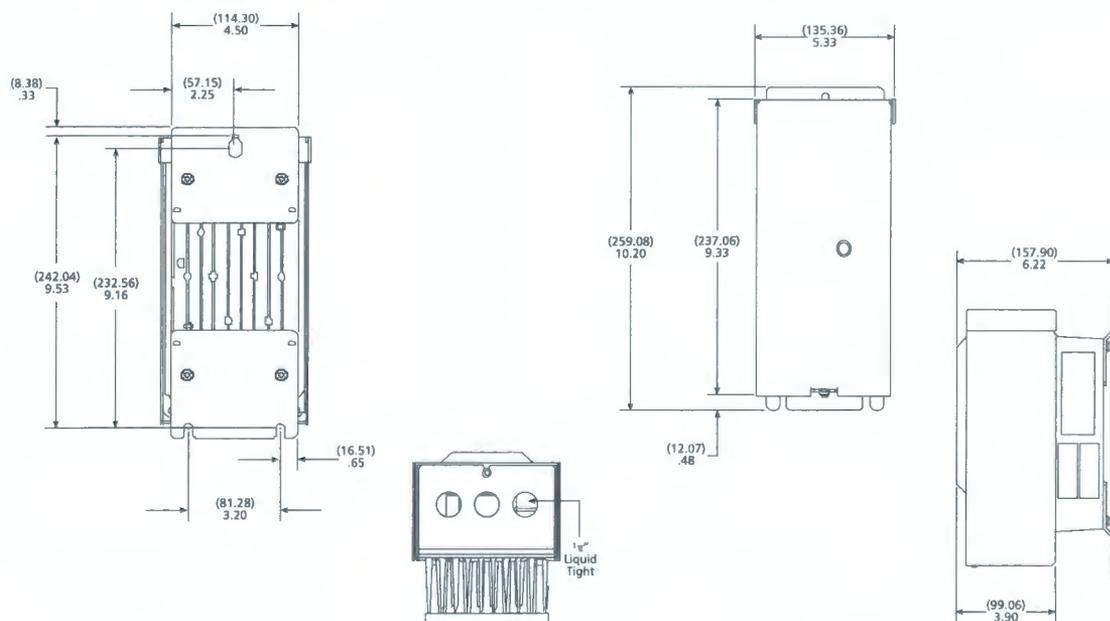
USE THE FOLLOWING TABLE TO HELP TROUBLESHOOT PROBLEMS.

GREEN LIGHT CODES		
Indicator Code	Status	Description
Constant	Standby/Low Voltage	Constant Green Light indicates the pump is off. The system is in Standby mode when there is no flow in the system and the pressure setting has been reached. The system is in a Low Voltage condition when the line input voltage drops below 196VAC for 1AB2 and 2AB2 controllers and 98VAC for 1151AB2 controllers.
Blinking	Pump Running	Flashing Green Light indicates the pump is running. If pump is not running, turn off power to controller and wait 5 minutes. Check output power connections from controller to motor.
RED LIGHT CODES		
Constant	Controller Error	Replace Aquavar ABII Controller
1 Blink	No Water/Loss Of Prime	This fault is indicated if the system pressure drops 5 PSI or more below the set pressure and the output current is less than 75% of the motor overload setting for 10 seconds. The system will automatically restart in 5 minutes. If 3 faults occur in an hour, the system will not restart and will need to be manually reset. If the problem reoccurs, please verify supply capacity, pump capacity, proper setting of the motor overload switches and that there are no restrictions between the supply and the pump.
2 Blinks	Tank Water-Logged	This warning is indicated if there is a drastic drop in system pressure in a short amount of time. The warning will not impact operation. The pump will continue to run. This warning can be caused by low air pressure in the tank or the tank bladder may have failed. This can also be caused by extreme changes in flow. The error is cleared each time the pump starts. If the error reoccurs often, check the air pressure in the tank. Before checking tank air pressure, turn power to control off to prevent pump from turning on. Relieve system pressure by opening a faucet.
3 Blinks	Pressure Sensor Fault	This fault indicates a problem with the pressure sensor feedback. Verify the connections from the Aquavar ABII Controller to the pressure sensor. Turn power to controller off and wait 5 minutes. Remove controller access panel. Be sure sensor cable is wired as shown in Diagram 4. If cable is wired correctly, check the voltage on the Input (White) pressure sensor terminal connection in the Aquavar ABII controller. Using a DC voltmeter, connect the positive lead to the Input (White) pressure sensor terminal connection, connect the negative lead to the Com. (Black) pressure sensor terminal connection. Turn power to controller on. The DC voltage measured should be in the valid range of 0.5 Vdc to 4.5 Vdc (+/- 0.2 Vdc). If the voltage is outside this range, replace pressure sensor.
4 Blinks	Pump or Motor Bound	This fault can be caused by mechanical binding from debris in pump or from an electrical failure in the motor. Verify the error by turning power to controller off for 1 minute and then on. Pump must be checked if error persists.

9: TROUBLESHOOTING (continued)

RED LIGHT CODES		
Indicator Code	Status	Description
5 Blinks	Short Circuit	Check wiring for shorting phase to phase and phase to ground. Turn power to controller off and wait 5 minutes. Remove controller access panel. Disconnect motor leads marked T1, T2, and T3. Measure resistance between all motor leads using an ohmmeter. NOTE: Motor winding resistance is typically 2 to 10 OHMS depending on motor.
6 Blinks	Ground Fault	Check wiring for shorting phase to ground. Turn power to controller off and wait 5 minutes. Remove controller access panel. Disconnect motor leads T1, T2, T3, and Ground from controller. Measure resistance between all motor leads and ground using a Megohmmeter. Connect one Megohmmeter lead to any one of the motor leads and the other to ground lead. Set Megohmmeter to 500V DC output. Resistance readings less than 500,000 ohms or 0.5 Megohms indicate a damaged motor.
7 Blinks	High Temperature	This fault is caused by a high temperature inside of the controller. The controller will shut off when the temperature inside the controller reaches 158° F (70° C). The controller will turn back on when the temperature inside the controller reaches 150° F (65.5° C). Avoid installing the controller where ambient temperatures exceed 104° F (40° C). Avoid installing the controller where it is exposed to direct sunlight.
8 Blinks	Over Voltage	Measure input voltage using an AC voltmeter. Connect the positive and negative leads to L1 and L2 on the Aquavar ABII controller. Verify line input voltage is not greater than 264 VAC for 1AB2 and 2AB2 controllers and 132VAC for 1151AB2.
9 Blinks	Motor Overload	This fault is indicated when the current supplied to the motor exceeds the Motor Overload Setting on the Aquavar ABII controller. Refer to Section 7, <i>Setting the Motor Overload DIP Switches</i> for details. If switches are set according to Section 7, check motor.

10: CONTROLLER DIMENSIONS



GOULDS WATER TECHNOLOGY LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Water Technology.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twenty-four (24) months from date of installation or thirty (30) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Water Technology distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Water Technology Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Water Technology and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.



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QUICK START GUIDE
IMS-ABII 1

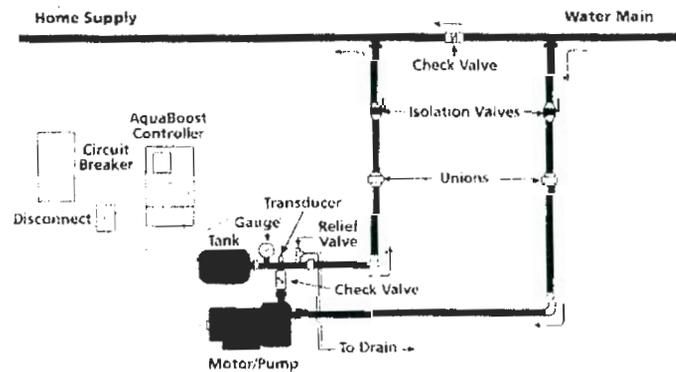
Aquavar ABII Quick Start Guide

Installation Steps:

1. Install the Pump
 - Plumb suction and discharge of pump into piping
 - Install a check valve on the suction side.
 - Locate the pump as near liquid source as possible.
2. Install the Pressure Transducer
 - Install the pressure transducer in the tank tee provided with the unit
 - Locate the transducer within 120" of the controller.
3. Mount the Controller
 - Mount vertically in a well ventilated, shaded area with 8 inches of free air space on every side and temperature between 34° F and 104° F
4. Connect Input Power
 - Connect the 1Ø power from a 20 amp 2-pole circuit breaker
 - Do not use GFCI protection with ABII as nuisance tripping will result
5. Output Power Connections
 - Connect the output power leads from the controller to the 3 motor leads in the conduit box on the motor.
6. Set the motor Overload Switches (or dials, 3 and 5 HP)
 - Complete systems have overloads pre-set at factory.
7. Set the Pressure - Factory pre-set is 50 PSI
 - Push and Hold the Increase or Decrease Pressure Adjust Pushbutton until the desired pressure setting is reached
 - The maximum allowable pressure setting is 85 psi.
8. Set the Application Switches (or dials, 3 and 5 HP)
 - Minimum Speed of 10 Hz - the incoming pressure is within 20 PSI of the desired pressure setting.
 - Minimum Speed of 30 Hz - the incoming pressure is 20 PSI or more below the desired pressure, if pumping from a tank or if drawing a suction lift.
 - Ramp Speed - Slow - Low flow; Medium - Medium flow; Fast - High flow

Aquavar ABII Controller Typical Installation

This diagram shows a set-up for municipal water connection. This allows pump maintenance without main line shut-off.



AquaBoost II Required Components:

1. Pump with Motor
2. AquaBoost II Controller with Integral Pressure Sensor Cable
3. Pressure Tank
4. Pressure Sensor
5. Mounting Kit
6. Tank Tee with Pipe Plug
7. Pressure Gauge

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Let's Solve Water



QUICK START GUIDE
IMS-ABII-2

Aquavar ABII Quick Start Up Guide

LABELS FOUND ON THE CONTROLLER ACCESS COVER:

Fault Codes

Motor Overload Setting		
⚠ WARNING: Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Motor Overload Setting Switches		
1 = UP 0 = DOWN		
DIP Switch Setting	Motor Overload Setting (Amps)	
1 2 3 4	1AB2	2AB2
1 1 1 1	2.5	4.6
1 1 1 0	2.8	5.2
1 1 0 1	3.3	5.3
1 0 1 1	3.5	5.8
0 1 1 1	3.8	6.5
0 0 0 0	4.2	6.9

Status Codes*	
Green Light Codes	
Constant	Standby/Low Voltage
Blinking	Pump Running
Red Light Codes	
Constant	Replace Controller
1 Blink	No Water/Loss Of Prime
2 Blinks	Tank Water Logged
3 Blinks	Pressure Sensor Fault
4 Blinks	Pump or Motor Bound
5 Blinks	Short Circuit
6 Blinks	Ground Fault
7 Blinks	High Temperature
8 Blinks	Over Voltage (>264V)
9 Blinks	Motor Overload
*No Light - No/Very Low Voltage	

Motor Overload Setting Label

Use this label to choose the correct Motor Overload Switch Setting. This label is found under the controller access cover.

Status Code Label

Use this label to diagnose any system errors. This label is found on the side of the controller access cover.

Application Switch Setting		
⚠ WARNING: Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Application Setting Switches		
1 = UP 0 = DOWN		
DIP Switch Setting	Minimum Speed (Hz)	Ramp Setting
1 2 3 4		
1 1 1 1*	10	Slow
1 1 1 0*	10	Medium
1 1 0 1*	10	Fast
1 0 1 1	30	Slow
0 1 1 1	30	Medium
0 0 0 0	30	Fast

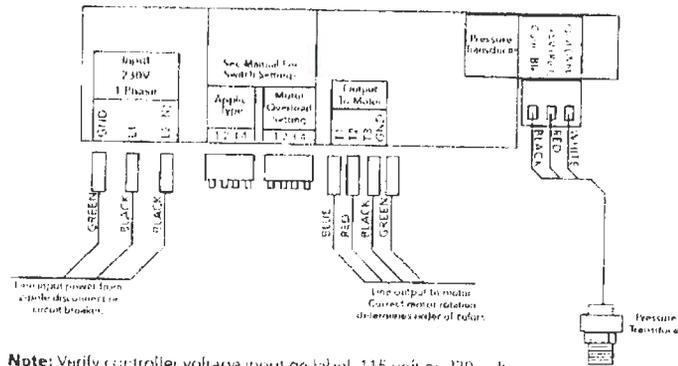
Application Switch Setting Label

Use this label to choose the correct Application Switch Setting. This label is found under the controller access cover.

*THESE SETTINGS ARE NOT TO BE USED WITH SUBMERSIBLE PUMPS.

Aquavar ABII Wiring Diagram

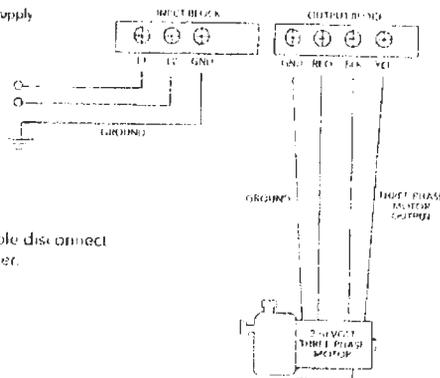
1 AND 2 HP



Note: Verify controller voltage input on label. 115 volt or 230 volt

3 AND 5 HP

* Input Power Supply
Single Phase
208-240 VAC



Note: Use 2 pole disconnect or circuit breaker.

Xylem Inc.
www.xyleminc.com

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Let's Solve Water



ITT

Commercial Water

Goulds Pumps

G&L SERIES

MODEL LB

Installation, Operation and
Maintenance Instructions



Goulds Pumps is a brand of ITT
Residential and Commercial Water.

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Engineered for life

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Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Dealer: _____

Dealer Phone No.: _____

Date of Purchase: _____

Date of Installation: _____

Current Readings at Startup:

1 Ø	3 Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.



This is a **SAFETY ALERT SYMBOL**. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.



DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.



WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.



CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.



Hazardous fluids can cause fire, burns or death.

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

DESCRIPTION and SPECIFICATIONS:

The Model LB is a single stage, centrifugal jet pump for general liquid transfer service and booster applications. The liquid end utilizes a 304SS stamped casing, Noryl[®] impeller, Lexan[®] ejector and guidevane, Amodel[®] motor adapter and EPR o-rings. All motors are NEMA 48Y and 56Y square flange with a 304SS threaded shaft extension.

1. IMPORTANT

- 1.1 Inspect unit for damage. Report any damage to carrier/dealer immediately.
- 1.2 Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., in compliance with National and Local electrical codes. Install an all-leg disconnect switch near pump.



CAUTION ALWAYS DISCONNECT ELECTRICAL POWER WHEN HANDLING PUMP OR CONTROLS.

1.3 Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.

1.4 Always use horsepower-rated switches, contactor and starters.

1.5 Motor protection

1.5.1 Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper overload. Fusing is permissible.

1.5.2 Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.

1.6 Maximum Operating Limits:

Liquid Temperature: 140°F (60°C)

Working Pressure: 85 PSI

Starts per Hour: 20, evenly distributed.

1.7 Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. INSTALLATION

2.1 Locate pump as near liquid source as possible (below level of liquid for automatic operation).

2.2 Protect from freezing or flooding.

2.3 Allow adequate space for servicing and ventilation.

2.4 All piping must be supported independently of the pump, and must "line-up" naturally.



CAUTION NEVER DRAW PIPING IN PLACE BY FORCING THE PUMP SUCTION AND DISCHARGE CONNECTIONS.

2.5 Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.

2.6 Units may be installed horizontally, inclined or vertically.



CAUTION DO NOT INSTALL WITH MOTOR BELOW PUMP. ANY LEAKAGE OR CONDENSATION WILL AFFECT THE MOTOR.

2.7 Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.

2.8 Tighten motor hold-down bolts before connecting piping to pump.

3. SUCTION PIPING

3.1 Low static suction lift and short, direct, suction piping is desired. Consult pump performance curve for *Net Positive Suction Head Required*.

- 3.2 Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.
- 3.3 If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.
- 3.4 Installation with pump below source of supply:
 - 3.4.1 Install full flow isolation valve in piping for inspection and maintenance.

CAUTION DO NOT USE SUCTION ISOLATION VALVE TO THROTTLE PUMP.

- 3.5 Installation with pump above source of supply:
 - 3.5.1 Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.
 - 3.5.2 All joints must be airtight.
 - 3.5.3 Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.
 - 3.5.4 Suction strainer open area must be at least triple the pipe area.
- 3.6 Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figures 2-5.
- 3.7 Use 3-4 wraps of teflon tape to seal threaded connections.

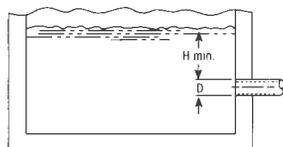


Figure 1

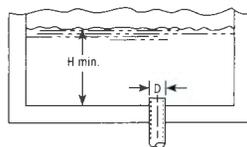


Figure 2

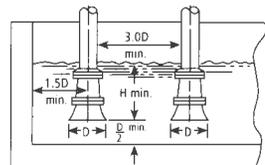


Figure 3

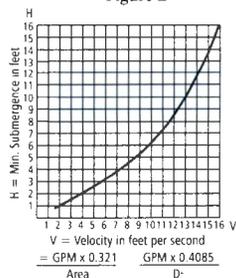


Figure 4

4. DISCHARGE PIPING

- 4.1 Allowance should be made for disconnecting discharge piping near casing to allow for pump disassembly.
- 4.2 Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.
- 4.3 If an increaser is required, place between check valve and pump.
- 4.4 Use 3-4 wraps of Teflon tape to seal threaded connections.

5. ROTATION

- 5.1 Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. To change rotation:
 - 5.1.1 Single-phase motor: Non-reversible
 - 5.1.2 Three-phase motor: Interchange any two power supply leads.

6. OPERATION

- 6.1 Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.
- 6.2 Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping.

7. MAINTENANCE

- 7.1 Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

CAUTION PUMPED LIQUID PROVIDES LUBRICATION. IF PUMP IS RUN DRY, ROTATING PARTS WILL SEIZE AND MECHANICAL SEAL WILL BE DAMAGED. DO NOT OPERATE AT OR NEAR ZERO FLOW. ENERGY IMPARTED TO THE LIQUID IS CONVERTED INTO HEAT. LIQUID MAY FLASH TO VAPOR. ROTATING PARTS REQUIRE LIQUID TO PREVENT SCORING OR SEIZING.

8. DISASSEMBLY

- 8.1 Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work required.
 - 8.1.1 Turn off power.
 - 8.1.2 Drain system and flush if necessary.
 - 8.1.3 Remove motor hold-down bolts.
- 8.2 Disassembly of liquid end:
 - 8.2.1 Remove casing screws (3).
 - 8.2.2 Remove back pull-out assembly from casing.
 - 8.2.3 Remove nozzle/venturi assembly (6) and o-rings (5, 7).
 - 8.2.4 Remove guidevane (8).

CAUTION DO NOT INSERT SCREWDRIVER BETWEEN THE FAN BLADES TO PREVENT ROTATION.

- 8.2.5 Remove impeller (9) by rotating in a counter-clockwise direction.

NOTE: For single and three phase motors, remove the motor end cover and hold the flats on the shaft with a wrench to stop rotation.

NOTE: Further disassembly will require removal of the mechanical seal. It is recommended that a new mechanical seal be installed at reassembly.

- 8.2.6 Lubricate the shaft and mechanical seal with soapy water.
- 8.2.7 Remove rotary portion of the mechanical seal (10).
- 8.2.8 Remove motor adapter screws (15) and motor adapter (13) from motor.
- 8.2.9 Remove stationary portion of mechanical seal (11) from motor adapter (13).

9. REASSEMBLY

- 9.1 Clean all parts before reassembly.
- 9.2 Recommend replacement of o-rings (5, 7, 12) and mechanical seal (10, 11) if removed during disassembly procedure.
- 9.3 Inspect and replace nozzle/venturi assembly (6) if any surface deterioration is noticed in the nozzle area.
- 9.4 Reassembly is the reverse of disassembly. Observe the following when reassembling the pump.
- 9.5 Lubricate o-rings and mechanical seal with soapy water to ease assembly.
- 9.6 Tighten casing screws (3) to 10 ft.-lb. of torque using a star pattern to prevent o-ring binding.

TROUBLESHOOTING

SYMPTOM

MOTOR NOT RUNNING

See Probable Causes 1 thru 6

LITTLE OR NO LIQUID DELIVERED

See Probable Causes 7 thru 17

POWER CONSUMPTION TOO HIGH

See Probable Causes 4, 17, 18, 19, 22

EXCESSIVE NOISE AND VIBRATION

See Probable Causes 4, 6, 9, 13, 15, 16, 18, 20, 21, 22

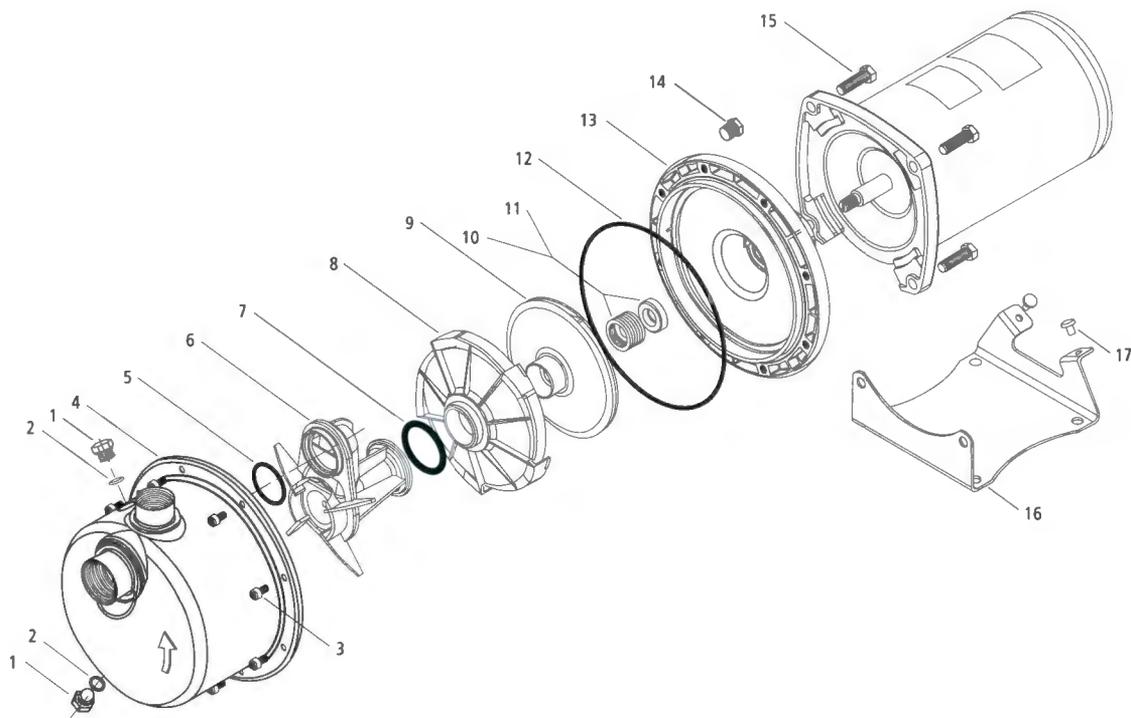
PROBABLE CAUSES

- 1. Tripped thermal protector
- 2. Open circuit breaker
- 3. Blown fuse
- 4. Rotating parts binding
- 5. Motor wired improperly
- 6. Defective motor
- 7. Not primed
- 8. Discharge plugged or valve closed
- 9. Incorrect rotation
- 10. Foot valve too small, suction not submerged, inlet screen plugged
- 11. Low voltage
- 12. Phase loss (3-phase only)
- 13. Air or gasses in liquid
- 14. System head too high
- 15. NPSHA too low:
Suction lift too high or suction losses excessive
Check with vacuum gauge
- 16. Impeller worn or plugged
- 17. Incorrect impeller diameter
- 18. Head too low, causing excessive flow rate
- 19. Viscosity or specific gravity too high
- 20. Worn bearings
- 21. Pump or piping loose
- 22. Pump and motor misaligned

LB COMPONENTS PARTS TABLE

Item No.	Part Description	Material
1	Plug	304 SS
2	O-ring – plug	EPR
3	Socket – head screw	304 SS
4	Casing with plug	304 SS
5	O-ring – suction	EPR
6	Nozzle/venturi assembly	Lexan® 500
7	O-ring – guide vane	EPR
8	Guide vane	Lexan® 10% G.F.
9	Impeller	LB05 4.50" DIA.
		LB07 5.00" DIA.
		LB10 5.25" DIA.
10	Mechanical seal – Rotary	Carbon
11	Mechanical seal – stationary	Ceramic
12	O-ring – casing	EPR
13	Motor adapter with inserts	Amodel® 45% G.F.
14	Pipe plug	SAE 1018
15	Hex cap screw	Steel (zinc plated)
16	Base	Steel
17	Grommet	BUNA

HP	Motor Codes			
	1Ø – ODP	3Ø – ODP	1Ø – TEFC	3Ø – TEFC
½	SFE04853	SFE04873	SFE04821	SFE04876
¾	SFE05853	SFE05873	SFE05821	SFE05876
1	SFE06853	SFE06873	SFE06821	SFE06876





ITT

Commercial Water

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.



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Noryl and Lexan are registered trademarks of GE Plastic.

Amodel is a registered trademark of Solvay.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

IM064R04 August, 2006

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Engineered for life

GOULDS PUMPS

Hydro-Pro® Water System Tank

**Réservoir Hydro-Pro®
pour systèmes
d'alimentation en eau**

**Hydro-Pro® Sistema da
Tanque bara Agua**



Installation, Operation and Maintenance Instructions Directives d'installation, d'utilisation et d'entretien Instalación, Operación e Instrucciones para el Mantenimiento

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Safety Instructions	2	Underground Pressure Tanks	5
The Water Systems Tank Concept	3	Operation	5
Here's how the tank operates at a 30/50 psig pressure switch setting	3	Trouble Shooting	6
Installation Procedures	4	Limited Warranty	7
Multiple Tank Installation Procedures	4		

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Fonctionnement du réservoir dans un système d'alimentation en eau et dans une plage de pression manométrique de 30-50 lb/po ²	9	Utilisation	11
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Lea y siga las instrucciones de seguridad	14	Instrucciones Para Instalación de Tanques de Presión Subterráneos	17
El Concepto de Tanques para sistema de Agua	15	Operación	17
Así es como el Tanque funciona con un sistema diseñado para operar puesto a una presión de 30/50 PSI	15	Buscando Fallas	18
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Read and Follow Safety Instructions!



⚠ DANGER

⚠ WARNING

⚠ CAUTION

This is the safety-alert symbol. When you see this symbol on your system or in this manual, look for one of the following signal words and be alert to the potential for personal injury;

DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

WARNING warns about hazards that **could** cause serious personal injury, death or major property damage if ignored.

CAUTION warns about hazards that may result in minor or moderate injury or property damage if ignored.

This label **NOTICE** indicates special instructions which are important but not related to hazards.

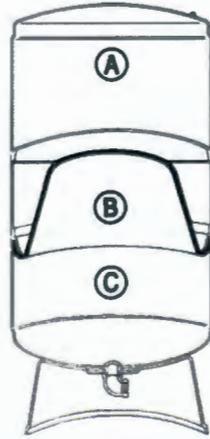
Carefully read and follow all safety instructions in this manual or on system.

Keep safety labels in good condition.
Replace missing or damaged safety labels.

Safety Instructions

1. **⚠ WARNING** - THESE WATER TANKS ARE DESIGNED FOR OPERATION ON AMBIENT TEMPERATURE WATER SYSTEMS LIMITED TO A MAXIMUM WORKING PRESSURE OF 125 POUNDS PER SQUARE INCH GAUGE (PSIG). IF YOUR SYSTEM HAS THE ABILITY TO EXCEED 125 PSIG WORKING PRESSURE (100 PSIG IF THIS IS A PUMP MOUNTED UNIT), A SUITABLE SAFETY DEVICE MUST BE INSTALLED. THIS CAN BE EITHER A HIGH PRESSURE ELECTRICAL CUT-OFF SWITCH AND/OR A PRESSURE RELIEF VALVE. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE TANK RUPTURE AND RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE.
2. It is your responsibility to make sure your installation meets all national and local plumbing and electrical codes.
3. **⚠ DANGER** - Before installing or servicing your pump or tank be sure power source is disconnected.
4. If a captive air water systems tank replaces a standard galvanized tank on a submersible pump installation, bleeder orifices or other air charging devices must be removed. Air charging devices on jet pumps must be removed.
5. **⚠ CAUTION** - Storage tanks are designed for use on ambient temperature - (maximum temperature of 120°F, effective Feb. 2001) water systems. Use of this product on other applications could cause tank failure and possibly personal injury. Use of this tank on other applications voids the warranty.
6. Complete pump, tank and piping system must be protected against freezing. Failure to do so will cause severe damage and voids the warranty.
7. **⚠ DANGER** - Tank contains air pressure. Do not puncture. Never throw tank into fire or incinerator.

The water systems tank concept



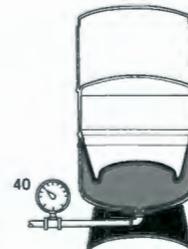
The water system tank does more than simply store water. It helps to protect the system components. A properly sized tank will provide adequate flow even when the pump is not running. It saves energy by reducing the number of pump starts. Another benefit is increased system component life due to fewer pump cycles.

The water system tank consists of a steel tank (A) containing a sealed-in-place heavy duty diaphragm (B) which separates air from the water. The portion of the tank where water is stored (C) is lined to isolate water from the metal tank. This protects the tank from corrosion.

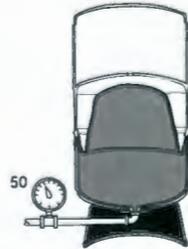
Here's how the tank works for a water system designed to operate at a 30/50 psig pressure switch setting.



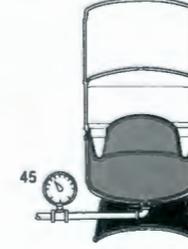
1. Prior to shipping, the tank is pressurized to a standard precharge as defined in "OPERATION" part of this manual.



2. As water enters the tank, the air above the diaphragm is compressed and its volume is reduced by the volume of water that enters.



3. The pressure in the tank rises. Water continues to enter until the pump cut-out pressure is reached. The pump shuts off and the tank is now filled.

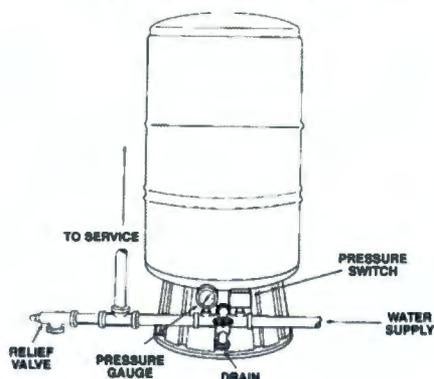


4. The pressure in the air chamber forces water into the system when a demand is made without causing the pump to operate immediately. When the pressure in the chamber finally drops to the pump cut-in pressure, the pump switch activates the pump and repeats the filling cycle.



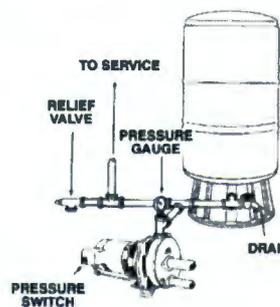
Installation Procedures

TYPICAL SUBMERSIBLE PUMP INSTALLATION



1. The water system tank should be installed as close as possible to the pressure switch (24 inches or less) to reduce the adverse effect of friction loss and elevation differences.
2. Disconnect electric power.
3. Drain system and remove old tank. On new system installation this step is unnecessary.
4. Locate the water system tank on a firm, level surface with adequate drainage. Typical installations are shown in the following section.

TYPICAL JET PUMP INSTALLATION

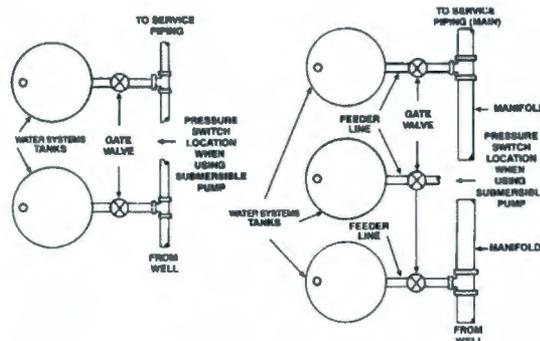


5. If your system is capable of exceeding a working pressure of 125 psig (typically submersible pumps), install a pressure relief valve (rated at 125 psig or less, but greater than turn-off pressure) in the system near the tank. The valve should be the same pipe size as the tank outlet. This is not necessary on tank-mounted jet pump units.
6. Connect tank to the pump discharge line using the same size pipe as the pump tap, or larger.
WARNING: Hold 90° tank street elbow with wrench when threading and tightening connecting pipe.
7. **The tank should be flushed 5 times prior to household use. (See operations section.)**

Multiple Tank Installation Procedure

Water system tanks can be connected together to increase the supply of usable water (drawdown). Two tanks of the same size will double the supply and three tanks will triple the supply. When using a high

capacity pump, the manifold and pressure switch assembly must be installed in the pipe line as close to the center of the tanks as possible. Manifold and main should be 2 times the size of the feederline.

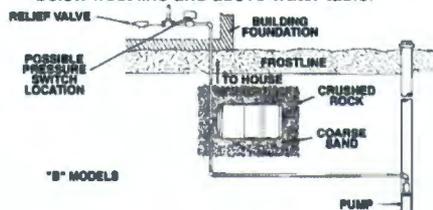


Underground Pressure Tanks

Buried model water system tanks are designed for direct burial and can be installed in the horizontal or vertical position. To eliminate the danger of freezing, tank must be buried below frost line.

The following steps should be taken when installing the water system tank.

1. Make sure that tank will be buried below frost line and above water table.



2. Use galvanized or plastic pipe for section of pipe buried in the ground.
3. Check tank precharge. Tank precharge must be adjusted to the pressure required by the pressure switch setting (see section on Operation).
4. Install tank on firm rock-free earth.
5. The water line from the pump to the tank and from the tank to the pressure switch location should be the same size.
6. Check system for performance and inspect for leaks.
7. Backfill hole with sand or rock-free dirt. Firmly tamp fill to prevent settling.
8. Make note of tank location so that it can be easily located at a later time.

Operation



THESE WATER TANKS ARE DESIGNED FOR OPERATION ON AMBIENT TEMPERATURE WATER SYSTEMS LIMITED TO A MAXIMUM WORKING PRESSURE OF 125 POUNDS PER SQUARE INCH GAUGE (PSIG). IF YOUR SYSTEM HAS THE ABILITY TO EXCEED 125 PSIG WORKING PRESSURE (100 PSIG IF THIS IS A PUMP MOUNTED UNIT), A SUITABLE SAFETY DEVICE MUST BE INSTALLED. THIS CAN BE EITHER A HIGH PRESSURE ELECTRICAL CUT-OFF SWITCH AND/OR A PRESSURE RELIEF VALVE. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE TANK RUPTURE AND RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE.

Before you operate the system you must check your water system tank and system to ensure proper operation.

All water system tanks are precharged at the factory. All 8 and 11 inch diameter tanks are precharged at 18 psig. The 15 inch diameter tanks are precharged at 28 psig while the 22 and 26 inch diameter tanks are precharged to 38 psig. The final precharge pressure should always be 2 to 3 psig below the cut-in (pump turns on) pressure of the pressure switch. Release air or add air as required using the following procedure.

1. Determine the pump cut-in pressure setting. The pressure switch should have this information located on/in the cover.
2. With no water in the tank, measure the precharge of the water system tank using an accurate pressure gauge at the air valve (similar to an auto tire gauge).
3. Release air or add air to the tank to make the pressure in the tank 2 to 3 psig *LESS* than the pump cut-in pressure setting.
4. It will be necessary to expel air from the piping system on new installations. To do this open all faucets and turn on the pump. Observe that a mixture of water and air will sputter from the faucet. Run the system until a steady flow of water exists. Open and close the faucets several times to assure that all air has been removed. If streams do not become steady, an air leak may exist. Check for leaks on suction side piping.
5. It may be necessary to make final adjustments on the system pressure switch setting because at times the actual pressure switch setting will vary from what is stated on the cover. Such variation, though not harmful, could cause a momentary lag of water delivery. To make this adjustment the following steps should be followed:
 - a. Fill the system until the pump shuts off.
 - b. Open a faucet and drain the water system tank until the pump starts.
 - c. If there is a pause in the water flow from the time the water system tank is emptied and the pump starts up again, decrease the air pressure in the tank until it is 2 to 3 psig below the cut-in pressure setting. (See Trouble Shooting section 3(a-b) for procedure)
 - d. Close the faucets and refill the water system tank. Repeat steps (b) and (c) if necessary until there no longer is a pause in water flow.

Trouble Shooting

IF YOU THINK YOU HAVE A PROBLEM WITH YOUR WATER SYSTEM TANK, YOU SHOULD MAKE THE FOLLOWING TESTS AND OBSERVATIONS BEFORE YOU CALL YOUR PROFESSIONAL DEALER.

1. Observe water system operation and note any unusual occurrence such as water spurting from a faucet rather than a steady flow (indicates air in the system) or short cycling of the pump (rapid starts and stops).
2. In the event that evidence of a small leak near the water fitting appears, check at elbow. The introduction of cold water to a warm tank may form condensation especially in warmer climates. It is important to provide adequate drainage.
3. Measure the water drawdown by collecting water in a sufficiently sized container from the time the pump is off (cut-off point) to the time it turns on (cut-in point). Compare the gallons with that shown in the table below for your model of tank. If the volume is close to that shown in the table, your system is operating properly.
 - a. **Air charge in Tank.** Turn off electric power to the pump. Open faucet nearby and drain the tank completely. Check the pressure in the water system tank using a standard, high quality tire gauge. If the air pressure in the tank is below the pump cut-in setting by more than 3 psi, add air to the tank to make it 2 psi less than the cut-in setting. Replace the valve stem cap. Check around the air stem using a soapy solution to check for leaks around welds and seams on the remainder of the tank. If a leak appears on the tank itself then replacement of the tank will be necessary.
 - b. **Pressure Switch Setting.** Start the pump and allow the system pressure to shut off pump. Note both the cut-in and cut-off pressure values on gauge. The difference should not exceed 25 psi. Adjust the pressure switch if necessary after shutting off the electric power to show a difference of 20 psi. Instructions from the pressure switch manufacturer will explain how to do this. Test the system after adjusting the limits. If the pressure switch can't maintain the proper differential then it may need replacement, not the tank.

Tank Specifications

MODEL NO.	DIMENSIONS (INCHES)		DRAWDOWN IN GALS. AT SYSTEM OPERATING PRESSURE RANGE OF:			MAX. DRAWDOWN VOL. (GALS.)	SYSTEM CONNECTION
	DIAMETER	HEIGHT	20/40 PSIG	30/50 PSIG	40/60 PSIG		
IN-LINE MODELS							
V6P	8	11 15/16	0.7	0.6	0.5	1.2	3/4" NPTM
V15P	11	13 15/16	1.7	1.4	1.2	2.7	3/4" NPTM
V25P	11	23 1/16	3.1	2.6	2.2	4.5	3/4" NPTM
V45P	15 3/8	21 1/16	5.1	4.3	3.7	8.4	1" NPTM
FREE STANDING MODELS							
V45	15 3/8	24 15/16	5.1	4.3	3.7	8.4	1" NPTF
V60	15 3/8	32 3/8	7.3	6.1	5.3	12.1	1" NPTF
V80	15 3/8	39 9/16	8.9	7.7	6.7	13.9	1" NPTF
V100	15 3/8	47 1/4	11.8	9.9	8.6	13.8	1" NPTF
V140	22	36 9/16	16.5	13.9	12.1	27.3	1 1/4" NPTF
V200	22	48 5/8	23.9	20.0	17.4	39.3	1 1/4" NPTF
V250	26	46	30.9	25.9	22.5	50.8	1 1/4" NPTF
V260	22	60 11/16	31.2	26.2	22.8	44.7	1 1/4" NPTF
V350	26	61 3/16	42.9	35.9	31.5	70.5	1 1/4" NPTF
FREE STANDING MODELS WITH BASE EXTENTION							
V80EX	15 3/8	42 5/8	8.9	7.7	6.7	13.9	1" NPTF
BURIED MODELS							
V45B	15 3/8	21 1/16	5.1	4.3	3.7	8.4	1" NPTM
V60B	15 3/8	28 1/2	7.3	6.1	5.3	12.1	1" NPTM
V140B	22	32 3/16	16.5	13.9	12.1	27.3	1 1/4" NPTM
V200B	22	44 1/4	23.9	20.0	17.4	39.3	1 1/4" NPTM
MOUNTING MODELS							
*V45MP/PST	15 3/8	25 11/16	5.1	4.3	3.7	8.4	3/4" NPTF
*V60MP/PST	15 3/8	33 1/8	7.3	6.1	5.3	12.1	3/4" NPTF

*Maximum working pressure of tank 100 PSIG; all other models above 125 PSIG.

Limited Warranty

A.O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this water system tank.

1. TANK

If within five years after installation the tank or a part thereof shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option, shall exchange or repair such part or portion. The warranty on the replacement tank will be limited to the unexpired term of the original warranty.

2. CONDITIONS AND EXPECTATIONS

This warranty shall apply only when the tank is installed in accordance with local plumbing and building codes, ordinances and regulations, and good industry practices. In addition, a high pressure electrical cut-off switch and/or a pressure relief valve must be installed when the tank is installed on an ambient temperature water system whose maximum working pressure has the ability to exceed 125 pounds per square inch gauge (psig). (100 pounds per square inch gauge (psig) on certain models)

a. This warranty shall apply only when the water system is used:

(1) on ambient temperature water systems at pressures not exceeding the working pressure for the water system;

(2) in the United States, its territories or possessions, and Canada.

b. Any accident to the water system tank, any misuse, abuse (including freezing), or alteration of it, any operation of it in a modified form, any attempt to repair tank leaks will void this warranty.

3. SERVICE AND REPAIR EXPENSE

Under this limited warranty the warrantor will provide only a replacement tank or part thereof. The owner is responsible for all other costs. Such costs may include but are not limited to:

a. Labor charges for service, removal, repair, or reinstallation of the water system or any component part,

b. Shipping and delivery charges for forwarding the new tank or replacement part from the nearest distributor and returning the claimed defective tank or part to such distributor except in the state of California where such charges are the manufacturer's responsibility.

4. LIMITATION ON IMPLIED WARRANTIES

Implied warranties, including any warranty of merchantability imposed on the sale of this tank under state law are limited to five (5) year duration for the tank or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. CLAIM PROCEDURES

Any claim under this warranty should be initiated with the dealer who sold the tank, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

U.S Customers
A.O. Smith Corporation
5621 W. 115th Street
Alsip, IL 60803
800-323-2636 or 708-489-4600

Canadian Customers
A.O. Smith Corporation
P.O. Box 310-768 Ene Street
Stratford, Ontario N5A 6T3
Telephone: (519) 271-5800

a. The warrantor will only honor replacement with identical or similar tank or parts thereof which are manufactured or distributed by the warrantor.

b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. DISCLAIMERS

NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE TANK OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE TANK. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR IN TORT.

a. Some states do not allow the exclusion or limitation of the incidental or consequential damages, so the above limitation or exclusion may not apply to you.

b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the water system tank.

Model No. _____ Serial No. _____ Date Installed _____

Dealer's Name _____

Dealer's Address _____ Phone No. _____

City & State (Provincial) _____ Zip (Postal Code) _____

Dangerous Goods Permit No. SU 5099 (Ren2) - by road or rail vehicle only, expiration date: March 31, 2003 (Pending Renewals)

Attachment D-2
Goulds 2AB22HMIF2EO

BEST AVAILABLE COPY



Item #2

RWS-SKD-001

Goulds Pump Model

2AB22HM1F2E0

IO&M Manual

PROCUREMENT / CONTRACT SUBMITTAL	
APW <input type="checkbox"/>	AP <input checked="" type="checkbox"/>
A <input checked="" type="checkbox"/> Complies to the Contract Requirements	
B <input type="checkbox"/> Minor Comments - Approved With Exceptions as Corrected	
<input type="checkbox"/> Re-submittal requested <input type="checkbox"/> Re-submittal not required	
C <input type="checkbox"/> Not Approved - Revise and Resubmit	
Sign: <i>Debra Bare/Harmon</i>	Date: <i>6/18/12</i>

PO Box 81186 • 5930 First Avenue South • Seattle, WA 98108
(206) 767-6700 • (800) 767-6700 • Fax (206) 767-6230
www.b-k.com

Goolds Pumps

Residential and Commercial Water Systems

INPUT AND OUTPUT POWER (VOLTAGE AND PHASE)

- All 1AB2 and 2AB2 require single-phase input power
 - All will work on 1Ø, 208-230V input power
 - Some 1AB2's will work on 1Ø, 115V input power
- All controllers output three phase, 230 Volt power
- All pumps are equipped with three phase motors

*1AB2 – Controller

- 4.2 Amp, 208-230 V, single phase input
- 1 HP variable speed controller
- Wall mount set • Transducer • Pre-wired
- Pump and tank not included

2AB2 – Controller

- 6.9 Amp, 208-230 V, single phase input
- 2 HP variable speed controller
- Wall mount set • Transducer • Pre-wired
- Pump and tank not included

*1AB2LB1035

- 1 HP controller • Wall mount set
- 1B stainless steel jet pump
- Transducer • Discharge tee • VGP tank, pressure gauge
- Controller is pre-wired to the pump. Flows to 15 GPM.

2AB21MC1F2B2

- 2 HP controller • Wall mount set • 208-230 V input
- MCC cast iron / stainless steel pump
- Transducer • VGP (2 gallon) tank and pressure gauge
- Controller is pre-wired. Flows to 27 GPM.

2AB21MC1G2A2

- 2 HP controller • Wall mount kit • 208-230 V input
- MCC cast iron / stainless steel pump
- Transducer • VGP (2 gallon) tank and pressure gauge
- Controller is pre-wired. Flows to 32 GPM.

*1AB21HM1E2D0

- 1 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- VGP (2 gallon) tank and discharge pipe tee
- Controller is pre-wired. Flows to 20 GPM.

*1AB22HM1E2D0

- 1 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- VGP (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 30 GPM.

2AB22HM1F2E0

- 2 HP controller • Wall mount kit • 208-230 V input
- HMS stainless steel pump • Transducer
- VGP (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 30 GPM.

3AB2LCB1H2D0

- 3 HP controller • Wall mount kit • 208-230 V input
- LCB stainless steel pump • Transducer
- VGP (2 gallon) tank, pressure gauge and discharge pipe tee
- Controller is pre-wired. Flows to 50 GPM.

2AB22MC1G2D2

- 2 HP controller • Wall mount kit • 208-230 V input
- MCC cast iron/stainless steel impeller pump
- Pressure transducer
- VGP (2 gallon) tank, pressure gauge, 1 1/2" bronze discharge tank tee
- Controller and motor are pre-wired. Flows to 80 GPM.

**5AB22MC1J2K2

- 5 HP controller • Wall mount • 208-230 V input
- MCC cast iron/stainless impeller pump
- Pressure transducer
- Pressure gauge, 1 1/2" bronze tank tee
- Controller and motor are pre-wired. Flows to 100 GPM.

**5AB2LCC1J2D0

- 5 HP controller • Wall mount • 208-230 V input
- LCC stainless steel pump • Pressure transducer
- Pressure gauge, 1 1/2" bronze tank tee
- Controller and motor are pre-wired. Flows to 70 GPM.

* 1 HP available in 115 volt models, see price book.

** Tank not included.



INSTRUCTION MANUAL

IM156



MODELS COVERED:

1151AB2 (115V, 4.2A), 1AB2 (230V, 4.2A),
2AB2 (230V, 6.9A)

Aquavar ABII Controller

VARIABLE SPEED PUMP CONTROL

INSTALLATION, OPERATION AND TROUBLESHOOTING MANUAL



Owner's Information

Controller Model Number: _____
 Controller Serial Number: _____
 Pump Model Number: _____
 Pump Serial Number: _____
 Motor Model Number: _____
 Motor SFA: _____
 Tank Serial Number: _____
 Installer: _____

 Installer Telephone Number: _____
 Installation Date: _____
 Wire Lengths (Feet)
 Service Entrance to Controller: _____
 Controller to Motor: _____
 Incoming Voltage: _____

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NOTICE: RECORD THE MODEL NUMBERS AND SERIAL NUMBERS FROM THE PUMP AND CONTROLLER IN THIS INSTRUCTION MANUAL FOR FUTURE REFERENCE. GIVE IT TO THE OWNER OR AFFIX IT TO THE CONTROLLER WHEN FINISHED WITH THE INSTALLATION.

NOTE:

- Use Copper wire only.
- Suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes. Branch circuit protection provided by fuses.
- Suitable for use in a pollution degree 2 micro-environment.
- Motor overload protection provided at 110% of full load current.
- In order to maintain the environmental rating integrity of the enclosure, all openings must be closed by equipment rated 3, 3R, 3S, 4, 4X, 6 or 6P.
- Maximum ambient temperature is 50° C.

1: SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON EQUIPMENT.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE UNIT.



This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump, the controller or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Used without a safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

NOTE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS CONTROLLER.

MAINTAIN ALL SAFETY DECALS.

ALL OPERATING INSTRUCTIONS MUST BE READ, UNDERSTOOD, AND FOLLOWED BY THE OPERATING PERSONNEL. GOULDS WATER TECHNOLOGY ACCEPTS NO LIABILITY FOR DAMAGES OR OPERATING DISORDERS WHICH ARE THE RESULT OF NON-COMPLIANCE WITH THE OPERATING INSTRUCTIONS.

1. This manual is intended to assist in the installation, operation and repair of the system and must be kept with the system.
2. Installation and maintenance **MUST** be performed by properly trained and qualified personnel.
3. Review all instructions and warnings prior to performing any work on the system.
4. Any safety decals **MUST** be left on the controller and pump.
5.  **DANGER** The system **MUST** be disconnected from the main power supply before attempting any operation or maintenance on the

Hazardous voltage

electrical or mechanical part of the system. Failure to disconnect electrical power before attempting any operation or maintenance can result in electrical shock, burns or death.

6.  **CAUTION** When in operation, the motor and pump could start unexpectedly and cause serious injury.

Hazardous Pressure

2: SYSTEM COMPONENTS

Please review the Aquavar ABII components and insure that you have all the parts and are familiar with their names. Be sure to inspect all components Goulds Water Technology supplies for shipping damage.

Aquavar ABII:

1. Pump with Motor
2. Aquavar ABII Controller with Integral Pressure Sensor Cable
3. Pressure Tank (supplied on some models)
4. Pressure Sensor
5. Mounting Kit
6. Tank Tee with Pipe Plug
7. Pressure Gauge

WARNING



Hazardous voltage



Hazardous Pressure

DO NOT power the unit or run the pump until all electrical and plumbing connections, especially the pressure sensor connection, are completed. The pump should not be run dry. All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code (CEC) as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury, death, damage to equipment, unsatisfactory performance and may void manufacturer's warranty.

3: SYSTEM DESIGN

NOTE: Systems **MUST** be designed by qualified technicians only and meet all applicable state and local code requirements.

The following diagrams show a typical system using the Aquavar ABII Constant Pressure System. Connection can be made directly to a water supply or water can be drawn from a supply tank. Diagram #1 shows a typical set up for a supply tank.

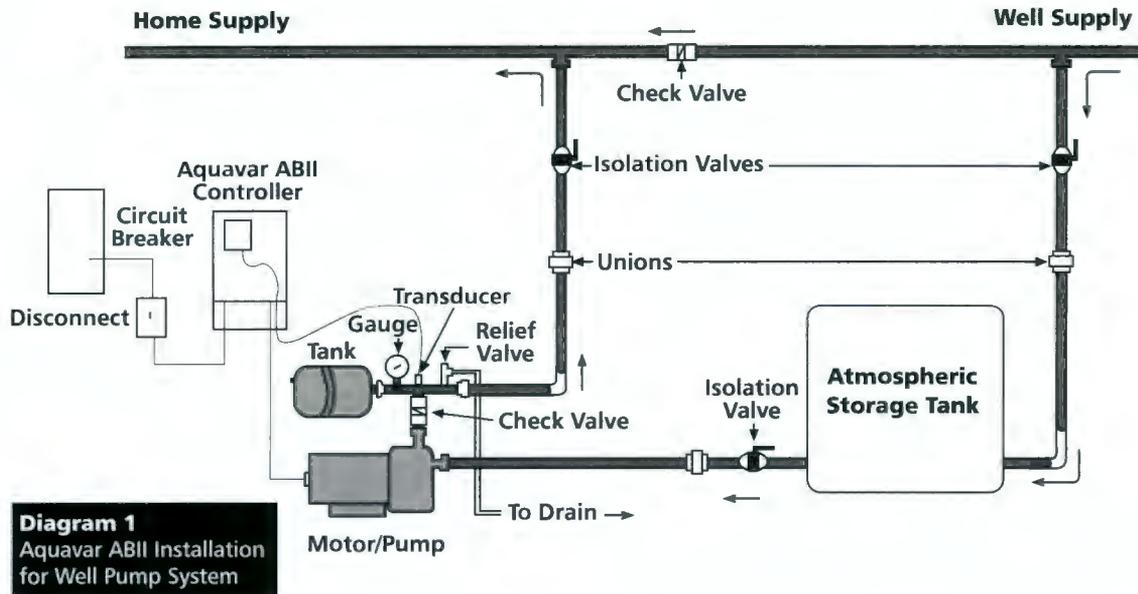
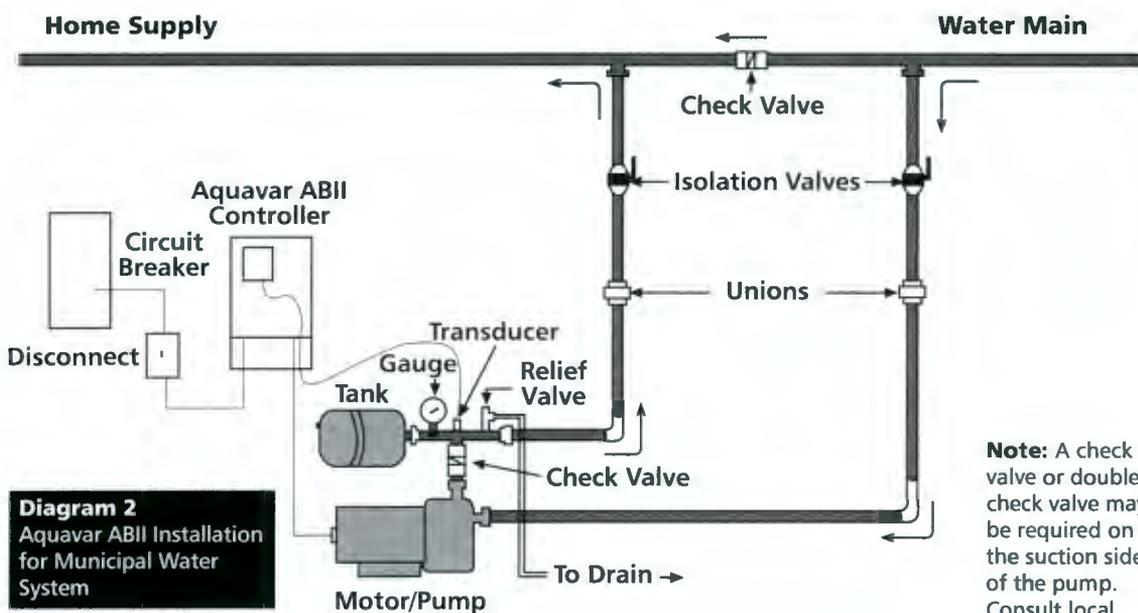


Diagram #2 shows a set-up for municipal water connection. This allows pump maintenance without main line shut-off.



4: PIPING

General

NOTE: All plumbing work must be performed by a qualified technician. Always follow all local, state and provincial codes.

A proper installation requires a pressure relief valve, a 1/4" female N.P.T. threaded fitting (found on tank tee) for the pressure sensor, and properly sized pipe. Piping should be no smaller than the pump discharge and/or suction connections. Piping should be kept as short as possible. Avoid the use of unnecessary fittings to minimize friction losses.

CAUTION **Hazardous Pressure** Some pump and motor combinations supplied with this system can create over 200 PSI. Select pipe and fittings accordingly per your pipe suppliers' recommendation. Consult local codes for piping requirements in your area.

All joints must be airtight. Use Teflon tape or another type of pipe sealant to seal threaded connections. Please be careful when using thread sealant as any excess that gets inside the pipe may plug the pressure sensor.

Galvanized fittings or pipe should never be connected directly to the stainless steel discharge head or casing as galvanic corrosion may occur. Barb type connectors should always be double clamped.

Pressure Tank, Pressure Relief Valve and Discharge Piping

The standard Hydro-Pro tanks have a pre-charge of 38 PSI. You may set the tank pre-charge anywhere between this value and 10 PSI below the system operating pressure. Use the higher tank pre-charge setting if the system drifts over 5 PSI at a constant flow rate. Use only "pre-charged" tanks on this system. Do not use galvanized tanks. Select an area that is always above 34° F (1.1° C) in which to install the tank and pressure relief valve. If this is an area where a water leak or pressure relief valve blow-off may damage property, connect a drain line to the pressure relief valve. Run the drain line from the pressure relief valve to a suitable drain or to an area where water will not damage property. Use the supplied tank tee to connect the discharge pipe to the pressure tank and house plumbing. It is allowable to pump to multiple locations.

WARNING Maximum working pressure of most HydroPro tanks is 125 psi. Check the tank label or instruction manual to verify data.

Installing the Pump

WARNING **Hazardous voltage** **CAUTION** **Hazardous Pressure** **WARNING:** Risk of electric shock - This pump system has not been investigated for use in swimming pool areas.

CAUTION **Hazardous Pressure** Plumb suction and discharge of pump into piping. Locate the pump as near liquid

source as possible. When pumping out of an atmospheric tank locate the pump below the level of the liquid in the tank. All piping must be supported independently of the pump. Be sure that suction and discharge piping are in line with the suction and discharge of the pump. Install a check valve between the discharge of the pump and the pressure sensor and tank. For additional information refer to Installation, Operation and Maintenance Instructions supplied with the pump.

Installing the Pressure Sensor

Install the pressure sensor in the tank tee provided with the unit. The pressure sensor cable supplied with the controller is 120 inches long. Locate the controller so there will be enough cable to properly install the pressure sensor.

CAUTION **Hazardous Pressure** Do not install any shut-off valves, filters or flow/pressure control devices (except for a check valve) between the pressure sensor and the discharge of the pump as this could create a hazardous situation.

Use **ONLY** the pressure sensor provided with the unit. Install the pressure sensor into one of the 1/4" holes on the tank tee provided in the kit. Install the pressure sensor vertically to avoid accumulation of debris in the sensor port. Do not install the tank tee with the 1/4" holes facing down. Align the connector on the end of the pressure sensor cable with the mating connector on the pressure sensor and push it on. The tab will lock it in place. Prevent water from following the cable and entering sensor connector by creating a "drip loop" in the cable.

5: MOUNTING THE CONTROLLER

General

Mount the controller in a well ventilated, shaded area using the supplied mounting kit. The controller must be mounted vertically. Be sure to leave 8 inches of free air space on every side of the unit. The controller must be in an area with an ambient between 34° F (1.1° C) and 104° F (40° C). Model 2AB2 will automatically decrease (derate) the maximum output current of the drive (6.9A) if the ambient temperature exceeds 104° F (40° C). The maximum output current of the drive will be decreased by 0.069A for every degree Fahrenheit above 104° F, or -1%/° F. The maximum output current of the drive will be decreased by 0.12A for every degree Celsius above 40° C, or -1.75%/° C. Model 1AB2 does not require ambient derating and will maintain a maximum output current of 4.2A in high ambient temperatures. If installation is more than 3300 feet above sea level, drive output should also be derated by 2% per 1000 feet above 3300 feet.

NOTE: Do not block the heat sink (fins) and do not set anything on the units.

⚠ WARNING The controller access cover should always be securely fastened to the control box due to the dangerous voltage/shock hazard inside the unit.

6: POWER SUPPLY AND WIRING

Power Supply

⚠ DANGER The 1151AB2 Controller requires a single phase power supply of 115 volts +/- 15%. The 1AB2 and 2AB2 Controllers require a single phase power supply of 230 volts +/- 15%. All controllers require a dedicated 20 amp two-pole circuit breaker. A dedicated circuit means no other appliances use the same circuit! The output power from the motor controller is three-phase, variable frequency and variable voltage. Maximum output voltage and frequency are line input voltage and 60 Hz, respectively. Low supply voltage will reduce pump performance.

NOTE: Installation and maintenance MUST be performed by properly trained and qualified personnel. Always follow the National Electric Code or Canadian Electric Code, as well as all local, state and provincial codes when wiring the system.

Wire and Conduit

Do not use wire smaller than 14 AWG. Use of Metal Conduit with Metal Conduit Connectors is recommended for all electrical connections.

Output Power Connections

⚠ DANGER Connect the motor leads for 230 volt or 208 volt operation using the nameplate as a reference. Connect the output power leads from the controller to the 3 motor leads in the conduit box on the motor. Connect the ground (green) output power lead to the ground screw in the conduit box on the motor. This step is performed in its entirety at the factory for complete systems. See diagram 4 for details.

NOTE: If the pump has more than 50 feet of wire from the controller, consult factory for selection of an output load filter (load reactor).

Connecting Input Power

⚠ DANGER Connect the single-phase power supply leads and Safety Ground wire from a 20 amp two-pole circuit breaker (in the OFF position) to one side of a 20-amp two-pole disconnect switch. Connect the input power leads supplied with the controller to the other side of the disconnect switch. Be sure to use Metal Conduit with Metal Conduit Connectors for electrical connections.

⚠ DANGER The controller has a high leakage current to ground. The terminals marked "GND" in the controller must be connected to the safety ground from the electrical service entrance. Failure

to properly ground the controller or motor will create an electrical shock hazard.

NOTE: Do not use GFCI protection with this controller. Nuisance tripping will result.

7: STARTING THE SYSTEM

⚠ DANGER Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker before servicing.

⚠ DANGER Once the controller is powered it will remain electrically charged for 5 minutes after power is turned off. Wait 5 minutes after disconnecting power before opening controller access cover as there is a severe shock hazard.

Setting the Motor Overload Switches

⚠ DANGER When the unit is powered, the Motor Overload Setting Switches are at a high voltage potential. DO NOT touch the Motor Overload Setting Switches while the power is on.

The Motor Overload Setting Switches adjust the level of motor overload current protection needed to protect the motor from damage due to overcurrent conditions. Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Remove controller access cover. On the inside of the access cover is the Motor Overload Setting table. See Diagram 6 for details. This table shows the switch setting for the desired Motor Overload Setting. Read the Service Factor Amps off the motor nameplate. Use the Motor Overload Setting table to match the Service Factor Amps (SF Amps) of the motor to the correct switch setting. See Diagram 5 for details. Set the Motor Overload Switches according to the correct combination on the table. If the Service Factor Amps of the motor do not match any of the Motor Overload Settings, use the next lowest switch setting. See Diagram 3 for details.

NOTE: The Motor Overload Setting Switches are preset at the factory for complete systems.

⚠ CAUTION Failure to perform this step will result in loss of Motor Overload Protection and will void the Motor Warranty. Nuisance Motor Overload Error tripping or motor damage can occur if these switches are not set properly.

Setting the Pressure

Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Remove controller access cover. Open a faucet in the system and turn the breaker/disconnect switch to the ON position. The pump will start and pressure will increase to the factory preset 50 PSI. After the pressure has stabilized, use the Increase/Decrease Pressure Adjust Push buttons on the right-hand side of the controller to adjust the pressure setting.

Push and Hold the Increase or Decrease Pressure Adjust Pushbutton until the desired pressure setting is reached. The new pressure setting is automatically saved. Close the faucet and turn power to controller off. Wait 5 minutes before installing the controller access cover.

NOTE: The maximum allowable pressure setting is 85 psi.

Setting the Application Switches

⚠ DANGER Hazardous voltage When the unit is powered, the Application Setting Switches are at a high voltage potential. **DO NOT** touch the Application Setting Switches while the power is on.

The controller has 6 possible Application Settings. These settings are used to adjust the Minimum Speed of the motor and the Ramp Setting, or acceleration and deceleration ramp. This allows the controller to fit a wide range of applications.

Before adjusting the Application Switches, turn the circuit breaker and disconnect switch to the off position. Wait 5 minutes. Remove the controller access cover. On the inside of the access cover is the Application Switch Setting Table. *See Diagram 6 for details.* This table shows the switch setting needed for the desired system response. *See Diagram 3 for details.*

Select a Minimum Speed of 10 Hz if the pressure at the pump's suction is within 20 PSI of the desired pressure setting. Select a Minimum Speed of 30Hz if the pressure at the pump's suction is more than 20 PSI below the desired pressure setting, if pumping from a tank or if drawing a suction lift.

Changing the Ramp Setting changes how fast the controller can change the speed of the motor. A Slow Ramp Setting allows the controller to work better in applications where the average demand for water is low (less than 3GPM or about 1 faucet). A Fast Ramp Setting allows the controller to work better in applications where the demand for water is high because the motor is allowed to change speed faster.

NOTE: The Application Switches are preset at the factory to "0000" or Minimum Speed = 30 Hz, Ramp Setting = Fast.

Motor Rotation Direction

If the pressure or flow seems low, check motor rotation direction. Turn the circuit breaker and disconnect switch to the off position, and wait 5 minutes. Switch any two leads on the controller output (T1, T2, or T3). Turn the circuit breaker and disconnect switch to the on position. Observe pressure and flow. If pressure or flow still seems low check plumbing.

NOTE: It is possible for the pump to maintain constant pressure with a low flow or a high positive suction head even if the pump is rotating backwards. While the pump is running, use an amp probe on one of the output power leads connected to the motor and compare the current draw between the two rotation directions. The lowest current reading indicates the pump is running in the correct direction.

System Status

The controller is always powered. A Solid Green Status Code indicates that the pump is in standby mode (pump not running) or that the line input voltage is low.

⚠ DANGER Hazardous voltage Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker and wait 5 minutes before servicing.

A Blinking Green Status Code indicates that the pump is running. A Blinking or Solid Red Light indicates a problem with the controller. Refer to the access cover side panel or Diagram 6 for Status Codes. *See Section 9 for more details.*

8: DIAGRAMS

Motor Overload and Application Switch Setting



When the unit is powered, the Motor Overload and Application Setting Switches are at a high voltage potential. Always turn off the disconnect switch and circuit breaker and wait 5 minutes before touching the Motor Overload or Application Setting Switches.

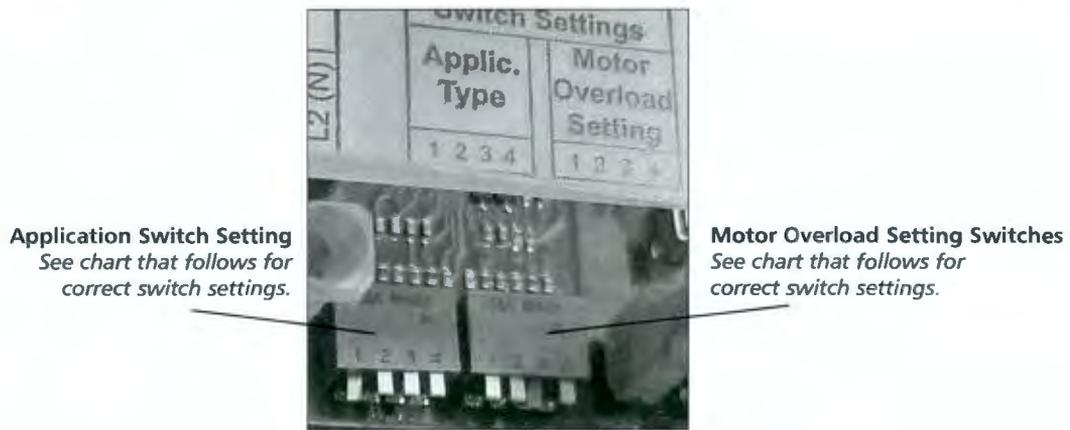


Diagram 3

Aquavar ABII Wiring Diagram

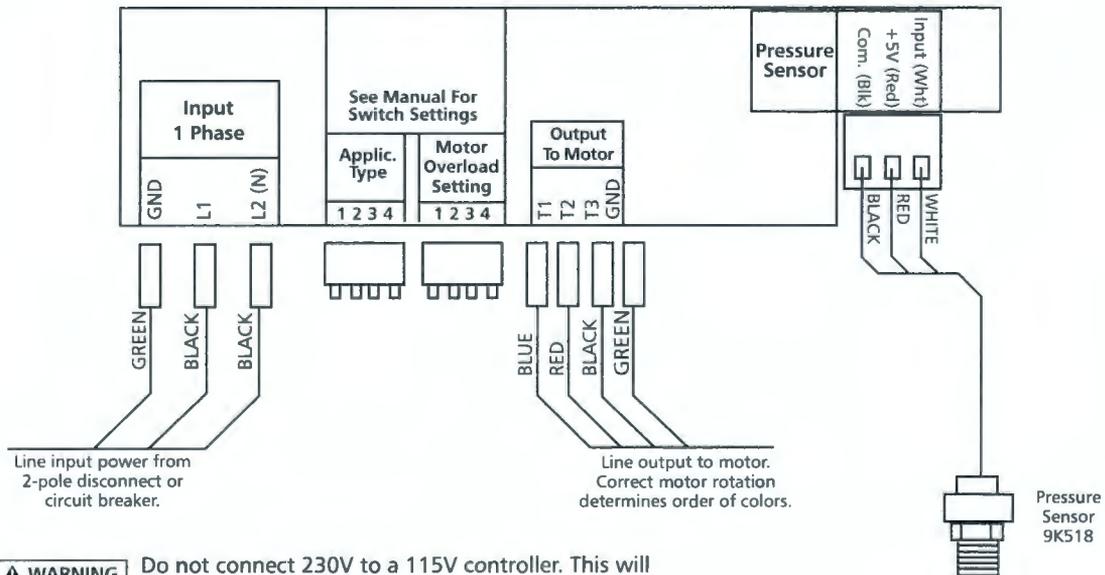
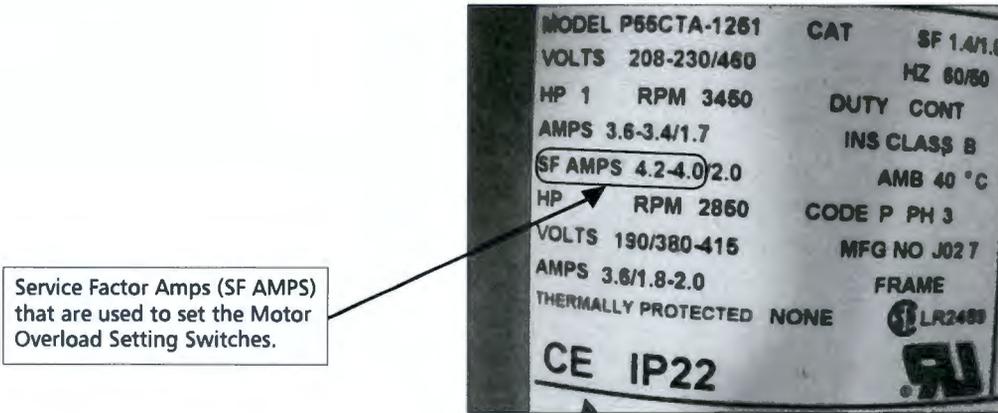


Diagram 4

8: DIAGRAMS (continued)

Typical Motor Nameplate Showing Service Factor Amps (SF AMPS)



In this example, use the 4.2 Amp setting indicated on the Motor Overload Setting Table. This setting is used to account for any voltage fluctuation.

Diagram 5

Labels found on the Controller Access Cover:

Motor Overload Setting		
▲ WARNING Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Motor Overload Setting Switches.		
1 = UP 0 = DOWN		
DIP Switch Setting	Motor Overload Setting (Amps)	
1 2 3 4	1AB2	2AB2
1 1 1 1	2.5	4.6
1 1 1 0	2.8	5.2
1 1 0 1	3.3	5.3
1 0 1 1	3.5	5.8
0 1 1 1	3.8	6.5
0 0 0 0	4.2	6.9

Motor Overload Setting Label

Use this label to choose the correct Motor Overload Switch Setting. This label is found under the controller access cover.

Application Type Switch Setting		
▲ WARNING Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Application Setting Switches.		
1 = UP 0 = DOWN		
DIP Switch Setting	Minimum Speed (Hz)	Ramp Setting
1 1 1 1 *	10	Slow
1 1 1 0 *	10	Medium
1 1 0 1 *	10	Fast
1 0 1 1	30	Slow
0 1 1 1	30	Medium
0 0 0 0	30	Fast
*THESE SETTINGS ARE NOT TO BE USED WITH SUBMERSIBLE PUMPS.		

Status Codes*	
Green Light Codes	
Constant	Standby/Low Voltage
Blinking	Pump Running
Red Light Codes	
Constant	Replace Controller
1 Blink	No Water/Loss Of Prime
2 Blinks	Tank Water-Logged
3 Blinks	Pressure Sensor Fault
4 Blinks	Pump or Motor Bound
5 Blinks	Short Circuit
6 Blinks	Ground Fault
7 Blinks	High Temperature
8 Blinks	Over Voltage (>264V)
9 Blinks	Motor Overload
*No Light - No/Very Low Voltage	

Status Code Label

Use this label to diagnose any system errors.

This label is found on the side of the controller access cover.

Application Switch Setting Label

Use this label to choose the correct Application Switch Setting. This label is found under the controller access cover.

Diagram 6

9: TROUBLESHOOTING

General

The Aquavar ABII is a self-diagnosing controller. If a problem occurs, observe the Status Code Indicator Light on the front of the unit. No Status Code Indicator Light means either no or low input voltage (less than 50 V).



Status Code Indicator Light is not a voltage indicator! Always turn off disconnect switch and circuit breaker and wait 5 minutes before servicing. High voltage may still remain on controller.

Refer to the status code label on the side of the controller access cover to diagnose system errors. See Diagram 6 for details.

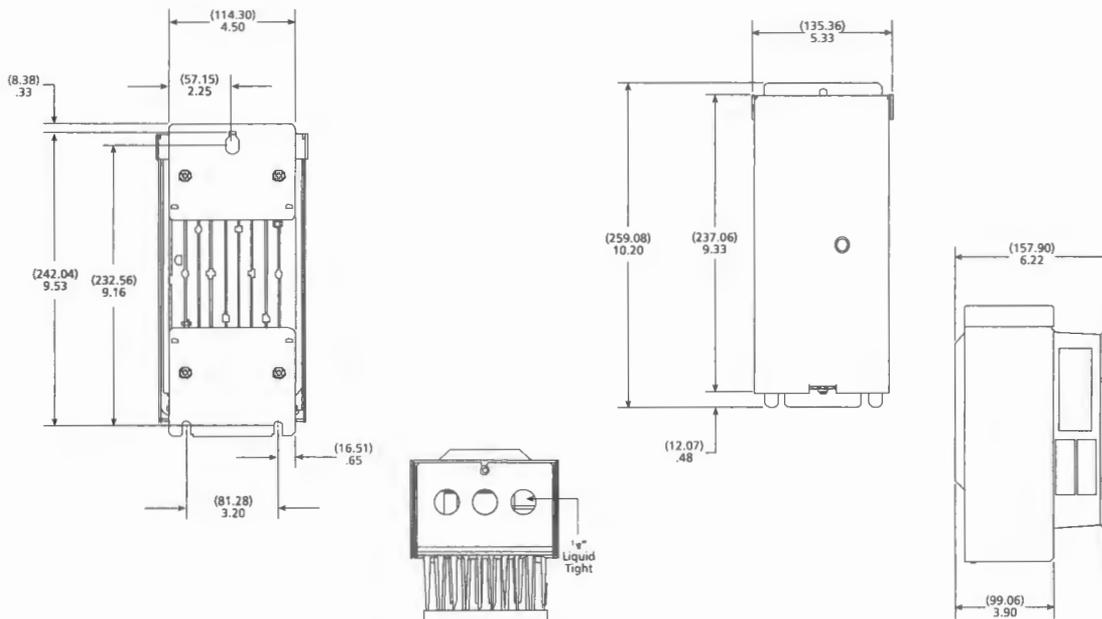
USE THE FOLLOWING TABLE TO HELP TROUBLESHOOT PROBLEMS.

GREEN LIGHT CODES		
Indicator Code	Status	Description
Constant	Standby/Low Voltage	Constant Green Light indicates the pump is off. The system is in Standby mode when there is no flow in the system and the pressure setting has been reached. The system is in a Low Voltage condition when the line input voltage drops below 196VAC for 1AB2 and 2AB2 controllers and 98VAC for 1151AB2 controllers.
Blinking	Pump Running	Flashing Green Light indicates the pump is running. If pump is not running, turn off power to controller and wait 5 minutes. Check output power connections from controller to motor.
RED LIGHT CODES		
Constant	Controller Error	Replace Aquavar ABII Controller
1 Blink	No Water/Loss Of Prime	This fault is indicated if the system pressure drops 5 PSI or more below the set pressure and the output current is less than 75% of the motor overload setting for 10 seconds. The system will automatically restart in 5 minutes. If 3 faults occur in an hour, the system will not restart and will need to be manually reset. If the problem reoccurs, please verify supply capacity, pump capacity, proper setting of the motor overload switches and that there are no restrictions between the supply and the pump.
2 Blinks	Tank Water-Logged	This warning is indicated if there is a drastic drop in system pressure in a short amount of time. The warning will not impact operation. The pump will continue to run. This warning can be caused by low air pressure in the tank or the tank bladder may have failed. This can also be caused by extreme changes in flow. The error is cleared each time the pump starts. If the error reoccurs often, check the air pressure in the tank. Before checking tank air pressure, turn power to control off to prevent pump from turning on. Relieve system pressure by opening a faucet.
3 Blinks	Pressure Sensor Fault	This fault indicates a problem with the pressure sensor feedback. Verify the connections from the Aquavar ABII Controller to the pressure sensor. Turn power to controller off and wait 5 minutes. Remove controller access panel. Be sure sensor cable is wired as shown in Diagram 4. If cable is wired correctly, check the voltage on the Input (White) pressure sensor terminal connection in the Aquavar ABII controller. Using a DC voltmeter, connect the positive lead to the Input (White) pressure sensor terminal connection, connect the negative lead to the Com. (Black) pressure sensor terminal connection. Turn power to controller on. The DC voltage measured should be in the valid range of 0.5 Vdc to 4.5 Vdc (+/- 0.2 Vdc). If the voltage is outside this range, replace pressure sensor.
4 Blinks	Pump or Motor Bound	This fault can be caused by mechanical binding from debris in pump or from an electrical failure in the motor. Verify the error by turning power to controller off for 1 minute and then on. Pump must be checked if error persists.

9: TROUBLESHOOTING (continued)

RED LIGHT CODES		
Indicator Code	Status	Description
5 Blinks	Short Circuit	Check wiring for shorting phase to phase and phase to ground. Turn power to controller off and wait 5 minutes. Remove controller access panel. Disconnect motor leads marked T1, T2, and T3. Measure resistance between all motor leads using an ohmmeter. NOTE: Motor winding resistance is typically 2 to 10 OHMS depending on motor.
6 Blinks	Ground Fault	Check wiring for shorting phase to ground. Turn power to controller off and wait 5 minutes. Remove controller access panel. Disconnect motor leads T1, T2, T3, and Ground from controller. Measure resistance between all motor leads and ground using a Megohmmeter. Connect one Megohmmeter lead to any one of the motor leads and the other to ground lead. Set Megohmmeter to 500V DC output. Resistance readings less than 500,000 ohms or 0.5 Megohms indicate a damaged motor.
7 Blinks	High Temperature	This fault is caused by a high temperature inside of the controller. The controller will shut off when the temperature inside the controller reaches 158° F (70° C). The controller will turn back on when the temperature inside the controller reaches 150° F (65.5° C). Avoid installing the controller where ambient temperatures exceed 104° F (40° C). Avoid installing the controller where it is exposed to direct sunlight.
8 Blinks	Over Voltage	Measure input voltage using an AC voltmeter. Connect the positive and negative leads to L1 and L2 on the Aquavar ABII controller. Verify line input voltage is not greater than 264 VAC for 1AB2 and 2AB2 controllers and 132VAC for 1151AB2.
9 Blinks	Motor Overload	This fault is indicated when the current supplied to the motor exceeds the Motor Overload Setting on the Aquavar ABII controller. Refer to Section 7, <i>Setting the Motor Overload DIP Switches</i> for details. If switches are set according to Section 7, check motor.

10: CONTROLLER DIMENSIONS



GOULDS WATER TECHNOLOGY LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Water Technology.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twenty-four (24) months from date of installation or thirty (30) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Water Technology distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Water Technology Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Water Technology and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.



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QUICK START GUIDE
IMS-ABII-1

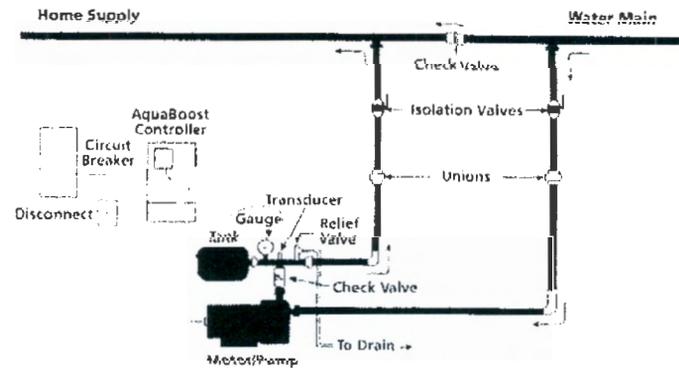
Aquavar ABII Quick Start Guide

Installation Steps:

1. **Install the Pump**
 - Plumb suction and discharge of pump into piping.
 - Install a check valve on the suction side.
 - Locate the pump as near liquid source as possible.
2. **Install the Pressure Transducer**
 - Install the pressure transducer in the tank tee provided with the unit.
 - Locate the transducer within 120" of the controller.
3. **Mount the Controller**
 - Mount vertically in a well ventilated, shaded area with 8 inches of free air space on every side and temperature between 34° F and 104° F.
4. **Connect Input Power**
 - Connect the 1Ø power from a 20 amp 2-pole circuit breaker.
 - Do not use GFI protection with ABII as nuisance tripping will result.
5. **Output Power Connections**
 - Connect the output power leads from the controller to the 3 motor leads in the conduit box on the motor.
6. **Set the motor Overload Switches (or dials, 3 and 5 HP)**
 - Complete systems have overloads pre-set at factory.
7. **Set the Pressure - Factory pre-set is 50 PSI**
 - Push and Hold the Increase or Decrease Pressure Adjust Pushbutton until the desired pressure setting is reached.
 - The maximum allowable pressure setting is 85 psi.
8. **Set the Application Switches (or dials, 3 and 5 HP)**
 - Minimum Speed of 10 Hz - the incoming pressure is within 20 PSI of the desired pressure setting.
 - Minimum Speed of 30 Hz - the incoming pressure is 20 PSI or more below the desired pressure, if pumping from a tank or if drawing a suction lift.
 - Ramp Speed - Slow - Low flow; Medium - Medium flow; Fast - High flow.

Aquavar ABII Controller Typical Installation

This diagram shows a set-up for municipal water connection. This allows pump maintenance without main line shut-off.



AquaBoost II Required Components

1. Pump with Motor
2. AquaBoost II Controller with Integral Pressure Sensor Cable
3. Pressure Tank
4. Pressure Sensor
5. Mounting Kit
6. Tank Tee with Pipe Plug
7. Pressure Gauge

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QUICK START GUIDE
IMS-ABII 2

Aquavar ABII Quick Start Up Guide

LABELS FOUND ON THE CONTROLLER ACCESS COVER:

Fault Codes

Motor Overload Setting		
▲ WARNING: Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Motor Overload Setting Switches.		
1 = UP 0 = DOWN		
DIP Switch Setting	Motor Overload Setting (Amps)	
1 2 3 4	1A62	2A82
1 1 1 1	2.5	4.6
1 1 1 0	2.8	5.2
1 1 0 1	3.3	5.3
1 0 1 1	3.5	5.8
0 1 1 1	3.8	6.5
0 0 0 0	4.2	6.9

Status Codes*	
Green Light Codes	
Constant	Standby/Low Voltage
Blowing	Pump Running
Red Light Codes	
Constant	Replace Controller
1 Blink	No Water/Loss Of Prime
2 Blinks	Tank Water Logged
3 Blinks	Pressure Sensor Fault
4 Blinks	Pump or Motor Binding
5 Blinks	Short Circuit
6 Blinks	Ground Fault
7 Blinks	High Temperature
8 Blinks	Over Voltage (>264V)
9 Blinks	Motor Overload
*No Light - No/Very Low Voltage	

Motor Overload Setting Label
Use this label to choose the correct Motor Overload Switch Setting. This label is found under the controller access cover.

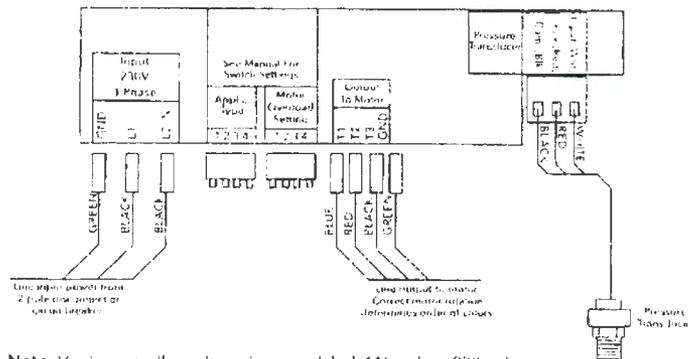
Status Code Label
Use this label to diagnose any system errors. This label is found on the side of the controller access cover.

Application Switch Setting		
▲ WARNING: Disconnect Power And Wait For LED Indicator To Turn Off Before Touching Application Setting Switches		
1 = UP 0 = DOWN		
DIP Switch Setting	Minimum Speed (Hz)	Ramp Setting
1 1 1 1 *	10	Slow
1 1 1 0 *	10	Medium
1 1 0 1 *	10	Fast
1 0 1 1	30	Slow
0 1 1 1	30	Medium
0 0 0 0	30	Fast
*THESE SETTINGS ARE NOT TO BE USED WITH SUBMERSIBLE PUMPS.		

Application Switch Setting Label
Use this label to choose the correct Application Switch Setting. This label is found under the controller access cover.

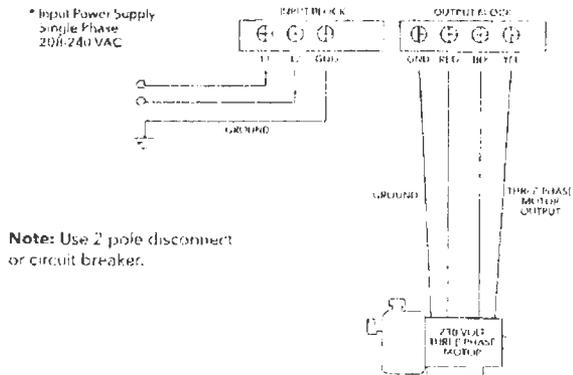
Aquavar ABII Wiring Diagram

1 AND 2 HP



Note: Verify controller voltage input on label, 115 volt or 230 volt.

3 AND 5 HP



Note: Use 2 pole disconnect or circuit breaker.

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Goulds Pumps

G&L SERIES

MODEL HMS

Installation, Operation and
Maintenance Instructions



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Owner's Information

Please fill in data from your pump nameplate.
Warranty information is on page 7.

Pump Model: _____

Serial Number: _____

Dealer: _____

Dealer's Phone Number: _____

Date of Purchase: _____

Installation Date: _____

Description and Specifications

The Model HMS is a close coupled, end suction, multi-stage centrifugal pump for general liquid transfer service, booster applications, etc. Liquid-end construction is all AISI Type 316 stainless steel, stamped and welded. Impellers are fully enclosed, non-trimmable to intermediate diameters. Casings are fitted with diffusers for efficiency and for negligible radial shaft loading. All units have NEMA 48Y or 56Y motors with square flange mounting and threaded shaft extension.

1. Important Instructions

- 1.1 Inspect unit for damage. Report any damage to carrier/dealer immediately.
- 1.2 Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., in compliance with National and Local electrical codes. Install an all-leg disconnect switch near pump.

CAUTION: ALWAYS DISCONNECT ELECTRICAL POWER WHEN HANDLING PUMP OR CONTROLS.

- 1.3 Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.
- 1.4 Always use horsepower-rated switches, contactor and starters.
- 1.5 Motor protection
 - 1.5.1 Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper load. Fusing is permissible.
 - 1.5.2 Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.
- 1.6 Maximum Operating Limits:
 - Liquid Temperature: 230°F (110°C)
 - Working Pressure to: 125 PSI (8 Bar)
 - Starts per Hour: 20, evenly distributed
- 1.7 Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. Installation

- 2.1 Locate pump as near liquid source as possible (below level of liquid for automatic operation).
- 2.2 Protect from freezing or flooding.
- 2.3 Allow adequate space for servicing and ventilation.
- 2.4 All piping must be supported independently of the pump, and must "line-up" naturally.

CAUTION: NEVER DRAW PIPING INTO PLACE BY FORCING THE PUMP SUCTION AND DISCHARGE CONNECTIONS.

- 2.5 Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.
- 2.6 Units may be installed horizontally, inclined or vertically.

CAUTION: DO NOT INSTALL WITH MOTOR BELOW PUMP. ANY LEAKAGE OR CONDENSATION WILL AFFECT THE MOTOR.

- 2.7 Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.
- 2.8 Tighten motor hold-down bolts before connecting piping to pump.

3. Suction Piping

- 3.1 Low static suction lift and short, direct, suction piping is desired. Consult pump performance curve for *Net Positive Suction Head Required*.
- 3.2 Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.
- 3.3 If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.
- 3.4 Installation with pump below source of supply:
 - 3.4.1 Install full flow isolation valve in piping for inspection and maintenance.
- CAUTION: DO NOT USE SUCTION ISOLATION VALVE TO THROTTLE PUMP**
- 3.5 Installation with pump above source of supply:
 - 3.5.1 Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.
 - 3.5.2 All joints must be airtight.
 - 3.5.3 Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.
 - 3.5.4 Suction strainer open area must be at least triple the pipe area.
- 3.6 Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figures 1-4.
- 3.7 Use 3-4 wraps of Teflon tape to seal threaded connections.

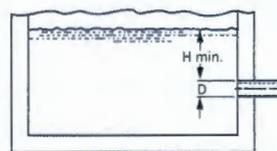


Figure 1

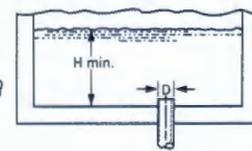


Figure 2

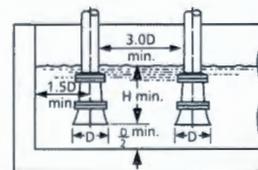


Figure 3

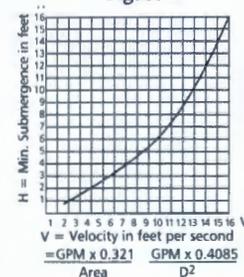


Figure 4

4. Discharge Piping

- 4.1 Allowance should be made for disconnecting discharge piping near casing to allow for pump disassembly.
- 4.2 Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.
- 4.3 If an increaser is required, place between check valve and pump.
- 4.4 Use 3-4 wraps of Teflon tape to seal threaded connections.

5. Rotation

- 5.1 Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. to change rotation:
 - 5.1.1 Single-phase motor: Non-reversible
 - 5.1.2 Three-phase motor: Interchange any two power supply leads.

6. Operation

- 6.1 Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.
- 6.2 Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping.

7. Maintenance

- 7.1 Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

CAUTION: PUMPED LIQUID PROVIDES LUBRICATION. IF PUMP IS RUN DRY, ROTATING PARTS WILL SEIZE AND MECHANICAL SEAL WILL BE DAMAGED. DO NOT OPERATE AT OR NEAR ZERO FLOW. ENERGY IMPARTED TO THE LIQUID IS CONVERTED INTO HEAT. LIQUID MAY FLASH TO VAPOR. ROTATING PARTS REQUIRE LIQUID TO PREVENT SCORING OR SEIZING.

8. Disassembly

- 8.1 Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work required.
 - 8.1.1 Turn off power.
 - 8.1.2 Drain system and flush if necessary.
 - 8.1.3 Disconnect discharge pipe from pump.
 - 8.1.4 Remove motor hold-down bolts.
- 8.2 Disassembly of liquid end
 - 8.2.1 Drain the pump body through the drain plug (4).
 - 8.2.2 Remove the casing screws (1) from the motor adapter (17).
 - 8.2.3 Remove the pump body (2) and the o-ring (15) located between the pump body and the seal housing (16).
 - 8.2.4 Remove motor fan cover (24) to expose wrench flats or slot on shaft end.

CAUTION: DO NOT INSERT SCREWDRIVER BETWEEN THE FAN BLADES TO PREVENT ROTATION.

8.2.5 Hold motor shaft at flat or slot to resist rotation and remove impeller nut and washer (5, 6).

8.2.6 The following parts can now be removed from the pump shaft in sequence: Diffuser with o-ring (7, 9), impeller spacer (8), impeller (10), impeller spacer (8), etc. until the complete "hydraulic element" is dismantled. Note: Each diffuser contains an o-ring (9).

8.2.7 Remove the shoulder washer (13) from the pump shaft (18).

NOTE: Further disassembly will require removal of the mechanical seal. It is recommended that a new mechanical seal be installed at reassembly.

8.2.8 Carefully pull the rotary portion of the mechanical seal (14) from the shaft coupling (19).

8.2.9 Remove the seal housing (16) from the motor adapter. The stationary portion of the mechanical seal (14) can now be removed from the seal housing.

8.2.10 Remove the motor screws (21) from the motor adapter and remove the motor adapter from the motor.

8.2.11 To remove the pump shaft (18) from the shaft coupling (19), heat must be applied to the small end of the shaft coupling. This is required to break the bond of the Loctite #271 between the pump shaft and coupling.

CAUTION: DO NOT DAMAGE THE SMALL END OF THE SHAFT COUPLING WHERE THE MECHANICAL SEAL SITS.

Hold the motor shaft at flats or slots to resist rotation. Repeat for removal of the shaft coupling from the motor shaft, this time heating the large end of the shaft coupling.

9. Reassembly

9.1 All parts should be cleaned before reassembly. Remove all cured Loctite from parts using denatured alcohol and wire brush. Allow parts to dry before reassembly.

9.2 Refer to parts list to identify required replacement items. Specify pump index or catalog number when ordering parts.

9.3 Reassembly is the reverse of disassembly.

NOTE: The impeller spacers must be assembled with the larger diameter edge adjacent to each impeller. The last stage diffuser (12) can be identified from the standard by the holes around its circumference, it is recommended that one of these holes be lined up with the discharge port. Fix the hydraulic element by tightening the impeller screw (5) and impeller washer (6) with a torque setting of 10 ft. Position the o-ring (15) on the mechanical seal housing (16), locate the pump body (2) and fit it to the motor adapter (17) with the four screws (1).

Observe the following when reassembling the pump:

9.4 Check for motor shaft runout. Maximum permissible is .002" TIR.

9.5 Apply Loctite 'Primer 7649' and allow 2-3 minutes to dry. Next apply Loctite #271 to motor shaft, thread coupling shaft in place and torque to 15 ft. of torque.

9.6 Apply Loctite 'Primer 7649' and allow 2-3 minutes to dry. Next apply Loctite #271 to pump shaft. Thread pump shaft in place and torque to 15 ft. of torque.

9.7 Check pump shaft runout. Maximum permissible is .010 TIR.

- 9.8 Lubricate shaft coupling and seal housing stationary seat holder with a 50/50 glycerin and water solution prior to installation of mechanical seal components.
- 9.9 Apply Loctite "Primer 7649" and allow 2-3 minutes to dry. Then apply Loctite #243 to impeller bolt (5). Thread bolt into pump shaft and torque to 10 lb. ft. of torque.
- 9.10 Inspect casing o-ring (15) and impeller o-rings (9) for damage or wear and replace if necessary.
- 9.11 O-rings may be lubricated with glycerin and water solution or petroleum jelly to ease assembly.
- 9.12 Tighten casing screws to 15 lb.ft. of torque using a star pattern to prevent o-ring binding.

10. Troubleshooting Guide

MOTOR NOT RUNNING

(See causes 1 through 6)

LITTLE OR NO LIQUID DELIVERED

(See causes 7 through 17)

POWER CONSUMPTION TOO HIGH

(See causes 4, 17, 18, 19, 22)

EXCESSIVE NOISE AND VIBRATION

(See causes 4, 6, 9, 13, 15, 16,18,20, 21, 22)

PROBABLE CAUSE

1. Tripped thermal protector
2. Open circuit breaker
3. Blown fuse
4. Rotating parts binding
5. Motor wired improperly
6. Defective motor
7. Not primed
8. Discharge plugged or valve closed
9. Incorrect rotation
10. Foot valve too small, suction not submerged, inlet screen plugged.
11. Low voltage
12. Phase loss (three phase only)
13. Air or gases in liquid
14. System head too high
15. NPSHA too low:
Suction lift too high or suction losses excessive
Check with vacuum gauge
16. Impeller worn or plugged
17. Incorrect impeller diameter
18. Head too low, causing excessive flow rate
19. Viscosity or specific gravity too high
20. Worn bearings
21. Pump or piping loose
22. Pump and motor misaligned

Parts List

Item No.	Part Description	Material
1	Screw, casing	400 SS
2	Pump, casing with plug and Viton o-rings	316L SS
3	O-ring, fill and drain plug	Viton
4	Fill and drain plug	315 SS
5	Impeller bolt	316 SS
6	Impeller lock washer	316 SS
7	Diffuser cover, first stage	316L SS
8	Impeller spacer	316L SS
8A*	Impeller spacer (Intermediate)	316L SS
9	O-ring, impeller	EPR Optional Viton
10	Impeller	316L SS
11	Diffuser, intermediate	316L SS
11A*	Diffuser with bushing	316L SS
12	Diffuser, last stage	316L SS
13	Washer, mechanical seal	316 SS
14	Mechanical seal	Varies
15	O-ring, casing	EPR Optional Viton
16	Seal housing	316L SS
17	Motor adapter	Aluminum
18	Shaft, pump	316 SS
19	Shaft coupling	316 SS
20	Foot, pump	Steel
21	Screw, motor to motor adapter	Steel
22	Spacer	Rubber
23	Motor, 1 PH ODP Motor, 3 PH ODP Motor, 575 V ODP Motor, 1 PH TEFC Motor, 3 PH, TEFC Motor, 575 V TEFC	303 SS
24*	Shaft Sleeve	Tungsten Carbide

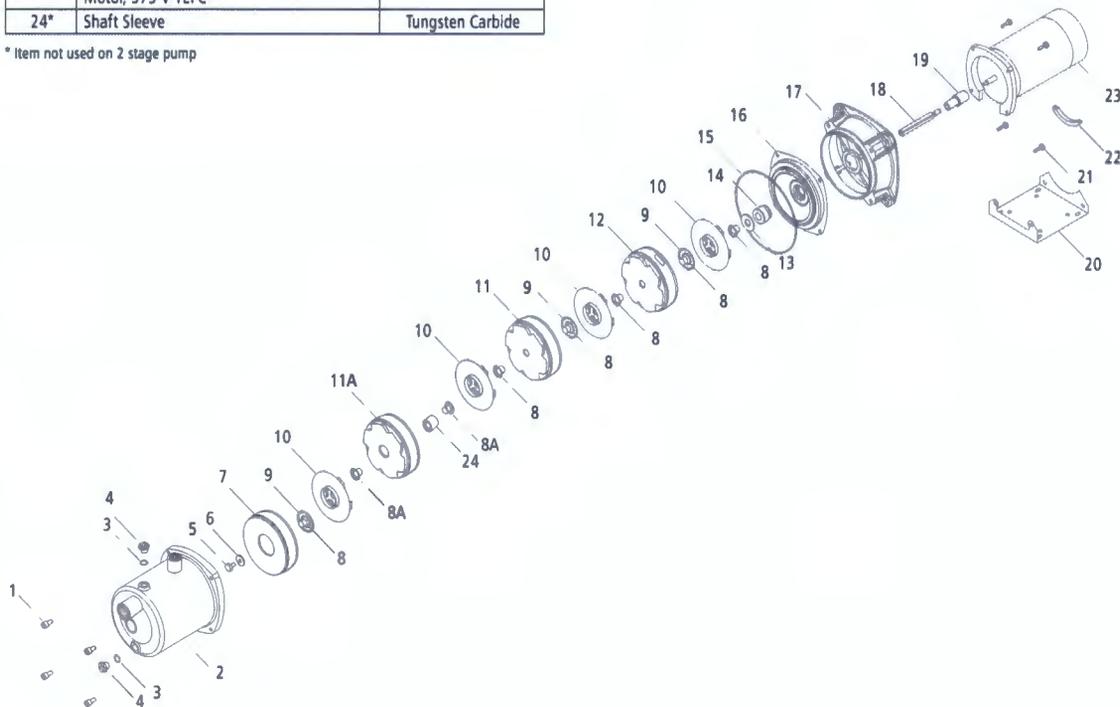
* Item not used on 2 stage pump

Mechanical Seal Application Chart

Rotary	Stationary	Elastomer	Metal Parts	Part No.	
				Before	After
				SN: F0264029 •	
Carbon	Silicon Carbide	EPR	316SS	-	10L35
		Viton		10L32**	10L36
	Silicon Carbide			-	10L34

• For pumps used in conjunction with the AquaBoost pumping system, use SN F0265181.

** Replacement for 10L29, 10L30 and 10L31





ITT

Commercial Water

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.



Goulds Pumps, G&L and the ITT Engineered Blocks Symbol are registered trademarks and tradenames of ITT Corporation.

Loctite is a registered trademark of Loctite Corporation.

Teflon is a registered trademark of Dupont.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

IM083R04 September, 2007

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Engineered for life

GOULDS PUMPS

Hydro-Pro® Water System Tank

Réservoir Hydro-Pro®
pour systèmes
d'alimentation en eau

Hydro-Pro® Sistema de
Tanque para Agua



Installation, Operation and Maintenance Instructions Directives d'installation, d'utilisation et d'entretien Instalación, Operación e Instrucciones para el Mantenimiento

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Así es como el Tanque funciona con un sistema diseñado para operar puesto a una presión de 30/50 PSI	15	Buscando Fallas	18
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Read and Follow Safety Instructions!



DANGER

WARNING

CAUTION

This is the safety-alert symbol. When you see this symbol on your system or in this manual, look for one of the following signal words and be alert to the potential for personal injury:

DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

WARNING warns about hazards that **could** cause serious personal injury, death or major property damage if ignored.

CAUTION warns about hazards that may result in minor or moderate injury or property damage if ignored.

This label **NOTICE** indicates special instructions which are important but not related to hazards.

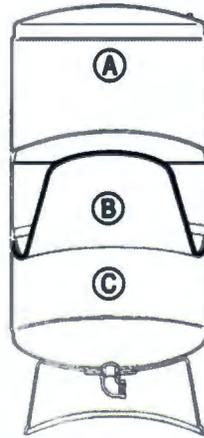
Carefully read and follow all safety instructions in this manual or on system.

Keep safety labels in good condition.
Replace missing or damaged safety labels.

Safety Instructions

1. **WARNING** - THESE WATER TANKS ARE DESIGNED FOR OPERATION ON AMBIENT TEMPERATURE WATER SYSTEMS LIMITED TO A MAXIMUM WORKING PRESSURE OF 125 POUNDS PER SQUARE INCH GAUGE (PSIG). IF YOUR SYSTEM HAS THE ABILITY TO EXCEED 125 PSIG WORKING PRESSURE (100 PSIG IF THIS IS A PUMP MOUNTED UNIT), A SUITABLE SAFETY DEVICE MUST BE INSTALLED. THIS CAN BE EITHER A HIGH PRESSURE ELECTRICAL CUT-OFF SWITCH AND/OR A PRESSURE RELIEF VALVE. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE TANK RUPTURE AND RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE.
2. It is your responsibility to make sure your installation meets all national and local plumbing and electrical codes.
3. **DANGER** - Before installing or servicing your pump or tank be sure power source is disconnected.
4. If a captive air water systems tank replaces a standard galvanized tank on a submersible pump installation, bleeder orifices or other air charging devices must be removed. Air charging devices on jet pumps must be removed.
5. **CAUTION** - Storage tanks are designed for use on ambient temperature - (maximum temperature of 120°F, effective Feb. 2001) water systems. Use of this product on other applications could cause tank failure and possibly personal injury. Use of this tank on other applications voids the warranty.
6. Complete pump, tank and piping system must be protected against freezing. Failure to do so will cause severe damage and voids the warranty.
7. **DANGER** - Tank contains air pressure. Do not puncture. Never throw tank into fire or incinerator.

The water systems tank concept



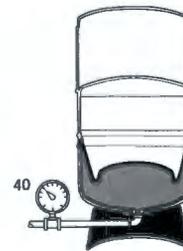
The water system tank does more than simply store water. It helps to protect the system components. A properly sized tank will provide adequate flow even when the pump is not running. It saves energy by reducing the number of pump starts. Another benefit is increased system component life due to fewer pump cycles.

The water system tank consists of a steel tank (A) containing a sealed-in-place heavy duty diaphragm (B) which separates air from the water. The portion of the tank where water is stored (C) is lined to isolate water from the metal tank. This protects the tank from corrosion.

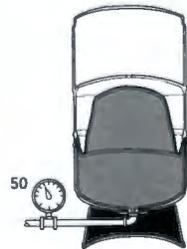
Here's how the tank works for a water system designed to operate at a 30/50 psig pressure switch setting.



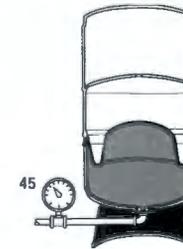
1. Prior to shipping, the tank is pressurized to a standard precharge as defined in "OPERATION" part of this manual.



2. As water enters the tank, the air above the diaphragm is compressed and its volume is reduced by the volume of water that enters.



3. The pressure in the tank rises. Water continues to enter until the pump cut-out pressure is reached. The pump shuts off and the tank is now filled.

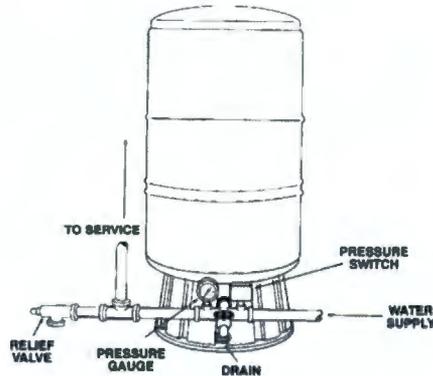


4. The pressure in the air chamber forces water into the system when a demand is made without causing the pump to operate immediately. When the pressure in the chamber finally drops to the pump cut-in pressure, the pump switch activates the pump and repeats the filling cycle.

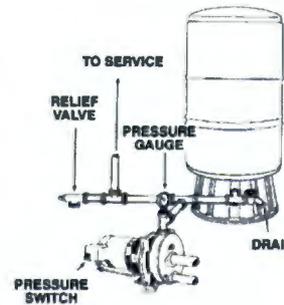


Installation Procedures

TYPICAL SUBMERSIBLE PUMP INSTALLATION



TYPICAL JET PUMP INSTALLATION

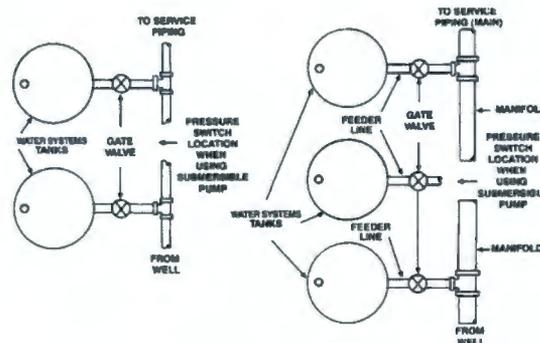


- The water system tank should be installed as close as possible to the pressure switch (24 inches or less) to reduce the adverse effect of friction loss and elevation differences.
- Disconnect electric power.
- Drain system and remove old tank. On new system installation this step is unnecessary.
- Locate the water system tank on a firm, level surface with adequate drainage. Typical installations are shown in the following section.
- If your system is capable of exceeding a working pressure of 125 psig (typically submersible pumps), install a pressure relief valve (rated at 125 psig or less, but greater than turn-off pressure) in the system near the tank. The valve should be the same pipe size as the tank outlet. This is not necessary on tank-mounted jet pump units.
- Connect tank to the pump discharge line using the same size pipe as the pump tap, or larger. **WARNING:** Hold 90° tank street elbow with wrench when threading and tightening connecting pipe.
- The tank should be flushed 5 times prior to household use. (See operations section.)**

Multiple Tank Installation Procedure

Water system tanks can be connected together to increase the supply of usable water (drawdown). Two tanks of the same size will double the supply and three tanks will triple the supply. When using a high

capacity pump, the manifold and pressure switch assembly must be installed in the pipe line as close to the center of the tanks as possible. Manifold and main should be 2 times the size of the feederline.

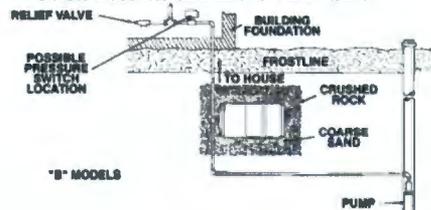


Underground Pressure Tanks

Buried model water system tanks are designed for direct burial and can be installed in the horizontal or vertical position. To eliminate the danger of freezing, tank must be buried below frost line.

The following steps should be taken when installing the water system tank.

1. Make sure that tank will be buried below frost line and above water table.



2. Use galvanized or plastic pipe for section of pipe buried in the ground.
3. Check tank precharge. Tank precharge must be adjusted to the pressure required by the pressure switch setting (see section on Operation).
4. Install tank on firm rock-free earth.
5. The water line from the pump to the tank and from the tank to the pressure switch location should be the same size.
6. Check system for performance and inspect for leaks.
7. Backfill hole with sand or rock-free dirt. Firmly tamp fill to prevent setting.
8. Make note of tank location so that it can be easily located at a later time.

Operation



THESE WATER TANKS ARE DESIGNED FOR OPERATION ON AMBIENT TEMPERATURE WATER SYSTEMS LIMITED TO A MAXIMUM WORKING PRESSURE OF 125 POUNDS PER SQUARE INCH GAUGE (PSIG). IF YOUR SYSTEM HAS THE ABILITY TO EXCEED 125 PSIG WORKING PRESSURE (100 PSIG IF THIS IS A PUMP MOUNTED UNIT), A SUITABLE SAFETY DEVICE MUST BE INSTALLED. THIS CAN BE EITHER A HIGH PRESSURE ELECTRICAL CUT-OFF SWITCH AND/OR A PRESSURE RELIEF VALVE. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE TANK RUPTURE AND RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE.

Before you operate the system you must check your water system tank and system to ensure proper operation.

All water system tanks are precharged at the factory. All 8 and 11 inch diameter tanks are precharged at 18 psig. The 15 inch diameter tanks are precharged at 28 psig while the 22 and 26 inch diameter tanks are precharged to 38 psig. The final precharge pressure should always be 2 to 3 psig below the cut-in (pump turns on) pressure of the pressure switch. Release air or add air as required using the following procedure.

1. Determine the pump cut-in pressure setting. The pressure switch should have this information located on/in the cover.
2. With no water in the tank, measure the precharge of the water system tank using an accurate pressure gauge at the air valve (similar to an auto tire gauge).
3. Release air or add air to the tank to make the pressure in the tank 2 to 3 psig *LESS* than the pump cut-in pressure setting.
4. It will be necessary to expel air from the piping system on new installations. To do this open all faucets and turn on the pump. Observe that a mixture of water and air will sputter from the faucet. Run the system until a steady flow of water exists. Open and close the faucets several times to assure that all air has been removed. If streams do not become steady, an air leak may exist. Check for leaks on suction side piping.
5. It may be necessary to make final adjustments on the system pressure switch setting because at times the actual pressure switch setting will vary from what is stated on the cover. Such variation, though not harmful, could cause a momentary lag of water delivery. To make this adjustment the following steps should be followed:
 - a. Fill the system until the pump shuts off.
 - b. Open a faucet and drain the water system tank until the pump starts.
 - c. If there is a pause in the water flow from the time the water system tank is emptied and the pump starts up again, decrease the air pressure in the tank until it is 2 to 3 psig below the cut-in pressure setting. (See Trouble Shooting section 3(a-b) for procedure)
 - d. Close the faucets and refill the water system tank. Repeat steps (b) and (c) if necessary until there no longer is a pause in water flow.

Trouble Shooting

IF YOU THINK YOU HAVE A PROBLEM WITH YOUR WATER SYSTEM TANK, YOU SHOULD MAKE THE FOLLOWING TESTS AND OBSERVATIONS BEFORE YOU CALL YOUR PROFESSIONAL DEALER.

1. Observe water system operation and note any unusual occurrence such as water spurting from a faucet rather than a steady flow (indicates air in the system) or short cycling of the pump (rapid starts and stops).
2. In the event that evidence of a small leak near the water fitting appears, check at elbow. The introduction of cold water to a warm tank may form condensation especially in warmer climates. It is important to provide adequate drainage.
3. Measure the water drawdown by collecting water in a sufficiently sized container from the time the pump is off (cut-off point) to the time it turns on (cut-in point). Compare the gallons with that shown in the table below for your model of tank. If the volume is close to that shown in the table, your system is operating properly.
 - a. **Air charge in Tank.** Turn off electric power to the pump. Open faucet nearby and drain the tank completely. Check the pressure in the water system tank using a standard, high quality tire gauge. If the air pressure in the tank is below the pump cut-in setting by more than 3 psi, add air to the tank to make it 2 psi less than the cut-in setting. Replace the valve stem cap. Check around the air stem using a soapy solution to check for leaks around welds and seams on the remainder of the tank. If a leak appears on the tank itself then replacement of the tank will be necessary.
 - b. **Pressure Switch Setting.** Start the pump and allow the system pressure to shut off pump. Note both the cut-in and cut-off pressure values on gauge. The difference should not exceed 25 psi. Adjust the pressure switch if necessary after shutting off the electric power to show a difference of 20 psi. Instructions from the pressure switch manufacturer will explain how to do this. Test the system after adjusting the limits. If the pressure switch can't maintain the proper differential then it may need replacement, not the tank.

Tank Specifications

MODEL NO.	DIMENSIONS (INCHES)		DRAWDOWN IN GALS. AT SYSTEM OPERATING PRESSURE RANGE OF:			MAX. DRAWDOWN VOL. (GALS.)	SYSTEM CONNECTION
	DIAMETER	HEIGHT	20/40 PSIG	30/50 PSIG	40/60 PSIG		
IN-LINE MODELS							
V6P	8	11 15/16	0.7	0.6	0.5	1.2	3/4" NPTM
V15P	11	13 15/16	1.7	1.4	1.2	2.7	3/4" NPTM
V25P	11	23 1/16	3.1	2.6	2.2	4.5	3/4" NPTM
V45P	15 3/8	21 1/16	5.1	4.3	3.7	8.4	1" NPTM
FREE STANDING MODELS							
V45	15 3/8	24 15/16	5.1	4.3	3.7	8.4	1" NPTF
V60	15 3/8	32 3/8	7.3	6.1	5.3	12.1	1" NPTF
V80	15 3/8	39 9/16	8.9	7.7	6.7	13.9	1" NPTF
V100	15 3/8	47 1/4	11.8	9.9	8.6	13.8	1" NPTF
V140	22	36 9/16	16.5	13.9	12.1	27.3	1 1/4" NPTF
V200	22	48 5/8	23.9	20.0	17.4	39.3	1 1/4" NPTF
V250	26	46	30.9	25.9	22.5	50.8	1 1/4" NPTF
V260	22	60 11/16	31.2	26.2	22.8	44.7	1 1/4" NPTF
V350	26	61 3/16	42.9	35.9	31.5	70.5	1 1/4" NPTF
FREE STANDING MODELS WITH BASE EXTENTION							
V80EX	15 3/8	42 5/8	8.9	7.7	6.7	13.9	1" NPTF
BURIED MODELS							
V45B	15 3/8	21 1/16	5.1	4.3	3.7	8.4	1" NPTM
V60B	15 3/8	28 1/2	7.3	6.1	5.3	12.1	1" NPTM
V140B	22	32 3/16	16.5	13.9	12.1	27.3	1 1/4" NPTM
V200B	22	44 1/4	23.9	20.0	17.4	39.3	1 1/4" NPTM
MOUNTING MODELS							
*V45MP/PST	15 3/8	25 11/16	5.1	4.3	3.7	8.4	3/4" NPTF
*V60MP/PST	15 3/8	33 1/8	7.3	6.1	5.3	12.1	3/4" NPTF

*Maximum working pressure of tank 100 PSIG; all other models above 125 PSIG.

Limited Warranty

A.O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this water system tank.

1. TANK

If within five years after installation the tank or a part thereof shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option, shall exchange or repair such part or portion. The warranty on the replacement tank will be limited to the unexpired term of the original warranty.

2. CONDITIONS AND EXPECTATIONS

This warranty shall apply only when the tank is installed in accordance with local plumbing and building codes, ordinances and regulations, and good industry practices. In addition, a high pressure electrical cut-off switch and/or a pressure relief valve must be installed when the tank is installed on an ambient temperature water system whose maximum working pressure has the ability to exceed 125 pounds per square inch gauge (psig). (100 pounds per square inch guage (psig) on certain models)

a. This warranty shall apply only when the water system is used:

- (1) on ambient temperature water systems at pressures not exceeding the working pressure for the water system;
- (2) in the United States, its territories or possessions, and Canada.

b. Any accident to the water system tank, any misuse, abuse (including freezing,) or alteration of it, any operation of it in a modified form, any attempt to repair tank leaks will void this warranty.

3. SERVICE AND REPAIR EXPENSE

Under this limited warranty the warrantor will provide only a replacement tank or part thereof. The owner is responsible for all other costs. Such costs may include but are not limited to:

- a. Labor charges for service, removal, repair, or reinstallation of the water system or any component part.
- b. Shipping and delivery charges for forwarding the new tank or replacement part from the nearest distributor and returning the claimed defective tank or part to such distributor except in the state of California where such charges are the manufacturer's responsibility.

4. LIMITATION ON IMPLIED WARRANTIES

Implied warranties, including any warranty of merchantability imposed on the sale of this tank under state law are limited to five (5) year duration for the tank or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. CLAIM PROCEDURES

Any claim under this warranty should be initiated with the dealer who sold the tank, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

U.S. Customers	Canadian Customers
A.O. Smith Corporation	A.O. Smith Corporation
5621 W. 115th Street	P.O. Box 310-768 Erie Street
Alsip, IL 60803	Stratford, Ontario N5A 6T3
800-323-2636 or 708-489-4600	Telephone: (519) 271-5800

- a. The warrantor will only honor replacement with identical or similar tank or parts thereof which are manufactured or distributed by the warrantor.
- b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. DISCLAIMERS

NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE TANK OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE TANK. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR IN TORT.

- a. Some states do not allow the exclusion or limitation of the incidental or consequential damages, so the above limitation or exclusion may not apply to you.
- b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the water system tank.

Model No. _____ Serial No. _____ Date Installed _____

Dealer's Name _____

Dealer's Address _____ Phone No. _____

City & State (Provincial) _____ Zip (Postal Code) _____

Dangerous Goods Permit No. SU 5099 (Ren2) - by road or rail vehicle only, expiration date: March 31, 2003 (Pending Renewals)

Attachment D-3
Gunnco Sidesloper P2K25.3

BEST AVAILABLE COPY



Pump & Control, Inc.
P.O. Box 2789 Cumming, GA 30028
515 Industrial Way Cumming, GA 30043
Phone: 770-889-7114 Fax: 770-889-2754

TRANSMITTAL

DATE:
08.02.11

PROJECT REFERENCE: Hanford Sewage Lagoon Project
GunnCo Project Reference# 3362

TO: Attn: Jared Janosky
Watts Construction, Inc.

* Engineering comments provide are for the attention of
both the reviewing engineer and installing contractor.
Please review and call with questions:

ITEM	QUANTITY	DOCUMENT PROVIDED	RESPONSE REQUIRED?
1	1	Submittal Package	E-mail

GunnCo

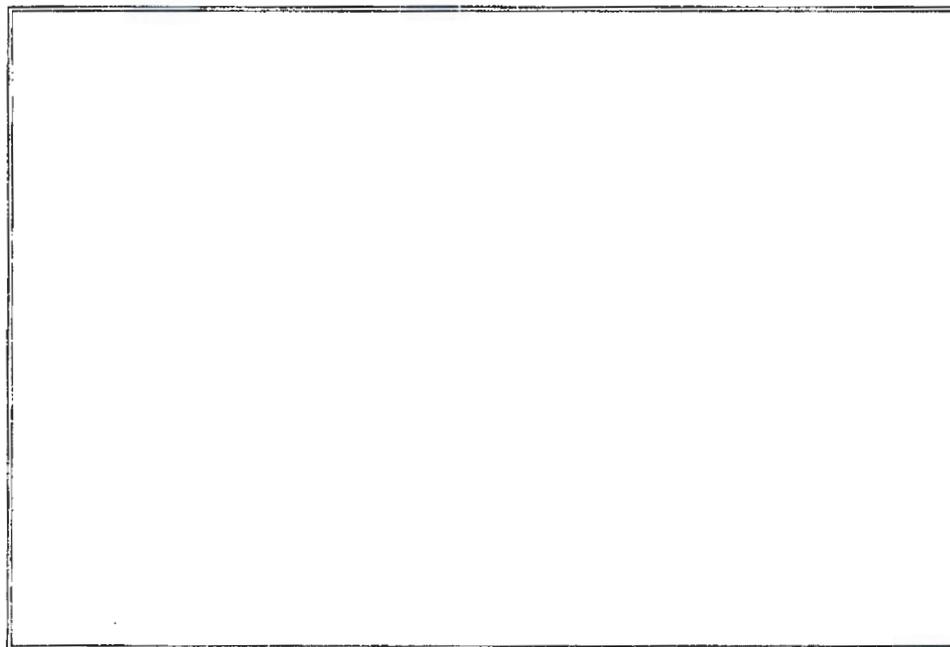
Pump and Control Inc.

Engineering Submittal Package

08/02/11

Hanford Sewage Lagoon Project
Watts Construction, Inc. - Contractor

Submersible Leachate Pumps



GunnCo Pump & Control, Inc.

515 Industrial Way

Cumming, GA 30040

Phone: 770-889-7114 Fax: 770-889-2754

e-mail: and.steyn@gunnco.com

Project Contact: Andre Steyn

GunnCo Pump & Control Inc. *Sidesloper™ Leachate Pumping System*

Project: Hanford Sewage Lagoon GunnCo Project Reference # 3362

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- 30 Safety.*

GunnCo Pump and Control, Inc.

***Sidesloper™* Leachate Pumping System**

For technical questions, replacement parts or service please contact GunnCo Pump and Control, Inc.

Mailing Address: P.O. Box 2789
Cumming, GA 30028

Shipping: 515 Industrial Way
Cumming, GA 30040

Phone: 770-889-7114
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Emergency: 404-316-3131

All returns must have a GunnCo Pump and Control, Inc. issued return authorization number. All warranty issues subject to GunnCo Pump and Control, Inc. terms and condition subject to component manufacturers coverage.

GunnCo Sidesloper Leachate Pumping System

Project Equipment List GunnCo Project Reference # 3362

Hanford Sewage Lagoon

Submersible Leachate Pumps

Seven (7) GunnCo Sidesloper Pump Assemblies P2K 25.3, stainless steel, Teflon fitted with 0.5 HP 3/460v motor. Each pump includes wheeled carrier (carriage) and 100' power cables. Discharge is 1 1/2" with stainless cam lock fittings.

Pump is capable of 24 GPM @ 55 feet.

Seven (7) 3/16" safety cable assembly with required cable fittings - 85'.

Seven (7) SETS discharge fittings for 1" Hose.

Seven (7) Motor Starters - NEMA 4X fiberglass enclosure, 0.5HP, 480V/3/60 Simplex. Panel has HOA switch for hand or automatic operation and mag contactor. Provides protection for the pump for high or low voltage, over or undercurrent protection, phase reversal or phase loss. Panel operates in conjunction with a built in timer and the underload current detection. Once set the pump will run in auto until a undercurrent is detected (No flow). It will then turn the pump off and the timer will time out to the next start (Timer is adjustable from 1 minute to 12 hours) Once it has timed out it will restart and pump down to no flow and turn off and time out again.

One (1) Sets of Cable Fittings as required for gas tight seal and cable recovery.

Operations and Maintenance books.

Seven (7) 1" bronze flow T, flow sensor (paddle wheel type) and digital display mounted in the pump control panel (battery operated display)

One (1) day start up services & training

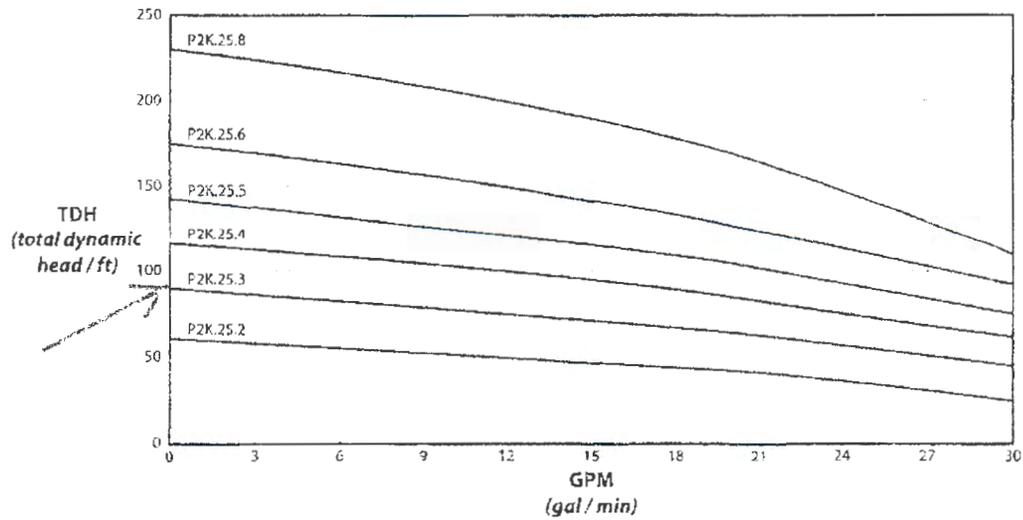
GunnCo *Sidesloper* Leachate Pumping System

Engineering Comments

GunnCo Project 3362

-
- We are not supplying, incoming electrical work, riser pipes, discharge pipe or valves. These items to be provided by general contractor.
 - An "AS BUILT" dimension should be provided prior to the installation of the pumping system.
 - The riser pipe, wet well and collection system should be inspected prior to final closure/welding to ensure that no HDPE shavings, mud, rock, or debris is present in the system. Pipe shavings from construction is a frequent cause of pump problems in new cells. Pumps are designed to pump clear leachate. Failure due to debris in pump is not covered under warranty.
 - GunnCo is not supplying any discharge hose or pipe.

Model P2K.25 Series Performance Curves

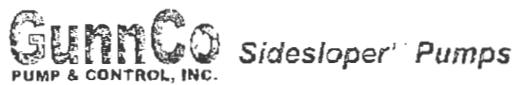


15-30 GPM Operating Range

Model	Max H.P.	Max Length (Standard Carrier)	Estimated Weight	Pull Cable	Breaking Strength Rating	Discharge	Riser Recommendation
25.2	0.5	24	40	3/16"	3700#	1.5"	18"
25.3*	0.5	24	40	3/16"	3700#	1.5"	18"
25.4	0.75	24	50	3/16"	3700#	1.5"	18"
25.5*	1.0	30	60	3/16"	3700#	1.5"	18"
25.6	1.0	30	60	3/16"	3700#	1.5"	18"
25.8	1.5	34	65	3/16"	3700#	1.5"	18"

* Preferred Model

Higher head pumps available.

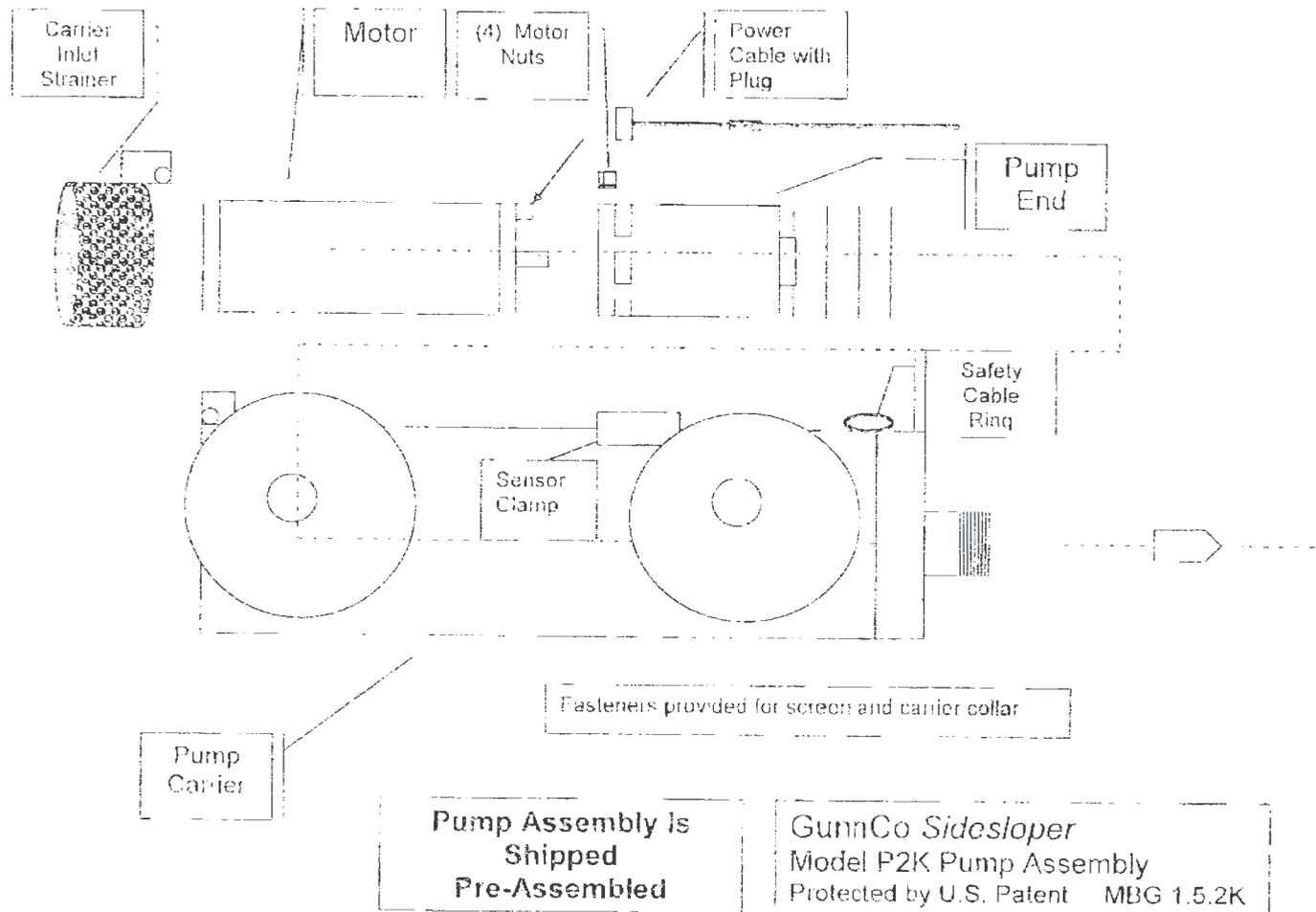


MATERIALS OF CONSTRUCTION

Leachate Pump

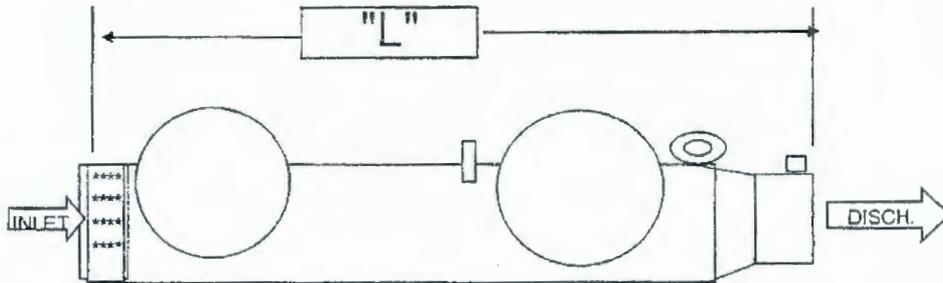
Pump Model P2K 25.3

Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	431 Stainless Steel
Straps	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	329/431 Stainless Steel
Check Valve Seat	Teflon/304 Stainless Steel
Top Bearing	Teflon/304 Stainless Steel
Impeller Seal Ring	Teflon/304 Stainless Steel
Intermediate Bearings	Teflon/304 Stainless Steel
Shaft Washer	LCP (Vectra®)
Split Cone	304 Stainless Steel
Split Cone Nut	304 Stainless Steel



GunnCo.....Sidesloper™ Pump

Dimensional Data and Weights P2K Models



Pump Model	"L" Max.	Discharge Size	Est. Weight	Pull Cable	
P2K-10 (ALL)	24"	*1.25"	50 pounds max.	1/8"	18" RISER
P2K-25 (ALL)	24"	1.5"	50 pounds max.	1/8"	
P2K-40-1/2/3	24"	2.0"	50 pounds max.	1/8"	
P2K-40-4/5	36"	2.0"	60 pound max.	1/8"	
P2K-40-6/7	42"	2.0"	60 pound max.	1/8"	
P2K-60-1/2/3/4	36"	2.0"	60 pound max.	1/8"	
P2K-60-5	42"	2.0"	90 pound max.	3/16"	
P2K-60-6 & 7	58"	2.0"	100 pound max.	3/16"	
P2K-60-8 & 9	63"	2.0"	100 pound max.	3/16"	
P2K-75-1/2	36"	2.0"	60 pound max.	3/16"	
P2K-75-3	36"	2.0"	60 pound max.	3/16"	
P2K-75-4/5	42"	2.0"	90 pound max.	3/16"	24" RISER
P2K-75-8	60"	2.0"	100 pound max.	3/16"	
P2K-85-1	36"	3.0"	75 pound max.	3/16"	
P2K-85-2	46"	3.0"	100 pound max.	3/16"	
P2K-85-3/4	55"	3.0"	130 pound max.	3/16"	
P2K-150-1	36"	3.0"	90 pound max.	3/16"	
P2K-150-2	55"	3.0"	110 pound max.	3/16"	
P2K-150-3	60"	3.0"	140 pound max.	3/16"	
P2K-230-1	55"	3.0"	100 pound max.	3/16"	
P2K-230-2	60"	3.0"	160 pound max.	3/16"	
P2K-230-3	55"	3.0"	200 pound max.	3/16"	
P2K-150-4	60	3.0	160 Pounds Max	1/4"	

* Select 1.5" Discharge Hose.

"L" Dimensions are maximum and may vary depending upon voltage and project requirements.

1/8" Pull Cable has 1760# breaking strength rating.

3/16" Pull Cable has 3700# breaking strength rating.

Optional 1/4" Pull Cable with 6400# breaking strength rating available.

Data Subject To Change

GunnCo Sidesloper™

MODEL P2K MOTOR DATA 0.5 HP, 3/460V/60

HORSE POWER	:	0.5 hp
PHASE	:	3
VOLTS	:	460 volts
FREQUENCY	:	60 Hz
SERVICE FACTOR	:	1.60
FULL LOAD AMPS	:	1.2 amps
AMPS @ SF	:	1.5 amps

Line to line Resistance : 38.4 – 44.1 Ohms

Locked rotor amps : 7.6 amps

Stainless

Applications

These motors are built for dependable operation in 4" diameter or larger water wells.

Basic Features

- Corrosion-resistant Stainless Steel Exterior
- Stainless Steel Splined Shaft
- Hermetically-sealed Windings
- Anti-track Self-healing Resin System
- Filter Check Valve
- Water Lubrication
- Kingsbury-type Thrust Bearing
- Pressure-equalizing Diaphragm
- Built-in Lightning Arrestors (All Single-phase; 200 & 230 V Three-Phase)
- Removable Water Bloc Lead
- Franklin-manufactured Control Boxes Available for Single-Phase Motors
- UL 778 Recognized (North American Voltages)
- CSA Certified
- ANSI/NSF 61 Certified
- Industry Standard NEMA Mounting Dimensions

Special Features

- No flow inducer sleeve required in water up to 86°F (30°C) for motors through 2 Hp.
- Two-wire motors are split-phase designs with integral starting components and do not require a control box. They feature Franklin's patented 2-wire BIAC starting switch which provides Reverse Impact Torque to aid starting in adverse environments and prevents extreme fast cycling (e.g. water logged tank).
- Three-wire motors through 1 Hp use Franklin's exclusive 3-wire QD (Quick Disconnect) Control Box with the patented QD Relay. This relay provides the ultimate in operational life.
- Single-phase motors can be used with Pumptec products to protect against dry-run and other installation conditions that can damage motors and/or pumps. See Single-phase Protection Devices for details.

Constant Pressure Options

- Use Franklin's MonoDrive controller with 1 1/2 Hp three-wire single-phase motors to provide constant water pressure.
- Three-phase motors can be used with SubDrive controllers to provide constant water pressure.

Pollution Recovery Options

- Pollution Recovery motors are equipped for use in monitoring and recovery wells in which hydrocarbons and other chemicals may be present.
- Special Vitor[®] rubber parts and other chemical resistant materials as listed in Construction Materials chart.

Stainless

4-Inch Super Stainless Motor Specifications

HP	Wiring	Wiring Range	Wiring Range	Des. No.	HP	Temp. Range	Run Mode	Notes
60	2-Wire	1/3 - 1.5	0.25 - 1.1	2	3450	86°F / 30°C	Continuous	
50	2-Wire	1/2 - 1.5	0.37 - 1.1	2	2875	86°F / 30°C	Continuous	CCW Facing Shaft End
60	3-Wire	1/3 - 3	0.25 - 2.2	2	3450	86°F / 30°C	Continuous*	
50	3-Wire	1/3 - 3	0.25 - 2.2	2	2875	86°F / 30°C	Continuous*	
60	3-Phase	1/2 - 3	0.37 - 2.2	2	3450	86°F / 30°C	Continuous*	Electrically Reversible
50	3-Phase	1/2 - 3	0.37 - 2.2	2	2875	86°F / 30°C	Continuous*	

4-Inch Pollution Recovery Motor Specifications

HP	Wiring	Wiring Range	Wiring Range	Des. No.	HP	Temp. Range	Run Mode	Notes
50	2-Wire	1/3 - 1.5	0.25 - 1.1	2	3450	86°F / 30°C	Continuous	
50	2-Wire	1/2 - 1.5	0.37 - 1.1	2	2875	86°F / 30°C	Continuous	CCW Facing Shaft End
60	3-Wire	1/3 - 2	0.25 - 1.5	2	3450	86°F / 30°C	Continuous	
50	3-Wire	1/3 - 2	0.25 - 1.5	2	2875	86°F / 30°C	Continuous	
60	3-Phase	1/2 - 2	0.37 - 1.5	2	3450	86°F / 30°C	Continuous	Electrically Reversible
50	3-Phase	1/2 - 2	0.37 - 1.5	2	2875	86°F / 30°C	Continuous	

*3 Hp motors require 0.25 ft³/sec flow past motor.

4-Inch Construction Materials

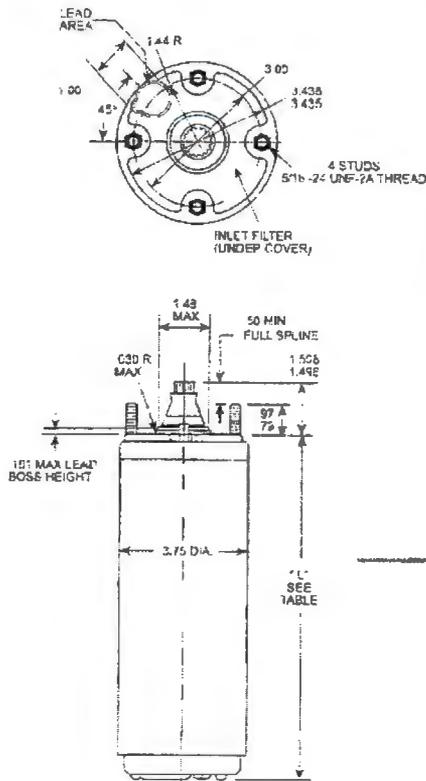
Component	Standard Material	Optional Material
Enc. Bells	304 SS over Iron	304 SS over Iron
Stator Shell	301 SS	301 SS
Shaft Extension	17-4 SS	17-4 SS
Fasteners	300 Series SS	316 SS
Seal Cover	Acetal	Tezel®
Seal	Nitrile Rubber Lip	Viton®
Diaphragm	Nitrile Rubber	Viton®
Slinger	Nitrile Rubber	Viton®
Lead Wire (or Cable)	XLPE	Lead not furnished with motor
Lead Potting	Epoxy	Lead not furnished with motor
Lead Jam Nut	300 Series SS	Lead not furnished with motor

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Viton® is a registered trademark of DuPont Dow Elastomers.
Tezel® is a registered trademark of E.I. du Pont Nemours and Company.

Stainless

4-inch Dimensions and Weights



Single-phase Motors - 2-wire

HP	EFF	LBS	SHIPPING WEIGHT		MOTOR FRAME SIZE (inches)
			BS	G	
1/3	0.25	8.76	16	7.3	4 x 4.375 x 16
1/2	0.37	9.51	18	8.2	4 x 4.375 x 16
3/4	0.55	10.64	21	9.5	4 x 4.375 x 19
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	15.10	31	14.1	4 x 4.375 x 21

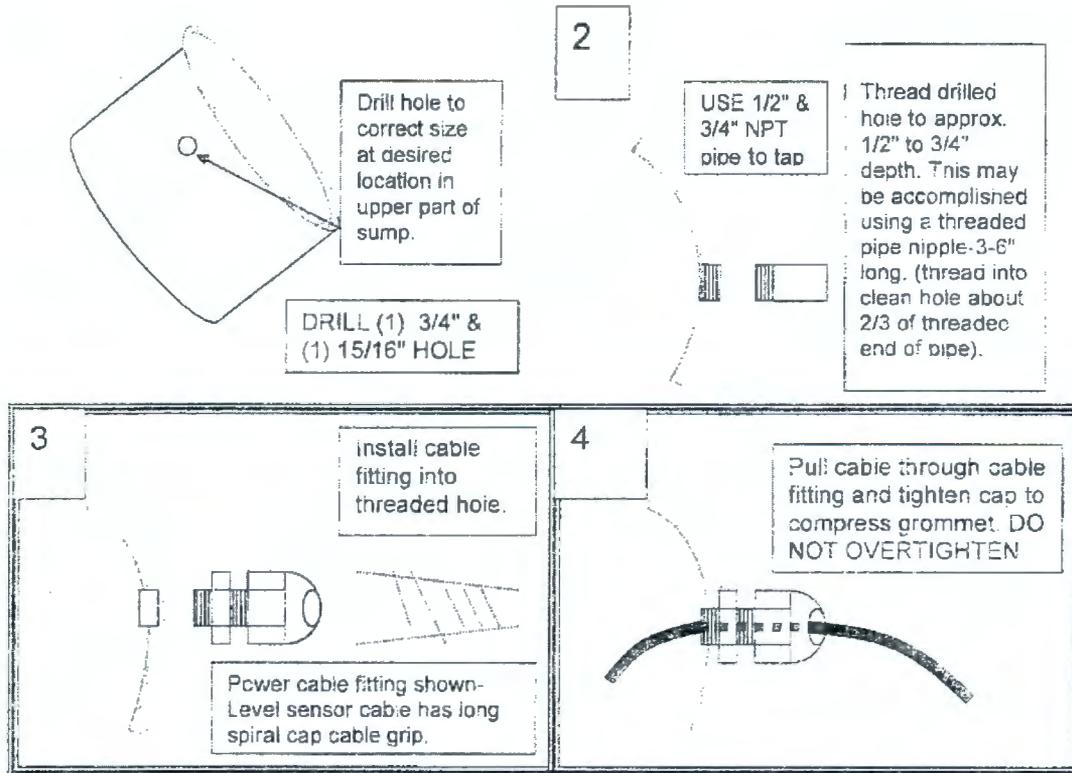
Single-phase Motors - 3-wire

HP	EFF	LBS	SHIPPING WEIGHT		MOTOR FRAME SIZE (inches)
			BS	G	
1/3	0.25	8.76	17	7.7	4 x 4.375 x 16
1/2	0.37	9.51	19	8.6	4 x 4.375 x 16
3/4	0.55	10.64	21	9.5	4 x 4.375 x 19
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	13.60	28	12.7	4 x 4.375 x 21
2	1.5	15.10	33	15.0	4 x 4.375 x 21
3	2.2	19.04	41	18.6	6 x 6 x 25

Three-phase Motors

HP	EFF	LBS	SHIPPING WEIGHT		MOTOR FRAME SIZE (inches)
			BS	G	
1/2	0.37	9.51	18	8.2	4 x 4.375 x 16
3/4	0.55	10.64	21	9.5	4 x 4.375 x 16
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	11.73	24	10.9	4 x 4.375 x 19
2	1.5	13.60	29	12.7	4 x 4.375 x 21
3	2.2	16.04	35	15.9	6 x 6 x 22

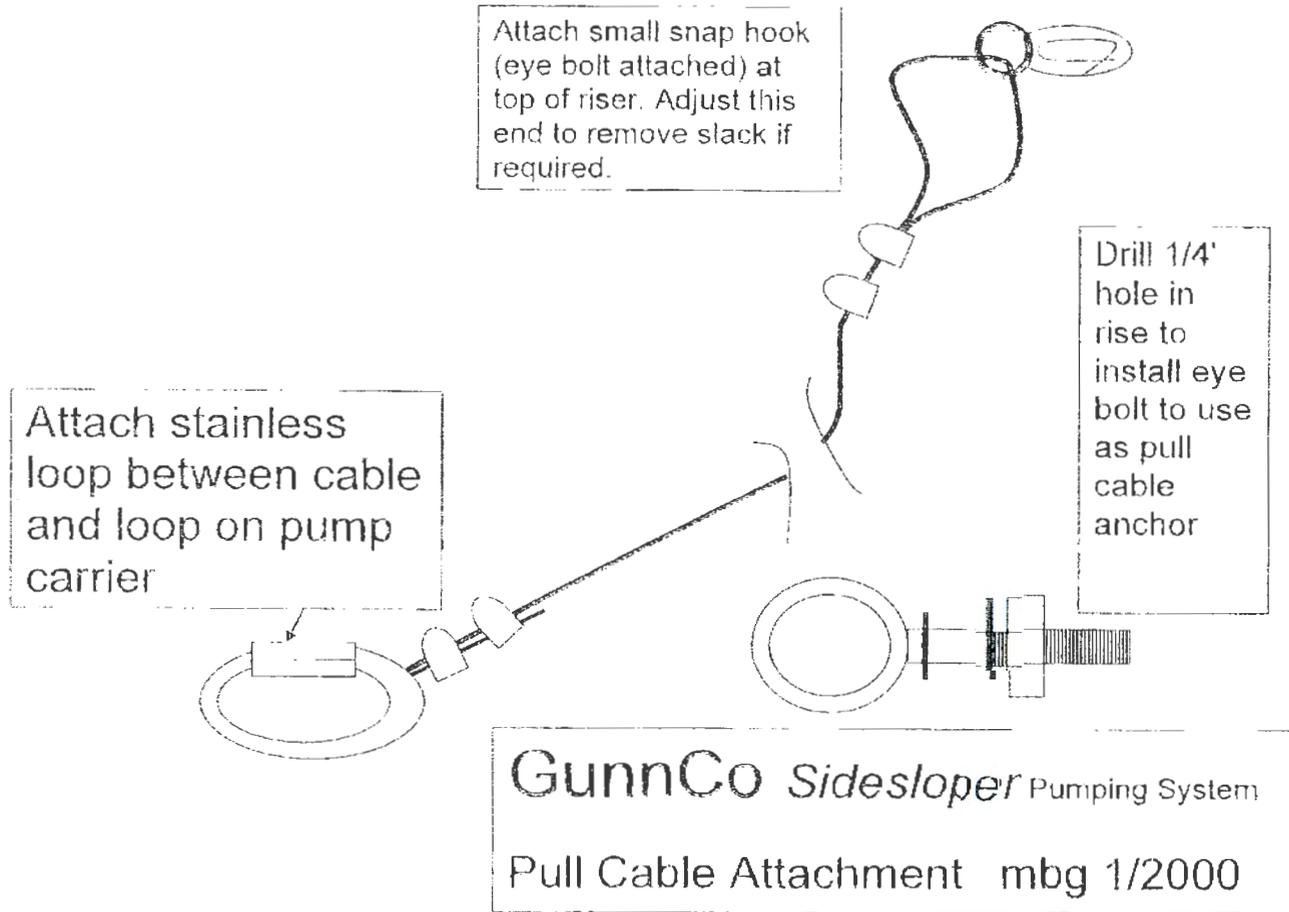
All dimensions listed above are for models supplied with lead. Consult factory for other models.



Cable Fitting Installation

The GunnCo *Sidesloper* pumping system is provided with riser pipe cable exit fittings to provide a neat and gas tight seals and allow cables to exit from the side wall of the riser pipe. The fittings allow the cables to be easily disconnected and removed if required and prevents gas from the riser pipe from migrating through conduit into the control panel where it will corrode and damage electrical components. The fittings are non-metallic and will not corrode and swell. Level

A matching set of cable fittings may be provided for the cables to enter conduit junction or control box. This leaves a short section of cable exposed but ensures the gas does not enter the control panel. An alternate version of this sealing system is to install the cable fittings on the inside of the riser and threaded conduit fittings on the outside of the riser-call to request details.



***Sidesloper*TM PUMPING SYSTEM CONTROL OPERATION-SIMPLEX "GCCP" Series" Panel**

The controller should provide automatic operation. Under normal conditions the pump should operate with the H-O-A switch in the A or automatic position.

Enclosure:

Fiberglass enclosure NEMA 4X rated.

Main Breaker

The main breaker turns power off to the controller. Rated 15 amps.

H-O-A Switch

The H-O-A switch should remain in the "A" setting for automatic operation. The "H" setting or hand is for testing only.

Motor Starter:

Magnetic coil to energize to allow power to the pump. Coii voltage is 110v.

Controller:

Overcurrent and undercurrent. Once pump is running in auto mode the Controller monitors current and will turn the pump off if either an overload, undercurrent (dry run) or voltage fault occurs.

RUN Light - indicates pump is called to operate.

Overload/Underload Light - Indicates a motor starter overload has occurred on controller.

Motor Breaker-triple pole circuit breaker-typically located on upper far right is provided for the short circuit protection and allow service of the system. If a breaker trips check for a short circuit and reset. If the breaker trips again there may be an electrical problem which should be checked by a qualified electrician. Motor breaker switches off primary voltage to the motor starter contactors and pump.

TECHNICAL DATA FOR 3 PH 460 V 0.5 HP CONTROLLER

<p>UNDERLOAD OR LACK OF FLUID</p> <p>Controller shuts off the pump within one second of running dry, and automatically restarts the pump at any time you dial on the timer from one minute to twelve hours.</p> <p style="text-align: center;">trip delay reset delay 1 second adjustable 1 minute - 12 hours</p>	<p>HORSEPOWER RATING</p> <p>208 Volts 1/3 - 60 HP 230 Volts 1/3 - 75 HP 380 Volts 1/3 - 125 HP 460 Volts 1/3 - 150 HP 575 Volts 1/3 - 200 HP</p>
<p>OVERLOAD</p> <p>If Controller shuts down the pump due to excessive current, it will restart it sixty seconds later. If the motor draws normal current Controller will allow it to run. If, however, after two consecutive attempts one minute apart the motor continues to draw excessive current, Controller locks out the pump so as not to burn out a motor winding and the overload light changes from on steady to blinking. The standard overload trip is 120% of normal. An option of 200% is available by cutting a trace on the front of Coyote and can be done in the field.</p>	<p>SOFT START</p> <p>For pumps using a soft start feature, a delay on start-up of fifteen seconds before Controller looks for voltage, overload, or underload is available by cutting a trace on the front of Controller and can be done in the field.</p>
<p>VOLTAGE FAULT</p> <p>Controller will trip on voltage if the voltage varies more than 10% from the operating voltage chosen.</p> <p>An option of 15% is available by cutting a trace on the front of Controller and can be done in the field.</p> <p style="text-align: center;">trip delay reset delay 2 seconds 60 seconds</p>	<p>COLD START</p> <p>For self-priming pumps that are pulling from a pond through an empty suction line, a cold start option of five minutes before Controller looks for an underload (run dry) condition is available by cutting a trace on the front of Controller and can be done in the field.</p>
<p>PHASE LOSS OR REVERSAL</p> <p style="text-align: center;">trip delay reset delay 1 second 60 seconds</p>	<p>OPERATING RANGE -20° to 70° C temperature 0% to 95% humidity noncondensing</p>
<p>RANDOM START</p> <p>When energizing Controller by turning on power at circuit breaker or fused disconnect there is a delay of 4 to 10 seconds before Controller turns on the pump. This "random start" feature is designed to prevent many pumps served by a single power source from all restarting at the same instant when power is restored after a power outage.</p>	

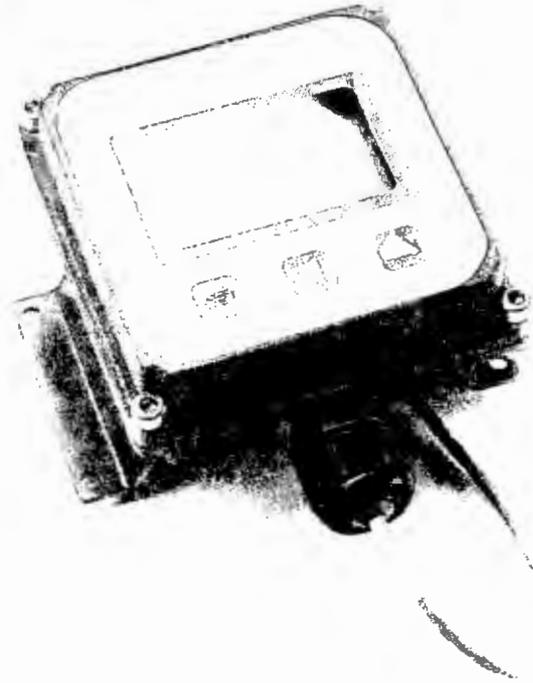
ALARM

If you wish to ring a bell, light a light, or activate some other alarm, Controller normally open dry alarm contact closes on any fault condition. For pumps that are expected to run dry but no alarm is wanted, an option is available to disable the alarm function on underload (run dry) only by cutting a trace on the front of Controller and can be done in the field.



FT400-SERIES Rate/Total Indicator

ISO 9001:2000
CERTIFIED



FEATURES

- Simple Setup
- Battery (FT415) or Loop Powered (FT420)
- Remote or Flow Sensor Mounted Indicator
- Rugged Metallic Housing
- Non-volatile Memory

APPLICATIONS

- Water Treatment
- Water Utility
- Industrial Chemical Handling

GENERAL INFORMATION:

The FT400-Series are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. The FT420 is powered by external DC voltage, and has both pulse and 4-20 mA analog outputs.

Both models can be factory-mounted on the meter (-M) or remotely wall-mounted with the brackets provided (-W). The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure. Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

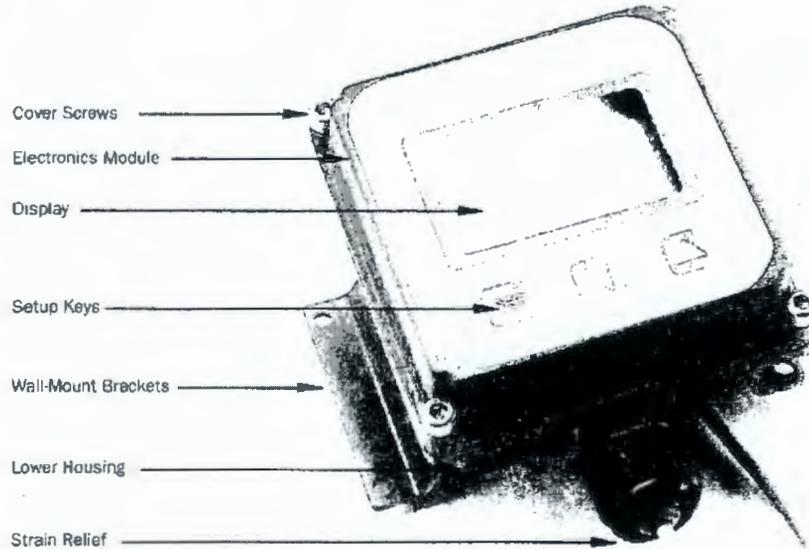
Housings for the -W and -M models are rugged cast aluminum, gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

The addition of a dual-relay output board allows for certain applications requiring dry contact output. Examples include certain metering pumps and water treatment controls. Dual relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a diastatic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters.



FT400-SERIES Rate/Total Indicator

FEATURES

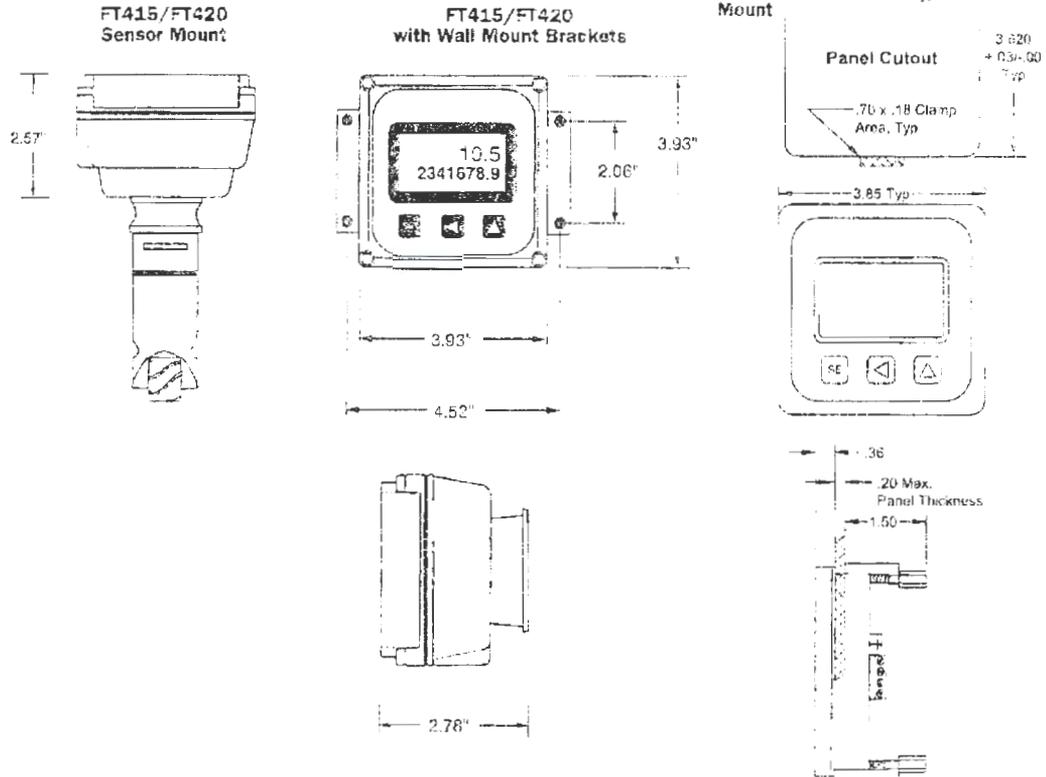


SPECIFICATIONS		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable, 3-5 year life	4 mA DC (4-20 mA loop), 12-32 Vdc
Display	Rate	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Output	Pulse	0.1 second open collector pulse (scaled) Sensor pulse (unscaled) High alarm or low alarm	0.1 second open collector pulse (scaled) Sensor pulse (unscaled) High alarm or low alarm
	Analog	None	4-20 mA loop; 24-32 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GWR Sensor (square wave)	Open collector/switch @ 5 Vdc
Input Range		1.0 - 2,500 pulses/second	1.0 - 10,000 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Temperature		0° C - 70° C (32° - 158° F)	0° C - 70° C (32° - 158° F)
Environmental		NEMA 4X	NEMA 4X

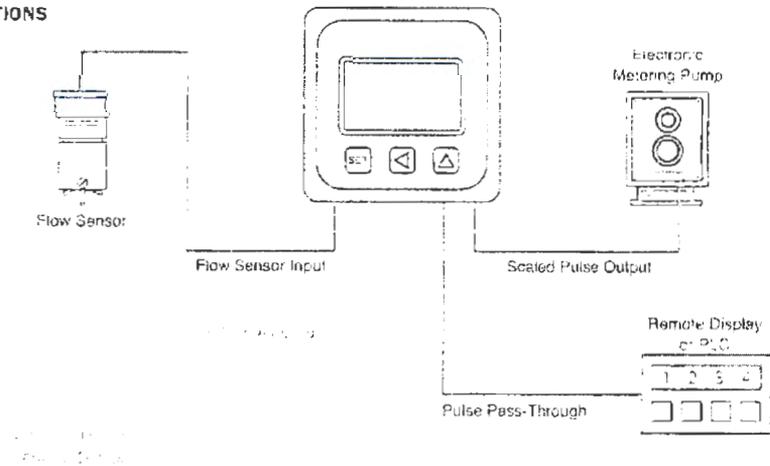


FT400-SERIES Rate/Total Indicator

DIMENSIONS



POSSIBLE APPLICATIONS





IP80 Series Flow Sensor Instructions

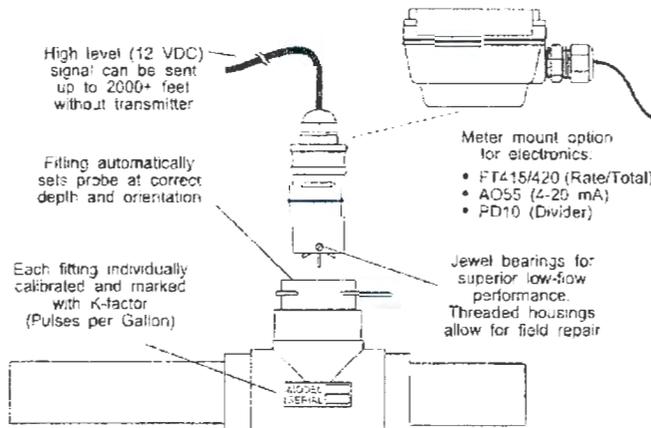
General Information

The IP80 Series are impeller-type insertion meters designed for use in pipe sizes 1/2" to 8". High-quality jewel bearings and nickel-bound tungsten carbide shaft are used for maximum life and extreme low friction. Bodies are machined from solid rod for maximum precision. Low-flow performance is superior. The rotation of the rotor is detected by a non-drag Hall-effect sensor. Output is a pulse-type square wave, which can be sent long distances (up to 2,000 feet) without a transmitter. This signal can be connected directly to SeaMetrics controls, as well as P.L.C.'s, counters, and computer cards.

SeaMetrics IP meters are ideal for chemical proportioning applications. If no display is required, a simple divider such as the PD10 provides adjustable pump pacing. For rate and total display, as well as pump pacing, the FT415/420 flow indicator can be mounted directly on the IP80 Series or remotely on a wall or panel.

The IP80 Series require special fittings, since they are not depth-adjustable as are the IP 100/200 series meters. Installation in the fitting ensures correct depth placement in the pipe. Fittings are available in PVC, brass, and stainless steel. Sensors are available in brass, 316 stainless steel, PVC, and polypropylene. In plastic pipe 3"-8", use an IP82 sensor, which is 1.00" longer than the IP81 to accommodate the larger fittings.

Features



Specifications

Sensor	Hall Effect Sensor	12 VDC current sinking pulse
Materials	Sensor Body	PVC, Polypro, Brass, or 316 SS
	Rotor	Kynar
	Shaft	Nickel-bound tungsten carbide, ceramic optional
	Bearings	Ruby jewel
Maximum Pressure	PVC	175 PSI (12 bar) at 75° *
	Polypro	175 PSI (12 bar) at 75° *
	Brass	200 PSI (14 bar)
	316 SS	250 PSI (17 bar)
Maximum Temperature	PVC, Polypro	130° F (55° C)*
	Brass, SS	200° F (93° C)
Accuracy		1-1/2% FS
Flow Range (GPM)		
	1/2" 3/4" 1" 1-1/2" 2" 3" 4" 6" 8"	
Min	0.28 0.5 0.6 1.9 3.1 6.9 12 27 47	
Max	28 50 80 190 314 691 1200 2700 4700	
Cable		#22 AWG 3-con, 18'

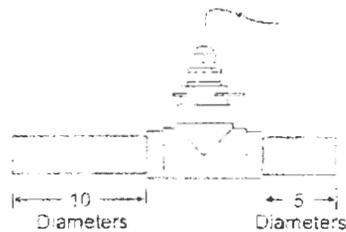
* (see Pressure vs. Temperature chart)

Installation



These water meters are not recommended for installation downstream of the boiler feedwater pump where installation fault may expose the meter to boiler pressure and temperature. Maximum recommended temperature is 130°F (Plastic), 200°F (Metal).

Fitting Installation. IP80 Series meters require special fittings. The meter fitting must first be installed in the pipeline. Straight pipe of at least ten times the diameter upstream of the meter and five diameters downstream are strongly recommended. Inadequate straight pipe, especially downstream of an elbow, change in pipe diameter, or partially-opened valve, can result in significant inaccuracy. Typically this inaccuracy is in the form of the meter reading high. Some IP80 Series meter fittings are supplied with upstream straight pipe.



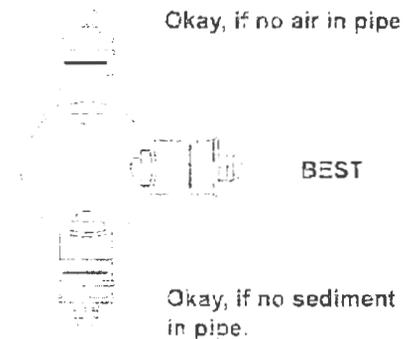
In the larger sizes, the length provided is less than ten diameters upstream and five downstream. It is not advisable to connect directly to the end of these fittings with a flow-disturbing device such as a valve or elbow. If possible, straight pipe should be added to these fittings.



Caution: Never remove the u-clip retainer when the pipe is under pressure. Always remove pressure from the pipe before attempting to remove the meter. Removal under pressure may result in damage or serious injury.

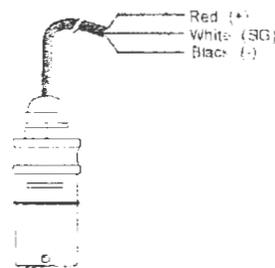
A PVC fitting is usually installed by solvent welding. The stainless steel and brass meter fittings have female pipe threads, requiring the appropriate male threaded fittings. Saddle fittings (size 2" and above) require a hole to be cut in the pipe. The recommended hole size is 1 3/4".

Meter Installation. After the meter fitting is installed in the pipeline, the meter can be installed in the fitting. Press the meter into the fitting as far as it will go. Then retain the meter in place by inserting the u-pin. This pin can be installed from either side. It is sometimes necessary to rotate the probe back and forth slightly to start the pin into the slots on the probe. Slide the pin in as far as it will go.



Meter Connection. See the "IP80 Series Connections" diagram for meter connections. Unless the meter is supplied pre-connected to a meter-mounted FT415/420 flow indicator, three leads must be connected. These three leads are color coded. The red wire is 6-24 VDC positive, the black is negative, and the white wire is the signal lead.

IP80 Series Connections

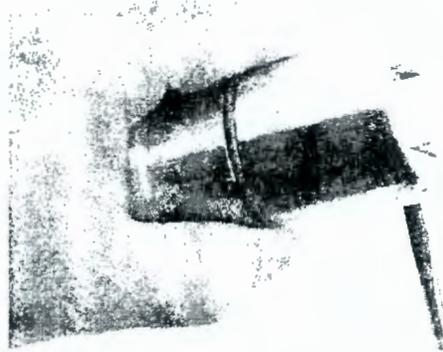


K-factor. If the IP80 Series meter is ordered with its fitting, the meter is factory calibrated in the fitting. A K-factor (meter factor) is indicated on the side of the fitting. This represents the actual number of pulses per gallon the meter produced during the factory flow test. This number can be entered into an FT415/420 or FT5210 flow indicator to make it read properly. If a pulse divider is being used, the K-factor is the starting point for calculating the divider number.

Maintenance and Repair

Rotor Replacement. Rotors are easily field-replaced. Shaft and rotor are a single unit, and are not replaced separately. If replacement is due only to normal shaft wear, bearing replacement is probably not necessary. If the rotor has been damaged by impact, the bearings should also be replaced. Rotor and bearings can be ordered as a kit, Part No.25901. Follow these steps:

1. Unscrew the threaded bearing housings to expose the shaft ends. If bearings are being replaced, back them completely out.
2. Remove the rotor. Put the new rotor in its place.
3. Thread in one bearing housing part way, then the other. Take care to start the end of the shaft into the bearing hole before tightening further.
4. Screw in bearing housings until they bottom. **Note: Do not use excessive force.**
5. Check for free spin. Blowing lightly on the rotor should result in it spinning rapidly and coasting to a smooth stop.



Sensor Replacement. It is very unusual for a sensor to require replacement in normal use. The primary cause of sensor failure is overvoltage (inadvertent connection of line voltage, for example) or incorrect polarity on hookup. The sensor is replaced by removing the strain relief, then threading out the sensor retainer plug. Remove the entire sensor capsule by pulling on the cable. The new sensor capsule can then be installed. It is important to orient the sensor capsule properly. Replace the retainer plug, and then replace and tighten the strain relief.

Troubleshooting Guide			
Problem	Probable Cause	To Check	To Repair
No signal after installation	Insufficient flow	See Min. GPM for size	Contact SeaMetrics
	Bad connections to control electronics	Check connections at control. Check polarity: red (+), black (-), white (signal)	Re-connect if necessary
	Incompatible control	Does control: 1) provide 6-24VDC power; 2) accept current sinking inputs	Contact SeaMetrics
	Damaged or missing rotor	Remove meter and check visually for free spinning	Obtain new rotor and replace
Inaccurate metering	Not enough straight pipe between meter and flow disturbance	See recommendations, measure	Move meter away from flow disturbance or field calibrate

GunnCo Hose Fittings

All Hose fittings supplied on GunnCo Pump and Control Systems are to a minimum standard of 304 SS.



1/2" hose coupling fitting



female coupling fitting NPT

GunnCo Sidesloper™

Pumps and Systems Warranty Policy

1. All **Sidesloper™** GunnCo packages sold as specified and complete systems (pump, panel, and level sensor) shall be covered by a 12-month warranty. The warranty period begins upon the date of shipment and covers all components against failure to function due to workmanship, component failure, or materials compatibility for the application as recommended and sold and paid for within quoted terms.
2. All **Sidesloper™** pumps or components not sold as a complete system are subject to a warranty period of one year from shipment date or per the manufacturer's standard warranty, whichever expires first.
3. Claims under the warranty can be made by obtaining a return authorization number from GunnCo during the warranty period and returning the defective component(s), freight pre-paid to GunnCo or the proper service location as directed by GunnCo. Details of the problem should be included with the returned item along with the return authorization number. The defective component must be returned within 30 days of the authorization date. The option to repair, replace, or adjust the problem component shall be that of GunnCo. Costs associated with troubleshooting, removal or replacement of components, rental equipment, rush premium charges, and freight is not included under warranty.
4. Warranty does not cover normal wear, damage due to accident or physical damage (during shipment, installation, storage), acts of nature (lightning), (blown fuses and voltage monitors), misuse, abuse, improper storage, improper/defective electrical service (low/high voltage/surges), improper installation, improper selection, or improper or unauthorized service or modifications.
5. GunnCo accepts no responsibility for damage, loss, or expenses incurred through the sale or use of its equipment. Under no condition shall GunnCo be held liable for any special, incidental, or consequential damage.

System Installation Service Warranty Policy

1. Pump systems sold as an installed system project package are covered for a 12-month service period after installation by GunnCo or our representative. The warranty does not cover physical damage, abuse, misuse, freezing, improper operation, or damage due to unauthorized design revisions or operating parameters. Materials failures may be subject to the original manufacturer terms and conditions of warranty.
2. The service warranty procedure shall include confirmation of nature of problem to GunnCo and may require local electrician or site personnel to confirm scope of problem.
3. Repairs by others should be authorized by GunnCo. No invoices or back charges will be accepted without prior approval by GunnCo. Charges should be customary and include a written description of the problem and solution. Damaged components must be returned to GunnCo for warranty consideration.
4. When applicable GunnCo requests site personnel replace a damaged component (such as plug in parts) or check status lights.
5. Service visits determined to be non-warranty related are subject to normal GunnCo service charges, per diem rates, and travel time charges.

Service Labor, Repairs and Components/Parts Warranty Policy

- 1) Service labor is warranted for quality of provided service. Repairs by GunnCo or GunnCo representative are warranted for 90 days from original installation/service dates. Failure due to work by others, modifications, non-approval for proper repairs, temporary repairs, materials by others, abuse, misuse, acts of nature, and non-recommended parts or components may not be covered by this warranty.
- 2) Parts and component are subject to original manufacturer's warranty periods and limits and may be subject to manufacturer's final inspection of a failed item.
- 3) GunnCo retains right to replace, repair, or refund labor and materials under the warranty where applicable.
- 4) Repair warranty for shop repairs is 90 days and does not include freight, removal, installation, non-GunnCo provided components or as noted for above service warranty.

.....

Please contact us immediately should you suspect there may be a problem or if you have any questions concerning the operation or installation of a system or component. By contacting us immediately we can assist in determining the problem and provide the fastest possible response.

Troubleshooting

PROBLEM	CAUSE	CORRECTION
Pump does not produce flow or enough flow	Pump is rotating in the wrong direction (three phase pump only).	Reverse two legs of wiring and re-try.
	Pump is under sized for application.	Check pump size against actual system requirements.
	Pump is clogged.	Check pump inlet screen or for debris (sludge) in sump.
	Valve closed or hose/pipe pinched or collapsed. Leaking or disconnected hose or pipe.	Inspect hose/piping and be sure all valves are opened.
	Pump has excessive wear or internal clogging or damage	Service Pump-inspect discharge port & impeller.
Pump will not start	Not enough liquid in well to start pump	Switch pump controller to "H" position
	No power at motor	Check incoming power/phase monitor and fuses
	Power on but pump will not start-Contactor will not pull in	Check contactor coil-test in "H" Contact electrician to check
	Defective power cable/wiring	Test/inspect wiring
	Motor locked up	Inspect Pump Inlet & Check Impeller
Tripped overload, breaker, or blown fuse	Motor locked up	Check Pump/Rebuild if Required
	Short Circuit in cable or wiring	Inspect cable/wiring-replace as required.
	Blown transformer fuses	Test/replace transformer
	Low voltage or phase loss	Test incoming power (auto reset)
	New Fuses Blow	Confirm correct size fuses

Sidesloper[™] PUMPING SYSTEM

SAFETY

The pumping system is designed to allow for an operator to check the system with a minimum of electrical knowledge. However when working around the pump and controller the following minimum safety precautions should be applied.

- When doing any service work within the interior of the control panel the main breaker should be in the off position.
- When visually inspecting interior control panel components do not touch any component unless power is switched off.
- Turn off power when replacing fuses.
- When working in the wet well or handling pump power should be off.
- A qualified electrician should install and connect the control panel.
- Control panel must be properly grounded with ground rod and conductor to back-plate.
- Pump ground wire should be connected to the ground lug provided.
- Do not work on control panel in wet conditions.
- All service work should be performed by qualified personnel.
- Any modifications to control panel should be approved by GunnCo prior to completion. Non-authorized modifications could void warranty and result in safety hazards.

SERVICE OR QUESTIONS

For authorized service of pump, controller, or components or returns and replacement of defective components call GunnCo @ 770-899-7114; Fax # 770-889-2754; e-mail info@gunnco.com.

Attachment D-4
Seepex BN52-6LS

Additional information vendor information can be found in Hanford Site
Integrated Document Management System (IDMS)

seepex.com

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Enon, Ohio 45323
Tel +1 (937) 864-71 50
Fax+1 (937) 864-71 57
sales@seepex.net
www.seepex.com

Operating and Assembly Instruction Progressive Cavity Pump



24h Helpline:
www.seepex.com

Commission No.

830709

Type

BN 52-6LS

Job#

2113301

Tag: SS Tag Pump:
STS-P-002 Sludge
Mixing Pump

**Read instructions before
beginning any work!**

**Always keep instructions
handy on the worksite.**

Issue: 01.12.2012

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Index

Operating and Maintenance
Instructions
Progressive Cavity Pump

item	document	denomination
1.0.0	OM.GEN.01e	General
2.0.0	OM.SAF.01e	Safety
3.0.0	OM.TRA.01e	Transport and Intermediate Storage
4.0.0	OM.DES.01e	Description of the seepex pump and Accessories
5.0.0	OM.INS.01e	Assembly and Installation
6.0.0	OM.COM.01e	Commissioning/De-commissioning
7.0.0	OM.MAI.02e	Service and Maintenance
	OM.PJT.02e	Pin Joint Assembly
	OM.HBD.01e	Holding Band Re-assembly
8.0.0	OM.REC.01e	Breakdown, reasons, remedies
9.0.0	OM.ACC.01e	Auxiliary seepex documentation
9.0.0	Comm.-no.	Data sheet
	CHA.52-6LS.use	Characteristic Curves
	062-062A1	Sectional drawing
		Parts list
	OM.SEA.__e	Shaft Sealing
	262-0GB/0170-0-084A3	Sectional drawing shaft sealing
	OM.WPS.02e	Wearing parts and gaskets
	262-C18/0520-S-701A4	Dimensional drawing
	OM.SPT.01e	Tools
		Accessories
10.0.0	OM.MDS.01e	Manufacturer's documents from sub-supplier
99.0.0	OM.ADR.01e	seepex Subsidiaries

**1.0
General**

**1.1
Application**

These operating instructions contain basic information on the installation, commissioning and maintenance of seepex machines. Compliance with the work steps described in the individual sections is essential.

**1.2
Details of the seepex machines**

**1.2.1
Operating Instructions**

The Commission Number (comm. no) assigns the operating instructions to a particular seepex machine. The operating instructions are produced in relation to a specific job/commission and are valid only for the machine whose comm. no. is identical with that indicated on the cover sheet and possessing the associated data sheet, Point 9.

**1.2.2
Manufacturer**

The machines were manufactured by seepex.

**1.2.3
Range, Size, Version**

of the machines are stated in the appended data sheet, Point 9.

**1.2.4
Machine Comm. No. and Year of Construction**

are stated on the type plate at the machine.

**1.2.5
Release Date of the Operating Instructions**

is stated on the cover sheet of the operating instructions.

**1.2.6
Modifications, Notes of Modification**

If modifications to the machines are carried out in agreement with seepex, a new set of operating instructions will be provided, or the existing operating instructions will be supplemented by an additional sheet together with a new cover sheet. The date of modification and modification index will be noted on the new cover sheet.

**1.2.7
EEC Machine Directive**

**1.2.7.1
Manufacturer's Declaration**

seepex Manufacturer's Declaration as required by the EEC Machine Directive 89/392/EEC, Appendix II B:

The seepex machines delivered in accordance with our design are intended to be fitted in one machine or assembled together with other machines to form one machine/plant. The commissioning of the machine is forbidden until such a time as has been established that the entire machine/plant satisfies the requirements of the EEC Directive for Machines as amended 91/368/EEC and 93/44/EEC.

Particular attention must be paid to the safety requirements specified in EN809 (s and Equipment for Fluids) as well as the information in these operating instructions.

**1.2.7.2
Declaration of Conformity**

seepex machines possessing no safety accessories do not fulfill the requirements of the EEC Machine Directive 89/392/EEC as amended 91/368/EEC and 93/44/EEC.

For this reason, no Declaration of Conformity as required by the EEC Machine Directive 89/392/EEC, Appendix IIA can be issued before appropriate safety devices have been installed/mounted on the machine and/or plant with due regard to the information given in these operating instructions.

The following harmonized standards are particularly applicable:
EN 809, EN292T1, EN292T2
Applicable national standards and specifications must be taken into consideration.

Following assessment of the conformity of the machine/plant with the EEC Machine Directive, customers may on their own initiative place on the full machine/plant the EEC symbol 'CE' as defined in Identification Directive 93/68/EEC.

CAUTION

This documentation must be kept available for at least 10 years.

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General

**1.2.8
Copyright and Industrial Property Rights**

These operating instructions are copyrighted. The reproduction, in particular by photocopying, of these instructions is not permitted (§§ 54, 54 UrhG) and constitutes a criminal offence (§ 106 UrhG). Proceedings will be instituted if the copyright is violated.

**1.2.9
Specifications Required for Inquiries and Orders**

The following information must be included when inquiring about replacement parts or placing orders:
- comm. no.
- / machine type
This information is given on the type plate mounted the machine.

**1.2.10
Technical Data Sheet**
see Point 9.

**1.2.11
Performance Data, Load Index, Power Consumption**

are indicated in the associated data sheet, Point 9.

**1.2.12
Sound Pressure Level**

The sound pressure level and/or noise characteristics of the seepex machines are ascertained in accordance with DIN 45635. The measuring guidelines are largely identical with the international standards ISO 3740-1980 and ISO 3744-1981.

**1.2.13
Operating Range**

Employment of the machine is not permissible for purposes other than those stated in the data sheet, see Point 9. seepex cannot accept liability for damage arising through failure to comply with this operating range.

**1.3
Supplementary Information**

**1.3.1
Accessories, Optional Extras**

Please refer to the data sheet, Point 9.

**1.3.2
Company Address, Service Addresses**

see Point 11

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Safety

2.0 Safety

These operating instructions contain basic requirements to be observed during the installation, operation and maintenance of the machine. Therefore, the instructions must be read by the mechanical fitter and by the technical personnel/operator responsible for the machine prior to assembly and commissioning, and kept available at the operating site of the machine/plant at all times.

Compliance is required not only with the general safety instructions given in this section but also with the detailed instructions, e.g. for private usage, given under the other main headings in these operating instructions.

2.1 Labeling of Advice in the Operating Instructions

In these operating instructions safety advice whose non-observance could lead to danger for life or limb is labeled with the following general hazard symbol:



safety symbol acc. to ISO 3864 - B.3.1

Warnings regarding electric power are labeled with:



safety symbol acc. to ISO 3864 - B.3.6

Safety instructions whose non-observance could jeopardize the machine and its functions are labeled by the word

CAUTION

Always comply with instructions mounted directly on the machine, e.g.

- rotational direction arrow
- fluid connection indicators

and ensure that the information remains legible.

2.2 Personnel Qualifications and Training

Personnel charged with operation, maintenance, inspection and assembly must be in possession of the appropriate qualifications for the tasks. The company operating the machine must define exact areas of responsibility, accountabilities and personnel supervision schemes. Personnel lacking the required skills and knowledge must receive training and instruction. If necessary, the operating company may commission the manufacturer/supplier to conduct these training courses. Furthermore, the operating company must ensure that the personnel fully understand the contents of the operating instructions.

2.3 Dangers Resulting from Failure to Observe Safety Instructions

Failure to comply with the safety instructions may lead to hazards to life and limb as well as dangers for the environment and the machine. Non-observance of safety instructions can invalidate the right of claim to damages.

The following are just some **examples** of possible dangers resulting from failure to comply with the safety instructions:

- Failure of important machine/plant functions
- Failure of prescribed methods of service and maintenance
- Danger to life and limb due to electrical, mechanical and chemical influences
- Danger to the environment due to the leakage of hazardous substances

2.4 Safety-conscious Working

Always comply with the safety instructions listed in this document, the existing national accident prevention regulations and any company-internal work, operating and safety rules.

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Safety

2.5 Safety Instructions for the Operating Company/Machine Operator

- Any potentially hazardous hot or cold machine parts must be provided with protection against accidental contact at the customer's premises.
- Protective guards for moving parts (e.g. coupling) must never be removed while the machine is in operation.
- Leakages (e.g. in the shaft seal) of hazardous conveying liquids (e.g. explosive, toxic, hot) must be drained in such a way that no danger arises for persons or for the environment. Always observe the relevant statutory requirements.
- The risk of exposure to electrical power must be eliminated (for details, see the VDE regulations, for example, or those of the local power supply company).

2.6 Safety Instructions for Maintenance, Inspection and Assembly Work

The operator must ensure that all maintenance, inspection and assembly tasks are carried out by authorized and qualified personnel who have studied the operating instructions closely and become sufficiently familiar with the machine.

As a basic rule, the machine must be brought to a standstill before work is carried out. Always comply with the de-commissioning procedure described in this document.

Any machines or assemblies conveying media that are detrimental to health must be decontaminated.

Immediately following completion of work, all safety and protective devices must be replaced in position and, where applicable, re-activated.

Before re-starting the machine, observe the points listed under the heading "Initial Startup".

2.7 Unauthorized Modification and Manufacture of Replacement Parts

Conversions or modifications of the machine are permissible only in consultation with the manufacturers. Original manufacturer replacement parts and manufacturer-approved accessories enhance the operational safety of the machine. The usage of unauthorized parts may lead to the nullification of the manufacturer's liability for any resultant damages.

2.8 Impermissible Modes of Operation

The operational safety of the machines supplied is warranted only for employment in accordance with the intended use as defined in Section 1 - General - of these operating instructions. Never allow the threshold values specified in the data sheet to be exceeded.

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Transport and Intermediate Storage

3.0 Transport and Intermediate Storage

3.1 Safety Precautions

Employ appropriate transport means, hoists and tools when transporting and storing the machine, always observing the safety instructions.

3.2 Transport

Depending on its weight, the seepex machine must be transported manually or with appropriate transport means. Comply with the transport instructions on the packing.

3.3 Unpacking

The design of the packing is such that the equipment can be removed manually or, if demanded by the weight, by means of appropriate hoists.

Any screw fittings between the machine and the packing must be undone. Comply with the attached information notices and symbols.

3.4 Intermediate Storage/Preservation

Unless otherwise indicated in the data sheet, seepex machines are provided with preservation only for the duration of transport. If a long period of intermediate storage is foreseen before the machine is commissioned, it is necessary to provide supplementary preservation. If necessary, the appropriate measures should be drawn up in consultation with seepex.

Intermediate storage in extreme climatic conditions is permissible only for machine whose design is appropriate to the circumstances. If necessary, seepex must be consulted.

CAUTION

Pumps of the range MAP

If the period from supply and subsequent storage until the commissioning is more than 4 weeks, the hoses should be dismantled, refer to Point 7.

3.5 Protection against Environmental Influences

To afford protection against environmental influences, the intermediate storage location must be dry, enclosed and free from frost.

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Description

4. Description of the seepex Progressive Cavity Pump and Accessories

4.1 General Description, Design and Mode of Operation

Like all progressive cavity pumps, seepex pumps belong to the rotating positive-displacement pump family. The characteristic attribute of these pumps is the special formation and arrangement of the two conveying elements, namely the rotor and the stator.

The difference in the number of threads possessed respectively by the rotor and stator produces a chamber that opens and closes alternately in line with the constant turning motion of the rotor, effecting the continuous transportation of the conveying product from the suction side to the pressure side.

The geometrical formation of the two conveying elements combined with the constant contact that exists between them result in sealing lines that effect an airtight seal between the suction and pressure side in every position of the eccentric screw, even when the pump is stationary. The pump owes its high suction capacity to this sealing between the suction and pressure sides.

4.2 Mechanical Design

Please consult the sectional drawing, Point 9, for the mechanical design of the pump. The data sheet, Point 9, gives information on the design of the pump housing, stator, rotor and rotating components.

Refer to document OM. SEA. ___, for information on the design of the shaft seal.

The data sheet, specifies details of the design of the drive engine. Further details are given in the appended manufacturer's documents, Point 10.

4.3 Accessories

Consult the data sheet for information.

4.4 Dimensions, Weight

Consult the appended dimensional drawing,

4.5 Design Variants

Refer to the data sheet, Point 9, for the design of the seepex progressive cavity pump. Other design variants are possible, whereby seepex must first check whether a particular pump is suitable for the intended purpose.

4.6 Operating Site Specifications

Operating site specifications are listed in the data sheet, Point 9. Details of the space required for installation, operation and maintenance are given in Point 5.2.1.

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Assembly and Installation

5.0 Assembly / Installation

5.1 Mounting Tools / Hoists

No special tools are required for the assembly and installation of the pump.

The customer must check the dimensions and weight of the seepex progressive cavity pump to ascertain whether the available hoisting apparatus is sufficient for the assembly and fitting of the pump.

5.2 Initial Assembly

5.2.1 Inspection Prior to Commencement of Assembly

5.2.1.1 Location

The place of installation for the pump must conform with the site stated in the data sheet in Point 9. Any change of location must be checked and approved by seepex.

5.2.1.2 Space Requirements

Customers are responsible for determining the space requirements; the following factors must be taken into consideration:

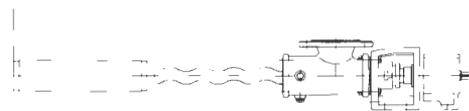
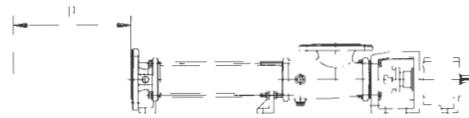
- dimensions and weight of the machine
- required transport and hoisting equipment
- possible piping layout with allowance for the space allowing disassembly of the rotor as defined in 5.2.1.3
- freedom of movement to:
 - operate the drive / speed regulation
 - read speed and pressure indicators
 - adjust a stator retensioning device, if fitted
 - operate a buffer fluid supply unit, if fitted
- space required for lubrication / renewal of lubricants
- disassembly of mechanical protective devices, e.g. V-belt or coupling protection
- space required for handling the mounting tools, e.g. sufficient wall clearance

5.2.1.3 Space Allowing Disassembly of Stator P

A specific space must be allowed for exchanging the stator. The required dimension "P" is indicated in the index of these operating instructions or in the appended dimensional drawing, Point 9.

CAUTION

Ensure also that the pipe work can be dismantled at this location too.



5.2.2 Installation of the Fully Assembled Pump

Installation in conformity with data sheet
Installation of the pump is permissible only in accordance with the data sheet specifications and the associated basic drawing, see Point 9. Any change in the position must be checked and approved by seepex.

Tension-free mounting of pump
This rule applies to pumps with and without drives, to versions with and without baseplate, for mounting on the foundation or other bearing elements. The entire area of all bearing surfaces of the machine must rest on the ground. Any unevenness must be corrected by appropriate supports.

- Correct seating of drives
All drives have been aligned ready for operation and mounted by seepex. However, displacements may occur during transport or installation. For this reason, check that the alignment and fastening of the drive and coupling are correct.

Protective devices
On completion of the assembly and installation work, immediately mount all safety and protective devices in their proper locations and set them in operation.



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**Assembly and
Installation**

**5.2.3
Protective and Controlling Equipment**

Information on equipment of this nature, where fitted, is provided in the data sheet, Point 9. Consult the attached manufacturer's specifications, Point 10, for instructions on assembly and installation.

**5.2.4
Electric Connection of Electric
Motor and Frequency Converter**

The electric connections must be established in accordance with the manufacturer's specifications, Point 10, as well as the safety specifications applying at the installation site. The mains voltage and frequency must match the ratings indicated on the type and rating plates.

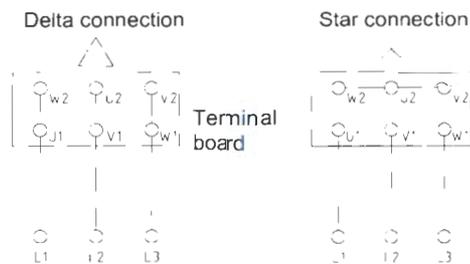


Switch on electric motor „direct-on-line“

CAUTION

An increased starting torque is necessary due to the clamping between the rotor and stator conveying elements. This means the electric motors that drive the progressive cavity pumps must always be switched on directly. As a rule, star-delta startup is not possible unless special arrangements have been made with seepex.

Three-phase cage motor



low high . . .
. . . voltage indicated on rating plate

Speed regulation via frequency inverter
When progressive cavity pumps with frequency-controlled drives are started up problems may occur due to unsuitable or wrongly set frequency inverters. For this reason we recommend the purchase of the complete drive, including frequency inverter, from seepex, so that the frequency inverter can be tuned on the seepex test field along with a trial run.

Ensure that customer-supplied frequency inverters comply with the starting torque and running power specified in the appended data sheet, Point 9.

CAUTION

Consult the appended document TI.FRU.01, see Point 9, for further information on the electric connection and the setting of frequency inverter and variable-speed motor.

**5.2.5
Piping**

**5.2.5.1
Suction and Pressure Flanges**

The position, nominal width and standard of the suction and pressure flange of the progressive cavity pump are specified in the dimension drawing, Point 9, and data sheet, Point 9. Always observe the rotational direction and flow direction defined in Point 6.2.5.

**5.2.5.2
Piping Dimensioning**

CAUTION

The pipe diameters on the suction and pressure sides must be dimensioned in accordance with the customer's pressure-loss calculation in such a way that the pressures specified in the data sheet, Point 9, are not exceeded. The nominal width of the suction pipe should at least match that of the pump suction flange.

**5.2.5.3
Residue-free Piping**

CAUTION

Prior to starting up the pump, ensure that all pipelines are free from foreign bodies. Installation residues (such as weld spatter, screws, steel chips etc.) will lead to damage of the seepex pump for which guarantee claims will not be accepted.

**5.2.5.4
Tension-free Mounting**

CAUTION

Pipelines and other components requiring to be connected with the pump must be mounted without stresses.

**5.2.5.5
Fluid Connections for Optional Extras**

Consult the data sheets, Point 9, for information regarding the optional extras, if any, that are fitted. The technical description is given under Point 9.

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Commissioning/ De-commissioning

6.0 Commissioning/De-commissioning

6.1 Engineering Data

Details regarding all technical specifications and operating conditions are given in these operating instructions together with the data sheet, Point 9.

To guarantee the correct assignment of documentation to pump, the commission number on the

- cover sheet
- and data sheet of these operating instructions must match the commission number stated on
- the nameplate of the pump.

6.1.1 See Point 7.2.2 for Lubricant Chart

6.2 Preparation for Operation

6.2.1 Bearing

6.2.1.1 See Point 7.2.1.4 for pump bearing.

6.2.1.2 See manufacturer's documents, Point 10, for drive bearings.

6.2.2 Shaft Sealing

See document OM.SEA.____.

6.2.3 Filling Up of Suction Side to Avoid Dry Running at Startup

CAUTION

Before switching on the pump, fill the suction-sided pump casing with fluid so that the first rotations will lubricate the conveying elements immediately. A small quantity of fluid is sufficient for lubrication; the subsequent operation of the pump is self-priming, even if an air column up to the liquid level remains.

6.2.4 Electric/Hydraulic Connections

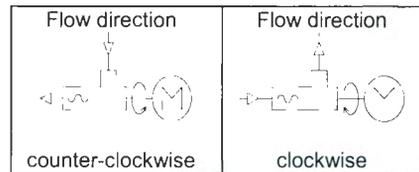
The connections are listed in the appended manufacturer's documents, Point 10.

The risk of exposure to electrical hazards must be ruled out. Always observe the safety regulations valid at the site of installation.



6.2.5 Checking Direction of Rotation

The rotational direction of the pump determines the flow direction of the conveying medium.



Prior to commissioning the rotational direction of the pump must be checked for compliance with the data sheet specification and the rotational direction arrow on the type plate of the pump.

6.3 Control and Monitoring Equipment

Where applicable, please refer to the associated documents, Point 10, for information on commissioning.

6.3.1 Performance Check

Any optional extras must be subjected to a performance check in conformity with the specifications by seepex or other manufacturers, see manufacturer's documents.

6.3.2 Setting

Unless already performed in the factory, setting must be carried out in accordance with the appended manufacturer's specifications, Point 10. Pay attention to the operating specifications in the data sheet.

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Commissioning/
De-commissioning

6.4 Equipment for Protection of Persons

Machines must be fitted with mechanical protective devices complying with DIN EN 809.

- Moving or working parts must be protected against accidental contact.
- However, safety considerations demand it be possible at all times to check without hindrance whether the shaft seal is fully functional. A protective guard is necessary in this area only if components are mounted on the rotating, smooth shaft.
- If pumps are operated with an open suction flange/feed hopper, a suitable protective guard complying with DIN EN 294 must be mounted.
- Country-specific protective regulations must be observed at the site of installation. Prior to activation of the pump, check the proper function of all protective equipment.



6.5 Commissioning

6.5.1 Initial Startup/Re-starting

CAUTION

Every seepex progressive cavity pump is designed for the specific operating conditions documented in the data sheet. Commissioning is permissible only if the operating conditions conform with those indicated in the data sheet. Although the potential usages of the seepex pump are not confined to the specified operating conditions, any change in the original conditions must be checked and approved by seepex.

The right to make claims under the warranty agreement will be annulled if operating conditions are changed without prior approval by seepex.

6.5.2 Avoid Dry Running of Pump

CAUTION

The dry running of a pump increases the friction between rotor and stator, quickly causing an unacceptably high temperature to develop on the inner surface of the stator. This overheating leads to burning of the stator material and the total failure of the pump.

For this reason it is necessary to ensure that the suction-sided flow never dries up completely. If a continuous flow cannot be guaranteed for the plant, it is essential to fit the seepex dry running protection device TSE, available as an optional accessory.

6.5.3 Check Pressure at Suction and Pressure Flanges

6.5.3.1 Safeguard Pump Against Excessive Pressure at the Suction Flange

The seepex pump is designed to operate with the pressure at the suction flange (suction head or inlet pressure) specified in the data sheet. Deviating pressure conditions may lead to the failure and/or destruction of the shaft seal or entire pump.



For this reason the suction pressure specified in the data sheet must be guaranteed. Appropriate monitoring devices are oil-filled contact manometers that deactivate the pump.

6.5.3.2 Safeguard Pump Against Excessive Pressure at the Pressure Flange

The seepex pump operates according to the positive displacement principle. Operation of the pump against an excessive pressure caused by closed valves, by high pressure losses in the piping or by product sedimentation will lead to the destruction of the pump, drive, pipe work and/or downstream equipment. Every progressive cavity pump must therefore be protected against overpressure. Safety valves with bypass pipes or oil-filled contact manometers that deactivate the pump are appropriate protective devices.



6.5.4 Drive Engine

Consult the attached manufacturer's operating instructions, Point 10, for information on commissioning the drive engine.



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Commissioning/ De-commissioning

6.5.5 Establish Clear Passage Through Pipelines

CAUTION

To prevent damage to the pump the unhindered flow of liquid must be guaranteed between the points of entry to and exit from the pipeline. For this reason, open all relevant valves etc. prior to activation of the pump.

6.6 De-commissioning

6.6.1 De-activation

The electric connections must be switched off and protected against accidental re-activation. Observe the safety regulations applying to the plants.



6.6.2 Stationary Pump

The pump and all optional equipment must be provided with the following protection modes while at a standstill:

- Frost protection
- Protection against solid particle deposits
- Protection against sedimentation of the medium
- Corrosion protection for parts in contact with the medium

We recommend that the pipeline and pump be emptied for the duration of the plant standstill. Following evacuation, the pump should be preserved.

6.6.3 Evacuation of the Pump

The pipeline must be evacuated on the suction and pressure side or shut-off directly behind the pump connections. Drain any residual liquid in the pump casing by opening/ removing the screwed sealing plugs (705) and (502), sealing rings (706) and (503). Casings without screwed plug must be evacuated by the connection branch (SAG and DRS). Refer to the data sheet and the sectional drawing of the associated operating instruction, Point 9, for information on the pump design. Conveying medium residues always remain in the rotor/ stator chambers and may run out during transport or disassembly of the pump. If conveying aggressive or hazardous media, therefore, wear appropriate protective gear during all installation work.

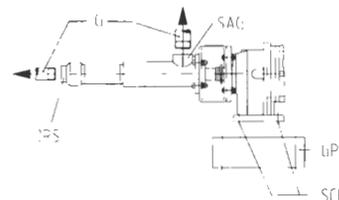
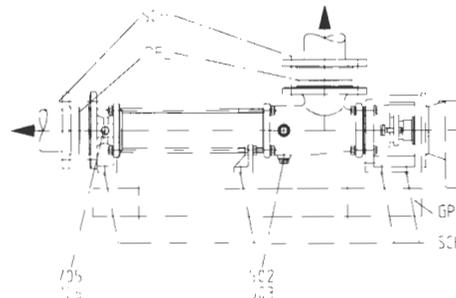


6.6.4 Disassembling the Pump

Dismantle the pipe work by removing the flange bolts (SCH) and flange seals (DFL) or the threaded connections (G).

Disassemble the pump together with the baseplate (GPU) or, as applicable, without the baseplate (GPU) following removal of the bolts (SCH) at the pump feet.

Block-design pumps with direct flange-mounted drive engine are liable to become unstable during disassembly. Stability can be restored by propping up the drive engine.



6.6.5 Preservation/Storage

The pump must be preserved prior to storage. Appropriate preservation measures must be agreed with **seepex**. Always state the pump commission number when making inquiries.

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**Service and
Maintenance**

**These operating instructions are valid for
range BN
size 05-24 to 300-6L**

**7.0
Service and Maintenance**

- Contents
7.1 General Instructions
7.2 Service and Inspection
7.3 Dismantling
7.4 Re-assembly

The sectional drawing and parts list relevant for
Points 7.3 and 7.4 can be found in Point 9.

**7.1
General Instructions**

A requirement for the reliable operation of any pump
is service and maintenance in compliance with
instructions. Maintenance personnel must therefore
have access to these operating instructions and
adhere to them meticulously. seepex will accept no
liability for damages arising through non-observance
of these operating instructions.

**7.2
Maintenance and Inspection**

**7.2.1
Lubrication**

**7.2.1.1
Rotor and Stator**

The rotor and stator are lubricated by the conveying
medium.

**7.2.1.2
Shaft Sealing**

Consult document OM.SEA.____ for information on
lubricating the shaft seal.

**7.2.1.3
Pin Joint**

The pin joints are filled with special grease and
lubricated for the expected duration of service. The
seepex joint grease specified in the index of these
operating instructions should be used exclusively for
any required maintenance work.

CAUTION

Usage of other grease types will lead to premature
joint failure and render invalid any right to claims
under guarantee.

**7.2.1.4
Bearing of the Pump/Drive Engine**

The bearing of the rotating pump parts is effected by
the drive engine. Lubrication instructions are
therefore included in the appended drive engine
operating instructions, Point 10.

**7.2.2
Lubricant Filling Levels**

Details are specified in the index.

**7.2.3
Drives and Optional Extras**

For maintenance and inspection
specifications, see the appended
manufacturer's documents, Point 10.



**7.2.4
Supervision during Operation**

**7.2.4.1
Shaft Sealing**

See document OM.SEA.____.

**7.2.4.2
Optional Extras**

These must be monitored in accordance with the
separate documents, Point 9/Point 10.

**7.2.4.3
Drive Engines**

These must be monitored in accordance with the
separate manufacturer's documents, Point 10.

**7.2.5
Preventive Measures**

To avoid the expenses incurred by lengthy stop
periods of the pump, seepex recommends the
acquisition of a set of wearing parts and a set of
gaskets. The contents are listed in the document
OM.WPS.02.

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Service and
Maintenance

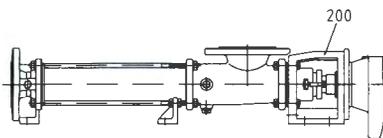
7.3

Dismantling the seepex Progressive Cavity Pump

Tools are required for dismantling and re-assembly. These tools are listed in Point 9 of the document OM.SPT.01.

The stator (601) and the rotating pump parts can be exchanged in site. The rotating pump parts can be dismantled as a complete rotating unit (RTE) (Point 7.3.4) or as individual components (Point 7.3.5).

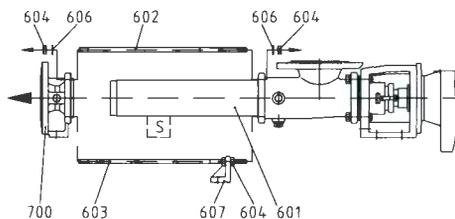
Before commencing the dismantling of pump parts, safeguard the pump against tipping over or falling down by fastening it at the lantern (200).



7.3.1

Pressure Flange (700) - Dismantling

Prior to dismantling see Point 7.3.2
Before dismantling the stator (601), provide it with a support (S) to prevent it from falling.



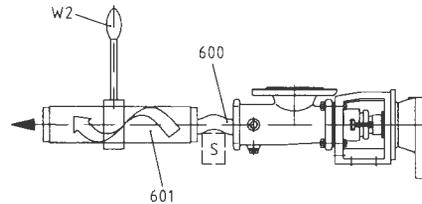
7.3.2

Stator (601) - Dismantling

Maintenance tip:
Disassembly of the stator can be made considerably easier by first moistening the inner surface of the stator with antiseize agent (soft or liquid soap). Before removing the pressure flange (700), pour the antiseize agent into the opening between rotor and stator on the pressure flange side. Several clockwise (see Point 6.2.5) revolutions of the rotor will then distribute the antiseize agent over the inner surface of the stator and reduce the friction between rotor and stator considerably.

Lock drive shaft against rotation.

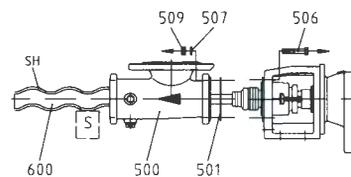
While dismantling the stator (601) with tool (W2/see Point 9) prop up the rotor (600) with support (S) to prevent it from falling.



7.3.3

Suction Casing (500) - Dismantling

Fit the rotor (600) with a protective cover (SH) and underprop it with support (S) to prevent it from falling down.



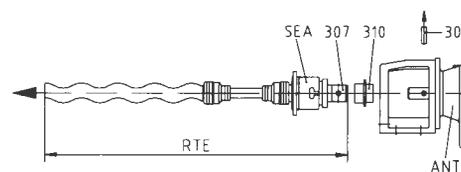
7.3.4

Rotating Unit (RTE) - Dismantling

CAUTION

Before dismantling the rotating unit it is essential to comply with the specifications in document OM.SEA.__ (Shaft Seal Dismantling).

- ▮ Remove flushing connections at shaft seal housing (SEA).
 - ▮ Raise/shift splash ring (310) and eject plug-in shaft pin (309) in horizontal direction.
 - ▮ Remove rotating unit (RTE)/plug-in shaft (307), together with shaft seal (SEA) from output shaft of the drive (ANT). See Point 9 for tool (W10) used for pulling off.
- See in document OM.SEA.__, for removal of the shaft seal (SEA) from the plug-in shaft (307).



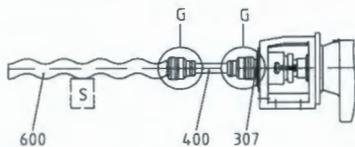
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Service and
Maintenance

7.3.5 Rotating Pump Parts - Dismantling

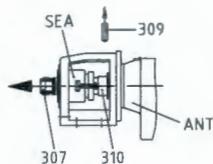
7.3.5.1 Rotor (600), Coupling Rod (400)

Detach the rotor (600) and coupling rod (400) from the plug-in shaft (307) by dismantling the joint (G) in accordance with Point 7.3.6.



7.3.5.2 Plug-in Shaft (307)

The plug-in shaft (307) is removed in the same way as the rotating unit (RTE), see Point 7.3.4.



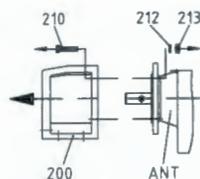
7.3.6 Dismantling of Joint

see document OM.PJT.02, Point 1.

7.3.7 Shaft Sealing

See document OM.SEA.__, for information on dismantling the shaft sealing.

7.3.8 Lantern (200)/Drive (ANT) - Dismantling



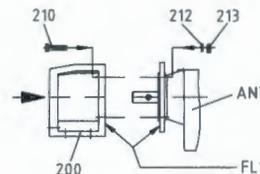
7.4 Re-assembly

Before commencing the re-assembly, fasten the lantern (200) in such a way that it cannot tip over or fall down during the re-assembly of the drive and all pump components.



7.4.1 Lantern (200)/Drive (ANT) - Assembly

Clean flange bearing surfaces (FLS), centering diameter and output pivot of the drive (ANT).

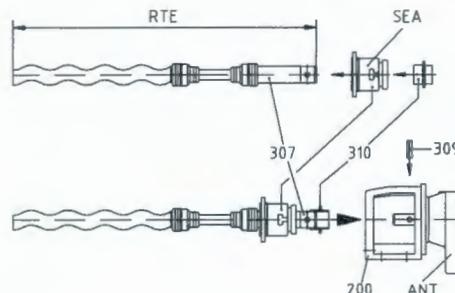


7.4.2 Rotating Unit (RTE) - Re-assembly

The rotating unit (RTE) has been assembled in accordance with the description in document OM.PJT.02.

- Mount shaft seal (SEA) on plug-in shaft (307) in the way described in document OM.SEA __, see Point 9.
- Moisten splash ring (310) and plug-in shaft (307) with joint grease (see index for type) and slide splash ring (310) onto plug-in shaft (307), observing the fitting position of the splash ring. (see writing on the splash ring).
- Apply antiseize graphite petroleum to the output pivot of the drive (ANT) and slide on the rotating unit (RTE). Insert plug-in shaft pin (309) horizontally.
- Splash ring position (310)

The collar of the splash ring should be mounted at a distance of 0.5 mm from the lantern (200).

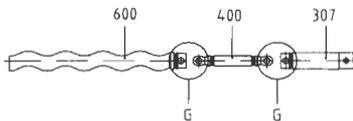


7.4.3 Rotating Pump Parts - Re-assembly

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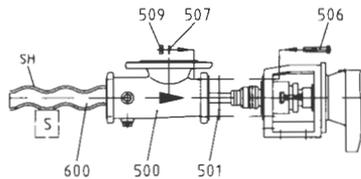
Service and
Maintenance

Prepare main components:
Prepare rotor (600), coupling rod (400) and
plug-in shaft (307) as described in document
OM.PJT.02, Point 2. to 2.3
Joint (G) re-assembly as described in document
OM.PJT.02, Point 3.



7.4.4 Suction Casing (500), Casing Gasket (501) - Re-assembly

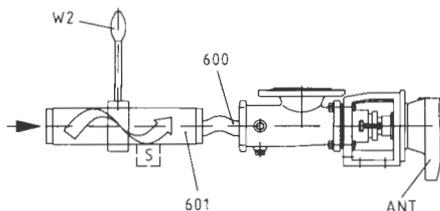
Fit protective cover (SH) on rotor (600) and prop
it up with support (S).



7.4.5 Stator (601) - Assembly / Re-assembly

Maintenance tip:
Disassembly of the stator can be facilitated con-
siderably by first moistening the inner surface of the
stator with antiseize agent (soft or liquid soap).
Before removing the pressure flanges (700), pour the
antiseize agent into the opening between rotor and
stator on the pressure flange side. Several clockwise
(see Point 6.2.5) revolutions of the rotor will then
distribute the antiseize agent over the inner surface of
the stator and reduce the friction between rotor
and stator considerably.

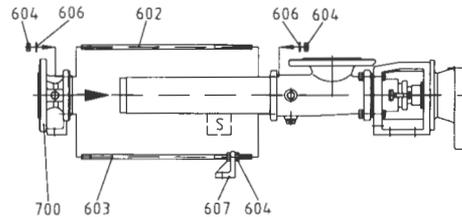
Lock drive (ANT) shaft against rotation. Using tool
(W2/see Point 9), turn stator (601) clockwise and
simultaneously push it over rotor (600), propping
up stator with support (S) at the same time.



7.4.6 Pressure Flange (700) - Assembly

CAUTION

Tighten tie bolts (602 and 603) in equally.



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Pin Joint Assembly

1.0 Dismantling of Joint

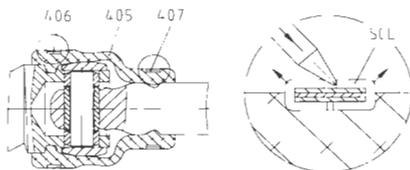
1.1 Holding Band (406, 407) and Universal Joint Sleeve (405)

Cut through loop (SCL) of the holding bands (406 and 407) with a metal saw.

Wear protective goggles when squeezing out the two halves of the holding band loop (SCL).

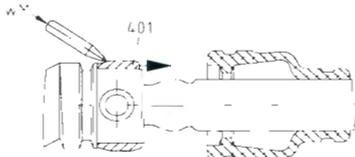


Remove holding bands (406,407). Pull universal joint sleeve (405) off joint.

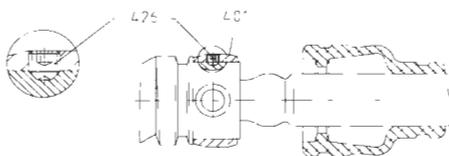


1.2 Retaining Sleeve (401) - Dismantling

- For rotors and plug-in shafts made of hardened and unhardened materials, knock back retaining sleeve (401) with tool/chisel (WM).



- For rotors made of synthetic material, release set screw (426).

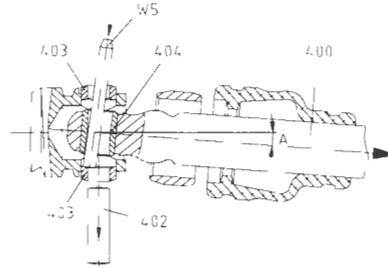


1.3 Separation of Joint

Eject coupling rod pin (402). Position coupling rod (400) at the correct angle (A) and, using tool (W5/see Point 9), drive both guide bushes (403) outwards. This releases the coupling rod (400), which can then be extracted.

CAUTION

To guarantee the proper function of the joints, it is advisable to renew the coupling rod pins (402), guide bushes (403) and coupling rod bushes (404) all at the same time.

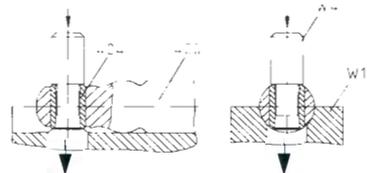


1.4 Coupling Rod Bushes (404) - Dismantling

CAUTION

As a precaution against incorrect re-assembly of coupling rod bushes (404), we recommend the employment of coupling rods (400) whose coupling rod bushes (404) have been pressed in by seepex.

The coupling rod bush (404) is pushed out of the coupling rod (400) with tools (W4 and W14/see Point 9).



2.0 Prepare main components for Re-assembly

2.1 Rotor (600) - Preparation for Joint Assembly

First remove any burr, flaws or similar defects from the rotor, then clean it.

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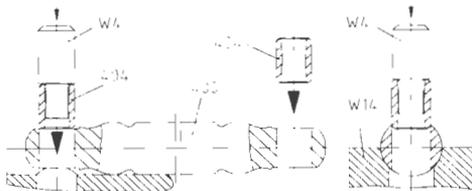
**Pin Joint
Assembly**

**2.2
Coupling Rod (400) - Preparation for the Joint
Assembly**

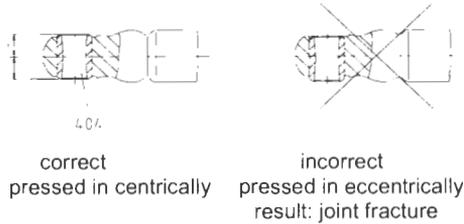
CAUTION

As a precaution against the incorrect re-assembly of coupling rod bushes (404), we recommend the employment of coupling rods (400) whose bushes (404) have been pressed in by seepex.

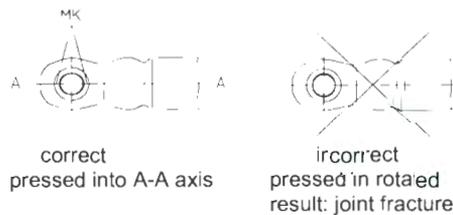
Press in new coupling rod bushes (404 using tool (W4) and (W14/see Point 9).



Position of coupling rod bush (404)



Marking notches in (MK) in A-A axis
permissible rotation 1,5°



**2.3
Plug-in Shaft (307) - Preparation for Joint
Assembly**

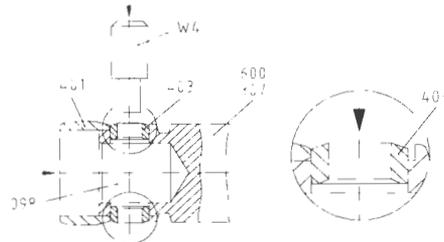
Remove any burr, flaws or similar defects from the plug-in shaft (307), then clean it.

**3.0
Joint - Re-assembly**

CAUTION

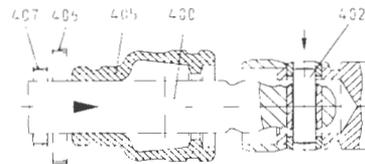
To guarantee the proper function of the joints, it is advisable to renew the coupling rod pins (402), guide bushes (403) and coupling rod bushes (404) all at the same time.

- Joint head on rotor (600) and plug-in shaft (307)
- Press guide bushes (403) in by only 2/3 of their length using tool (W4/see Point 9)
- Fill joint head with joint grease (U98), see index for special grease
- Slip on joint sleeve (401)



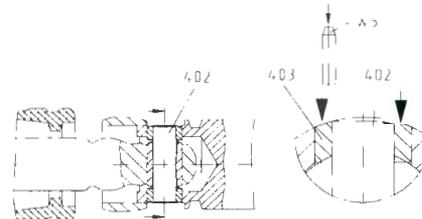
Coupling rod (400)

- Slide holding bands (406/407).
- Moisten inner surface of universal joint sleeve (405) with joint grease (see index for special grease) and slide it.
- Push coupling rod (400) into joint head.
- Push in coupling rod pin (402).



Guide bush (403)

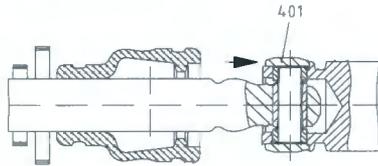
Press in with tool (W5/see Point 9)



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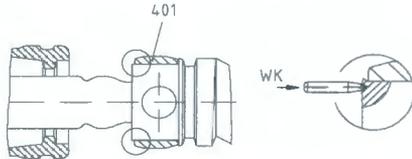
Pin Joint Assembly

Retaining sleeve (401)

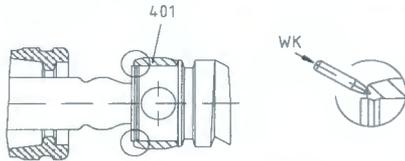


Securing of retaining sleeve

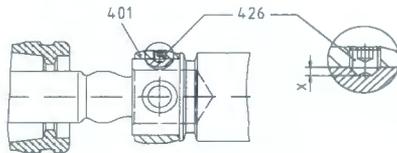
For drive shafts, plug-in shafts and rotors made of unhardened materials such as St 70, AISI 304, AISI 316, Hastelloy C, secure 2 x 180° offset indents, with tool/centre punch (WK)



For rotors made of hardened materials such as tool steel (AISI D6), 1.2842, secure 2 x 180° offset indents with tool/centre punch (WK)

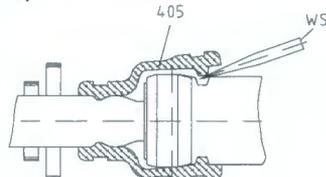


- For rotors made of synthetic material, secure using set screw (426). During this process, point of set screw presses into the synthetic surface (X). Set screw (426) is medium strength secured by screw locking device /adhesive.



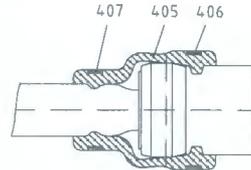
Universal joint sleeve (405)

Remove air from interior of joint with tool/screw driver (WS).



Holding bands re-assembly

Mount holding bands (406 and 407) using tool (W3/see Point 9) as described in document OM.HBD.01.



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Holding Band Re-assembly

Holding Band (HBD) - Assembly

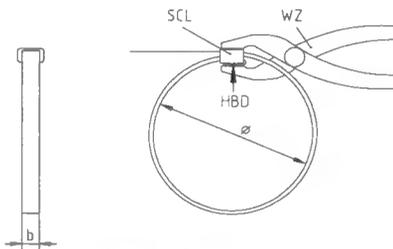
Tools required for the re-assembly, see document OM.SPT.01.

□ Prepare holding band

Only prefabricated double-band holding bands should be used. The diameter (\varnothing) and in particular the breadth (b) of the holding band is matched to the universal joint sleeve.

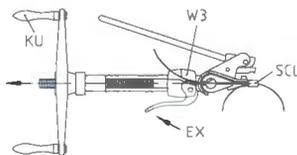
□ Test holding band

The bent holding band (HBD) must fit against the holding band loop (SCL), if necessary apply pressure with the tool/pliers (WZ).

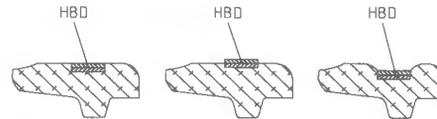


□ Assembly of holding band

Insert holding band in tool (W3/ see Point 9). Hold free end of holding band with control lever (EX), turn crank (KU) until the holding band is strained and fitting against the holding band loop (SCL). Carefully contract holding band until it fits inside the circular groove of the universal joint sleeve.



□ Correct holding band tension (HBD)



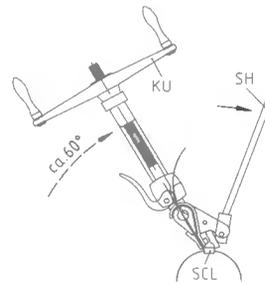
Correct
Holding band (HBD) has slightly contracted outer form of universal joint sleeve and is stuck in position.

Incorrect
Holding band (HBD) is too slack and liable to slip.

Incorrect
Holding band (HBD) is too tight. Universal joint sleeve will be damaged/sheared off.

□ Folding back the holding band (HBD)

Slowly swivel mounting tool upward by 60° , at the same time slackening the crank (KU) by approximately one half revolution. Swivel cutting lever (SH) forward until the pressure plate fits against the holding band loop (SCL).



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Holding Band Re-assembly

- Shearing off holding band (HBD) made of material AISI 304 and AISI 316

A blow with the palm of the hand against the cutting lever (SH) causes the end of the holding band behind the loop (SCL) to be folded back and sheared off. If the holding band on the sheared off side is slightly raised as a result, it must be straightened carefully.

CAUTION

Never tap or hammer against the loop of the holding band (SCL), otherwise damage to the universal joint sleeve may occur.



- Shearing off holding band (HBD) made of Hastelloy C

The high strength of this material makes it impossible to shear off the holding band (HBD) with the cutting lever (SH). Once the end of the holding band is folded back, cut off the holding band (HBD), file off projecting edges and remove burr.



- Check after mounting of holding band

The holding band must run all the way round the groove of the universal joint sleeve.

The holding band (HBD) must be bent back and sheared off at the holding band loop (SCL) in such a way that the holding band (HBD) is unable to slip back through the holding band loop (SCL). If this has not been accomplished, then the holding band (HBD) must be replaced by a new one.



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**Breakdown,
Reasons,
Remedies**

Breakdown										Reasons / Remedies	
1	2	3	4	5	6	7	8	9	10		
				X			X			a	Adhesion between rotor and stator excessive (as delivered). Lubricate (soft soap, genuine soap) between stator and rotor. Then turn the pump by means of the tool W2.
X										b	Check rotational direction of the pump per data sheet and nameplate. In case of wrong direction, change wiring of motor.
X	X	X			X	X				c	Suction pipe or shaft sealing leak. Eliminate the leakage.
X	X	X				X				d	Suction head too high (item 6.5.3.1). Check suction head with vacuum gauge. Increase the suction pipe diameter and fit larger filters. Open the suction valve fully.
X	X	X								e	Viscosity of the liquid too high. Check and accommodate per data sheet.
		X		X			X			f	Wrong pump speed. Correct pump speed per data sheet.
	X	X								g	Avoid inclusions of air in the conveying liquid.
		X		X	X		X	X		h	Pressure head too high (point 6.5.3.2). Check pressure head with manometer. Reduce the pressure head by increasing the pressure pipe diameter or by shortening the pressure pipe.
X	X	X			X			X		i	Pump runs partially or completely dry (point 6.5.2). Check flow in the suction chamber. Install dry running protection TSE.
						X	X			j	Check coupling, possibly pump shaft is misaligned to drive. Check whether coupling gear is worn. Realign coupling. The coupling gear has perhaps to be replaced.
X		X								k	Speed too low. Increase the speed when high suction performances are required and when the liquid is very thin.
X	X					X				l	Speed too high. Reduce the speed when pumping products with high viscosities - danger of cavitation.
						X				m	Check the axial play in the coupling rod linkage. Check that the bush has been installed correctly see document OM.PJT.
X		X		X	X			X		n	Check for foreign substances in the pump. Dismantle the pump, remove foreign substances and replace worn parts.
X		X	X		X					o	Stator or rotor worn. Dismantle the pump and replace defective parts.
X		X			X	X				p	Joint parts worn. Replace worn parts and fill with special pin joint grease.
X		X			X			X		q	Suction pipework partially or completely blocked. Clean suction pipework.
X				X	X		X	X		r	Temperature of the pumping liquid too high. Excessive expansion of the stator. Check temperature and install rotor with diameter smaller than specified.
X		X		X			X		X	s	Gland packing too strongly tightened or worn. Ease or tighten stuffing box. Replace defective packing rings.
X				X	X			X		t	Solid contents and/or size of solids too large. Reduce pump speed and install perhaps a screen with suitable meshes. Increase fluid share.
X				X				X	X	u	When the pump is non operational the solids settle out and become hard. Clear and flush the pump immediately.
X				X	X			X	X	v	The liquid becomes hard when temperature falls below a certain limit. Heat the pump.
				X	X		X	X		w	Stator swollen and unsuitable for the pumped liquid. Select a suitable stator material. Use perhaps rotor with diameter smaller than specified.
						X			X	x	The bearing in the drive casing of the pump or in the drive engine is defective. Replace bearing.
									X	y	Mechanical seal defective. Check seal faces and O-rings. If necessary replace corresponding defective parts.

seepex progressive cavity pumps will operate trouble-free if they are used in accordance with our data sheet (see item 9) and our operating and maintenance instructions:

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**Auxiliary seepex
documentation**

9.0 Auxiliary seepex documentation

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Inc.

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Data Sheet 830709 Page 1

seepex date	1/12/2012	commission no.	830709
customer	Tencarva – Greensboro, NC / Ram Piping – Kennewick, NC		
seepex job no.	2113301	offer/item	5344/0558 item 1
project	PO#: 201169DS		
1 of	seepex progressive cavity pump		
	type BN 52-6LS / A1-A7-A7-F0-GA-X		
	X= 02R, 0804, 12F, 163, 17SCT		

conveying product	Sludge			S/494/SC
denomination	Sludge			
rate of solids	no advice			
size of solids	no advice			
specific gravity	ass.1.0			
composition	no advice			
remarks	Sludge Mixing Pump STS-P-002			
viscosity	ass. < 500cPs			
pH-value	ass. 5-9			
temperature	ass. 32-113F			

performance data	nom.	min	max	USGPM
conveying capacity		90	100	
pump speed		162	179	rpm
press in press. branch		50	50	psi
press in suct. branch	ass. flooded			
differential pressure	50	psi	operating torque	171 lb. ft.
required drive power	7.03	Hp	starting torque	259 lb. ft.
remarks	Data according to performance curve			

technical pump data	range	BN	kind of install.	horizontal
	size	52	direction of rot.	clockwise
	pressure stage	6LS	pos. of branch	1

component	material	design/option
lantern	grey cast iron GG25	standard
suction casing	grey cast iron GG25	standard
inlet dimension		5" ANSI B16.5 150 lb.
pressure branch	grey cast iron GG25	standard
pressure connection		5" ANSI B16.5 150 lb.
joint	standard	standard
joint grease	30321	standard
joint seal	NBR	standard
coupling rod	1.4571/316 TI SS	hydraulically balanced
rotor	1.4571/316 TI SS	SCT Design, Ductile coated
stator	NBR	SCT Design
seal casing	1.4408/316ss	Single Acting Mechanical Seal
seal		Burgmann MG1-G60-070-Q1Q1-VGG
plug-in shaft	1.4571/316 TI SS	drilled ϕ 40 x 75 mm
special designs		

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Data Sheet 830709 Page 2

general operating data

kind of operation operation - 8 h/day
site of installation indoor - dry atmosphere
remarks

drive

type	Geared motor	ratio	i= 8.36	
make	Nord		nom./ min- max	
model	SK32ALF/132M4	output speed	211 / 162 – 179	rpm
mounting position	M1 (B5)	motor speed	1760 / 1361 – 1502	rpm
flange dia	250 mm	frequency	60 / 46 – 51	Hz
output shaft	716/0170-002B4			
remarks	AL Bearings			

electric motor

manufacturer	Nord	voltage	3x230/460	VAC
model	132M4	frequency	60	Hz
nominal power	10 Hp	protection	IP55	
starting	Direct on Freq Inverter	thermal class	F	
special				

baseplate

standard	B-ST-LS US design	material	steel
drawing no.	801-200/0520-A-100B3	surface	painted

special/accessories

painting

execution standard
color RAL 5013 (blue)
remarks

packing

packing type Crate
marking 2113301

documentation

dimensional drawing no. [115504](#) **operating manual** 1 copy English
sectional drawing no. [062-062_1](#)
shaft sealing sect. view [262-0GB/0170-0-084_3](#)
remarks

additional accessories / special designs / remarks

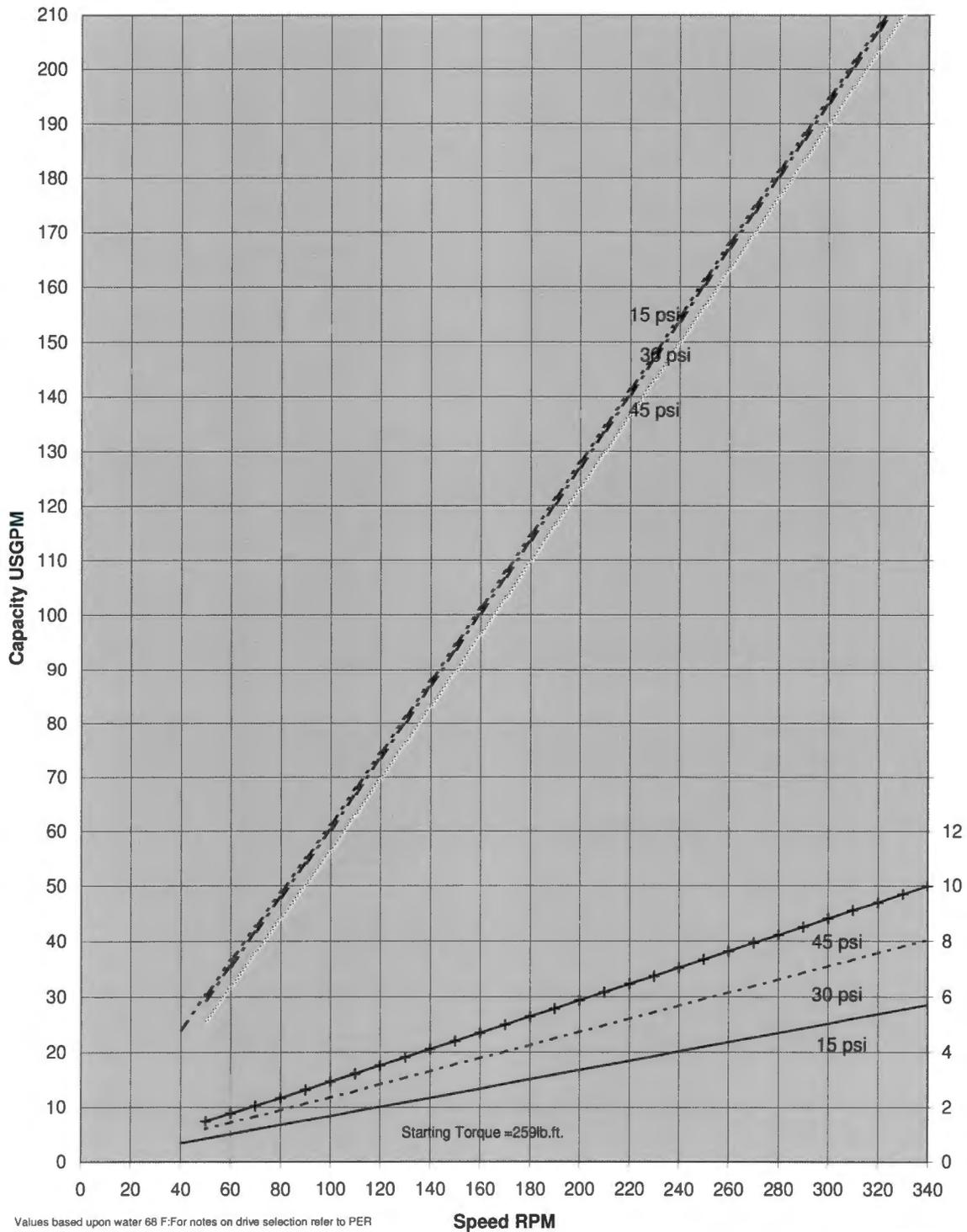
SS Tag Pump: STS-P-002 Sludge Mixing Pump

Mark Shipment: RAM-L691-001

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all things flow

Characteristic Curves
Size 52-6LS



Values based upon water 68 F. For notes on drive selection refer to PER

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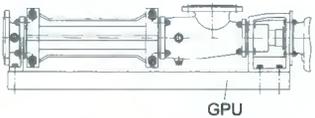
9
Dismantling / Reassembly

9.1 Dismantling / Reassembly - pump with Smart Stator Technology (SST)

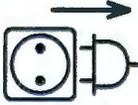
Range: BN

Size: 5-6LS to 130-6LS

9.1.1 Pump - Dismantling

	WARNING
<p>Tilting or falling pump. Death or serious injury can result.</p> <ul style="list-style-type: none"> ➤ Attach the base plate (GPU) to secure the pump. 	
 <p style="text-align: center; margin-top: 5px;">GPU</p>	

9.1.1.1 Prepare the pump for dismantling

	DANGER	
<p>Dangerous voltage. Death or serious injury can occur.</p> <ul style="list-style-type: none"> ➤ Note safety regulations. ➤ Disconnect pump from all sources of energy. ➤ Secure electrical connections against restarting. 		

- Allow pipelines to cool down.
- Note decommissioning (chapter 6. _).



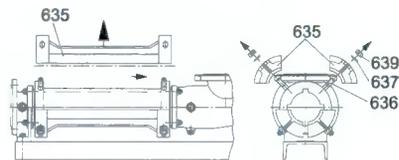
No dimension for stator replacement required in case of stator dismantling/reassembly.

9.1.1.2 Stator (601) - dismantling



Pump with dry-running protection device

- The holding device for the dry-running protection device can obstruct dismantling the adjusting segments.
 - If this is the case, remove the holding device and self-tapping screws.
- Dismantle adjusting segments (635).



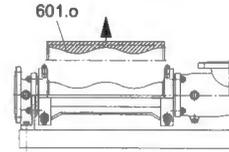
Pump with dry-running protection device

- Mount self-tapping screws and the holding device.

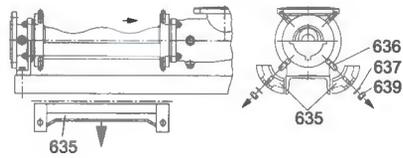
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**9
Dismantling / Reassembly**

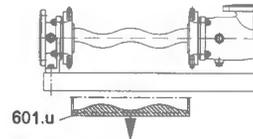
- Remove upper half of the stator (601.o).



- Dismantle adjusting segments (635).
 - Secure adjusting segments (635) to prevent them from falling down.

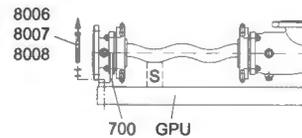


- Remove lower half of the stator (601.u) smoothly.
 - Conveying product can escape.



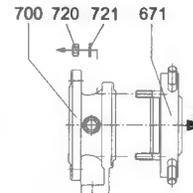
9.1.1.3 Pressure branch (700) - dismantling

- Prop up the rotor (600) with support (S).
- Dismantle the pressure branch (700).

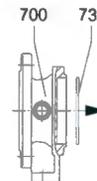


**Segment receiver (671) - dismantling - pressure branch
Standard**

- Dismantle the segment retainer (671) on the suction casing (500).



- Remove the O-ring (731) from the centring recess on the pressure branch (700).

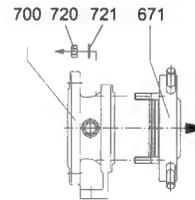


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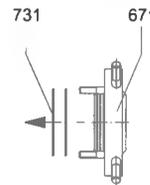
**9
Dismantling / Reassembly**

Variant for sizes 17-6LS, 35-6LS

- Dismantle the segment retainer (671) on the pressure branch (700).

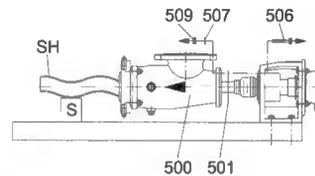


- Remove O-ring (731).



9.1.1.4 Suction casing (500) - dismantling

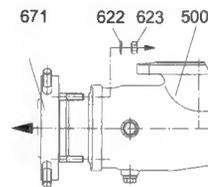
- Provide rotor (600) with protective cover (SH).
- Prop up the rotor (600) with support (S).
- Observe the document on dismantling the shaft seal (chapter 9._) in the case of shaft seals with cartridge units.
- Remove the suction casing (500).



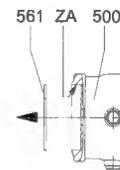
Segment retainer (671) - dismantling - suction casing

Standard

- Dismantle the segment retainer (671) on the suction casing (500).



- Remove the O-ring (561) from the centring recess on the suction casing (ZA, 500).

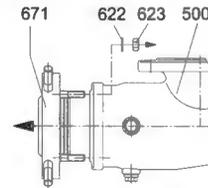


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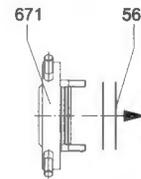
9
Dismantling / Reassembly

Variant for sizes 17-6LS, 35-6LS

- Dismantle the segment retainer (671) on the suction casing (500).



- Remove O-rings (561).



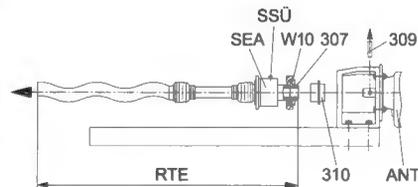
9.1.1.5 Rotating unit (RTE) – dismantling

With flush connection



Tool (W10/ dismantling of the plug-in shaft)

- Remove the flushing connection (SSÜ) on the casing of the shaft seal (SEA).
- Lift/slide splash ring (310) and turn out plug-in shaft pin (309).
- Pull the rotating unit (RTE) with shaft seal (SEA) off from the output shaft of the drive (ANT).
- Dismantle shaft seal (SEA).
 - Note dismantling the shaft seal (chapter 9._).

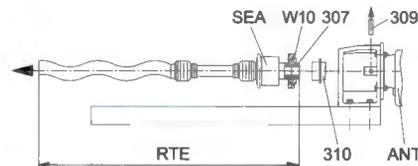


Without flush connection



Tool (W10/ dismantling of the plug-in shaft)

- Lift/slide splash ring (310) and turn out plug-in shaft pin (309).
- Pull the rotating unit (RTE) with shaft seal (SEA) off from the output shaft of the drive (ANT).
- Dismantle shaft seal (SEA).
 - Note dismantling the shaft seal (chapter 9._).

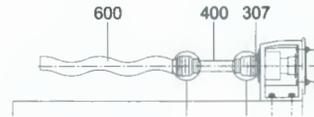


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9 Dismantling / Reassembly

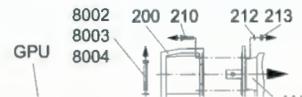
9.1.1.6 Rotor (600), coupling rod (400), plug-in shaft (307) - dismantling

- Dismantling joint (G)
 - Note rotating unit – individual parts (chapter 9._).



9.1.1.7 Lantern (200)/drive (ANT) - dismantling

- Disconnect the drive (ANT) from the lantern (200).
- Remove the lantern (200) from the base plate (GPU).

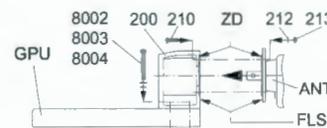


9.1.2 Pump - reassembly

	WARNING
	<p>Tilting or falling pump. Death or serious injury can result.</p> <ul style="list-style-type: none"> ➤ Attach lantern (200) to secure the pump.
	CAUTION
	<p>Risk of fingers being crushed. Slight injury may result.</p> <ul style="list-style-type: none"> ➤ Do not grasp between connections.

9.1.2.1 Base plate (GPU), lantern (200), drive (ANT) – reassembly

- Assemble the lantern (200) on the base plate (GPU).
- Clean the flange bearing surfaces (FLS), bolt circle (ZD) and output shaft of the drive (ANT).



9.1.2.2 Rotor (600), coupling rod (400), plug-in shaft (307) - reassembly

- Joint (G) reassembly
 - Note rotating unit - individual parts (chapter 9._).

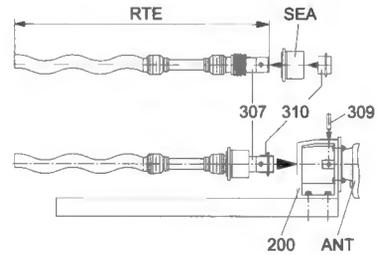


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**9
Dismantling / Reassembly**

9.1.2.3 Rotating unit (RTE) - reassembly

- Assemble shaft seal casing (SEA).
 - Note reassembly shaft seal (chapter 9.).
- Moisten splash ring (310)/plug-in shaft (307) with pin joint grease.
- Slide splash ring (310) onto plug-in shaft (307).
 - Observe fitting position of splash ring (see writing on splash ring).
- Apply antiseize graphite petroleum to the output pivot of drive (ANT). Slide on rotating unit (RTE).
- Slide in plug-in shaft pin (309).
- Install the splash ring collar at a distance of 0.5 mm from the lantern (200).



With flush connection

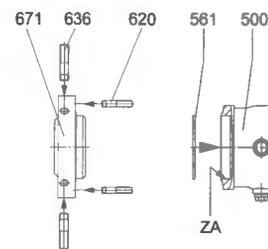
- Mount the flush connection.

9.1.2.4 Segment retainer (671), suction casing (500) - pre-assembly

NOTICE
<p>Avoid destruction of the O-ring/O-rings (561)! Damage to property can occur.</p> <ul style="list-style-type: none"> ➤ Remove contaminants such as paint and corrosion from all sealing surfaces/centring recesses (ZA). ➤ Moisten O-ring/O-rings (561) with soft soap.

Standard

- Insert the O-ring (561) into the centring recess on the suction casing (ZA, 500).
- Assemble the stud bolts (620, 636) into the segment retractor (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.

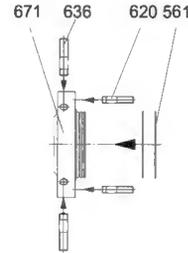


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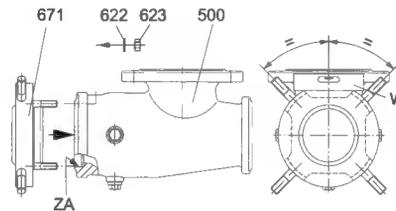
**9
Dismantling / Reassembly**

Variant for sizes 17-6LS, 35-6LS

- Slide the O-rings (561) onto the segment retainer (671).
- Assemble the stud bolts (620, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.

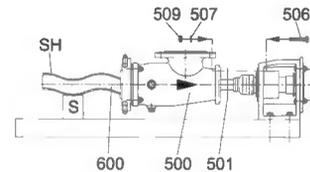


- Assemble the segment retainer (671) on the suction casing (500) and align it using a spirit level.



9.1.2.5 Suction casing (500) - reassembly

- Provide rotor (600) with protective cover (SH).
- Prop up rotor (600) with support (S).
- Slide on casing gasket (501).
- Mount pre-assembled suction casing (500) and adjust (using spirit level).

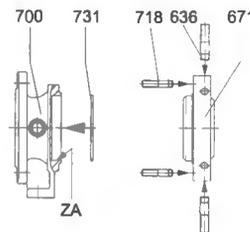


9.1.2.6 Segment retainer (671), pressure branch (700) – pre-assembly

NOTICE	
Avoid destruction of the O-ring/O-rings (731)! Damage to property can occur.	
➤	Remove contaminants such as paint and corrosion from all sealing surfaces/centring recesses (ZA).
➤	Moisten O-ring/O-rings (731) with soft soap.

Standard

- Insert O-ring (731) into the centring recess of the pressure branch (ZA,700).
- Assemble the stud bolts (718, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.

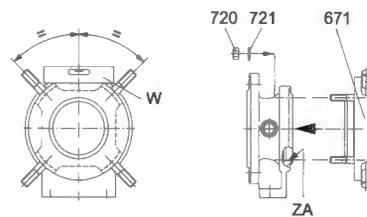
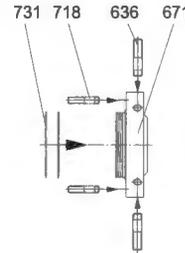


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9
Dismantling / Reassembly

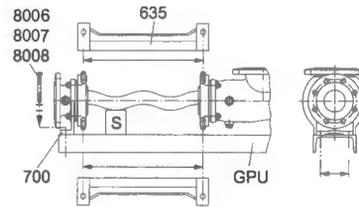
Variant for sizes 17-6LS, 35-6LS

- Slide the O-rings (731) onto the segment retainer (671).
- Assemble the stud bolts (718, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.
- Assemble the segment retainer (671) on the pressure branch (700) and align it using a spirit level (W).



9.1.2.7 Pressure branch (700) - reassembly

- Prop up the rotor with support (S).
- Align the pressure branch (700)/lantern (200) axially and radially on the base plate (GPU).
 - Use at least 2 adjusting segments (635) opposite each other for the alignment.
- Assemble the pressure branch (700)/lantern (200) on the base plate (GPU).



9.1.2.8 Stator (601) - reassembly



- Rotor fits in the pressure branch and suction casing.
 - Use a suitable lifting device (only for sizes 70-6L and 130-6L).
- For easier assembly, moisten sealing surfaces, geometry of the stator halves and rotor with soft soap.
 - Do not moisten the outer surfaces of the stator with soft soap.

NOTICE

Danger of rotor falling down!
Damage to property can occur.
Only for sizes 70-6LS to 130-6LS.

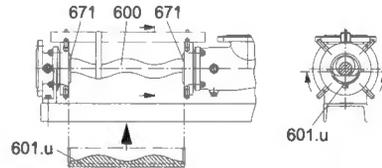
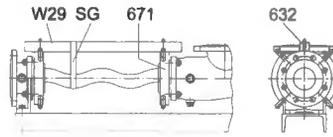
- Use tool (W29).



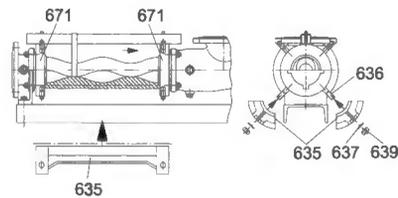
seepex.com

9
Dismantling / Reassembly

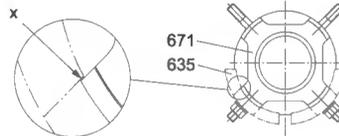
- Mount the tool (W29) to the stud bolts (632) of the segment retainer (671).
- Place the lashing strap (SG) around the rotor.
- Raise the rotor (600) using the lashing strap (SG) until it touches the segment retainer (671).
- Attach the lower half of the stator (601.u).
- Press the stator half (601.u) onto the tapered surfaces of the segment retainer (671) and align it.



- Secure the lower half of the stator (601.u).
 - Fix the lower adjusting segments (635) to the segment retainer (671).

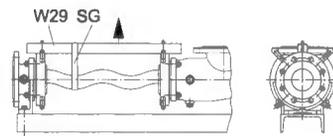


- Tighten the screws until the adjusting segments (635) interlock with the guide of the segment retainer (671) (detail x).

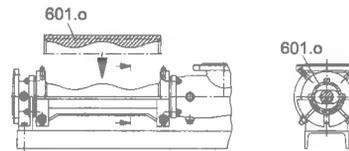


 Tool (W29/mounting device)

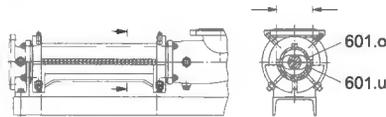
- Remove the lashing strap (SG).
- Remove the tool (W29).



- Attach the upper half of the stator (601.o).



- Align the long side of the upper half of the stator (601.o) to the lower half of the stator (601.u).



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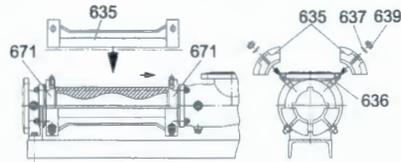
9
Dismantling / Reassembly



Pump with dry-running protection device

- The holding device for the dry-running protection device can obstruct dismantling the adjusting segments.
- If this is the case, remove the holding device and self-tapping screws.

- > Secure upper half of the stator (601.o).
- Fix the upper adjusting segments (635) on the segment retainer (671).



Pump with dry-running protection device

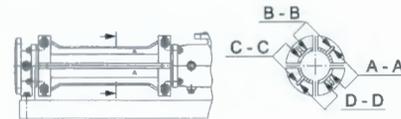
- Mount self-tapping screws and the holding device.

9.1.2.9 Smart Stator setting

Basic setting

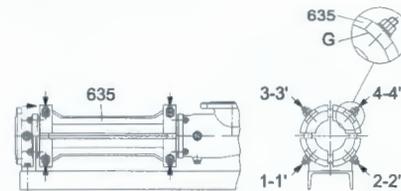
NOTICE
<p>Stator is leaky! Damage to property can occur.</p> <ul style="list-style-type: none"> > A gap between the stator halves is not allowed.

- > Observe the segment order.
- (A-A, B-B, C-C, D-D).



Variant 1

- > Tighten screws of the adjusting segments (635) evenly in 90° steps up to the scaling mark (G = basic setting).
- > Observe the order.
- (1-1', 2-2', 3-3', 4-4').

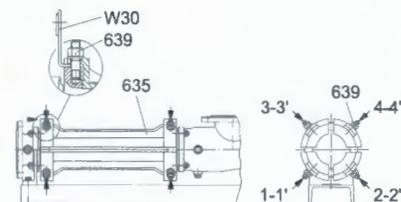


Variant 2



Tool (W30/feeler gauge)

- > Use tool (W30) for setting the gap (basic setting) at the setting nuts (639).
- > Tighten the screws of the adjusting segments (635) until there is resistance from the tool (W30).
- > Observe the order.
- (1-1', 2-2', 3-3', 4-4').



Fine adjustments

Fine adjustment of the pump parameters:



Fine adjustments for the pump parameters can be made by evenly adjusting the nuts at the adjusting segments.

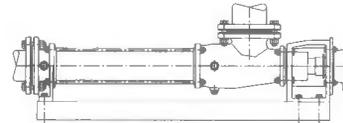
- +45° = increases clamping.
- -45° = reduces clamping.

9.1.3 Pump – dismantling – retrofit

9.1.3.1 Prepare the pump for dismantling

	⚠ DANGER	
	<p>Dangerous voltage. Death or serious injury can occur.</p> <ul style="list-style-type: none"> ➤ Note safety regulations. ➤ Disconnect pump from all sources of energy. ➤ Secure electrical connections against restarting. 	

- Empty pipelines.
- Allow pipelines to cool down.
- Remove pipeline connections (suction side/pressure side).
- Note decommissioning (chapter 6.).



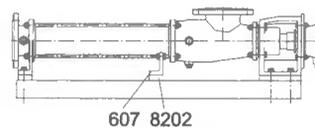
	⚠ WARNING	
	<p>Tilting or falling pump. Death or serious injury can result.</p> <ul style="list-style-type: none"> ➤ Attach lantern (200) to secure the pump. 	

9.1.3.2 Trestle (607) - dismantling



Dismantling the trestle only applies to size 130-6L.

- Remove trestle (607).
- Remove the support (8202).
 - Note chapter (9.1.3.7) support - dismantling.



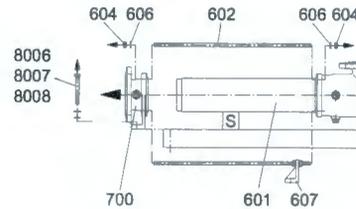
607 8202

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9
Dismantling / Reassembly

9.1.3.3 Pressure branch (700) - dismantling

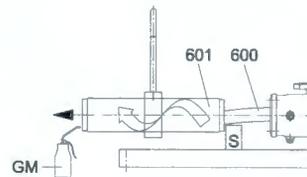
- Prop up stator (601) with support (S).



9.1.3.4 Stator (601) - dismantling

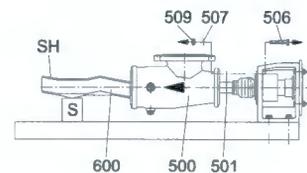
 Tool (W2/chain pipe wrench)

- Add lubricant (liquid soap) to the opening on pressure branch side between the rotor (600) and the stator (601).
- Turn the stator (601) in the "right" rotating direction.
- Dispense lubricant (GM) on the stator internal surface in order to reduce friction between the rotor and stator.
- Prop up the rotor (600) with support (S).



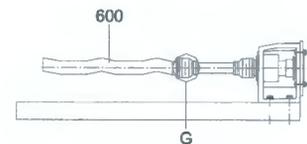
9.1.3.5 Suction casing (500) - dismantling

- Provide rotor (600) with protective cover (SH).
- Prop up the rotor (600) with support (S).
- Observe the document on dismantling the shaft seal (chapter 9.) in the case of shaft seals with cartridge units.
- Remove the suction casing (500).



9.1.3.6 Rotor (600) – dismantling

- Dismantling joint (G)
 - Note rotating unit – individual parts (chapter 9.).



9.1.3.7 Support (8202) - dismantling



Dismantling the support only applies to size 130-6L.



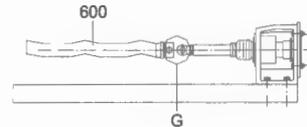
- To remove the support (8202) from the base plate, use the following tools:
 - Angle grinder, hammer and chisel.



9.1.4 Pump – reassembly – retrofit

9.1.4.1 Rotor (600), coupling rod (400), plug-in shaft (307) - reassembly

- Joint (G) reassembly
 - Note rotating unit - individual parts (chapter 9._).



9.1.4.2 Segment retainer (671), suction casing (500) - pre-assembly

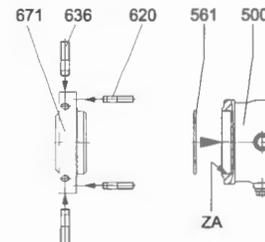
NOTICE

Avoid destruction of the O-ring/O-rings (561):
Damage to property can occur.

- Remove contaminants such as paint and corrosion from all sealing surfaces/centring recesses (ZA).
- Moisten O-ring/O-rings (561) with soft soap.

Standard

- Insert the O-ring (561) into the centring recess on the suction casing (ZA, 500).
- Assemble the stud bolts (620, 636) into the segment retainer (671).
 - Secure the stud bolts with Loc tite 243 medium-strength.
 - Note the cure time of the glue.

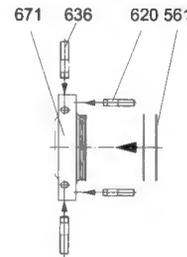


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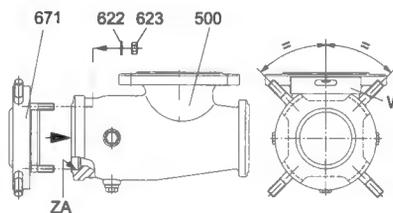
**9
Dismantling / Reassembly**

Variant for sizes 17-6LS, 35-6LS

- Slide the O-rings (561) onto the segment retainer (671).
- Assemble the stud bolts (620, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.

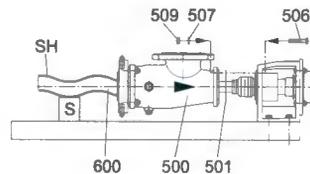


- Assemble the segment retainer (671) on the suction casing (500) and align it using a spirit level.



9.1.4.3 Suction casing (500) - reassembly

- Provide rotor (600) with protective cover (SH).
- Prop up rotor (600) with support (S).
- Slide on casing gasket (501).
- Mount pre-assembled suction casing (500) and adjust (using spirit level).

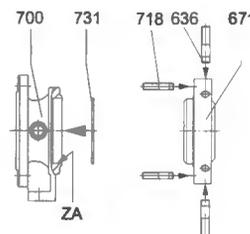


9.1.4.4 Segment retainer (671), pressure branch (700) – pre-assembly

<i>NOTICE</i>	
Avoid destruction of the O-ring/O-rings (731)! Damage to property can occur.	
➤	Remove contaminants such as paint and corrosion from all sealing surfaces/centring recesses (ZA).
➤	Moisten O-ring/O-rings (731) with soft soap.

Standard

- Insert O-ring (731) into the centring recess of the pressure branch (ZA,700).
- Assemble the stud bolts (718, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.

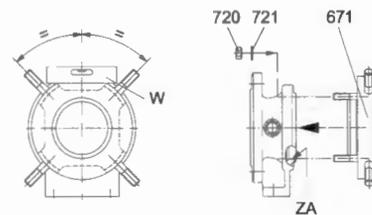
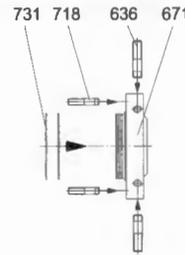


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9
Dismantling / Reassembly

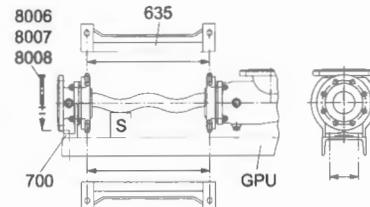
Variant for sizes 17-6LS, 35-6LS

- Slide the O-rings (731) onto the segment retainer (671).
- Assemble the stud bolts (718, 636) into the segment retainer (671).
 - Secure the stud bolts with Loctite 243 medium-strength.
 - Note the cure time of the glue.
- Assemble the segment retainer (671) on the pressure branch (700) and align it using a spirit level (W).



9.1.4.5 Pressure branch (700) - reassembly

- Prop up the rotor with support (S).
- Align the pressure branch (700)/lantern (200) axially and radially on the base plate (GPU).
 - Use at least 2 adjusting segments (635) opposite each other for the alignment.
- Assemble the pressure branch (700)/lantern (200) on the base plate (GPU).



9.1.4.6 Stator (601) - reassembly



- Rotor fits in the pressure branch and suction casing.
 - Use a suitable lifting device (only for sizes 70-6L and 130-6L).
- For easier assembly, moisten sealing surfaces, geometry of the stator halves and rotor with soft soap.
 - Do not moisten the outer surfaces of the stator with soft soap.

NOTICE

Danger of rotor falling down!
Damage to property can occur.
Only for sizes 70-6LS to 130-6LS.

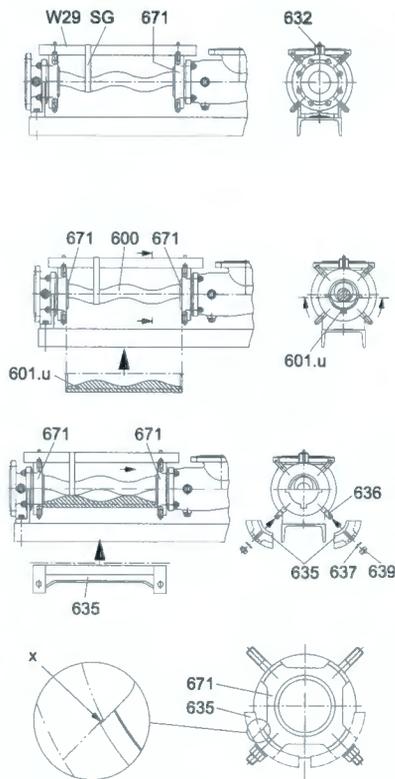
- Use tool (W29).



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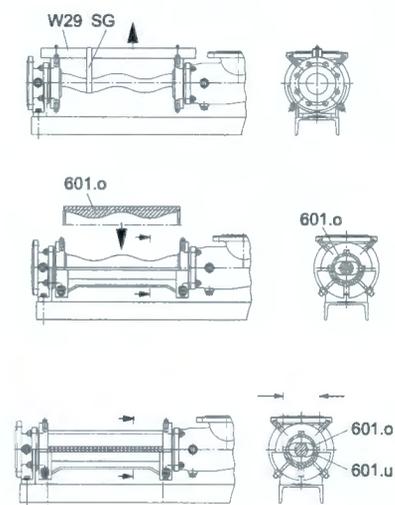
9
Dismantling / Reassembly

- Mount the tool (W29) to the stud bolts (632) of the segment retainer (671).
- Place the lashing strap (SG) around the rotor.
- Raise the rotor (600) using the lashing strap (SG) until it touches the segment retainer (671).
- Attach the lower half of the stator (601.u).
- Press the stator half (601.u) onto the tapered surfaces of the segment retainer (671) and align it.
- Secure the lower half of the stator (601.u).
 - Fix the lower adjusting segments (635) to the segment retainer (671).
- Tighten the screws until the adjusting segments (635) interlock with the guide of the segment retainer (671) (detail x).



 Tool (W29/mounting device)

- Remove the lashing strap (SG).
- Remove the tool (W29).
- Attach the upper half of the stator (601.o).
- Align the long side of the upper half of the stator (601.o) to the lower half of the stator (601.u).



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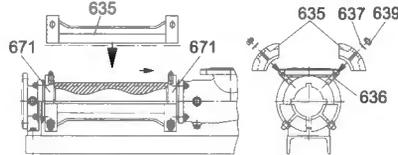
9
Dismantling / Reassembly



Pump with dry-running protection device

- The holding device for the dry-running protection device can obstruct dismantling the adjusting segments.
- If this is the case, remove the holding device and self-tapping screws.

- Secure upper half of the stator (601.o).
 - Fix the upper adjusting segments (635) on the segment retainer (671).



Pump with dry-running protection device

- Mount self-tapping screws and the holding device.

9.1.4.7 Smart Stator setting

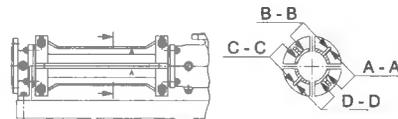
Basic setting

NOTICE

Stator is leaky!
Damage to property can occur.

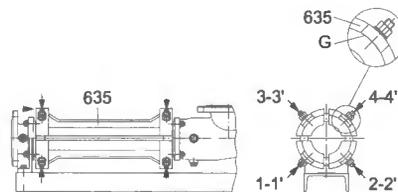
- A gap between the stator halves is not allowed.

- Observe the segment order.
 - (A-A, B-B, C-C, D-D).



Variant 1

- Tighten screws of the adjusting segments (635) evenly in 90° steps up to the scaling mark (G = basic setting).
- Observe the order.
 - (1-1', 2-2', 3-3', 4-4').

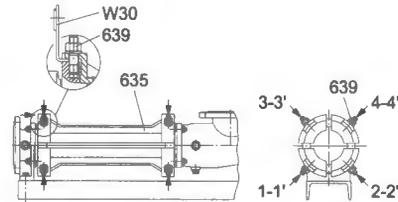


Variant 2



Tool (W30/feeler gauge)

- Use tool (W30) for setting the gap (basic setting) at the setting nuts (639).
- Tighten the screws of the adjusting segments (635) until there is resistance from the tool (W30).
- Observe the order. (1-1', 2-2', 3-3', 4-4').



Fine adjustments

Fine adjustment of the pump parameters:



Fine adjustments for the pump parameters can be made by evenly adjusting the nuts at the adjusting segments.

- +45° = increases clamping.
- -45° = reduces clamping.

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Single-Acting Mechanical Seal

1.0 General

- ▬ Please take the appertaining drawing from respective pump data sheet.
- ▬ The mechanical seal is suitable for the operating conditions indicated in the pump data sheet. Modifications are only admissible after the customer has consulted with seepex. Additionally, attention must be paid to the manufacturer's operating manual.

2.0 Safety

Any mode of operation impairing the operating safety of the mechanical seal has to be avoided.

The operator is advised to consider the possible effects on the environment which could be caused by a defective mechanical seal and what additional measures must be taken to protect the environment and the public.

The pump must be mounted and operated in such a way that operation with a defective mechanical seal will not result in injury or harm to the public and that any leakage can be safely and properly dealt with.

Mechanical seals are often used to seal hazardous material (chemicals, drugs, etc.). It is essential that rules pertaining to the handling of hazardous materials are adhered to.

Modifications effected by the customer himself and changes influencing the safety of the mechanical seal are not allowed.

3.0 Emissions

A mechanical seal is a dynamic seal and leakage is unavoidable.

ATTENTION

Components that may contact leakage must be resistant to corrosion or be protected accordingly.

Mechanical seal leakage must be drained in a safe and proper manner.

4.0 Flushing or circulation of single-acting mechanical seals

Single-acting mechanical seals contacting the conveying liquid require no additional flushing or a circulation pipe because sufficient flushing and heat exchange occurs around the seal due to the conveying liquid.

However, in particular cases, a direct flushing pipe can be installed into the flushing connection on the mechanical seal housing.

5.0 Commissioning

Regardless of the pump's operating status, the conveying medium to be sealed must always be in liquid form at the mechanical seal. This particularly applies to the pump's commissioning and its placing out of service.

6.0 Maintenance

When operating the pump according to the instructions, no maintenance is required.

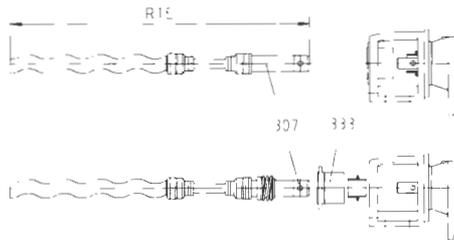
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**Single-Acting
Mechanical Seal**

**7.0
Disassembly / Reassembly**

**7.1
Disassembly**

- Remove flushing connections at shaft seal housing (SEA).
- Lift / displace splash ring (310) and eject plug-in shaft pin (309) horizontally.
- Withdraw rotating unit (RTE) together with shaft seal parallel from output shaft of drive and avoid chocking.
- Clean plug-in shaft (307) and remove burrs etc., which may damage sealing elements. Moisten plug-in shaft (307) with slip additive (diluted fluid soap).
- Loosen axial safety device of mechanical seal (330 or 372) and withdraw mechanical seal (330) from plug-in shaft (307).
- Remove mechanical seal housing (333) from lantern (200).
- Press counter-ring of mechanical seal with o-ring out of mechanical seal housing (333).



**7.2
Reassembly**

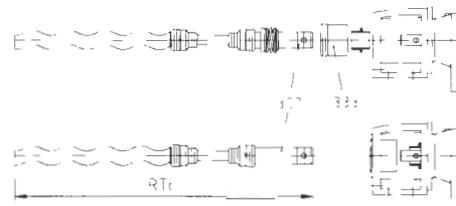
ATTENTION

Mechanical seals are precision parts of high quality. Therefore, the installation must be effected with care. Gentle handling and extreme neatness are essential.

- Clean mechanical seal housing (333)
- Evenly press counter-ring with o-ring into mechanical seal housing (333). To facilitate assembly, the o-ring should be moistened with a lubricant (diluted fluid soap).

ATTENTION

- Oil or grease must not be used to facilitate assembly.
- Install mechanical seal housing (333) to lantern (200) and ensure correct position of flushing connections.
- Remove plug-in shaft (307), burrs and roughness and clean the unit.
- Check / adjust set dimension of mechanical seal on plug-in shaft (307). Moisten plug-in shaft (307) and elastomer parts of mechanical seal with lubricant (diluted fluid soap).
- Slip mechanical seal onto plug-in shaft (307) as far as set ring.
- Lubricate drive shaft (ANT) with antiseize graphite petroleum.
- Moisten splash ring (310) and plug-in shaft (307) with pin joint grease, (for type, please see index) and slip splash ring (310) onto output shaft of drive. Note installing position of splash ring and refer to description on splash ring.
- Move rotating unit (RTE) through mechanical seal housing (333) and splash ring (310) and slip splash ring (310) onto output shaft of drive (ANT). Push in plug-in shaft pin (309) in horizontal position.
- Position of splash ring:
Collar of splash ring shall be fitted in a distance of about 0.5 mm to lantern (200).



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Werkzeuge
Tools

Allgemeine normierte Werkzeuge / Standardized tools							
Werkzeug Nr. tool No.	W1	W2	W5	W6	W9	W11	W13
zur Montage von: tool for mounting of:	Packung packing	Stator stator	Gelenk joint	Lager bearing	allgemein general	Mutter für Teflon- manschette nut for teflon universal joint sleeve	Stator Stator 1)
Benennung: denomination:	Packungszieher packing lever	Ketten-Rohrzange + Ersatzkette chain pipe wrench +replacement chain	Durchschlag drift	Bolzen pin	Montierhebel mounting lever	Bandschlüssel strap wrench	Bandschlüssel strap wrench
Baugröße size							
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L 025-12T, 05-6LT	PKZ XX 000 0000 0 X35M0	Siehe W 13 see W 13					WKZ BDS 027 0 430
025-12, 025-24 05-12, 1-6L			DHS XX 020 0000 0 A2620				
05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L 2-24, 2-12V	PKZ XX 000 0000 0 X0FQ0	KRZ XX Z55 0250 0 00000 KEZ XX Z55 0250 0 00000	DHS XX 050 0000 0 A2620	BLZ XX 020 0008 0 A2619			
5-12, 8-12T 10-6L, 15-6LT 05-48	PKZ XX 000 0000 0 XOHV0		DHS XX 050 0000 0 A2620	BLZ XX 020 0010 0 A2619			
5-24, 5-12V			DHS XX 100 0000 0 A2620	BLZ XX 020 0010 0 A2619			
10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48			DHS XX 100 0000 0 A2620	BLZ XX 020 0010 0 A2619			
14-12, 26-6L, 40-6LT 10-24, 10-12V 17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R 2-48 17-24, 17-12V		KRZ XX Z55 0300 6 00000 KEZ XX Z55 0300 6 00000	DHS XX 120 0000 0 A2620	BLZ XX 025 0012 0 A2619	2 Stück 2 pieces MHL XX SA 610		WKZ BDS 027 0 430
35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R 5-48	PKZ XX 000 0000 0 XA01A	KRZ XX Z55 0300 8 00000 KEZ XX Z55 0300 8 00000	DHS XX 160 0200 0 A2620	BLZ XX 030 0012 0 A2619			
35-24, 35-12V			DHS XX 200 0200 0 A2620	BLZ XX 035 0012 0 A2619			
70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48 200-6L			DHS XX 200 0200 0 A2620	BLZ XX 035 0012 0 A2619			
130-12, 202-6L, 300-6L, 200-12T 70-18, 100-18, 130-18 70-24, 70-12V 130-24R 17-48		KRZ XX Z55 0301 2 00000 KEZ XX Z55 0301 2 00000	DHS XX 240 0250 0 A2620	BLZ XX 040 0015 0 A2619			
240-12, 300-12T 130-18, 130-24 35-48/70-48							

1) Gilt nur für Pumpen in Edelstahl Ausführung / only valid for pumps in special steel design

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Werkzeuge
Tools

Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeuge bedingt ersetzbar. Recommended seepex tools Due to the design recommended for certain repairs, these tools partially replace the standardized tools.								
Werkzeug Nr. tool No.	W4	W7	W8	W10	W12	W14	W15	W16
zur Montage von: tool for mounting of:	Gelenk joint	Lager bearing	Schmier- nippel lubrication nipple	Steckwelle plug-in shaft	Teflon- manschette teflon universal joint sleeve	Kuppelstangen- buchsen coupling rod bushing	Manschette universal joint sleeve	Lippendichtung lip seal
Benennung: denomination:	Montagedom assembly mandrel	Montage- hülse mounting sleeve	Einschlag- hülse drive-in sleeve	Demontage- werkzeug dismantling tool	Montage- werkzeug mounting tool	Presswerkzeug pressing tool	Montageplatte mounting plate	Montagehülse Mounting sleeve
Baugröße size								
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L 025-12T, 05-6LT	MTD L2 060 M120 0 XXXXX 2)						MTP A7 703 M500 0 002XX	MTH B7 703 M120 0 W0260
025-12, 025-24 05-12, 1-6L	MTD L2 060 M500 0 XXXXX	MTH M8 060 M500 0 XXXXX		AZV B2 262 M500 0 XXXXX			MTP A7 703 M500 0 002XX	
05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L	MTD L2 060 0020 0 XXXXX	MTH M8 060 0020 0 XXXXX		AZV B2 262 0020 0 XXXXX	MMT M8 060 0020 0 XXXXX	PWZ C6 060 0020 0 XXXXX		
2-24, 2-12V 5-12, 8-12T 10-6L, 15-6LT 05-48	MTD L2 060 0050 0 XXXXX	MTH M8 060 0050 0 XXXXX		AZV B2 262 0050 0 XXXXX	MMT M8 060 0050 0 XXXXX	PWZ C6 060 0050 0 XXXXX		
5-24, 5-12V 10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48	MTD L2 060 0100 0 XXXXX	MTH M8 060 0100 0 XXXXX		AZV B2 262 0100 0 XXXXX	MMT M8 060 0100 0 XXXXX	PWZ C6 060 0100 0 XXXXX		
14-12, 26-6L, 40-6LT 10-24, 10-12V 17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R 2-48	MTD L2 060 0140 0 XXXXX	MTH M8 060 0140 0 XXXXX		AZV B2 262 0170 0 XF5XX		PWZ C6 060 1400 0 XXXXX		
17-24, 17-12V 35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R, 5-48	MTD L2 060 0170 0 XXXXX	MTH M8 060 0170 0 XXXXX	ESH N0 000 0000 0 A01A4	AZV B2 262 0170 0 XG0XX	MMT M8 060 0170 0 XXXXX	PWZ C6 060 0170 0 XXXXX		
35-24, 35-12V 70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48, 200-6L	MTD L2 060 0350 0 XXXXX	MTH M8 060 0350 0 XXXXX		AZV B2 262 0350 0 XH0XX		PWZ C6 060 0350 0 XXXXX		
130-12, 202-6L, 300-6L, 200-12T 70-18, 100-18, 130-18 70-24, 70-12V 130-24R 17-48	MTD L2 060 1300 0 XXXXX	MTH M8 060 1300 0 XXXXX				PWZ C6 060 1300 0 XXXXX		
240-12, 300-12T 130-18, 130-24 35-48/70-48						PWZ C6 060 2400 0 XXXXX		

2) entfällt ab Pumpen-Herstellungsdatum 01.04.93 / can be omitted as from 01.04.93 (pump manufacturing date)

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**Werkzeuge
Tools**

Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeuge bedingt ersetzbar. Recommended seepex tools Due to the design recommended for certain repairs, these tools partially replace the standardized tools.									Spezial- werkzeuge
Werkzeug Nr. tool No.	W17	W18	W19	W20	W22	W23	W24	W25	W3
zur Montage von:	Lippendichtung	Gleitlager- buchse	Wellen- sichonhülse	Cartridge- Einheit	Wellen- dichtring	Wellen- dichtring	Antriebs- gehäuse	Steckwellen- bolzen	Halteband
tool for mounting of:	lip seal	plain bearing bush	shaft securing sleeve	cartridge- unit	lip seal	lip seal	drive casing	plug-in shaft pin	holding band
Benennung:	Schlagzylinder Zentrierdorn Montagebolzen	Montagedorn	Montagehülse	Aufnahme	Montage- werkzeug	Montage- werkzeug	Aufhänge- vorrichtung	Montagedorn	Montage- werkzeug
denomination:	cylinder centering mandrel mounting pin	mounting mandrel	mounting sleeve	intake	mounting tool	mounting tool	suspension device	mounting mandrel	mounting tool
Baugröße size									
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L, 025-12T, 05-6LT 025-12, 025-24 05-12, 1-6L 05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L 2-24, 2-12V 5-12, 8-12T 10-6L, 15-6LT 05-48 5-24, 5-12V 10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48 14-12, 26-6L, 40-6LT 10-24, 10-12V 17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R, 2-48 17-24, 17-12V 35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R, 5-48 35-24, 35-12V 70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48, 200-6L 130-12, 202-6L, 300-6L, 200-12T 70-18, 100-18, 130-18 70-24, 70-12V 130-24R 17-48 240-12, 300-12T 130-18, 130-24 35-48/70-48	ZSH B7 703 M120 0 W0171 ZDR B7 703 M120 0 W0172 MBL A7 703 M120 0 W0173								
								MTD L8 703 0050 0 SXX0J	
								MTD L8 703 0170 0 SXX0J	MHB WH A00 1WHV 0 01000
			SPT B4 703 0170 0 01000	SPT M8 703 0170 0 00900	SPT B4 703 0170 0 01100				
								MTD L8 703 0350 0 SXX0J	
		SPT M8 703 1300 0 01000	SPT M8 703 1300 0 01100	SPT M8 703 1300 0 00900	SPT B4 703 1300 0 0A200	SPT B4 703 1300 0 0A300		MTD L8 703 0700 0 SXX0J	
								MTD L8 703 1300 0 SXX0J	
							SPT M8 703 2400 0 01400		

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Werkzeuge
Tools

BIG Baugrößen / BIG sizes

Allgemeine normierte Werkzeuge / Standardized tools					
Werkzeug Nr. tool No.	W1	W2	W5	W6	W9
zur Montage von: tool for mounting of:	Packung packing	Stator stator	Gelenk joint	Lager bearing	allgemein general
Benennung: denomination:	Packungszieher packing lever	Ketten-Rohrzange + Ersatzkette chain pipe wrench +replacement chain	Durchschlag drift	Bolzen pin	Montierhebel mounting lever
Baugröße size					
240-6C	PKZ XX 000 0000 0 XA01A	KRZ XX Z55 0301 2 00000 KEZ XX Z55 0301 2 00000	DHS XX 240 0250 0 A2620	BLZ XX 040 0015 0 A2619	2 Stück 2 pieces MHL XX SA 610
300-3TR					
400-3TN					
500-3LA					
240-9C					
300-9TR					
400-6TN					
400-6TR					
500-6LA					
240-12C					
300-12TR					
240-18L					
400-12TR					
300-18TU					
300-24TV					
300-27TH					
400-18TU					

Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeuge bedingt ersetzbar. Recommended seepex tools Due to the design recommended for certain repairs, these tools partially replace the standardized tools.							Spezialwerkzeuge Special tools
Werkzeug Nr. tool No.	W4	W7	W8	W14	W24	W25	W3
zur Montage von: tool for mounting of:	Gelenk joint	Lager bearing	Schmiernippel lubrication nipple	Kuppelstangen- buchsen coupling rod bushing	Antriebs- gehäuse drive casing	Steckwellen- bolzen plug-in shaft pin	Halteband holding band
Benennung: denomination:	Montagedom assembly mandrel	Montagehülse mounting sleeve	Einschlaghülse drive-in sleeve	Presswerkzeug pressing tool	Aufhänge- vorrichtung suspension device	Montagemandrel mounting mandrel	Montagewerkzeug mounting tool
Baugröße size							
240-6C	MTD L2 060 1300 0 XXXXX	MTH M8 060 1300 0 XXXXX	ESH N0 000 0000 0 A01A4	PWZ C6 060 1300 0 XXXXX		MTD L8 703 1300 0 SXX0J	MHB WH A00 1WHV 0 01000
300-3TR							
400-3TN							
500-3LA							
240-9C							
300-9TR							
400-6TN							
400-6TR							
500-6LA							
240-12C							
240-12L							
300-12TU							
300-12TR							
240-18L							
400-12TR							
300-18TU							
300-24TV							
300-27TH							
400-18TU							

The Optimum Rotor Surface

seepex demands the highest performance from its rotors. This is only possible by providing the highest quality rotor surface.

The most modern methods are used to machine, polish, harden and coat the rotor. In this way, we can ensure the best rotor surface possible for each application.

High Standards

The smoothness of the rotor surface affects its longevity. Improper machining produces microscopic mountains and valleys with only the mountain peaks contacting the stator. These rough surfaces will wear rapidly, due to the reduced contact area, and certain metals will be subject to increased likelihood of failure as corrosive compounds collect in the microscopic valleys. Improper machining can adversely affect the rated strength and hardness of the material, as well.

Benefits of high quality rotor surfaces:

- Reduced starting and running torques
- Improved hydraulic and mechanical efficiencies
- Smoother operation
- Increased service life

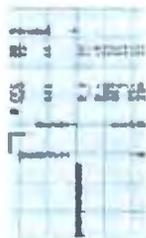
Surface roughness charts and photographs from a scanning electron microscope of different rotor surface cross sections (1000 X)



Rotor surface, machine finish



Rotor surface, ground finish



seepex standard finish

Optimum Service Life

For applications on abrasive liquids, surface coatings can be applied to substantially increase rotor service life.

seepex is able to provide a very hard, superior chromium coating with the Duktal-coating technique. By applying the Duktal-coating, increased advantages can be realized over standard hard chrome plating.

This new, electrolytic procedure produces a fissure-free, non-porous coating with a hardness of 1,250 Vickers. This material fuses deep into the base metal so that it can not lift or peel, as is common with standard chrome, that has a hardness of only 600 Vickers.

The diagram below clearly shows the boundary layer between the galvanically applied chrome plating (top) and the base metal (below), with no diffusion zone. When highly stressed, large particles of chrome can peel away from the base metal.



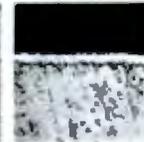
This diagram shows the deep fusing of the Duktal-chromium layer resulting in superior durability.



Bending test of hard chrome plating. The surface shows large fissures and significant areas are missing, due to a poor diffusion with the base metal.



Flat test of Duktal hard coating, polished to 600 X, fissure free. The hardness of Duktal is recorded at 1,620 Vickers and the base material is recorded at 180 Vickers.



Bending test of Duktal hard coating, the adhesion to the base material is very good, no surface fissures.

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**Manufacturer's
documents**

10.0 Manufacturer's documents from sub-supplier

Ausgabe issue	B / 17.01.2006	Dokument document	OM.MDS.11e	Blatt sheet	1 (1)
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OPERATING MANUAL

This document was drawn up observing the EC directives
"Machinery" 98/37/EC, EN ISO 12100-2 and the German Standard VDI 4500



In case of this mechanical seal is operated in **explosion area an appropriate additional operating manual**, following EC directives 94/9/EC (ATEX 95), has to be observed **by all means!** If required this could be ordered at BURGEMANN.

BURGMANN MECHANICAL SEAL (M.S.)

Type MG1/dw-00 and versions

applies to all mechanical seals of the same series
dw = specified shaft diameter

These instructions are intended for the assembly, operating and control personnel and should be kept at hand on site.

PLEASE READ this manual carefully and OBSERVE the information contained as to:

- Safety
- Transport / Storage
- Information about the product
- Installation
- Operation
- Servicing

If there are any unclear points please contact BURGEMANN by all means!

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Keywords and Symbols

Following symbols for particularly important information are used:



"Attention, please pay special attention to these sections of text"

DANGER!

Draws attention to a direct hazard that will lead to injury or death of persons

WARNING!

Draws attention to the risk that a hazard could lead to serious injury or death of persons

CAUTION!

Draws attention to a hazard or unsafe method of working that could lead to personal injury or damage to equipment

ATTENTION!

Identifies a potentially dangerous situation. If it is not avoided the product or something in its vicinity could be damaged

IMPORTANT!

Identifies tips for use and other particularly useful information.

GENERAL SAFETY NOTES



Any person being involved in assembly, disassembly, start up, operation and maintenance of the BURGMANN Mechanical Seal must have read and understood this Instruction Manual and in particular the safety notes. We recommend the user to have this confirmed.

BURGMANN Mechanical Seals are manufactured on a **high quality level** (quality management EN ISO 9001: 2000) and they keep a **high working reliability**. Yet, if they are **not operated** within their **intended purpose** or handled **inexpertly** by untrained personnel they may cause **risks**.

The machine has to be set up in such a way that seal leakage can be led off and disposed properly and that any personal injury caused by spurting product in the event of a seal failure is avoided.

Any operation mode that affects the **operational safety** of the mechanical seal is not permitted.

Unauthorised modifications or alterations are **not permitted** as they affect the **operational safety** of the mechanical seal.

BURGMANN mechanical seals must be installed, operated, maintained, removed or repaired by **authorised, trained and instructed personnel only**.

The **responsibilities** for the respective jobs to be done **have to be determined clearly and observed** in order to prevent unclear competencies from the point of **security**.

Any work to be done on the mechanical seal is **generally only permitted** when the seal is **neither operating nor pressurised**.

WARNING! Seals that have been used with **hazardous substances must be properly cleaned** so that there is no possible **danger** to people or to the environment.

Apart from the notes given in this manual the general **regulations for worker's protection and those for prevention of accidents** have to be observed.

Instructions for worker's protection



WARNING! If the **medium to be sealed** and/or the **supply liquid** is subject to the **Hazardous Substances Regulation** (GefStoffV), the **instructions for handling dangerous substances** (safety data sheets to EU Directive 91/155/EEC) and the **accident prevention regulations** have to be observed.

Medium to be sealed and/or **supply medium may escape** if the seal **fails**. Injury of persons and environment may be **prevented by the user** providing for splash protection and wearing safety goggles. Care has to be taken by the user for **proper disposal** of the leakage. The user has to control these measures.

The **user** has to **check** what **effects a failure** of the mechanical seal might have and what safety measures have to be taken to prevent **personal** injury or damage to the environment.

TRANSPORT / STORAGE

Transport

If not specified differently by contract the BURGMANN standard packing is used which is suitable for dry transport by truck, train or plane. The warning signs and notes on the packing must be observed.

In addition seaworthy packing may become necessary.

Notes for income inspection:

- Check packaging for visible damages.
- Open packaging carefully. Do not damage or lose parts supplied separately.
- Check if consignment is complete (delivery note). Inform the supplier immediately in writing if parts are damaged or missing.

The mechanical seal has to be protected from damage during transport and storage. The transport case in which the seal is supplied is well suited for this purpose and should be kept for a possible return transport.

ATTENTION! If the machine as well as the mechanical seal installed into the machine are transported together the shaft has to be protected from deflection and shocks.

Packing and storage

The following recommendations apply to all BURGMANN mechanical seals which have been supplied and stored in their **undamaged original packaging**, as well as to seals which have been installed in a machine (e.g. pump, compressor, agitator, etc.) but have not yet been put into operation.

BURGMANN mechanical seals and spare parts are super finished and repeatedly tested machine elements. For the storage special conditions have to be followed.

Sliding materials and elastomers are subject to material-specific and time-based alterations (distortion, ageing) which might reduce the full efficiency of the mechanical seals. Yet, this may be avoided by observing the storage instructions.

For the stock keeping of elastomers special conditions are required. For all rubber-elastic parts the rules of DIN 7716 resp. of ISO 2230-1973 (E) are valid.

Conveniences for storing of mechanical seals

- dust free
- moderately ventilated
- constantly tempered
 - relative air humidity below 65 %,
 - temperature between 15 °C and 25 °C.

Protect the seal from

- direct exposure to heat (sun, heating)
- **ultraviolet light** (halogen or fluorescent lamps, sunlight, arc welding)
- presence or development of **ozone** (arc welding, mercury vapour lamps, high-voltage devices, electric motors)
- **risk of embrittlement** of elastomeric materials

It has to be differentiated between:

- **M.S. stored** in the stock room
- **M.S. installed** in the machine, but not yet in operation.

□ **M.S. in the stock**

IMPORTANT! Store the seal in the original packing lying on a flat surface.

- Check the packaging periodically for damages.
- Plastic sheet packagings with humidity indicators have to be checked every 8 weeks. The check has to be recorded.
- Packings **exceeding 50 % rel. humidity** values have to be sent to the manufacturer or the **nearest BURGMANN service centre** for inspection and new packaging.

Duly stored mechanical seal:

- Latest 3 years after delivery of the mechanical seal
- For reasons of safety shipment of the M.S. to BURGMANN resp. nearest BURGMANN service centre for
- Exchange of all secondary seals and springs
- Verification of the flatness of the faces
- Perhaps static pressure test.

□ **M.S. installed into the machine:**

ATTENTION! A preservation of the BURGMANN mechanical seals is **not allowed**.

Check in case of a preservation of complete machines with mechanical seals installed BURGMANN has to be contacted.

- **Do not** use corrosion protection agents.
- Risk of deposition and possibly chemical attack of the secondary seals.

Due to longer erecting times of new designed plants the period between delivery of the mechanical seal and on the other hand its installation and start up may exceed the period of 2-3 years.

Latest after 3 years and in time before the planned start-up of the plant the seal has to be dismantled and to be sent to the manufacturer or the nearest BURGMANN service centre where it can be checked and reconditioned, if necessary.

Damages caused by **improper** storage may **not** be claimed with reference to the **warranty** on the BURGMANN company.

INFORMATION ABOUT THE PRODUCT

All technical information given is based on the results of extensive testing and on BURGMANN's long term practical experience. However, in view of the great diversity of possible applications the technical data can only be taken as being of approximate nature. We can only guarantee the safe and efficient functioning in individual cases if we have been comprehensively informed of the operating conditions to which they will be subject, and if this has been confirmed in a separate agreement.

Manufacturer and country of origin

Burgmann Industries GmbH & Co. KG
Äußere Sauerlacher Str. 6-10
D - 82515 Wolfratshausen
Germany

Declaration by the manufacturer

within the meaning of the EC-directive "MACHINERY" 98/37/EG

A mechanical seal does **not function independently**. It is intended to be incorporated into or assembled with machinery.

Type designation

BURGMANN Mechanical Seal **MG1/dw-00**

Designated use

This mechanical seal is **exclusively** designed for the use in the specified application. A **different utilisation** or a utilisation going beyond the specification is considered **contrary to its designated use** and excludes a liability by the manufacturer.

Operation under conditions lying **outside** those limits stated in paragraph "Operating limits" is considered **contrary to its designated use**.

Should the seal be **operated under different conditions or at a different application** BURGMANN has to be asked for **recognition as safe in advance**.

➤ **Changes** to operating conditions **have to** be documented.

Operating limits

ATTENTION! Operating limits depend on the materials, the media to be sealed and the diameter of the sealing. (If there are any unclear points please contact BURGMANN.)

Shaft diameter	(dw)	: 10 - 100 mm
Pressure to be sealed	(p1)	: 12 bar g
Temperature to be sealed	(t1)	: -20 ... 120° C
Max. sliding speed	(vg)	: 10 m/s

Operation under several limit values **simultaneously** should be **avoided** as higher loads (pressure, temperature, speed) can increase wear or lead to **damage** of sliding faces or elastomers. This could result in a shorter service life and in the **risk** of a sudden seal failure **endangering** men and environment.

The **selection** of the mechanical seal (type, suitability, materials) should be done **by BURGMANN staff** or other **authorised** persons. A wrong selection by unauthorised persons is **not covered by BURGMANN's warranty**.

Further information about the operating conditions can be found in the BURGMANN assembly drawing MG1/dw-00 or in the specification sheets of the machine manufacturer.

Materials

The materials of the mechanical seal depend on the application and are fixed in the order.

Drawings, diagrams

Assembly drawing MG1/dw-00

The original assembly drawing in its latest edition (latest revision) only is decisive for both the design of M.S. as well as the utilisation of this manual.

In the following description all figures in parentheses, e.g. (2) define the respective part item no. in fig. 1. The part item no. may vary from those stated in the assembly drawing.

Versions

- MG12/...
- MG13/...
- MG1S20/...
- RMG12/...

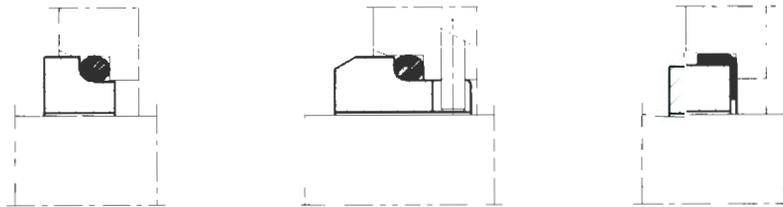
- MG1 MULTIPLE M.S.

The mechanical seal type MG1 can also be used as **multiple mechanical seal** (also in combination with seal types of other series) in **tandem arrangement** with quench (API, plan 52) or as **dual mechanical seal** with barrier fluid (API, plan 53). Consultation with the BURGMANN company is recommended.

ATTENTION! PTFE o-rings or double-PTFE-wrapped o-rings **may not** be used at seat versions **without torsion lock**.

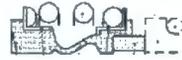
This operating manual applies also to the mentioned seal versions with slight modifications and/or to combinations with seats not stated in this manual.

Seat Versions



Description and function

- single seal
- unbalanced
- bi-directional
- stationary seat (2)
- o-ring (3)
- rotating seal face (1.1)
- elastomeric bellows (1.2)
- cylindrical single spring (1.5)
- no glued joints
- materials of the sliding parts replaceable
- for media containing solids (e.g. sewage applications)
- rotating, torsion-free elastomeric bellows serving as
 - face housing
 - secondary sealing element
 - drive collar
- torque transmission from the seal face by means of "L"-rings and a rotating, cylindrical single spring
- axial movability
 - d_w: 10 ... 12 mm ±0,5 mm
 - d_w: 14 ... 18 mm ±1,0 mm
 - d_w: 20 ... 26 mm ±1,5 mm
 - d_w: 28 ... 100 mm ±2,0 mm



1.2 1.3 1.5 1.4 1.1 2 3



Required space, connecting dimensions

The required mounting space for the mechanical seal is decisive for the design of the housing parts by the machine manufacturer. The connecting dimensions have to be checked by the machine manufacturer by means of the BURGMANN drawing before mounting the mechanical seal.

Supply of M.S.

The mechanical seal has to be constantly wetted by liquid medium. The medium to be sealed must not damage the M.S. neither chemically (e.g. corrosion, embrittlement) nor physically (e.g. erosion, abrasion).

For a safe operation of the mechanical seal we recommend to apply **at inboard** the most suitable **type of circulation** described in **API 610 / 682**. This measure protects the seal cavity from deposition of solids.

To operate multiple seals special supply systems are required. Please contact BURGMANN.

Emissions

A mechanical seal is a **dynamic seal** that **cannot be free of leakage** due to physical and technical reasons. Seal design, manufacture tolerances, operating conditions, running quality of the machine, etc. mainly define the leakage value. In fact, compared to other sealing systems there is **few leakage**.

WARNING! If the **medium to be sealed** and/or the **supply liquid** is subject to the **Hazardous Substances Regulation** (GefStoffV), the **instructions for handling dangerous substances** (safety data sheets to EU Directive 91/155/EEC) and the **accident prevention regulations** have be observed.

A possibly increased leakage during start-up will decrease to a normal quantity after the running-in period of the sliding faces.

If this is not the case or if there are other malfunctions the mechanical seal has to be shut down, removed and checked for reasons of safety.

The leakage can be liquid or gaseous. Its aggressiveness corresponds to that of the medium to be sealed.

Leakage of mechanical seal at outboard side has to be drained and disposed properly.

IMPORTANT! Components which may get in contact with the leakage have to be corrosion-resistant or have to be adequately protected.

INSTALLATION

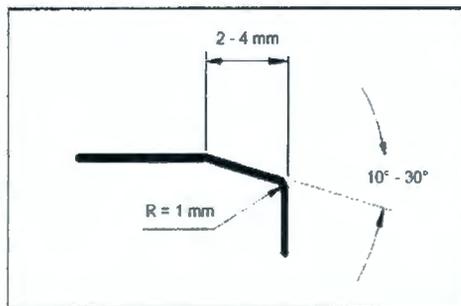
Assembly utilities

- ethyl alcohol
- cellulose-tissue (no rag, no cloth!)
- o-ring lifter
- water and washing up liquid
- cardboard discs

Preparation for assembly

ATTENTION! The seal should remain **packed** until the following working steps have been completely **terminated**.

Check the parts of the machine for:



- **chamfered edges**
(sliding cones i.e. 2 mm / 30° or in accordance with EN 12756)
- radiused transitions
- **mating fits** and o-ring surfaces:
fine finished **Rz 10 µm** (= N7 = CLA 63)

- **Shaft surface** in the area of the mechanical seal finished according to EN 12756:
Ra = 0.8 µm (= N6 = CLA 32).
- **Shoulder** or stop device for the bellows of the mech. seal to take up axial forces

Check at the machine:

- damage of connecting surfaces to the M.S.
- mating dimensions, rectangularity and concentricity to the shaft axis.

Run-out accuracy of the shaft (acc. to DIN ISO 5199):

- Shaft diameters up to 50 mm: max. 0.05 mm
- Shaft diameters 50 mm - 100 mm: max. 0.08 mm
- Prepare the place of assembly, take away any not required tool, cuttings, dirty cleaning wool etc.
- Cover the work bench with a piece of clean, non-fibrous cardboard.

Assembly / installation

BURGMANN mechanical seals are super-finished and repeatedly tested machine elements whose handling during assembly in particular of sliding materials and elastomers requires special care during several procedures.

For installation the assembly drawing of mechanical seal has to be observed.

IMPORTANT! The mechanical seal has to be installed under the cleanest conditions and very carefully.

- Unpack the seal and check seal face, seat and elastomer bellows for possible damages.
- Never place the seal faces or seats on their sliding faces without having covered them adequately.

- Check before starting assembly:
 - complete availability of all components by means of the drawing
 - all components have to be clean and in perfect condition.

- Sprinkle the elastomer bellows and the shaft with low-surface-tension water (add washing up liquid) or ethyl alcohol to decrease frictional force during assembly of the seal.



Oil or grease as assembly agent is not permitted in any case.

ATTENTION! Do never force during installation.

ATTENTION! Avoid unnecessary rotation of the shaft (damage of the sliding faces is possible).

ATTENTION! Avoid knocking the seal! Damage to mechanical seals has an adverse effect on their safe operation.

Possible installation order:

- Feed the **degreased** sealing element (o-ring, rubber cup) onto the seat.

If present:

- At the seat mark the position of the rear slot beside the sliding face.
- Align the seat with the torque transmission pin.

- Cover the sliding face of the seat with a cardboard washer
- Press the seat slowly and without interruption into its position.
 - Use plenty of water or alcohol as lubricant.
 - Use a distance sleeve, if necessary.
- Remove the cardboard washer from the sliding face.
- Check the rectangular position of the seat to the shaft axis.

- Mount the seal cover with the seat installed before.
- Clean the sliding faces thoroughly with ethyl alcohol and paper tissues (**no fabric, no cloths!**).
 - In case of material "**BUKO**" (carbon graphite) wipe it until the paper tissues stay clean.
 - Do not touch the sliding faces any more with bare fingers.
 - Mount the sliding faces absolutely dry, dust-free and clean. Do not use any lubricants!



- Push rotating seal unit (bellows unit) with a slow clockwise turn onto the shaft.
- Stick to the dimensions in the assembly drawing!
 - If necessary use a mounting sleeve.
 - For long pushing distances add liquid several times.
- Check "L" rings, spring and seal face for correct fit.
- Mount stop device for bellows unit to take up axial forces.
 - Stick to the dimensions in the assembly drawing **by all means!**
- Further assembly of the machine in accordance with the instructions of the machine manufacturer.

OPERATION

Instructions for safe operation

For a single mechanical seal the **pressure in the seal chamber** (stuffing box pressure) has to be **higher** than the ambient pressure at the machine at any time. Otherwise the machine will **suck in air** via the sliding faces, which will result in **dry-running** and consequent **failure** of the mechanical seal.

Damages due to dry-running are excluded from the warranty.

During every state of operation the mechanical seal has to be constantly wetted by the **medium** to be sealed **in its liquid form**, in particular when the machine is **started or stopped**. The machine design has to be such as to take this necessity into consideration.

If the medium to be pumped builds deposits or tends to solidify during cooling down or standstill of the machine the stuffing box has to be flushed with suitable clean liquid. The flow and the liquid should be determined by the user.

If the operation limit values and the instructions given in this manual are followed a trouble-free operation of the mechanical seal can be expected.

Instructions for start up

Safety checks before start up

- Torque transmission between mechanical seal and shaft duly installed
- Supply connections tightened pressure-sealed
- Disposal connections installed environmentally safe

For a safe operation of the mechanical seal we recommend to apply **at inboard** the most suitable **type of circulation** described in **API 610 / 682**. This measure protects the seal cavity from deposition of solids.

- Flood machine and seal cavity (stuffing box) with medium and vent thoroughly.
 - Now the seal is ready for operation.

SERVICING

Maintenance

A correctly operated mechanical seal needs **low maintenance**. Wear parts, however, have to be replaced, if necessary.

A duly operation includes a regular check of the following parameters:

- Temperature
- Leakage (drainage) rate of the mechanical seal

An inspection of the mechanical seal should be carried out during a revision of the complete plant. We recommend to have this inspection be performed by responsible BURGMANN personnel.

If the mechanical seal is removed during a revision of the plant it has to be replaced by a new one.

Directives in case of failure

Try to define the kind of failure and record it.

- In the event of **excessive leakage**, note changes in the leakage amount and switch the pump off if necessary.
- If a constant amount is leaking in a steady flow, the mechanical seal is damaged.
- In the event of a **inadmissible temperature rise**, the machine **has to** be stopped for safety reasons.

If there is a **malfunction** which you cannot correct on your own, or if the cause of malfunction is not clearly recognisable please immediately contact the nearest **BURGMANN agency**, a BURGMANN service centre or the BURGMANN headquarters.

During the **warranty period** the BURGMANN mechanical seal must only be disassembled with approval of the manufacturer or when a representative is present.

After-sales service by BURGMANN

BURGMANN's customer service department offers a comprehensive service package covering consultancy, engineering, standardisation, installation, commissioning as well as damage analysis right through to seminars on sealing technology.

Addresses are listed in the known BURGMANN Design Manuals as well as in various other BURGMANN brochures.

Address of headquarters:

Burgmann Industries GmbH & Co. KG

Postfach 1240

D - 82515 Wolfratshausen

Germany

☎ +49 (0) 81 71-23 0

Fax +49 (0) 81 71-23 12 14

www.burgmann.com

Reconditioning (repair)

If **reconditioning** is necessary, the complete **seal** should be sent to the **manufacturer**, as this is the best way to find out which components can be reconditioned or which parts must be replaced in order to ensure an optimum tightness.

If, for **compelling reasons**, a **reconditioning** has to be carried out **on site** (e.g. no spare seal on stock, long transport, problems with customs) the seal may be repaired in a clean room by **trained** personnel of the user under the direction of **BURGMANN mechanics**.

Disassembly / removal



- Stop the machine as instructed, allow to cool, depressurise and ensure that pressure cannot build up again.
- Work on the M.S. is only permitted when the machine is at a standstill and depressurised.
- There must be no product on the M.S. ⇒ if necessary drain the machine and rinse it out.
- Isolate the machine to prevent it starting up unexpectedly.
- Comply with the safety notes (safety data sheets).

IMPORTANT! When removing, please observe **by all means**:

- current **accident prevention regulations**
- **regulations for handling hazardous substances**

WARNING! Seals that have been used with **hazardous substances must be properly cleaned** so that there is no possible **danger** to people or to the environment.

IMPORTANT! The packaging used to transport the seal must

- be **identified** with the relevant **hazard symbol** and
- **include** the **safety data sheet** for the product and/or supply medium

The order of disassembly to remove the mechanical seal out of the machine depends on the design of the machine and should be determined by the machine manufacturer.

- Remove the seal in the reverse sequence as described for assembly (set up).

Spare parts

- Only BURGMANN original spare parts must be used. Otherwise
 - **Risks** of a seal failure, **endangering** persons and environment.
 - The BURGMANN guarantee for the mechanical seal **lapses**.
- For a quick exchange a complete **spare seal** should be on stock.

Required details for enquiries and orders

For enquiries and orders the following details are required:

- BURGMANN commission no.
- Drawing no. of M.S. **MG1/dw-00**
dw = specified shaft diameter
- Part item no., designation, material, number of pieces with reference to the drawing.

Address of headquarters product field FA
Standard Mechanical Seals

Burgmann Industries GmbH & Co. KG

Postfach 1240

D - 82502 Wolfratshausen

Germany

☎ +49 (0) 81 71 - 23 0

Fax +49 (0) 81 71 - 23 14 44

Disposal of the BURGMANN mechanical seal

Usually, the BURGMANN mechanical seals can be easily disposed after a thorough cleaning.

- Metal parts (steels, stainless steels, non-ferrous heavy metals) divided into the different groups belong to scrap metal waste.
- Ceramic materials (synthetic carbons, ceramics, carbides) belong to waste products. They can be separated from their housing materials, as are physiologically recognised as safe.
- Synthetic materials/plastics (elastomers, PTFE) belong to special waste.

CAUTION! Material containing fluorine must not be burnt.

IMPORTANT! Some of the synthetic materials, divided into the different groups can be recycled.

Copyright

The **Burgmann Industries GmbH & Co. KG** (Germany) holds the copyright to this document. Customers and operators of mechanical seals are free to use this document in the preparation of their own documentation. No claims of any type or form can be derived in such instance.

We reserve the right to carry out technical modifications of the product, even if they have not yet been considered in this manual.

June 13, 2006
Department Technical Documentation



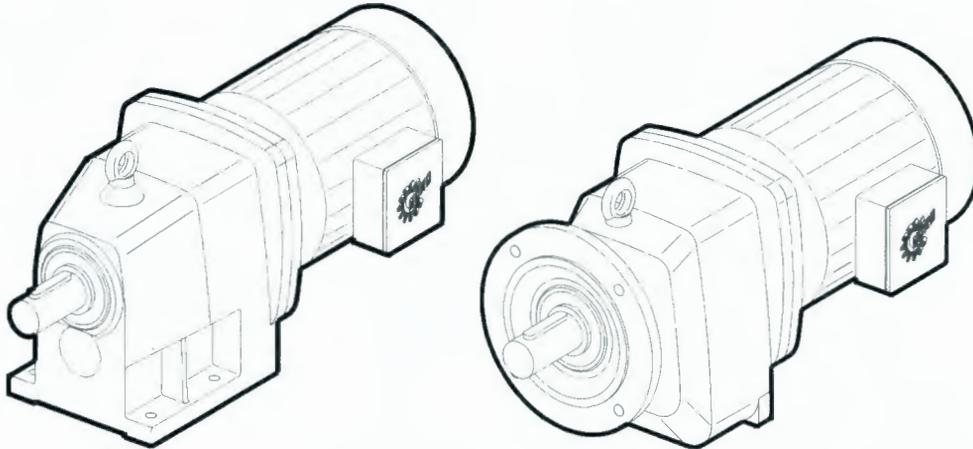
UNICASE[®] Helical Inline Gearboxes Installation and Maintenance Instructions

BIM 1010

USA

CDN

Retain These Safety Instructions For Future Use



INSPECTION OF UNIT

Thoroughly inspect the equipment for any shipping and handling damage before accepting shipment from the freight company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the NORD Gear invoice, nor should payment of the NORD Gear invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest NORD Gear Sales Office for assistance. Please keep a written record of all communications.

RECORD NAMEPLATE DATA

Locate the gear reducer nameplate and record all nameplate data for future reference.

SK _____ S/N _____
RATIO _____ MAX TORQUE _____ RPM _____ MTG. POS _____

STORAGE

PROPER STORAGE UNTIL INSTALLED

Keep unit in a dry, temperature controlled area. If stored other than said, long term storage methods must be applied to the unit including complete fill with lubricant. Protect machined surfaces and rotate shafts periodically. Prior to putting unit into service, drain lubricant and refill to proper level as determined by the mounting position.

PROPER HANDLING OF THE UNIT

Exercise care to prevent damage to the unit when moving. Lift only at designed lifting points. Do not attach other machinery and lift by the unit lifting points. The lifting points are to be used to lift the unit only. Insure that adequate safety measures are taken to protect personnel during transportation. Protect the mounting surface from damage.

INSTALLATION OF UNIT

To ensure long service and dependable performance, an enclosed gear drive must be rigidly supported and the shafts accurately aligned. The following describes the minimum precautions required to accomplish this end.

FOUNDATION

The responsibility for the design and construction of the foundation lies with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads.

MOUNTING POSITION

Unless a unit is specifically ordered for inclined mounting, the foundation must be level and flat. The lubrication system may not operate properly if the unit is not mounted in the position for which it is designed. It may be desirable to elevate the foundation to facilitate oil drainage.

CONCRETE FOUNDATION

If a concrete foundation is used, steel mounting pads and bolts of sufficient size to distribute the stress into the concrete should be grouted into the foundation.

STEEL FOUNDATION

If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit.

FOOT MOUNTED UNITS

Use shims under the feet of the unit to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will reduce the life of the unit and may cause failure. Dowel pins may be installed to prevent misalignment and ensure proper realignment if removed for service.

FLANGE MOUNTED UNITS

If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit. If a bulk head plate is used it should be of proper strength to minimize buckling distortions.

Flange Pilot 'AK' or 'AK1' tolerance

Metric (mm)

- > $\varnothing 50 \leq \varnothing 80 = +0.012/-0.007$
- > $\varnothing 80 \leq \varnothing 120 = +0.013/-0.009$
- > $\varnothing 120 \leq \varnothing 180 = +0.014/-0.011$
- > $\varnothing 180 \leq \varnothing 230 = +0.016/-0.013$
- > $\varnothing 230 \leq \varnothing 315 = +0.000/-0.032$
- > $\varnothing 315 \leq \varnothing 400 = +0.000/-0.036$
- > $\varnothing 400 \leq \varnothing 500 = +0.000/-0.040$

Inch

- > $\varnothing 1.969 \leq \varnothing 3.150 = +0.005/-0.0003$
- > $\varnothing 3.150 \leq \varnothing 4.724 = +0.005/-0.0004$
- > $\varnothing 4.724 \leq \varnothing 7.087 = +0.006/-0.0004$
- > $\varnothing 7.087 \leq \varnothing 9.055 = +0.006/-0.0005$
- > $\varnothing 9.055 \leq \varnothing 12.402 = +0.000/-0.0013$
- > $\varnothing 12.402 \leq \varnothing 15.748 = +0.000/-0.0014$
- > $\varnothing 15.748 \leq \varnothing 19.685 = +0.000/-0.0016$

BOLT STRENGTH

Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement.

PRIME MOVER MOUNTING

Align the prime mover to the reducer-input shaft using shims under the feet. Make sure that the feet are supported. Dowel the prime mover to its foundation.

SHAFT CONNECTIONS

When connecting shafts to either the input or output of the reducer, consider the following instructions.

FITS

Clearance or interference fits for coupling hubs should be in accordance with ANSI/AGMA 9002-A86 or as follows.

Output and Input shaft Diameter tolerance

Metric (mm)

- $\leq \varnothing 18 = +0.012/+0.001$
- > $\varnothing 18 \leq \varnothing 30 = +0.015/+0.002$
- > $\varnothing 30 \leq \varnothing 50 = +0.018/+0.002$
- > $\varnothing 50 \leq \varnothing 80 = +0.030/+0.011$
- > $\varnothing 80 \leq \varnothing 120 = +0.035/+0.013$
- > $\varnothing 120 \leq \varnothing 180 = +0.040/+0.015$

Inch

- $\leq \varnothing 1.750 = +0.0000/-0.0005$
- > $\varnothing 1.750 = +0.0000/-0.0010$

Output and Input shaft Drill and tap shaft end

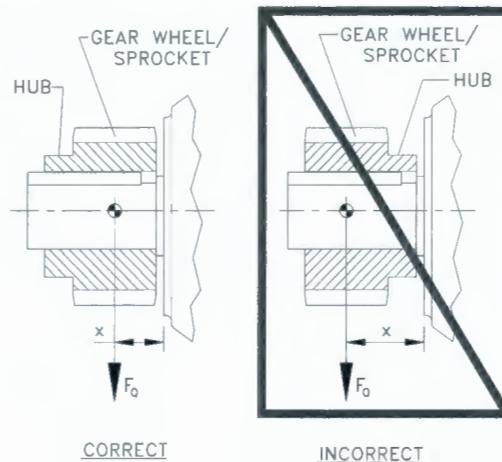
Metric (mm)

- $\leq \varnothing 16 = M5$
- > $\varnothing 16 \leq \varnothing 21 = M6$
- > $\varnothing 21 \leq \varnothing 24 = M8$
- > $\varnothing 24 \leq \varnothing 30 = M10$
- > $\varnothing 30 \leq \varnothing 38 = M12$
- > $\varnothing 38 \leq \varnothing 50 = M16$
- > $\varnothing 50 \leq \varnothing 85 = M20$
- > $\varnothing 85 \leq \varnothing 130 = M24$

Inch

- $\leq \varnothing 0.438 = \#10-24 \times 0.4 \text{ deep}$
- > $\varnothing 0.438 \leq \varnothing 0.813 = \#1/8-20 \times 0.6 \text{ deep}$
- > $\varnothing 0.813 \leq \varnothing 0.938 = \#5/16-18 \times 0.7 \text{ deep}$
- > $\varnothing 0.938 \leq \varnothing 1.125 = \#3/8-16 \times 0.9 \text{ deep}$
- > $\varnothing 1.125 \leq \varnothing 1.375 = \#1/2-13 \times 1.1 \text{ deep}$
- > $\varnothing 1.375 \leq \varnothing 1.875 = \#5/8-11 \times 1.4 \text{ deep}$
- > $\varnothing 1.875 \leq \varnothing 3.250 = \#3/4-10 \times 1.7 \text{ deep}$
- > $\varnothing 3.250 = \#1-8 \times 2.2 \text{ deep}$

Outboard pinion and sprocket fits should be as recommended by the pin sprockets with interference fits should be heated according to the manufacturer's recommendations, generally 250°F to 300°F, (120°C to 150°C) before assembling to the shaft.



LOCATION

Coupling hubs should be mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Pinions, sprockets and sheaves should be mounted as close as possible to the unit housing to minimize bearing loads and shaft deflections.

COUPLING ALIGNMENT

Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. In many installations, it is necessary to allow for thermal and mechanical shaft movement when determining shaft alignment. The coupling manufacturer's recommendations should be followed.

AXIAL DISPLACEMENT

The gap between shaft ends should be the same as the specified coupling gap unless overhung mounting of the coupling hub is specified. The coupling gap and shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement.

ANGULAR ALIGNMENT

Insert a spacer or shim stock equal to the required coupling gap between the coupling hub faces and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT

Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT

After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

SPROCKET OR SHEAVE ALIGNMENT

Align the sheaves or sprockets square and parallel by placing a straight edge across their faces. Alignment of bushed sheaves and sprockets should be checked after bushings have been tightened. Check horizontal shaft alignment by placing a level vertically against the face of the sheave or sprocket. Adjust belt or chain tension per the manufacturer's specified procedure.

OUTBOARD PINION ALIGNMENT

Align the pinion by adjusting the gear tooth clearance according to the manufacturer's recommendations and checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the unit moved slightly to obtain this contact. When the unit is moved to correct tooth contact, the prime mover should be realigned.

RECHECK ALIGNMENT

After a period of operation, recheck alignment and adjust as required.

1. Properly install unit on a rigid foundation
 - adequately supported
 - securely bolted into place
 - leveled so as not to distort the gear case
2. Properly install couplings suitable for the application and connected equipment.
3. Ensure accurate alignment with other equipment.
4. Furnish and install adequate machinery guards as needed to protect operating personnel and as required by the applicable standards of the Occupational Safety and Health Administration (OSHA), and by other applicable safety regulations;

5. Ensure that driving equipment is running in the correct direction before coupling to reducers with backstops (designed to operate only in a specific direction) or machinery designed to operate only in one direction.

CHANGES IN PERFORMANCE SPECIFICATIONS

Owner has the responsibility to consult with NORD GEAR if such items such as applied loads, operating speeds or other operating conditions have changed.



WARNING:

LOCK OUT POWER before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the gearbox.

START-UP

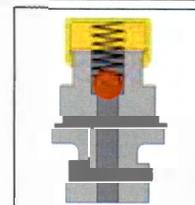
1. Ensure that switches, alarms, heaters, coolers and other safety and protection devices are installed and operational for their intended purpose.
2. Verify that the installed mounting position is the same as the nametag mounting position. If not, adjust the oil level accordingly and relocate the vent plug, fill plug and drain plug according to the mounting position. See following.

AUTOVENT PLUG

The Autovent plug is brass in color and will be located at the highest point on the gearbox. It operates like a check-valve to allow the reducer to relieve internal pressure while preventing lubricant contamination during cooling. A spring presses a ball or plunger against a machined orifice until pressure exceeds 2 psi. Above 2 psi the air is allowed to escape depressurizing the gearcase. When internal pressure drops below 2 psi, the autovent re-seals closing the unit to the outside environment. After shutdown, the reducer cools along with the air inside the reducer. The unit will temporarily maintain a slight vacuum until normalization occurs. NORD Gear supplies an Autovent as a standard feature.



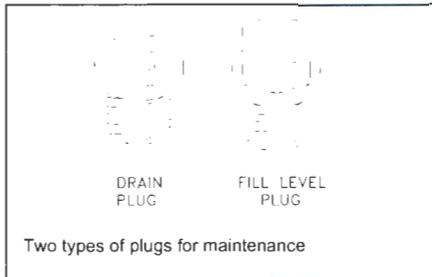
AUTOVENT
PLUG



The Autovent releases built-up air pressure from inside the gearbox (Max. pressure 2 psi).

FILL LEVEL & DRAIN PLUGS

The drain plugs are metric socket head cap screws. They will be located at the lowest part of the gearbox for ease of draining. The fill level plug is a hex head cap screw. It will be located between the Autovent and drain plug. Both types of plugs will have gaskets included to prevent oil from leaking.



LUBRICANT

All NORD reducers are shipped from the factory properly filled with lubricant and all plugs are installed according to the mounting position given on the reducer nametag. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

OPERATION AND MAINTENANCE CHECKLIST

1. Operate the equipment as it was intended to be operated
2. Do not overload.
3. Run at correct speed.
4. Maintain lubricant in good condition and at proper level.
5. Dispose of used lubricant in accordance with applicable laws and regulations.
6. Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7. Perform periodic maintenance of the gear drive as recommended by NORD.

MOUNTING POSITIONS

These charts detail the mounting positions for horizontal and vertical mounting. The Autovent, oil fill plug and drain plug are indicated on each mounting position picture. The factory set mounting position and plug locations match that shown on the gearbox nametag. For mounting orientations other than shown consult NORD Gear.

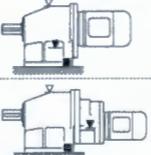
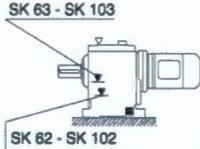
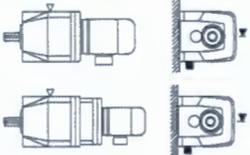
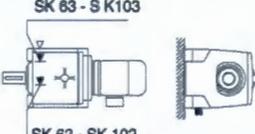
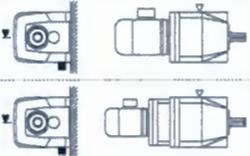
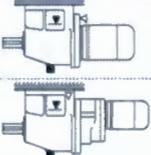
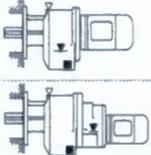
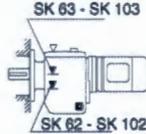
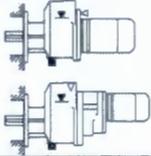
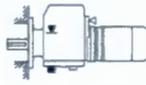
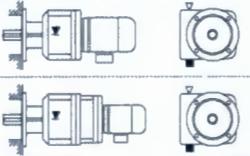
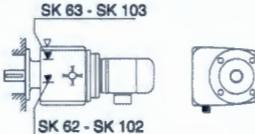
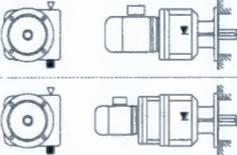
VERTICAL POSITION

	SK 11E - SK 51 E	SK 02 - SK 52	SK 03 - SK 53	SK 62 - SK 103
V1 *				
V3				
V5 *				
V6				

Symbols:  Vent plug  Oil level  Drain plug  Mounting surface

* Mounting position V1 or V5 with lubricant expansion unit

HORIZONTAL POSITION

	SK 11 E - SK 51 E	SK 02 - SK 52 SK 03 - SK 53	SK 62 - SK 103
B3			
B6			
B7			
B8			
B5			
B5I			
B5II			
B5III			

Symbols:  Vent plug  Oil level  Drain plug  Mounting surface

MAINTENANCE

Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS

NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

STANDARD OIL – ISO VG220

Ambient Temperature	Formulation
20 to 104°F (-5 to 40°C)	Mineral

TYPICAL OILS

Viscosity ISO NLGI	Formulation	Service Temperature Range						
VG 460	Conventional Mineral	20°C to +50°C 68F to +122°F	Mobilgear 634	Omala 460	7EP	Klüberoil GEM 1-460	Energol GR-XP 460	Tribol 1100/460
	Synthetic PAO	-30°C to +80°C -22°F to +176°F	Mobil SHC 634	Omala 460 HD	Isolube EP 460	Klübersynth EG 4-460	N/A	Tribol 1510/460
VG 320	Conventional Mineral	0°C to +30°C 32°F to +86°F	Mobilgear 632	Omala 320	6EP	Klüberoil GEM 1-320	Energol GR-XP 320	Tribol 1100/320
	Synthetic PAO	-35°C to +80°C -31°F to +176°F	Mobil SHC 632	Omala 320 HD	Isolube EP 460	Klübersynth EG 4-320	N/A	Tribol 1510/320
VG 220	Conventional Mineral	-5°C to +40°C +20°F to +104°F	Mobilgear 630	Omala 220	5EP	Klüberoil GEM 1-220	Energol GR-XP 220	Tribol 1100/220
	Synthetic PAO	-34°C to +80°C -30°F to +176°F	Mobil SHC 630	Omala 220 HD	Isolube EP 220	Klübersynth EG 4-220	N/A	Tribol 1510/220
VG 150 & VG 100	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 629	Omala 100	4EP	Klüberoil GEM 1-150	Energol GR-XP 100	Tribol 1100/100
	Synthetic PAO	-37°C to +10°C -35°F to +50°F	Mobil SHC 629	Omala 150 HD	Isolube EP 150	Klübersynth EG 4-150	N/A	N/A
VG 68	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 626	Omala 68	2EP	Klüberoil GEM 1-68	Energol GR-XP 68	Tribol 1100/68
	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 626	N/A	Isolube EP 68	N/A	N/A	N/A
VG 32	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 624	N/A	N/A	Klüber-Summit HySyn FG-32	N/A	N/A

PAO = Poly Alpha Olefin

SPECIAL PURPOSE LUBRICANTS

Ambient Temperature	Formulation	Manufacturer	Oil Brand Name
20 to 104°F (-5 to 40°C)	Food Grade Oil - Synthetic	Chevron	FM ISO 220
20 to 104°F (-5 to 40°C)	Food Grade Oil - Synthetic	OilJAX	Magnaplate 85W140-FG
5 to 125°F (-20 to 50°C)	Fluid Grease	Mobil	Mobilux EP023
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Mobil	Mobilith SHC 007
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Shell	Albida LC

STANDARD BEARING GREASE – NLGI 2EP Lithium

Ambient Temperature	Formulation
-20 to 140°F (-30 to 60°C)	Mineral

OPTIONAL BEARING GREASES

Ambient Temperature	Formulation	Manufacturer	Grease Brand Name
-40 to 230°F (-40 to 110°C)	Synthetic	Shell	Aeroshell 6
-40 to 230°F (-40 to 110°C)	Food Grade - Synthetic	Lubriplate	SFL1

LUBRICANT CAPACITY

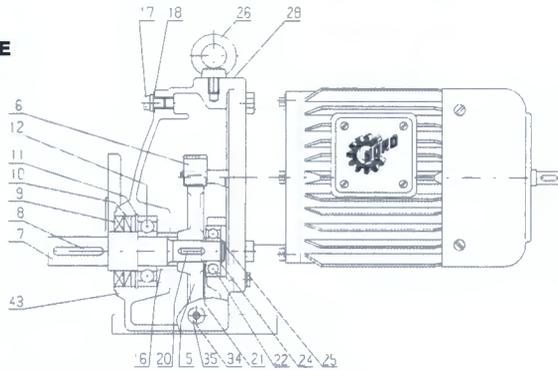
Each reducer has the oil level and oil quantity adjusted according to the mounting position shown in the tables. When replacing the oil, consult the tables below to determine the proper amount of oil to be installed according to the reducer size and mounting position. Note that this is approximate and the final level will be adjusted when the reducer is installed. Acceptable oil fill level is within 1/2 inch of the bottom of the fill plug threads.

LUBRICATION CAPACITY – HELICAL INLINE GEARBOXES													
Mounting position		Horizontal position							Vertical position				
		single reduction											
		B 3	B 6	B 7	B 8	B 5	B 5I	B 5II	B 5III	V 1	V 3	V 5	V 6
SK 11E	quarts	0.26	0.37	0.37	0.58	0.32	0.53	0.42	0.42	0.32	0.37	0.42	0.53
	liters	0.25	0.35	0.35	0.55	0.30	0.50	0.40	0.40	0.30	0.35	0.40	0.50
SK 21E	quarts	0.63	1.06	1.06	1.27	0.53	1.16	0.95	0.95	0.74	1.48	1.06	1.27
	liters	0.60	1.00	1.00	1.20	0.50	1.10	0.90	0.90	0.70	1.40	1.00	1.20
SK 31E	quarts	1.16	1.80	1.80	2.32	0.85	1.74	2.11	2.11	1.16	1.37	2.43	2.85
	liters	1.10	1.70	1.70	2.20	0.80	1.65	2.00	2.00	1.10	1.30	2.30	2.70
SK 41E	quarts	1.80	2.75	2.75	3.49	1.06	2.96	3.49	3.49	1.69	2.75	2.64	2.75
	liters	1.70	2.60	2.60	3.30	1.00	2.80	3.30	3.30	1.60	2.60	2.50	2.60
SK 51E	quarts	2.32	3.59	3.59	4.97	1.90	4.33	4.02	4.02	3.17	3.70	4.23	4.65
	liters	2.20	3.40	3.40	4.70	1.80	4.10	3.80	3.80	3.00	3.50	4.00	4.40
Mounting position		double reduction											
		B 3	B 6	B 7	B 8	B 5	B 5I	B 5II	B 5III	V 1	V 3	V 5	V 6
SK 02	quarts	0.16	0.42	0.42	0.74	0.26	0.63	0.53	0.53	0.63	0.63	0.63	0.63
	liters	0.15	0.40	0.40	0.70	0.25	0.60	0.50	0.50	0.60	0.60	0.60	0.60
SK 12	quarts	0.26	0.53	0.53	0.90	0.37	0.95	0.63	0.63	0.95	0.90	0.79	0.79
	liters	0.25	0.50	0.50	0.85	0.35	0.90	0.60	0.60	0.90	0.85	0.75	0.75
SK 22	quarts	0.53	1.43	1.43	2.11	0.74	2.11	1.64	1.64	1.90	2.11	1.90	1.90
	liters	0.50	1.35	1.35	2.00	0.70	2.00	1.55	1.55	1.80	2.00	1.80	1.80
SK 32	quarts	0.95	2.11	2.11	3.17	1.37	3.49	2.54	2.54	3.28	3.06	3.06	2.64
	liters	0.90	2.00	2.00	3.00	1.30	3.30	2.40	2.40	3.10	2.90	2.90	2.50
SK 42	quarts	1.37	3.38	3.38	4.76	1.90	4.76	3.91	3.91	4.23	4.65	4.54	6.13
	liters	1.30	3.20	3.20	4.50	1.80	4.50	3.70	3.70	4.00	4.40	4.30	5.80
SK 52	quarts	2.64	5.39	5.39	7.19	3.17	6.55	5.92	5.92	7.82	7.19	7.19	7.40
	liters	2.50	5.10	5.10	6.80	3.00	6.20	5.60	5.60	7.40	6.80	6.80	7.00
SK 62	quarts	6.87	15.85	15.85	13.74	7.40	14.79	16.91	16.91	19.55	15.85	16.91	15.85
	liters	6.50	15.00	15.00	13.00	7.00	14.00	16.00	16.00	18.50	15.00	16.00	15.00
SK 72	quarts	9.51	24.30	24.30	19.02	10.57	19.55	24.30	24.30	29.59	24.30	27.47	24.30
	liters	9.00	23.00	23.00	18.00	10.00	18.50	23.00	23.00	28.00	23.00	26.00	23.00
SK 82	quarts	14.79	33.81	33.81	28.53	15.85	30.64	36.46	36.46	47.55	39.10	46.49	36.98
	liters	14.00	32.00	32.00	27.00	15.00	29.00	34.50	34.50	45.00	37.00	44.00	35.00
SK 92	quarts	26.42	54.95	54.95	49.66	27.47	49.66	54.95	54.95	82.42	77.14	80.31	77.14
	liters	25.00	52.00	52.00	47.00	26.00	47.00	52.00	52.00	78.00	73.00	76.00	73.00
SK 102	quarts	38.04	75.02	75.02	69.74	42.27	69.74	76.08	76.08	109.90	85.59	107.78	83.48
	liters	36.00	71.00	71.00	66.00	40.00	66.00	72.00	72.00	104.00	81.00	102.00	79.00
Mounting position		triple reduction											
		B 3	B 6	B 7	B 8	B 5	B 5I	B 5II	B 5III	V 1	V 3	V 5	V 6
SK 03	quarts	0.32	0.63	0.63	0.85	0.53	0.95	0.85	0.85	1.16	0.86	0.95	1.32
	liters	0.30	0.60	0.60	0.80	0.50	0.90	0.80	0.80	1.10	0.81	0.90	1.25
SK 13	quarts	0.63	0.74	0.74	1.16	0.85	1.27	1.00	1.00	1.27	1.27	1.27	1.32
	liters	0.60	0.70	0.70	1.10	0.80	1.20	0.95	0.95	1.20	1.20	1.20	1.25
SK 23	quarts	1.37	1.69	1.69	2.43	2.64	1.59	2.96	2.96	2.96	2.75	2.48	2.54
	liters	1.30	1.60	1.60	2.30	2.50	1.50	2.80	2.80	2.80	2.60	2.35	2.40
SK 33	quarts	1.69	2.43	2.43	3.38	2.01	3.70	2.75	2.75	4.65	3.59	4.44	3.06
	liters	1.60	2.30	2.30	3.20	1.90	3.50	2.60	2.60	4.40	3.40	4.20	2.90
SK 43	quarts	3.17	3.80	3.80	5.49	3.70	5.28	4.33	4.33	6.45	6.02	6.97	5.92
	liters	3.00	3.60	3.60	5.20	3.50	5.00	4.10	4.10	6.10	5.70	6.60	5.60
SK 53	quarts	4.76	6.34	6.34	8.14	5.49	7.40	7.08	7.08	9.40	8.88	9.19	9.19
	liters	4.50	6.00	6.00	7.70	5.20	7.00	6.70	6.70	8.90	8.40	8.70	8.70
SK 63	quarts	10.57	13.74	13.74	11.62	11.62	12.68	14.79	14.79	19.02	14.79	16.91	15.32
	liters	10.00	13.00	13.00	11.00	11.00	12.00	14.00	14.00	18.00	14.00	16.00	14.50
SK 73	quarts	14.79	21.13	21.13	18.49	14.79	19.02	21.13	21.13	29.06	23.78	28.53	21.13
	liters	14.00	20.00	20.00	17.50	14.00	18.00	20.00	20.00	27.50	22.50	27.00	20.00
SK 83	quarts	23.25	34.87	34.87	27.47	24.30	28.53	35.93	35.93	42.27	35.93	39.10	32.76
	liters	22.00	33.00	33.00	26.00	23.00	27.00	34.00	34.00	40.00	34.00	37.00	31.00
SK 93	quarts	42.27	51.78	51.78	46.49	42.27	46.49	51.78	51.78	78.19	73.97	76.08	73.97
	liters	40.00	49.00	49.00	44.00	40.00	44.00	49.00	49.00	74.00	70.00	72.00	70.00
SK 103	quarts	58.12	70.80	70.80	58.12	58.12	62.34	70.80	70.80	104.61	82.42	102.50	75.02
	liters	55.00	67.00	67.00	55.00	55.00	59.00	67.00	67.00	99.00	78.00	97.00	71.00

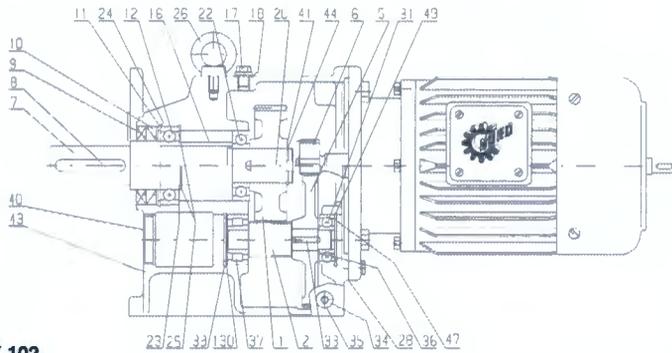
Note: Filling quantities are approximate figures. Oil level must be checked according to oil level plug after final installation. Acceptable oil fill level is within 1/2 inch of the bottom of the fill plug threads. For mounting angles not shown, consult factory.

PARTS LIST

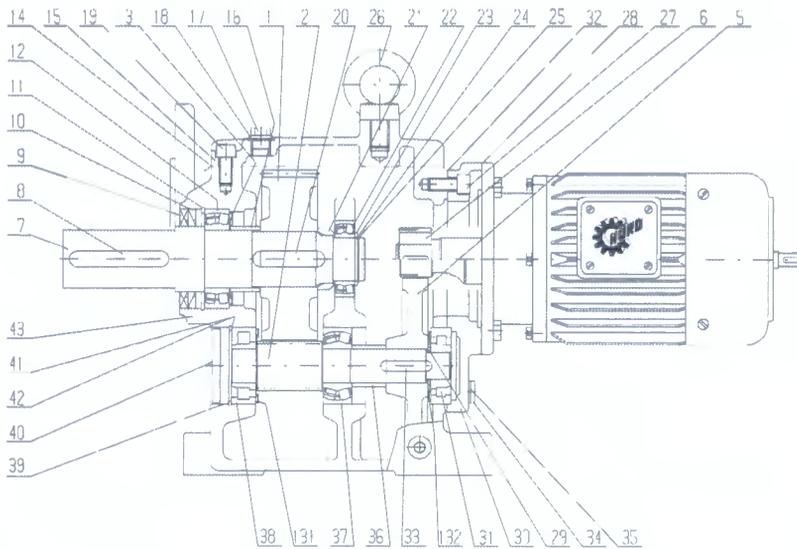
SK 11 E - SK 51 E



SK 02 - SK 52



SK 62 - SK 102



- 1 Driven gear
- 2 Pinion shaft
- 5 Driving gear
- 6 Driving pinion
- 7 Output shaft
- 8 Key
- 9 Shaft seal
- 10 Shaft seal
- 11 Circlip
- 12 Output shaft bearing
- 13 NILOS ring
- 14 Seal
- 15 Gearcase cover
- 16 Spacer
- 17 Vent plug
- 18 Seal
- 19 Socket head screw
- 20 Key
- 21 Spacer
- 22 Output shaft bearing
- 23 Supporting disc
- 24 Shim
- 25 Circlip
- 26 Flanged eye bolt
- 27 Bolt
- 28 Seal
- 29 Spacer
- 30 Gearbox cover
- 31 Pinion shaft bearing
- 32 Seal
- 33 Key
- 34 Drain plug
- 35 Seal
- 36 Spacer
- 37 Pinion shaft bearing
- 38 Pinion shaft bearing
- 39 Circlip
- 40 Locking cap
- 41 Shim
- 42 Supporting disc
- 43 Gear case
- 44 Circlip
- 47 Shim
- 49 Circlip
- 130 Shim
- 131 NILOS ring
- 132 NILOS ring

RECOMMENDED SPARE PARTS

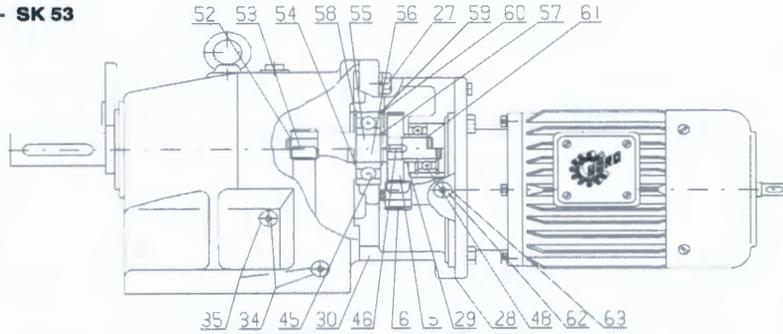
- Bearings – all
- Gaskets – all
- Shims – all
- Seals – all
- Seal Plugs – all

IMPORTANT!

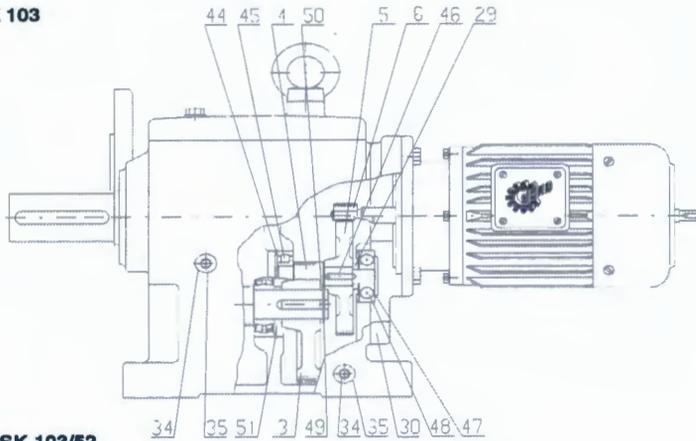
When ordering parts, it is necessary to have the **NORD SERIAL NUMBER** from the unit the parts are for. The serial number will dictate the correct parts for that particular unit. The gearbox nameplate will have the serial number on it.

PARTS LIST

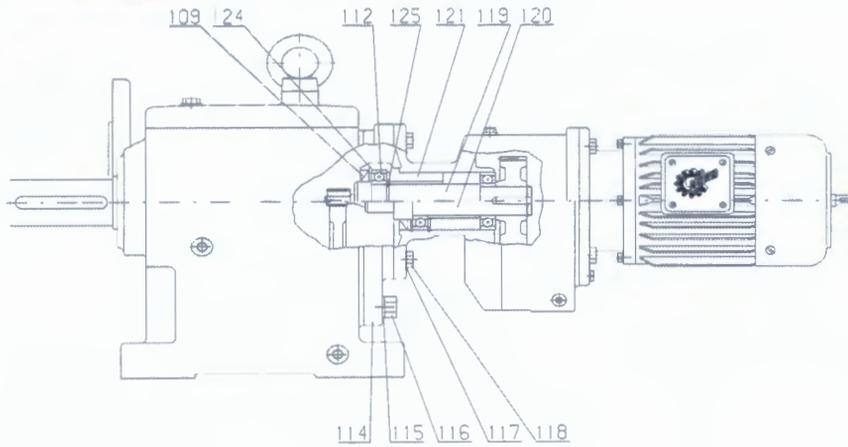
SK 03 - SK 53



SK 63 - SK 103



SK 12/02 - SK 103/52



- 3 Driven gear
- 4 Pinion shaft
- SK 63 - SK 103
- 5 Driving gear
- 6 Driving pinion
- 27 Fixing bolt
- 28 Seal
- 29 Spacer
- 30 Third reduction gearcase
- 34 Drain plug
- 35 Seal
- 44 Circlip
- 45 Ball bearing
- 46 Key
- 47 Shim
- 48 Ball bearing
- 49 Circlip
- 50 Supporting disc
- 51 Circlip
- 52 Circlip
- 53 Key
- 54 Circlip
- 55 Intermediate shaft, plain
- 56 Intermediate shaft, gearcut
- 57 Circlip
- 58 Circlip
- 59 Shim
- 60 Circlip
- 61 Circlip
- 62 Oil-plug
- 63 Seal
- 109 Shaft seal
- 112 Ball bearing
- 114 Intermediate flange
- 115 Spring washer
- 116 Bolt
- 118 Bolt
- 119 Intermediate shaft, plain
- 120 Intermediate shaft, gearcut
- 121 Bearing sleeve
- 124 Circlip
- 125 Circlip

NOTES

TROUBLE SHOOTING

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/ or reinforce mounting and structure
		Loose hold down bolts	Tighten bolts
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.	
Output Shaft Does Not Turn	Internal parts are broken	Overloading of reducer can cause damage.	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

NORD Gear Corporation

National Customer Service Toll Free 888-314-6673

www.nord.com

NORD Gear Limited

Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
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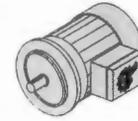
MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

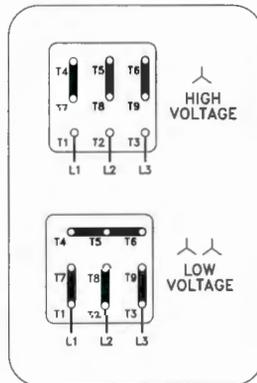
CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130



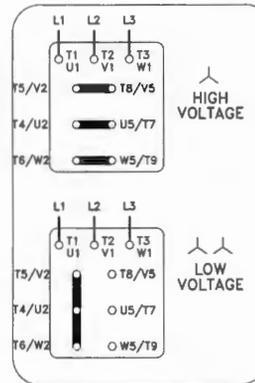
Connections



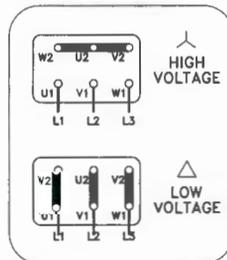
Frame 63 - 132
230/460V - 60 Hz



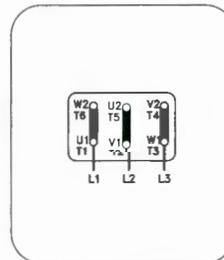
Frame 160 +
230/460V - 60 Hz



332/575V - 60 Hz
230/400V - 50 Hz
400/690V - 50 Hz



460 V Δ - 60 Hz



General Brake Connection

Normal brake reaction time
(AC-Switching)



L1/L2 - Brake voltage (AC)

Rapid brake reaction time
(DC-Switching)



* The normally-open contact (NO) is not supplied by nord. It must close at the same time power is supplied to the brake.



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sales@seepex.net

TERMS & CONDITIONS OF SALES AND/OR REPAIR

The following terms and conditions shall apply to an order for all or any part the articles covered by this quotation unless specifically excepted therein:

Prices

All prices quoted shall only be valid for orders placed within 30 days from the date of issue of the quotation. Prices are F.O.B. our plant in U.S. or Canadian dollars. We reserve the right to correct typographical or clerical errors.

Terms

All orders are subject to approval by our Credit Department. Unless otherwise stated, if payment for the invoice due is not made within thirty (30) days after shipment, administration fees of eighteen percent (18%) per year (equivalent to a nominal monthly interest rate of 1½%) will be applied on overdue accounts. The terms and conditions herein set forth are based upon tariffs, taxes, foreign exchange rates, delivery, and other conditions in effect on the date of this contract. In the event changed conditions, legislations, regulations, or other matters shall become applicable to any quotation, contract, or delivery hereunder, any increased exchange, duties, taxes, ocean freight, or other charges resulting from such action shall be for the customer's account and **seepex, Inc.** may charge such increased duties, taxes, or charges to the customer.

Unless the order includes the appropriate exemption certificates and/or licenses, duties, and taxes levied by Federal, State, or other governments are required to be charged automatically at the rate imposed at time of importation/shipment. Any change in law, regulations, or Government Department practice which causes a variation of any kind in the applicable charges from the amounts allowed for the quotation, shall result in an equivalent change in the price quoted.

Until payment is made in full, **seepex, Inc.** shall retain the right, without notice, to repossess and/or retain the items, and/or dispose of them, for its benefit and hold the customer responsible for any loss. Customer agrees to enter into any agreements, contracts, or notices required to confirm such rights.

Security

In order to secure any obligations due to **seepex, Inc.** from the customer (whether or not under this contract) the customer grants and confirms in **seepex, Inc.** a security interest in:

- a) the merchandise covered by this contract, and
- b) in all property and funds of the customer now or hereafter in **seepex, Inc.** possession, whether or not arising out of this contract, and in all additions, accessions, and proceeds of such merchandise and/or property. The customer hereby authorizes **seepex, Inc.** to sign alone any financing statement or statements and to do all and any other things which may be necessary to perfect such security interest.

Cancellation

After acceptance, orders may be canceled only with our approval and payment in accordance with contract by the customer for work performed and/or material expenses incurred by us to date of cancellation. We reserve the right to cancel the order if the customer's financial condition, in our sole judgment, places the payment in jeopardy.

Return

No credit will be allowed for returns unless our authorization in writing for such returns has been obtained beforehand. A copy of this authorization is to be returned with the item as the packing slip.

Shipment

- a) **Handling Charge:** Customer shall be responsible for making all arrangements for shipment of the order with a suitable carrier. In the event that customer requests that **seepex** make arrangements for shipment, then customer agrees to pay to **seepex**, in addition to the applicable shipping charges, a handling charge in the amount of 10% of the shipping charges with a minimum \$5.00 to a maximum charge of \$150.00, with special services requiring additional charges.
- b) **New Articles:** Where shipping instructions indicate no exact routing, our best judgement will be used in determining routing but we shall not be liable for any charges beyond F.O.B. point. If changes are made at customer's request in a) F.O.B. point, b) in our normal routing from either the manufacturers' or our own plants and in these changes involve extra costs, such costs shall be for the customer's account, unless otherwise noted on the **seepex** price quotation.
- c) **Repair Work:** Defined as work and services performed by **seepex, Inc.** All orders shall be delivered to and picked up from our plant unless otherwise specified. All costs of delivery shall be for the customer's account unless otherwise agreed to in writing prior to shipment.
- d) **All Orders:** On collect freight shipments, cartage charges from plant to carrier are for customer's account. Title to articles passes to customer upon delivery to carrier acting as customer's agent subject to any right of retention by us. All claims for shortage in, and damages in, shipment or otherwise must be reported to carrier immediately upon receipt with copy or report to ourselves within five (5) days.

Guarantee

- a) **New Articles:** We guarantee articles of our manufacture against defects in material and/or workmanship for a period of three (3) years from date of acceptance, providing that the articles have been installed, maintained, and operated in accordance with our recommendations and instructions.
- b) **Repair Work:** Defined herein as work and services performed by **seepex, Inc.** We

guarantee all work and services performed by us against defect arising from workmanship and/or materials provided by us for a period of ninety (90) calendar days from the date of shipment to customer.

- c) **All Orders:** Claims shall be submitted promptly in writing to **seepex, Inc.** Replacement and/or repair under guarantee shall be made F.O.B. our plant. Our liability under these guarantees is limited to the replacement and/or repair only of defective material or workmanship and in no event shall **seepex, Inc.** be liable for any loss or damage of whatever kind of nature out of defects in material and/or workmanship, or resulting from delay, or loss of use of articles, or any installation into which the article may be installed, or arising out of the contract of the work or service or from negligence.

seepex, Inc. shall not be liable for any loss or damage resulting from delay and/or late delivery due to causes beyond our reasonable control. In no event shall seepex, Inc. be liable for any claim exceeding the amount of this order. Our guarantee on products of other than our own manufacture is limited to the guarantee extended to us by the original manufacturer. On any claims for repairs and/or replacement under such guarantee, all costs incurred by us which are not underwritten by the original manufacturer's shall be for the claimant's account. Except as stated above no representations, conditions, or warranties are made with respect to products, work, or services, express or implied verbal or otherwise, including warranties of merchantability and fitness. Our guarantee and warranty shall not apply to materials or workmanship which have been subject to misuse, neglect, or accident. seepex, Inc. shall be held free and harmless from any dispute or claim anywhere arising relating to infringement of patent, design, trademark, or copyright of items sold or repaired under this contract.

Property rights and risks

The customer's property at all times shall remain at the risk of the customer while being worked on by our personnel or on our premises and shall not be responsible for any loss or damage to the customer's property resulting from any cause whatsoever.

Title to and rights in relation to item sold under this contract/quotations shall remain with **seepex, Inc.** until such items are paid for, subject to risk on products sold passing to the customer upon acceptance by a carrier or other, which shall constitute good delivery.

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seepex.m@seepex.com

And what can we get flowing for you?
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More seepex sales partners in Europe,
America, Asia, Africa and Oceania
you will find on our website.

Or visit www.seepex.com

Attachment D-5
Siemens PolyBlend WSLP 2400 F10P



WSLP-2400 Series Liquid Polymer Preparation Systems

Equipment Type Liquid Polymer Preparation Systems

Description

Liquid Polymer Preparation Systems are designed for long-term, dependable operation. Every design incorporates years of field experience with liquid polymer preparation with the knowledge of the leading manufacturer of water-soluble polymers. All liquid polymer preparation units add two unique options: variable speed mixing and automatic dosage control with constant solution strength to meet a wide range of polymer feed application requirements.

WSLP-2400 Series

The WSLP-2400 Series use multi-zone mixing. The first zone exposes the polymer to a high energy environment to minimize agglomeration. Reduced mixing energy in the second zone protects the fragile polymer chains from fracturing, making more polymer available for work. The baffling is designed to create a tapered mixing regime. The optional variable speed mixing optimizes the hydration process within each zone regardless of the type of polymer in use. Whether you adjust the output remotely or right at the unit, water flow and polymer feed increase and decrease together, automatically maintaining constant solution strength. Even primary and secondary dilution water is kept at the same ratio as output is adjusted.

Advantages

- Diaphragm, Gear, or Progressive Cavity Polymer Pumps
- 2.4 – 24 gph polymer output
- 240 to 12,000 gph water flow rate
- Mixes neat emulsion or solution polymers
- Mixes product in-line to begin proper activation
- Variable speed mixer (optional)
- Simple installation and operation
- Low water flow protection
- Self-cleaning check-valve stainless steel
- 304 Stainless steel frame / PVC
- Calibration column

Utilities

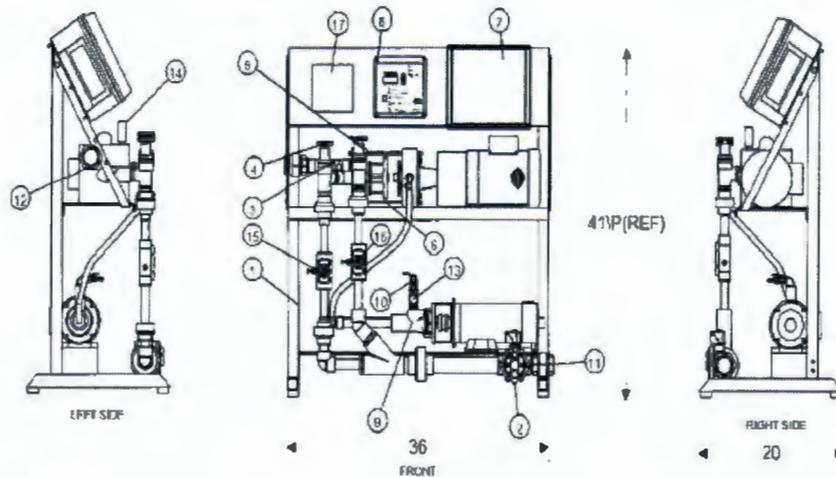
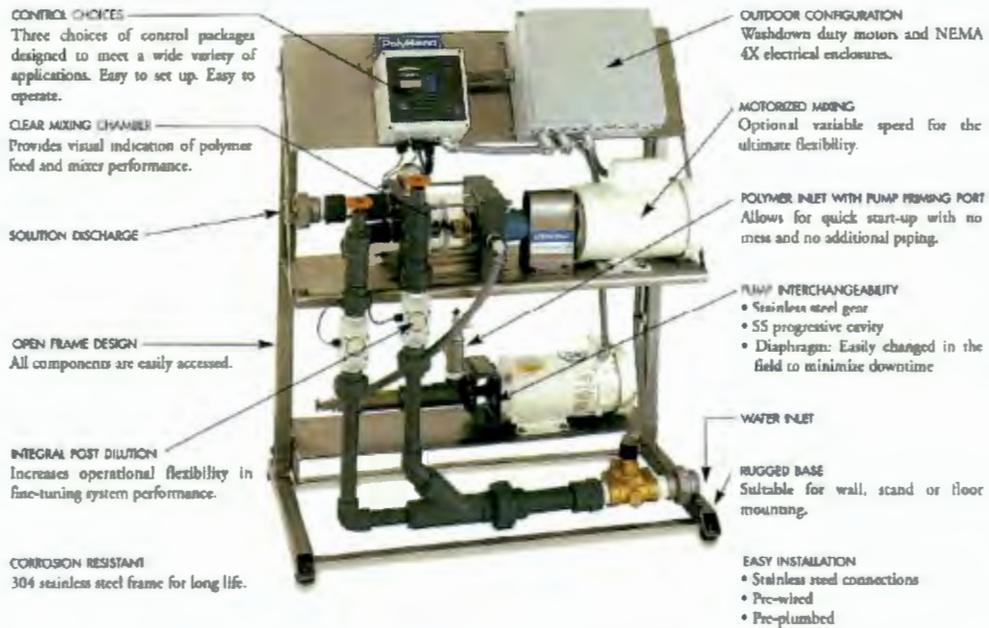
- 100 psi required primary dilution
- 120VAC/60Hz/1Ph
- Connections: 1½" FPT (water), 1½" FPT (solution), ½" FPT (polymer)

Frame

- 36"W x 40"H x 16"D, 345 lbs, skid mounted

This information is for the specific material described only and may not be valid if the material is used in combination with any other materials or in any other process. To the knowledge of WaterSolve LLC, the information is accurate and reliable, but WaterSolve makes no express or implied warranty of merchantability for the material or for the information. WaterSolve makes no express or implied warranty of fitness for a purpose for the material or for the information.

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READ THE MANUAL BEFORE YOU INSTALL, OPERATE, OR SERVICE THIS UNIT

SAFETY PRECAUTIONS:

- ✓ Ensure that the control panel is grounded to avoid possible electrical shock or damage to equipment.
- ✓ Before servicing, turn off all power and assure power "lockout" to avoid possible electric shock.
- ✓ Disconnect external power to the control panel before removing or replacing fuses.

SAFETY NOTICE:

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

WARNING:

Do not touch electrical connections before you first ensure that power has been disconnected.

Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. National Electrical Code and Local Codes must be carefully followed.

Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices.

This equipment may be connected to other machinery that has rotating part or parts that are driven by this equipment. Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment. Do not by-pass or disable protective safety guards or devices.

Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if load decouples from the shaft during operation. Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods can cause muscle strain or other injuries.

Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from motor shaft before maintained is performed.

Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Do not use these motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.

Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate. UL rated motors must only be serviced by authorized dealers.

CAUTION:

To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.

Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate only for lifting the motor. Disconnect the load from the motor shaft before moving the motor.

If eyes bolts are used for lifting the motor be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.

To prevent equipment damage, be sure that the electric service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.

If a HI POT test (High Potential Insulation Test) must be performed, follow the precautions and procedures in NEMA MG-1 and MG-2 standards to avoid equipment damage.

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your authorized dealer.

TROUBLESHOOTING

Symptom	Possible Cause	Corrective Action
No Water Flow	<ul style="list-style-type: none"> • Closed Valve on Water Supply • Blocked Solenoid Valve • Closed or clogged discharge line • Rate Control Valve Closed 	<ul style="list-style-type: none"> • Make sure valve is open • Dis-assemble and clean valve • Remove any blockages or open any closed valves • Make sure valve is open
Pump won't pump Chemical	<ul style="list-style-type: none"> • Pump is turned OFF • No Water Flow • Blocked Pump Discharge Line • Back Pressure is too high • Not enough water flow 	<ul style="list-style-type: none"> • Make sure pump is in ON position • Make sure all water valves (supply and discharge) are open • Take discharge line apart, check for blockage and clean if necessary • Reduce Back pressure on unit • Increase water flow or adjust water monitoring device (flow switch, DP switch, etc.) set point lower than the desired flow rate.
Clogged Injection Check Valve	<ul style="list-style-type: none"> • Debris or Clumps in Polymer • Valve is stuck open allowing water into polymer line 	<ul style="list-style-type: none"> • Check polymer supply for contamination • Remove valve from chamber and clean it
Pump won't stop	<ul style="list-style-type: none"> • Water flow is still established • Pump is in internal mode 	<ul style="list-style-type: none"> • Shut off water valve or power to the unit • Switch pump to external

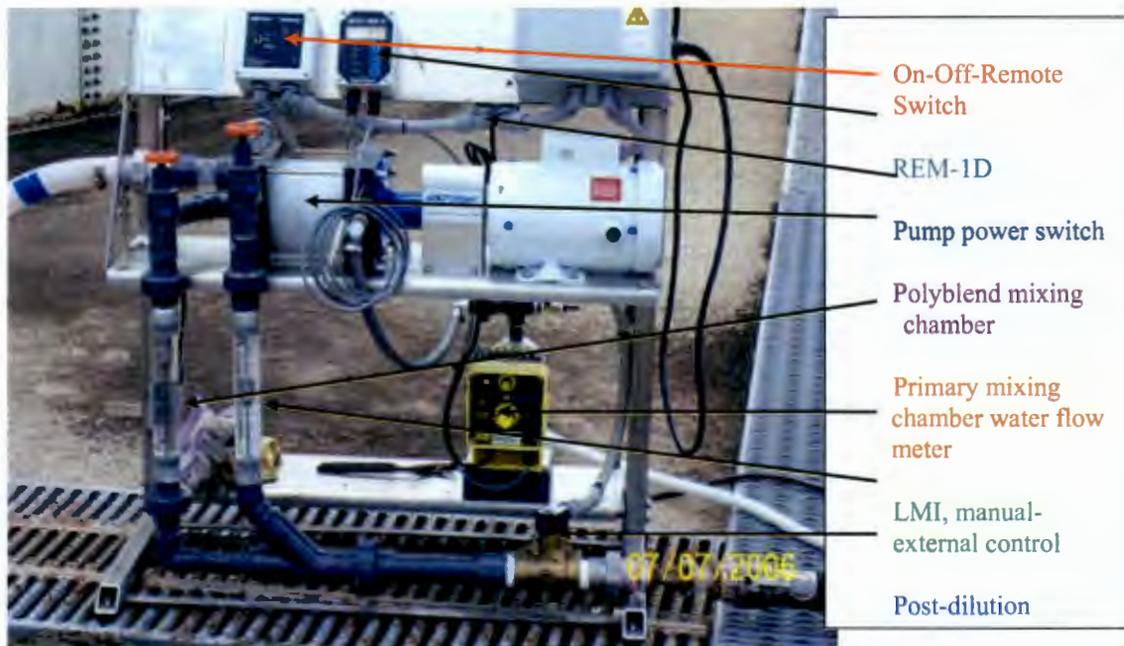
INITIAL SYSTEM STARTUP



- ✓ Verify all wiring, pipe/hose fitting connections are tight and all water supply valves are open fully.
- ✓ Energize power circuit that feeds unit. Turn the system "on-off-remote" switch to the "on" position (figure 6.1). Solenoid opens and water flow is established.
NOTE: To prevent surges, always start generators prior to plugging in unit.
- ✓ Verify water flow adjust the system's water regulating valve (orange globe valve) until the desired GPM flow rate is achieved. Optimal flow is 20 gpm on primary mixing chamber flow meter. The other globe valve can be adjusted for post-dilution.
- ✓ "Open" main polymer supply valves. Switch LMI pump to external mode at pump face.
- ✓ Prime polymer pump, using priming kit provided with unit. Please contact a WaterSolve representative for priming instructions. For optimum pump performance, flooded suction is recommended.
- ✓ Turn pump power hand switch (located in back of unit) to "on" position. The polymer pump electronic controller (REM-1D) should be on and adjusted to 0%.
- ✓ After water flow is established, mixing chamber motor starts. Adjust the REM-1D to "50%". Verify polymer "enters" the pump and mixing chamber.
- ✓ Increase or decrease the polymer pump speed with REM-1D touch pad to achieve the desired % polymer concentration.

CAUTION: DO NOT OPERATE POLYMER PUMP WITHOUT PRODUCT. DO NOT RUN UNIT UNLESS WATER FLOW IS ESTABLISHED. POLYMER ALONE CAN PLUG DISCHARGE PLUMBING.

SYSTEM SHUTDOWN & MAINTENANCE



- ✓ Turn off sludge pump.

- ✓ Adjust REM-1D to 0%. Shut off polymer feed with ball cock.

Allow water to run through make-down unit, polyblend, injection port(s), and discharge line for 10 minutes.

- ✓ Turn off pump power hand switch on back of unit.
- ✓ Close polymer solution injection port.
- ✓ Turn off make-down unit and close primary water flow valve.
Disconnect power and water from unit if not using for a week or more.



WSLP 2400 SERIES MODEL OPTIONS GUIDE

Model numbers can be generated as follows:

EXAMPLE : WSLP 2400

F-----10-----N-----V

DIAPHRAGM

	GPH	LPH
A.	.04	(1.5)
B.	1	(3.8)
C.	2.5	(9.5)
D.	4	(15.2)
E.	10	(38)

PROGRESSIVE CAVITY

F.	10	(38)
G.	30	(114)
H.	50	(190)

GEAR

I.	18	(68)
J.	36	(137)
K.	60	(228)

VOLTAGE

10. 120 VAC 60 Hz 1Ph

CONTROLS

- N. On-OFF-REMOTE
- O. MICROCONTROLLER
- P. FLOW PROPORTIONALS

OPTIONS

- V. Variable Speed Mixer

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www.gowatersolve.com

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Liquid Polymer Preparation Systems

WSDP-2400 Series

This system is the best product available to handle your liquid/solid separation needs. The combines USFilters's proven motorized mixing technology with precise controls to provide superior polymer preparation. This system can be configured with a variety of pump offerings, variable speed mixing and automatic dosage control with constant solution strength to meet a wide range of polymer feed application requirements. The open frame design permits quick and easy maintenance and is engineered to handle the harshest environments. The is designed to handle new polymer developments, ultra-high molecular weights, different charge densities, and even totally new chemistries. Variable speed drives are available or the constant speed motor is standard. Whether you adjust the output remotely via 4-20 mA signal or right at the unit, water flow and polymer feed increase or decrease together.

- **115-230VAC/60Hz/1PH**
- **230-460VAC/60Hz/3PH**
- **36"W x 41"H x 20"**
- **DIAPHRAGM, GEAR OR PROGRESSIVE CAVITY**
- **304 SS FRAME/ PVC**
- **POLYBLEND A, B, OR C**

Picture

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WaterSolve's PolyBlend WSLP-600USF and WSLP-2400USF Standard Operating Procedure 2006



1. OBJECTIVE

The objective of this Standard Operating Procedure (SOP) is to provide a detailed overview of start-up and shutdown of WaterSolve's PolyBlend WSLP-600USF and WSLP-2400USF units. These polymer make-down units were designed for field application of emulsion polymer(s) to sludges and liquid residuals as they are pumped to Geotube® containers and other dewatering applications. This SOP provides contractors and facility operators a synopsis of the setup, startup, and shutdown for this unit as well as packaging for pickup by LTL Freight Handlers.

2. PROCESS OVERVIEW

WaterSolve Emulsion Systems WSLP-600USF and WSLP-2400USF dilute emulsion or solution polymer to a pre-determined concentration. Adjustable system parameters allow the operator to make dependable solutions for polymer optimization (our recommended range is 0.1% to 1.0%).

The system was designed as a direct polymer solution feed to the application point system.

The system can be automated to a batch process with the addition of an application tank and tank level sensors.

OPERATION

The standard WSLP Series dilutes and mixes polymer solutions up to 40gpm. This can be a continuous or batch operation. A diaphragm pump meters emulsion or solution polymer. The polymer is injected through a self-cleaning check valve into a polyblend mixing chamber for initial mixing. Final solution mixing takes place with an in-line static mixer. The resulting solution is discharged to the application point or to an application tank (Automated Series) to await distribution.

3. SAFETY

These instructions contain general information, which should be observed by any operator that is responsible for this equipment. The entire manual should be read and understood before operating the unit.

- This is a general guidance for safety precaution and will not supersede any local or national safety regulations. Best available safety practices should always be used.
- The end user must ensure that all maintenance, inspection, and installation work is carried out by authorized and qualified personnel.
- All electrical sources to the equipment must be "tagged" and "locked out" prior to work performed.
- All mechanical devices need to be at "zero potential energy" before commencing work. The unit could start automatically if not properly shutdown.
- All safety and protection devices (e.g. coupling guards) must be replaced once repairs are completed.
- Warranty is void if modifications are made and not agreed upon prior to and between the buyer and seller. Use of this equipment that differs from the design specification (or products) will revoke any and all liability from the seller.
- Only the recommended spare parts should be used for repairs or replacement.
- Check with the seller or manufacturer before any chemical, other than the one designed for, is used.

4. INSTALLATION

Place the polymer preparation unit in a well-lit area that is:

- **Clean and dry**
- **Temperature controlled, if possible**
- **On a firm foundation, free from vibration**
- **Anchored to a firm foundation if a permanent installation**
- **Away from high traffic areas**
- **Not underneath a walkway or other contaminating situations**
- **Close as possible to the polymer supply tank or room provided to place polymer containers**
- **Close proximity to the polymer application tank.**

5. UTILITY CONNECTIONS:

5.1 Water Supply

Use 1" FPT fitting for clean particulate-free water. Supply must be 30-60 GPM of uninterrupted flow at less than 100 PSI. The water must be a continuous, steady supply. There should not be other equipment or wash down hoses connected to this supply. A lack of consistent supply will shut the system down (Figure 5.1).

5.2 Solution Output

Discharge connection: 1 1/2" FPT fitting. The discharge lines should be at least 1" I.D. and should be supported appropriately to prevent undue stress (Figure 5.1).

5.3 Electrical

The WSLP Series preparation units operate with 120/1/60, 10 Amps.

5.4 Polymer Supply

For optimum performance, the polymer-metering pump should always have a flooded suction. Connect to the 1/2" female hose fitting with hard pipe or reinforced hose (Figure 5.1).

- Level sensors, if supplied, should be installed according to the original manufacturers' instructions. Reference the electrical schematics for the proper wiring terminals.
- WaterSolve strongly recommends the skid framework be grounded securely to prevent any damage or hazards.
- All local and national electrical codes should be followed for safety and accident prevention.



Figure 5.1. WSLP-2400USF.

6. INITIAL SYSTEM STARTUP:

- Verify all wiring connections are tight and secure.
- Verify all pipe/hose fittings are tight and secure.
- If practical, position and secure solution discharge hose into an injection port or drain until all calibrations are made.
- Verify all water supply valves are open fully.
- Energize power circuit that feeds unit.
- Turn the system "on-off-remote" switch to the "on" position (Figure 6.1). Solenoid opens and water flow is established.
- Verify water flow.
- Adjust the system's water regulating valve (orange globe valve) until the desired GPM flow rate is achieved. Optimal flow is 20 gpm on primary mixing chamber flow meter. The other globe valve can be adjusted for post-dilution.
- "Open" main polymer supply valves.
- Switch LMI pump to external mode at pump face.
- Prime polymer pump, using priming kit provided with unit. Please contact a WaterSolve representative for priming instructions. For optimum pump performance, flooded suction is recommended.
- Turn pump power hand switch (located in back of unit) to "on" position. The polymer pump electronic controller (REM-1D) should be on and adjusted to 0%.
- After water flow is established, mixing chamber motor starts. Use air bleed valve to purge any air trapped in the mixing chamber.
- Adjust the polymer pump electronic controller (REM-1D) to "50%".
- Verify that product "enters" the pump and mixing chamber.
- Adjust the REM-1D to 0%.
- Increase or decrease the polymer pump speed with REM-1D touch pad to achieve the desired % polymer concentration. (Output can also be adjusted at pump face by varying the stroke length.) Repeat above steps as necessary.

CAUTION: DO NOT OPERATE POLYMER PUMP WITHOUT PRODUCT. DO NOT RUN UNIT UNLESS WATER FLOW IS ESTABLISHED. POLYMER ALONE CAN PLUG DISCHARGE PLUMBING.



Figure 6.1. WSLP-2400USF startup.

7. CALCULATIONS:

Unit output is determined by setting pump stroke length and stroke frequency together with setting dilution water flow. Establish desired solution volume and solution concentration, then proceed.

EXAMPLE:

100 GPH (380 LPH) of 0.5% polymer solution desired.

A 2 GPH (7.6 LPH) diaphragm pump is used.

Neat Polymer Requirement:

$(100 \text{ GPH}) \times (0.005) = 0.5 \text{ GPH neat polymer}$

Determine Pump Usage:

$(0.5 \text{ GPH}) / (2 \text{ GPH}) = 25\% \text{ pump capacity}$

Set Controls:

A 2 GPH pump @ 100% stroke length and 25 strokes per minute will deliver 0.5 GPH. However, 2 GPH pump @ 50% stroke length and 50 strokes per minute will also deliver 0.5 GPH with a more homogenous mix.

NOTE: Do not exceed polymer concentrations of 1% in the PolyBlend!!!

8. SYSTEM SHUTDOWN & MAINTENANCE

IF OUT OF SERVICE FOR LESS THAN ONE WEEK:

1. Turn off sludge pump.
2. Adjust REM-1D to 0%. Shut off polymer feed with ball cock. Allow water to run through make-down unit, polyblend, injection port(s), and discharge line for 10 minutes.
3. Turn off pump power hand switch on back of unit.
4. Close polymer solution injection port.
5. Turn off make-down unit and close primary water flow valve. Disconnect power and water from unit if not using for a week or more.

IF OUT OF SERVICE FOR MORE THAN TWO WEEKS OR RETURNING TO WATERSOLVE:

1. Turn off sludge pump.
2. Adjust REM-1D to 0%. Shut off polymer feed with ball cock. Disconnect polymer feed line and connect to quart of mineral oil (vegetable or corn oil). Turn REM-1D to 25% and allow oil to flow through polymer pump, mixing chamber, and discharge line. **DO NOT USE WATER TO CLEAN POLYMER PUMP!!**
3. Set REM-1D to 0%.
4. Allow water to run through make-down unit, injection port(s), and discharge line for 10 minutes.
5. Turn off pump power hand switch on back of unit.

6. Close polymer solution injection port.
7. Turn off make-down unit and close primary water flow valve. Disconnect power and water from unit if not using for a week or more.
8. Drain water from mixing chamber (valve under unit), flow chambers, and piping.

PACKAGING:

1. Place make down unit on pallet and secure with 1" x 2" across the unit base with 6 screws provided.
2. Place cardboard walls over unit, inside pallet base.
3. Put lid over the unit and secure entire crate with strapping and clips provided as per directions below.

Strapping

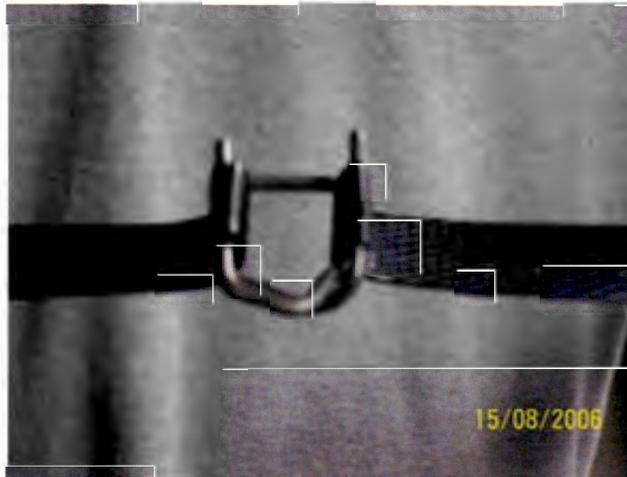
Strapping A. Fold over 12" of strapping material on itself. With the open ends of the clip up, push the folded strapping up through the center of the clip.



Strapping B. While holding the folded strapping under the clip, slide the strapping loop over the clip end.



Strapping C. Repeat for other side. To pull strapping tight, place a knee on the strapping, and pull end until taunt.



9. TROUBLESHOOTING

Symptom	Possible Cause	Corrective Action
No Water Flow	<ul style="list-style-type: none"> • Closed Valve on Water Supply • Blocked Solenoid Valve • Closed or clogged discharge line • Rate Control Valve Closed 	<ul style="list-style-type: none"> • Make sure valve is open • Dis-assemble and clean valve • Remove any blockages or open any closed valves • Make sure valve is open
Pump won't pump Chemical	<ul style="list-style-type: none"> • Pump is turned OFF • No Water Flow • Blocked Pump Discharge Line • Back Pressure is too high • Not enough water flow 	<ul style="list-style-type: none"> • Make sure pump is in ON position • Make sure all water valves (supply and discharge) are open • Take discharge line apart, check for blockage and clean if necessary • Reduce Back pressure on unit • Increase water flow or adjust water monitoring device (flow switch, DP switch, etc.) setpoint lower than the desired flow rate
Clogged Injection Check Valve	<ul style="list-style-type: none"> • Debris or Clumps in Polymer • Valve is stuck open allowing water into polymer line 	<ul style="list-style-type: none"> • Check polymer supply for contamination • Remove valve from chamber and clean it
Pump won't stop	<ul style="list-style-type: none"> • Water flow is still established • Pump is in internal mode 	<ul style="list-style-type: none"> • Shut off water valve or power to the unit • Switch pump to external

Attachment D-6
Tsurumi 80SFQ23.7

BEST AVAILABLE COPY



17240534/B-10040-7

BQ Submersible Stainless-Steel Channel Impeller Pump

CQ Submersible Stainless-Steel Cutter Pump

SFQ Submersible Stainless-Steel Centrifugal Pump

OPERATION MANUAL

INTRODUCTION

Thank you for selecting the Tsurumi BQ Submersible Stainless-Steel Channel Impeller Pump, CQ Submersible Stainless-Steel Cutter Pump, or SFQ Submersible Stainless-Steel Centrifugal Pump for your application.

This equipment should not be used for applications other than those listed in this manual. Failure to observe this precaution may lead to a malfunction or an accident. In the event of a malfunction or an accident, the manufacturer will not assume any liability. After reading this Operation Manual, keep it in a location that is easily accessible, so that it can be referred to whenever information is needed while operating the equipment.

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TSURUMI MANUFACTURING CO., LTD.

1 BE SURE TO READ FOR YOUR SAFETY

Be sure to thoroughly read and understand the SAFETY PRECAUTIONS given in this section before using the equipment in order to operate the equipment correctly.

The precautionary measures described in this section are intended to prevent danger or damage to you or to others. The contents of this manual that could possibly be performed improperly are classified into two categories: **⚠ WARNING**, and **⚠ CAUTION**. The categories indicate the extent of possible damage or the urgency of the precaution. Note however, that what is included under **⚠ CAUTION** may at times lead to a more serious problem. In either case, the categories pertain to safety-related items, and as such, must be observed carefully.

- **⚠ WARNING** : Operating the equipment improperly by failing to observe this precaution may possibly lead to death or injury to humans.
- **⚠ CAUTION** : Operating the equipment improperly by failing to observe this precaution may possibly cause injury to humans and other physical damage.
- **NOTE** : Gives information that does not fall in the WARNING or CAUTION categories.

● Explanation of Symbols:

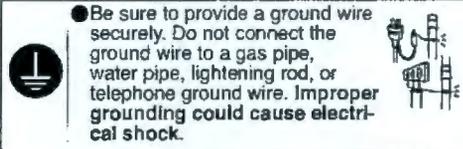
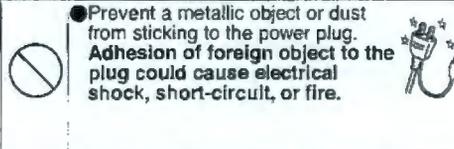
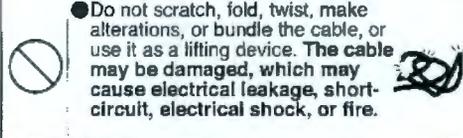
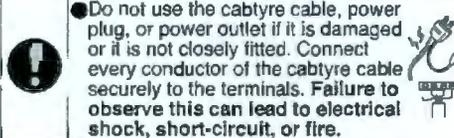
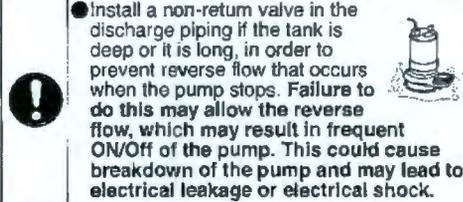
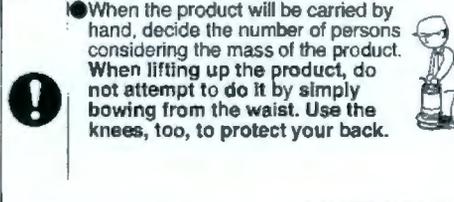
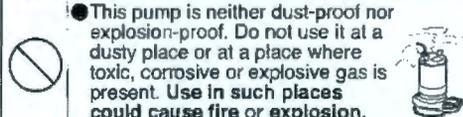
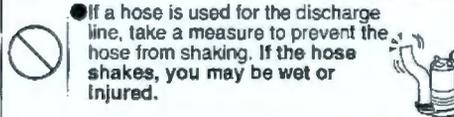
- ⚠ : The ⚠ mark indicates a WARNING or CAUTION item. The symbol inside the mark describes the precaution in more detail ("electrical shock", in the case of the example on the left).
- ⊘ : The ⊘ mark indicates a prohibited action. The symbol inside the mark, or a notation in the vicinity of the mark describes the precaution in more detail ("disassembly prohibited", in the case of the example on the left).
- ⬇ : The ⬇ mark indicates an action that must be taken, or instructs how to perform a task. The symbol inside the mark describes the precaution in more detail ("provide ground work", in the case of the example on the left).

PRECAUTIONS TO THE PRODUCT SPECIFICATIONS

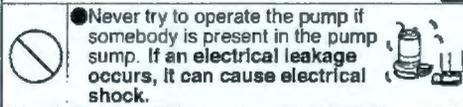
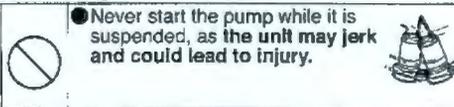
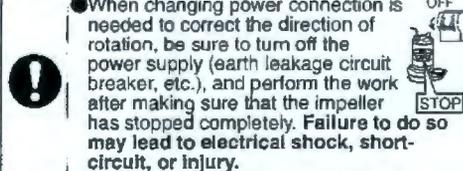
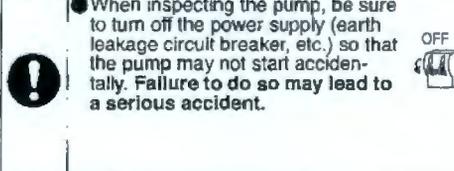
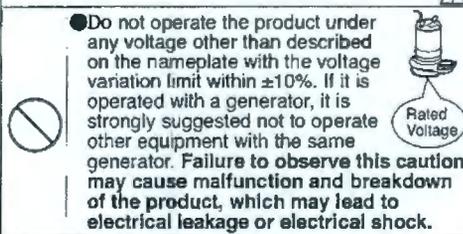
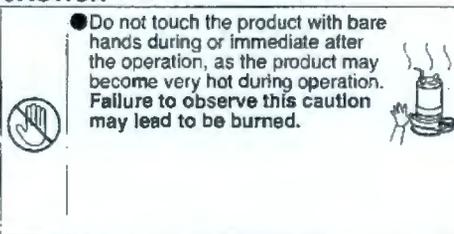
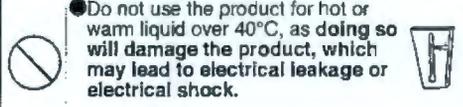
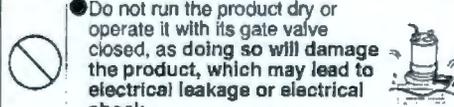
⚠ CAUTION	
	<ul style="list-style-type: none"> ● Do not operate the product under any conditions other than those for which it is specified. Failure to observe the precaution can lead to electrical leakage, electrical shock, fire, water overflow or other problems.

PRECAUTIONS DURING TRANSPORT AND INSTALLTION

⚠ WARNING	
<ul style="list-style-type: none"> ● Use an appropriate lifting equipment to lift the unit. Improper lifting may result in the fall of the product which could cause damage of the product or human injury. 	<ul style="list-style-type: none"> ● Install the product properly in accordance with this instruction manual. Improper installation may result in electrical leakage, electrical shock, fire, water leakage, or injury.
<ul style="list-style-type: none"> ● Electrical wiring should be performed in accordance with all applicable regulations in your country. Imperfect wiring or neglecting the installation of proper equipment will cause electrical leakage or fire. 	<ul style="list-style-type: none"> ● Provide a secure grounding dedicated for the product. Never fail to provide an earth leakage circuit breaker and a thermal overload relay in your starter or control panel (Both available on the market). If an electrical leakage occurs by due to a product failure, it may cause electrical shock.
<ul style="list-style-type: none"> ● Use a power outlet that has a sufficient rating and has been exclusively provided for the pump. If the power outlet is shared with other equipment, it can lead to an abnormal heat of the outlet and can cause fire as a result. 	

⚠ CAUTION	
<p>● Be sure to provide a ground wire securely. Do not connect the ground wire to a gas pipe, water pipe, lightning rod, or telephone ground wire. Improper grounding could cause electrical shock.</p> 	<p>● Prevent a metallic object or dust from sticking to the power plug. Adhesion of foreign object to the plug could cause electrical shock, short-circuit, or fire.</p> 
<p>● Do not scratch, fold, twist, make alterations, or bundle the cable, or use it as a lifting device. The cable may be damaged, which may cause electrical leakage, short-circuit, electrical shock, or fire.</p> 	<p>● Do not use the cable, power plug, or power outlet if it is damaged or it is not closely fitted. Connect every conductor of the cable securely to the terminals. Failure to observe this can lead to electrical shock, short-circuit, or fire.</p> 
<p>● Install a non-return valve in the discharge piping if the tank is deep or it is long, in order to prevent reverse flow that occurs when the pump stops. Failure to do this may allow the reverse flow, which may result in frequent ON/Off of the pump. This could cause breakdown of the pump and may lead to electrical leakage or electrical shock.</p> 	<p>● When the product will be carried by hand, decide the number of persons considering the mass of the product. When lifting up the product, do not attempt to do it by simply bowing from the waist. Use the knees, too, to protect your back.</p> 
<p>● This pump is neither dust-proof nor explosion-proof. Do not use it at a dusty place or at a place where toxic, corrosive or explosive gas is present. Use in such places could cause fire or explosion.</p> 	<p>● If a hose is used for the discharge line, take a measure to prevent the hose from shaking. If the hose shakes, you may be wet or injured.</p> 

▶ PRECAUTIONS DURING TEST OPERATION AND OPERATION

⚠ WARNING	
<p>● Never try to operate the pump if somebody is present in the pump sump. If an electrical leakage occurs, it can cause electrical shock.</p> 	<p>● Never start the pump while it is suspended, as the unit may jerk and could lead to injury.</p> 
<p>● When changing power connection is needed to correct the direction of rotation, be sure to turn off the power supply (earth leakage circuit breaker, etc.), and perform the work after making sure that the impeller has stopped completely. Failure to do so may lead to electrical shock, short-circuit, or injury.</p> 	<p>● When inspecting the pump, be sure to turn off the power supply (earth leakage circuit breaker, etc.) so that the pump may not start accidentally. Failure to do so may lead to a serious accident.</p> 
⚠ CAUTION	
<p>● Do not operate the product under any voltage other than described on the nameplate with the voltage variation limit within $\pm 10\%$. If it is operated with a generator, it is strongly suggested not to operate other equipment with the same generator. Failure to observe this caution may cause malfunction and breakdown of the product, which may lead to electrical leakage or electrical shock.</p> 	<p>● Do not touch the product with bare hands during or immediate after the operation, as the product may become very hot during operation. Failure to observe this caution may lead to be burned.</p> 
<p>● Do not use the product for hot or warm liquid over 40°C, as doing so will damage the product, which may lead to electrical leakage or electrical shock.</p> 	<p>● Do not run the product dry or operate it with its gate valve closed, as doing so will damage the product, which may lead to electrical leakage or electrical shock.</p> 

⚠ CAUTION	
<p>● Do not allow foreign object (pin, wire, etc.) to enter the suction inlet of the pump. Failure to observe this caution could cause it to malfunction or to operate abnormally, which may lead to electrical leakage or electrical shock.</p> 	<p>● When the product will not be used for an extended period, be sure to turn off the power supply (earth leakage circuit breaker, etc.). Deterioration of the insulation may lead to electrical leakage, electrical shock, or fire.</p> 

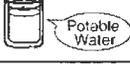
PRECAUTIONS DURING MAINTENANCE AND INSPECTION

⚠ WARNING	
<p>● Absolutely turn off the power supply or disconnect the plug before starting maintenance or inspection. Do not work with wet hands. Failure to observe these cautions may lead to electrical shock or injury.</p> 	<p>● Do not disassemble or repair any parts other than those designated in the operation manual. If repairs are necessary in any other than the designated parts, consult with the dealer where it was purchased or Tsurumi representative. Improper repairs can result in electrical leakage, electrical shock, fire, or water leakage.</p> 
<p>● In case any abnormality (excessive vibration, unusual noise or odor) is found in the operation, turn the power off immediately and consult with the dealer where it was purchased or Tsurumi representative. Continuing to operate the product under abnormal conditions may result in electrical shock, fire, or water leakage.</p> 	<p>● After reassembly, always perform a test operation before resuming use of the product. Improper assembly can result in electrical leakage, electrical shock, fire, or water leakage.</p> 

PRECAUTION TO POWER OUTAGE

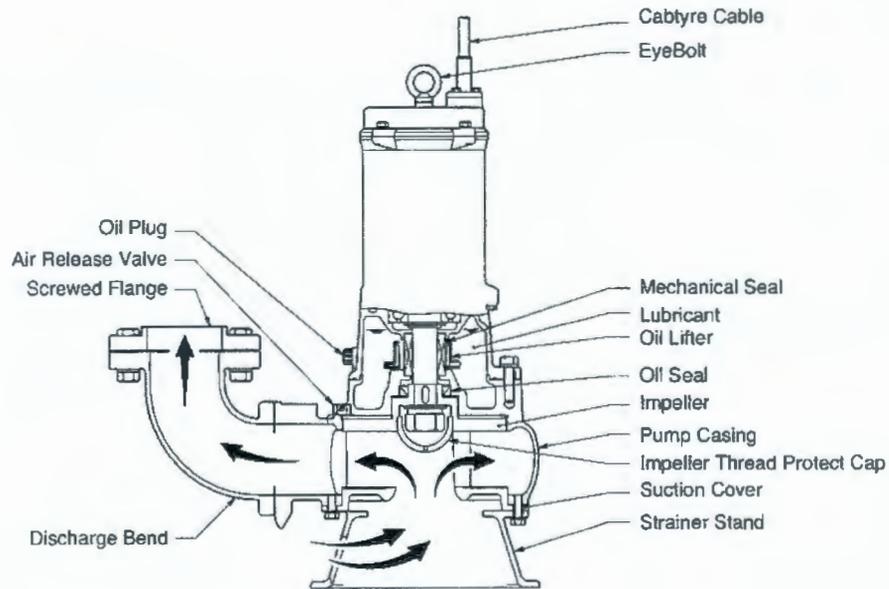
⚠ WARNING	
<p>● In case of power outage, turn off the power supply. The product will resume operation when the power is restored, which presents serious danger to people in the vicinity.</p>	

OTHER PRECAUTION

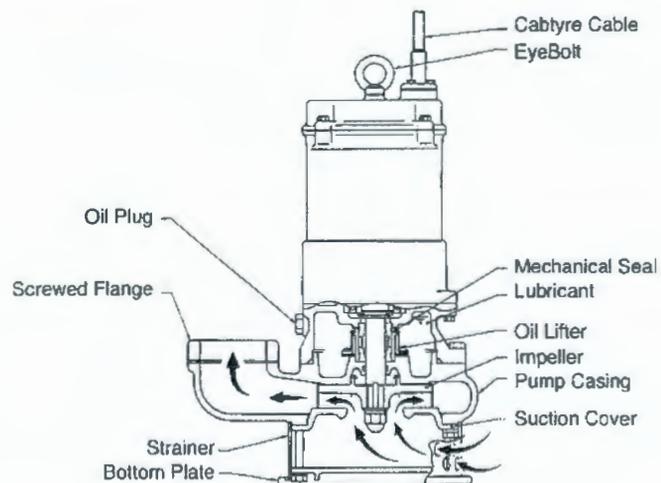
⚠ CAUTION	
<p>● Never use the product for potable water. It may present a danger to human health.</p>	

2 PART NAMES

■ Example: BQ Series



■ Example: SFQ Series



3 PRIOR TO OPERATION

After unpacking, verify the contents.

Product Inspection

Inspect the product for damage during shipment, and make sure all bolts and nuts are tightened properly.

Specification Check

Check the nameplate of the unit to verify that it is the product that you have ordered. Pay particular attention to its voltage and frequency specifications.

Accessory Check

Verify that all accessory items are included in the package.
Operation Manual 1

Note: *If you discover any damage or discrepancy in the product, please contact the dealer where this equipment was purchased or the Tsurumi sales office in your area.*

Product Specifications

CAUTION Do not operate this product under any conditions other than those that have been specified.

Major Standard Specifications

Applicable Liquids	Consistency and Temperature	BQ ,CQ Series: Waste water, sewage, and liquid carrying waste and solid matters and Chemical Waste water ; 0 ~ 40°C SFQ Series: Chemical Waste water ; 0 ~ 40°C
Pump	Impeller	BQ Series: Channel type CQ Series: Channel type (with Cutter Mechanism) SFQ Series: Semi-open type
	Shaft Seal	Double Mechanical Seal
	Bearing	Sealed Ball Bearing
Motor	Specifications	Dry Submersible Induction Motor, 2-Pole, 4-Pole
	Insulation	Class E and F
	Protection System (built-in)	Circle thermal protector (7.5kW max.) Miniature protector (11kW)
	Lubricant	Turbine oil VG32 (non-additive)
Connection		BQ ,CQ Series: Special screwed flange (1.5kW max.) JIS10K flange (above 2.2kW minimum and guide-rail type) SFQ Series: Special screwed flange (3.7kW max.) JIS10K flange (above 5.5kW minimum and guide-rail type)

4 INSTALLATION

- CAUTION**
- Use with a power supply voltage variation within $\pm 10\%$ of the rated voltage.
 - The water temperature for operating the pump should be between $0 \sim 40^{\circ}\text{C}$. Failure to observe the precautions given above could cause the pump to malfunction, which may lead to current leakage or electrical shock.

Note: To use the pump for a special solution, contact the dealer where it was purchased, or the Tsurumi sales office in your area.

■ Critical Use Pressure

- CAUTION** Do not operate the pump in an area that is exposed to a water pressure that exceeds the values given below.

BQ ,CQ Series

Applicable Pump	Critical Use Pressure
Models with output of 0.4kW	0.2MPa (2kgf/cm ²) - discharge pressure during use
Models with output of 0.75kW - 3.7kW	0.3MPa (3kgf/cm ²) - discharge pressure during use

SFQ Series

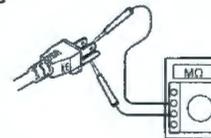
Applicable Pump	Critical Use Pressure
Models with output of 0.75kW or under	0.2MPa (2kgf/cm ²) - discharge pressure during use
Models with output between 1.5kW - 3.7kW	0.3MPa (3kgf/cm ²) - discharge pressure during use
Models with output of 5.5kW or above	0.3MPa (3kgf/cm ²)

■ Preparation for Installation

■ Single-phase power supply:

Use a megger to measure the resistance between the tip of the cabtyre cable plug and the ground terminal to verify the insulation resistance of the motor.
(This diagram shows a 2-pin plug type.)

Single-Phase

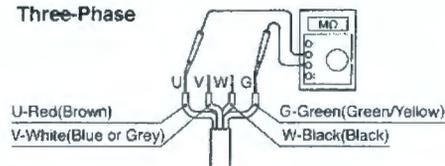


- CAUTION** Beware that the power plug varies by country or region.

■ Three-phase power supply:

Use a megger to measure the resistance between each core of the cabtyre cable and the (green) ground wire to verify the insulation resistance of the motor.

Three-Phase



Insulation resistance reference value
= 20M Ω minimum

Note: The insulation resistance reference value of 20M Ω minimum is based on a new or repaired pump. For reference values of a pump that has already been put into operation, refer to section "7. Maintenance and Inspection" of this manual.

Precautions During Installation

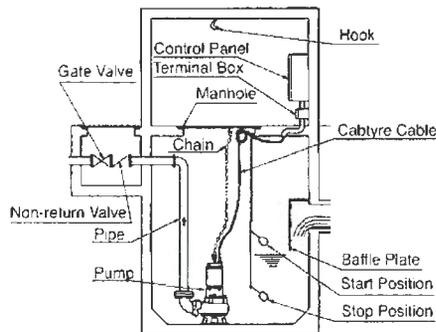
WARNING When installing the pump, be mindful of the pump's center of gravity and weight. If the pump is not suspended properly, the pump may fall and break, which may lead to injury.

CAUTION When installing or moving the pump, never suspend the pump by the cabtyre cable. Doing so will damage the cable, which may cause a current leakage, electrical shock, or fire.

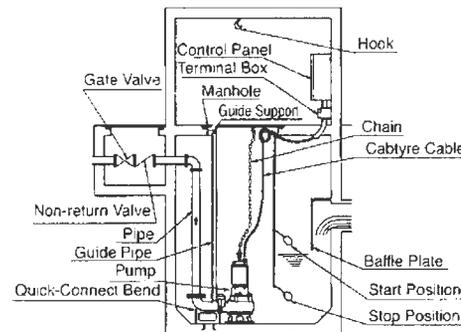
Refer to the installation examples illustrated below and pay attention to the points described below to install the pump.

CAUTION During piping work if the welding sparks, paint, or concrete come in contact with the pump, they could cause the pump to malfunction, which may lead to current leakage or electrical shock.

Free Standing Specification



Guide-Rail Specification



- (1) When transporting or installing the pump, do not kink the cabtyre cable or use it in place of a rope.
- (2) With the cabtyre cable lifted slightly, secure it to the hook (a hook must be prepared in advance by placing it on the frame of a manhole or the like).

CAUTION Do not operate the pump with the cabtyre cable dangling. Failure to observe this precaution may cause the cabtyre cable to become wrapped around the impeller, which could cut the cable, break the impeller, or cause flooding, which may lead to current leakage or electrical shock.

- (3) Install the pump on a horizontal and rigid surface such as concrete, in an area that is free from turbulence and does not cause the pump to take air in.
- (4) The area near the inlet of a water tank is susceptible to turbulence or allows the pump to take air in; therefore, place the pump and the float switch away from the inlet or install a baffle plate.
- (5) Properly perform piping work so as not to create any air pockets in the middle of piping.

CAUTION With automatic control, the sewage water in the pipe could flow backwards, causing the water surface control to react immediately. As a result, the pump will operate ON/OFF repeatedly, which could cause the pump to malfunction.

- (6) Install a non-return valve if the pump tank is deep, or if the vertical head or the lateral distance is long.

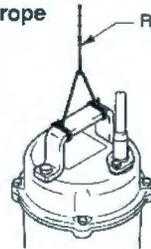
Attaching a Chain or Rope to Suspend the Pump

Refer to the illustration on the right in order to suspend the pump by a chain or rope.

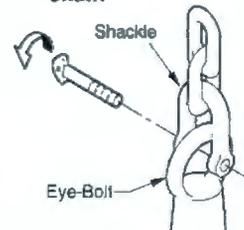
CAUTION Make sure that the rope does not become twisted during installation. Failure to observe this precaution could cause the chain to break and the pump to fall and break, which could lead to injury.

When you mount shackles, be also careful so that the eye-bolt (pin) may not get dislocated, by means of providing a stainless steel wire or tying band.

Suspending with a rope

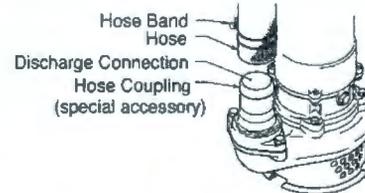


Suspending with a chain



Connecting a Hose

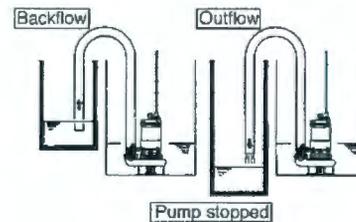
(1) When a hose is used, attach the hose to the hose coupling as far as it will go, then fasten it securely with a hose band.



(2) Operate the pump in a location that has a sufficient water level and collects water easily.

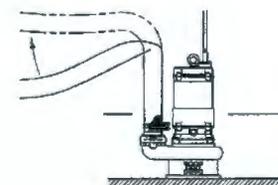
Note: For the water level required for operating the pump, refer to the external dimension drawing, which is provided separately.

Extend the end of the hose (discharge side) above the water surface. If the end of the hose is submerged in water, it may cause the water to flow back when the pump has been stopped. Conversely, if the end of the hose is located at a level that is lower than the source water surface, water may continue to flow out even after the pump has been stopped.



(3) Route the hose as straight as possible. Excessive bending of the hose could obstruct the flow of water, reduce the pumping volume, or clog the pump with mud, thus disabling the pumping function.

If the hose is kinked at its base, it will create air pockets in the pump, making the pump operate dry. To prevent this from occurring, straighten the bend while operating the pump.



CAUTION If the pump draws in a large amount of mud, it could cause the pump to wear prematurely and lead to a malfunction, current leakage, and electrical shock.

(4) Operate the pump upright. If there is the likelihood of the pump drawing in excess mud, place a concrete block under the pump.

5 ELECTRICAL WIRING

Electrical Wiring Work

- ⚠ WARNING**
- All electrical work must be performed by an authorized electrician, in compliance with local electrical equipment standards and internal wiring codes. Never allow an unauthorized person to perform electrical work because it is not only against the law, but it can also be extremely dangerous.
 - Improper wiring can lead to current leakage, electrical shock, or fire.
 - Absolutely provide a dedicated earth leakage circuit breaker and a thermal overload relay suitable for the pump (available on the market). Failure to follow this warning can cause electrical shock or explosion when the product fails or an electrical leakage occurs.

Operate well within the capacity of the power supply and wiring.

Grounding

- ⚠ WARNING** Be sure to install the ground wire securely. Failure to observe this precaution could damage the pump and cause current leakage, which may lead to electrical shock.

- ⚠ CAUTION** Do not connect the ground wire to a gas pipe, water pipe, lightning rod, or telephone ground wire. Improper grounding could cause electrical shock.

Connecting the Power Plug

- ⚠ WARNING** Before inserting the power plug or connecting the wires to the terminal board, make sure that the power supply (i.e. circuit breaker) is properly disconnected. Failure to do so may lead to electrical shock, short, or injury caused by the unintended starting of the pump.

- ⚠ CAUTION** Do not use damaged cable, power plugs, or loose power outlets. Failure to observe this precaution could lead to electrical shock, short circuit, or fire.

- ⚠ CAUTION** Route the control cable (S) away from the power cable as much as possible. Wiring them together will cause the pump to operate improperly.

Follow the diagram on the right to connect the power.

When using a three-prong grounded plug, connect as shown in the drawing.

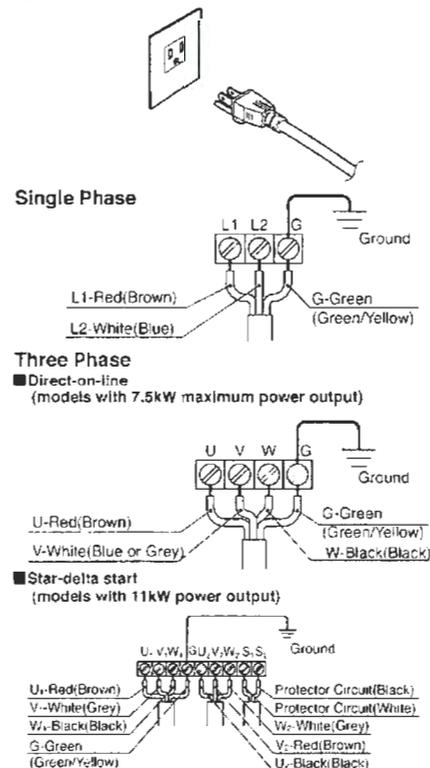
- ⚠ CAUTION** Be sure to use a dedicated power supply with a ground leakage circuit breaker.

(This diagram shows a 2-pin plug type.)

- ⚠ CAUTION** Beware that the power plug varies by country or region.

Note: *the shape of the plug may differ from that shown in the illustration.*

When a three-phase power source is used, connect the leads to the control panel terminals as shown in the diagram, making sure they do not become twisted together.



Motor Protector

The pump is equipped with an internal motor protector.

1. Circle Thermal Protector:

If a current overload or overheating occurs under the symptoms given below, the pump will stop automatically to protect the motor regardless of the water level at the time of operation. Because the motor protector is designed to cancel itself automatically if it trips to stop the pump, remove the cable from the terminal board and make sure to eliminate the cause of the problem, such as the following:

- Extreme fluctuation of power supply voltage
- Pump operated under overload condition
- Pump operated at open phase or binding condition

2. Miniature Protector

Embedded in the winding of the motor, the miniature protector's bimetal trips if the motor winding overheats for any reason. Upon receiving this signal, the current to the motor can be cut off through the use of an external starting panel or installing a dedicated electrical circuit in the control panel. When the motor's temperature decreases, the bimetal reverts automatically, but the restarting must be effected at the external starting panel or the control panel.

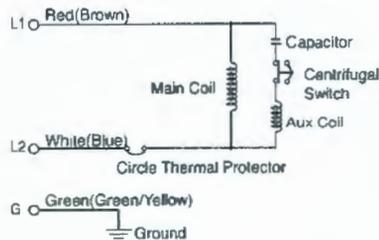
Note: *Tsurumi's miniature protector adopts a "normally closed" contact system in which the circuit opens when the protector trips (the circuit remains closed when normal). Also, make sure to install an external starting panel or a motor breaker or thermal relay in the control panel to protect the motor from overload. The motor can be protected from overload, open phase, or reverse phase condition by installing a 3E relay.*

Note: *Make sure to eliminate the cause of the problem if the motor protector has tripped. Do not operate the pump at unusually low head, or with the impeller clogged with debris. Doing so will not only prevent the pump from attaining its full potential, but may also generate abnormal noise and vibration and damage the pump.*

Electrical Circuit Diagrams

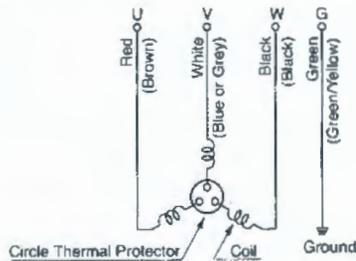
Capacitor Start (Output 0.4kW)

Power Supply: Single-Phase



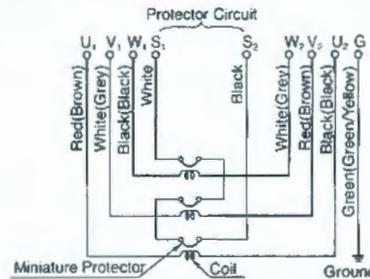
Direct-on-line (models with 7.5kW maximum power output)

Power Supply: Three-Phase



Star-delta start (models with 11kW minimum power output)

Power Supply: Three-Phase



6 OPERATION

Prior to Operation

- (1) Once again, check the nameplate of the pump to verify that its voltage and frequency are correct.

CAUTION Improper voltage and frequency of the power supply will prevent the pump from attaining its full potential, and may also damage the pump.

Note: Verify the specs on the pump's nameplate.

- (2) Check the wiring, power supply voltage, the capacity of the ground leakage circuit breaker, and the insulation resistance of the motor.

■ Insulation resistance reference value = 20MΩ minimum

Note: The insulation resistance reference value of 20MΩ minimum is based on a new or repaired pump. For reference values of a pump that has already been put into operation, refer to section "7. Maintenance and Inspection".

- (3) Adjust the setting of the thermal relay (i.e. 3E relay) to the pump's rated current.

Note: Verify the rated current on the pump's nameplate.

Trial Operation

WARNING Never start the pump while it is suspended, as the pump may jerk and cause a serious accident involving injury.

- (1) Operate the pump for a short time (1 to 2 seconds) and verify the direction of the rotation of the impeller. Observe the pump unit from above, and if its recoil is in the counterclockwise direction, the direction of its rotation is correct.

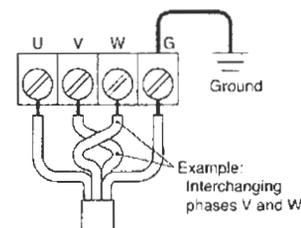
CAUTION Make sure to check the pump's direction of rotation with the pump exposed to the atmosphere. Operating the pump in reverse while it is submerged in water will damage the pump, which may lead to current leakage and electrical shock.

- (2) To reverse the rotation, the following countermeasures must be taken.

WARNING Before changing the connections for reverse rotation, make sure that the power supply (i.e. circuit breaker) is properly disconnected and that the impeller has stopped completely. Failure to observe this may lead to electrical shock, short, or injury.

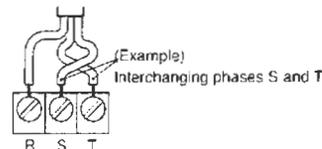
COUNTERMEASURE

Direct-on-line starting
Interchange any two of the three wires designated U, V, and W, respectively.



COUNTERMEASURE

Star Delta starting
Interchange any two of the three phases designated R, S, and T, respectively.

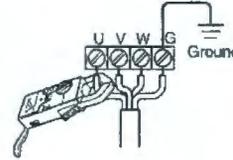


Note: This method cannot be used if the starting panel is equipped with a reverse-phase detector such as a 3E relay. If this is the case, contact the manufacturer of the starting panel, the dealer where the pump was purchased, or the Tsurumi sales office in your area.

(3) Connect the pump to the pipe and submerge it in water.

(4) Operate the pump for a short time (3 to 10 minutes) and perform the following checks:

Using an AC ammeter (clamp), measure the operating current at the phases U, V, and W that are connected to the terminal board.

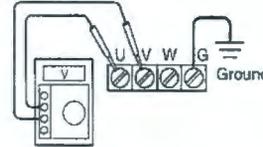


COUNTERMEASURE

Because an overload condition may be present at the pump motor if the operating current exceeds the rated current, follow the instructions in section "4. Installation" to operate the pump in the correct manner.

Using an AC voltmeter (tester), measure the voltage at the terminal board.

■ Power supply voltage variation = within $\pm 10\%$ of the rated voltage



COUNTERMEASURE

If the power supply voltage deviates from the variation value, the cause of the deviation may be the capacity of the power supply or the extension cable that is used. Refer to section "5. Electrical Wiring" to operate the pump in the correct manner.

CAUTION In case the pump exhibits an abnormal condition (such as a considerable amount of vibration, noise, or smell), disconnect the power supply immediately and contact the dealer where you purchased the equipment, or Tsurumi's sales office in your area. If the pump continues to be used in the abnormal state, it may cause current leakage, electrical shock, or fire.

(5) Proceed with the normal operation if no abnormal conditions are found during the trial operation.

Operation

WARNING The pump unit may be extremely hot during operation. To prevent burns, do not touch the pump unit with bare hands during or after the operation.

Pay attention to the water level during the pump operation. The pump will become damaged if it is allowed to operate dry.

Due to an overload operation or a pump malfunction, if the motor protector trips to stop the pump, make sure to eliminate the cause of the problem before restarting.

To operate a submersible pump (including automatic operation), set the water level so that the pump will operate at approximately the following rate: less than 10 times per hour on models with output of 0.75kW or less, 5-6 times per hour on models with output of 1.5kW-3.7kW, and 3-4 times per hour on models with output of 5.5kW or more.

Note: A large amount of amperage flows when a submersible pump is started, causing the temperature of its windings to rise rapidly. Beware that a frequent stop-and-go operation of the pump will accelerate the deterioration of the insulation of the motor windings and thus affect the use life of the motor.

Automatic Operation

To operate the pump in the automatic mode, a control panel is necessary for turning the pump ON/OFF by detecting the water level. The standard Tsurumi control panels include the Z type. The water level sensors that are normally used are the float switches (RF and MF types) or the level sensor (MC type); however, an electrode type may also be used.

Note: Consult the operation manual provided with each equipment for its proper use.

Operating Water Level

CAUTION Do not operate the pump at the lowest water level longer than 30 minutes, as it could damage the pump, causing current leakage and electrical shock. For details on the lowest water level, refer to the dimension drawing, which is provided separately.

7 MAINTENANCE AND INSPECTION

Regular maintenance and inspection are indispensable to maintaining the pump's performance. If the pump behaves differently from its normal operating condition, refer to section "9. Troubleshooting" and take appropriate measures at an early stage. We also recommend that you have a spare pump on hand for an emergency.

Prior to Inspection

⚠ WARNING Make sure that the power supply (i.e. circuit breaker) is disconnected and disconnect the cable from the power outlet or remove it from the terminal board. Failure to do so may cause electrical shock or unintended starting of the pump, which may lead to serious accidents.

(1) Washing the Pump

Remove any debris attached to the pump's outer surface, and wash the pump with tap water. Pay particular attention to the impeller area, and completely remove any debris from the impeller.

(2) Inspecting the Pump Exterior

Verify that there is no damage, and that the bolts and nuts have not loosened.

Note: If the pump must be disassembled for repair due to damage or loose bolts or nuts, contact the dealer where it was purchased, or the Tsurumi sales office in your area.

Daily and Periodic Inspection

Interval	Inspection Item
Daily	Measuring the operating current ■ To be within the rated current Measuring the power voltage ■ Power supply voltage variation = within ± 10% of the rated voltage
Monthly	Measuring the insulation resistance ■ Insulation resistance reference value = 1MΩ minimum [NOTE] The motor must be inspected if the insulation resistance is considerably lower than the last inspection.
Semi-yearly	Inspection of lifting chain or rope ■ Replace if damage, corrosion, or wear has occurred to the chain or rope. Remove if foreign object is attaching to it.
Yearly	Inspecting oil ■ 6,000 hours or 12 months, whichever comes first Changing oil ■ 9,000 hours or 24 months, whichever comes first
Once every 2 years	Changing the mechanical seal [NOTE] The inspection and replacement of the mechanical seal requires specialized equipment. To have this operation performed, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.
Once every 2 to 5 years	Overhaul ■ The pump must be overhauled even if the pump appears normal during operation. Especially, the pump may need to be overhauled earlier if it is used continuously. [NOTE] To overhaul the pump, contact the dealer where it was purchased, or the Tsurumi sales office in your area.

Note: Refer to section "Oil Inspection and Change Procedures" below for further detail.

Storage

If the pump will not be operated for a long period of time, pull the pump up, wash the pump, allow it to dry, and store it indoors.

Note: For reinstallation, be sure to perform a trial operation before putting the pump into operation.

If the pump remains immersed in water, operate it on a regular basis (i.e. once a week).

Oil Inspection and Changing Procedures

Inspecting Oil

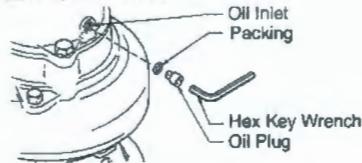
Remove the oil plug and take out a small amount of oil. The oil can be extracted easily by tilting the pump so that the oil filler plug faces downward. If the oil appears milky or intermixed with water, a likely cause is a defective shaft sealing device (i.e. mechanical seal), which requires that the pump be disassembled and repaired.

Changing Oil

Remove the oil plug and drain the oil completely. Pour a specified volume of oil into the oil filler inlet.

Note: The drained oil must be disposed of properly to prevent it from being released into the sewer or rivers. The packing or the O-ring for the oil plug must be replaced with a new part at each oil inspection and change.

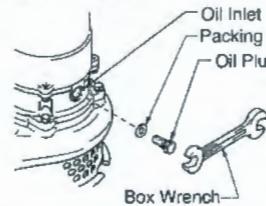
■ BQ,CQ Series



Specified Oil: Turbine Oil VG32 (non-additive)

Applicable Model	Specified Volume Unit : ml
Model with 0.4kW power output	180
Model with 0.75kW power output	770
Model with 1.5kW power output	900
Model with 2.2kW power output	1,650
Model with 3.7kW power output	1,850
Model with 3.7kW power output(High Head)	2,000

■ SFQ Series



Specified Oil: Turbine Oil VG32 (non-additive)

Applicable Model	Specified Volume Unit : ml
Model with 0.75kW maximum power output	125
Model with 1.5kW power output	900
Model with 3.7kW power output	850
Model with 5.5 ~ 7.5kW power output	2,250
Model with 11kW power output	2,250

8 DISASSEMBLY AND REASSEMBLY PROCEDURE

■ Prior to Disassembly and Reassembly



WARNING Before disassembling and reassembling the pump, be sure that the power supply (i.e. circuit breaker) is disconnected, and remove the cable from the outlet or the terminal board. Do not connect or disconnect the power plug with a wet hand, in order to prevent electrical shock. Do not perform an activation test (to check the rotation of the impeller) during disassembly and reassembly. Failure to observe this precaution could lead to a serious accident, including injury.

This section explains the disassembly and reassembly processes that are involved up to the replacement of the impeller itself. Operations involving the disassembly and reassembly of the sealing portion (i.e. mechanical seal) and of the motor require a specialized facility including vacuum and electrical test equipment. For these operations, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.

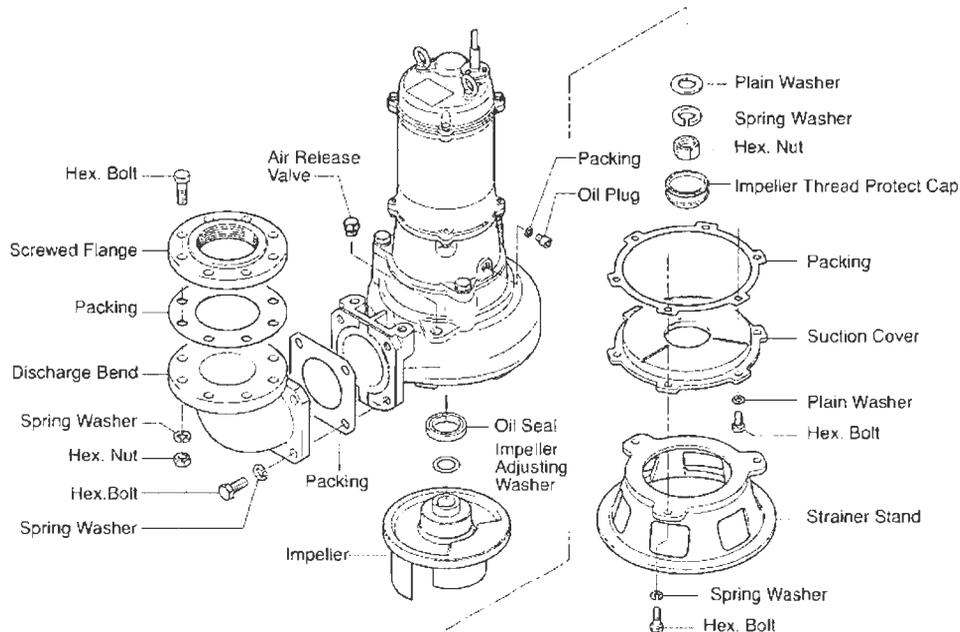
BQ, CQ Series

Disassembly Procedure

Note: Before disassembling, be sure to drain the oil from the pump.

- (1) Removing the strainer stand
Remove the hex bolts and spring washers ; then, remove the strainer stand from the pump.
- (2) Removing the suction cover
Remove the hex bolts and plain washer; then, remove the suction cover and the packing from the pump casing.
- (3) Removing the impeller
Remove the impeller protection cap. Using a box wrench, remove the impeller nut and spring washer and plain washer; then, remove the impeller and the impeller adjusting washer from the shaft.

Disassembly Diagram



Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.

Note: After completing the reassembly, make sure to fill the pump with the specified amount of oil. The packings must be replaced with a new part. If any part is worn or damaged, make sure to replace it with a new part.

After reinstalling the impeller or the suction cover, check that the impeller rotates smoothly and that there is no interference between the pump casing and the suction cover.

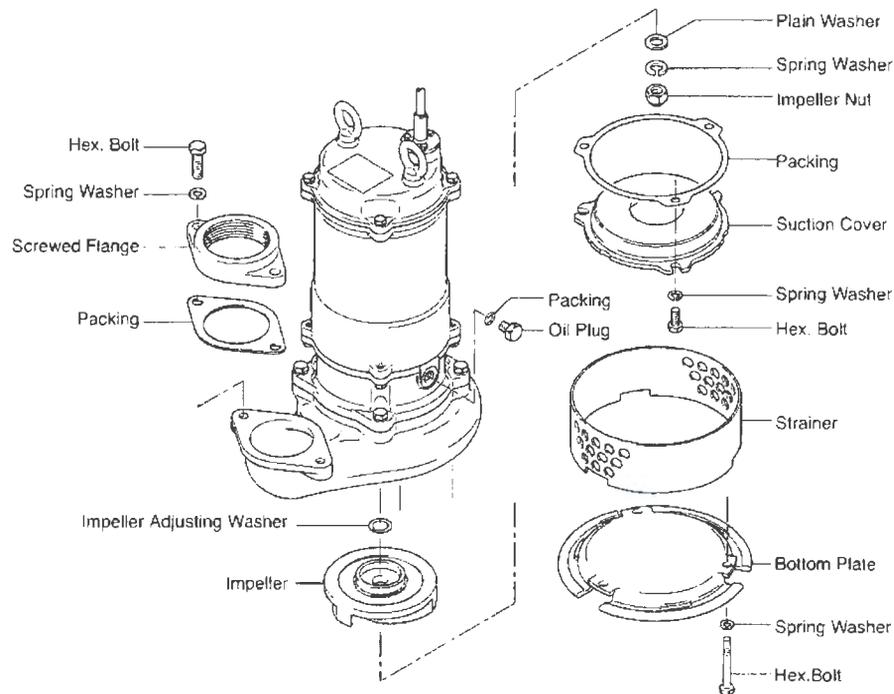
SFQ Series

Disassembly Procedure

Note: Before disassembling, be sure to drain the oil from the pump.

- (1) Removing the bottom plate and strainer
Remove the hex bolts and spring washers from under the bottom plate; then, remove the bottom plate and the suction cover from the pump.
- (2) Removing the suction cover
Remove the hex bolts; then, remove the suction cover and the packing from the pump casing.
- (3) Removing the impeller
Using a box wrench, remove the impeller nut and spring washer and plain washer; then, remove the impeller and the impeller adjusting washer from the shaft.

Disassembly Diagram



Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.

Note: After completing the reassembly, make sure to fill the pump with the specified amount of oil. The packings must be replaced with a new part. If any part is worn or damaged, make sure to replace it with a new part.

After reinstalling the impeller or the suction cover, check that the impeller rotates smoothly and that there is no interference between the pump casing and the suction cover.

9 TROUBLESHOOTING

⚠ WARNING To prevent serious accidents, disconnect the power supply before inspecting the pump.

Read this Operation Manual carefully before requesting repair. After re-inspecting the pump, if it does not operate normally, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.

Problem	Possible cause	Countermeasure
Pump fails to start; or, starts but stops immediately.	(1) No proper power is supplied (i.e. power outage). (2) Malfunction in automatic control (control panel). (3) Foreign matter is wedged in the propeller, causing the motor protector to trip. (4) Damaged motor. (5) Open circuit or poor connection of cable. (6) Voltage drop due to the extension of cable.	(1) Contact the electric power company or an electrical repair shop. (2) Have the cause investigated and repaired by a specialist. (3) Inspect the pump and remove the debris. (4) Repair or replace. (5) Replace or properly connect the cable. (6) Shorten the extension cable or replace it with one with a larger size.
Motor protector trips.	(1) Malfunction of motor (seizure or water damage). (2) A 50Hz unit is used at 60Hz. (3) Liquid temperature is too high. (4) Pump has been operating for a long time while being exposed to air. (5) Amperage overload.	(1) Repair or replace. (2) Check the nameplate and replace the pump or the impeller. (3) Lower the liquid temperature. (4) Stop the pump; then lower the water level. (5) Refer to the section on amperage overload.
Pump operates but does not pump water.	(1) An air lock occurred in the pump. (2) The pump or the piping is blocked. (3) The piping is partially blocked or the valve is operating improperly. (4) The motor rotates in reverse.	(1) Stop momentarily and then restart; or, clean the air release valve. (2) Remove the blockage. (3) Remove the blockage, or repair or replace the valve. (4) Change the power supply connection.
Low pumping volume.	(1) The impeller or the pump casing is significantly worn. (2) Excessive piping loss. (3) Operating water level is too low, allowing pump to draw in air. (4) A 60Hz pump is used at 50Hz. (5) There is a leak in the piping. (6) The piping or the pump is clogged with debris.	(1) Repair or replace the affected part. (2) Re-examine the work plan. (3) Raise the water level or lower the pump position. (4) Check the nameplate and replace the pump or the impeller. (5) Inspect and repair. (6) Remove the debris.
Amperage overload	(1) Excessive imbalance in the power supply voltage. (2) Excessive voltage drop. (3) Phase interruption. (4) A 50Hz pump is used at 60Hz. (5) Motor rotates in reverse. (6) Pump is clogged with debris. (7) Motor bearing is damaged.	(1) Contact the electric power company or an electrical repair shop. (2) Contact the electric power company or an electrical repair shop. (3) Inspect the connections and the magnetic switch. (4) Check the nameplate and replace the pump or the impeller. (5) Change the connection of the power wires. (6) Remove the debris. (7) Disassemble the motor and replace the bearing.

The following information is required when ordering repairs or making other inquiries.

Product model	
Manufacturing number	
Purchase date	
Remarks	

Disposal of Product

Properly dispose of the product by disassembling it, presorting the contents, and sending them to the waste material treatment site.

Attachment D-7

Wilden PX-1

P1/PX1 Submitted #77, Edition 1/1997

EOM

Original Series **METAL** Pumps

Simplify your process

UL

Ex

WILBEN

CE

Submittal #77, Section 15447

Specification

Supernatant Pump SWS-P-001

Pump Model Number: Wilden PX1/SSAAA/BNS/BN/SBN

FRL installation Kit: IKMA-LF

Pump shall be Wilden PX1 double diaphragm air pump or equal with 0.5" inlet and outlet connections, and capable of providing 10 gpm @ 85' TDH. Pump shall be provided in stainless steel and buna wetted construction. Pump will be lube free and be capable of adjusting the air volume of the pump inlet with a built in variable control dial. Pump will have an unbalanced spool to help ensure effective non-stalling operation.

Pump should include IKM filter regulator kit as supplied by Tencarva Machinery 865-588-7674



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Section 1



CAUTIONS—READ FIRST!



-  **CAUTION:** Do not apply compressed air to the exhaust port — pump will not function.
-  **CAUTION:** Do not over-lubricate air supply — excess lubrication will reduce pump performance. Pump is pre-lubed.
-  **CAUTION:** Do not under any circumstance loosen the set screw located at the adjuster dial of the Pro-Flo X™ pump. If the set screw is loose when the pump is pressurized, it could eject and cause injury to anyone in the area.
-  **TEMPERATURE LIMITS:**

Neoprene	-17.7°C to 93.3°C	0°F to 200°F
Buna-N	-12.2°C to 82.2°C	10°F to 180°F
EPDM	-51.1°C to 137.8°C	-60°F to 280°F
Viton®	-40°C to 176.7°C	-40°F to 350°F
Saniflex™	-28.9°C to 104.4°C	-20°F to 220°F
Polytetrafluoroethylene (PTFE)		
	4.4°C to 104.4°C	40°F to 220°F
Polyurethane	-12.2°C to 65.6°C	10°F to 150°F
Tetra-Flex™ PTFE w/Neoprene Backed		
	4.4°C to 107.2°C	40°F to 225°F
Tetra-Flex™ PTFE w/EPDM Backed		
	-10°C to 137°C	14°F to 280°F
- NOTE:** Not all materials are available for all models. Refer to Section 2 for material options for your pump.
- NOTE:** Canadian Standards Association (CSA) configured pumps should not be used in temperatures lower than 0.0°C to 51.6°C (32°F to 125°F).
- NOTE:** UL listed configured pumps have the following temperature limits:
UL 79 Buna- -12.2°C (10°F) to 52°C (125°F)
-  **CAUTION:** When choosing pump materials, be sure to check the temperature limits for all wetted components. Example: Viton® has a maximum limit of 176.7°C (350°F) but polypropylene has a maximum limit of only 79°C (175°F).
-  **CAUTION:** Maximum temperature limits are based upon mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperatures. Consult Chemical Resistance Guide (E4) for chemical compatibility and temperature limits.
-  **WARNING:** Prevention of static sparking — If static sparking occurs, fire or explosion could result. Pump, valves, and containers must be grounded to a proper grounding point when handling flammable fluids and whenever discharge of static electricity is a hazard.
-  **CAUTION:** Canadian Standards Association (CSA) configured pumps must be electrically grounded using the grounding location identified. Improper grounding can cause improper and dangerous operation.
-  **CAUTION:** Do not exceed 8.5 bar (125 psig) air supply pressure.
-  **CAUTION:** Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100 psig) sweet gas supply pressure.
-  **CAUTION:** For U.L. listed pumps, do not exceed 3.4 bar (50 psig) air supply pressure.
-  **CAUTION:** The process fluid and cleaning fluids must be chemically compatible with all wetted pump components. Consult Chemical Resistance Guide (E4).
-  **CAUTION:** Do not exceed 82°C (180°F) air inlet temperature for Pro-Flo X™ models.
-  **CAUTION:** Pumps should be thoroughly flushed before installing into process lines. FDA and USDA approved pumps should be cleaned and/or sanitized before being used.
-  **CAUTION:** Always wear safety glasses when operating pump. If diaphragm rupture occurs, material being pumped may be forced out air exhaust.
-  **CAUTION:** Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from pump. Disconnect all intake, discharge and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container.
-  **CAUTION:** Blow out air line for 10 to 20 seconds before attaching to pump to make sure all pipeline debris is clear. Use an in-line air filter. A 5µ (micron) air filter is recommended.
-  **NOTE:** When installing PTFE diaphragms, it is important to tighten outer pistons simultaneously (turning in opposite directions) to ensure tight fit. (See torque specifications in Section 7.)
-  **NOTE:** Cast Iron PTFE-fitted pumps come standard from the factory with expanded PTFE gaskets installed in the diaphragm bead of the liquid chamber. PTFE gaskets cannot be re-used. Consult PS-T6 for installation instructions during reassembly.
-  **NOTE:** Before starting disassembly, mark a line from each liquid chamber to its corresponding air chamber. This line will assist in proper alignment during reassembly.
-  **CAUTION:** Pro-Flo® pumps cannot be used in submersible applications. Pro-Flo X™ is available in both submersible and non-submersible options. Do not use non-submersible Pro-Flo X™ models in submersible applications. Turbo-Flo® pumps can also be used in submersible applications.
- CAUTION:** Tighten all hardware prior to installation.
-  **CAUTION:** The gas outlet of CSA configured pumps must be vented to a safe location in accordance with local codes or, in the absence of local codes, an industry or nationally recognized code having jurisdiction over the specified installation.
-  **CAUTION:** For U.L. listed pumps, all pipe connections are to be made using U.L. classified gasoline-resistant pipe compound.
-  **CAUTION:** For U.L. listed pumps all installations must conform to NFPA 30, NFPA 30A, and all other applicable codes.
-  **CAUTION:** For U.L. listed pumps, air exhaust port is to be connected to pipe or tubing to be routed outdoors or other location determined to be equivalent.
-  **CAUTION:** For U.L. listed pumps, pump is to be grounded using the jam-nut located at the top of the long vertical carriage bolt. The ground connection is marked with a tag having the grounding symbol.



Grounding Symbol

Section 2

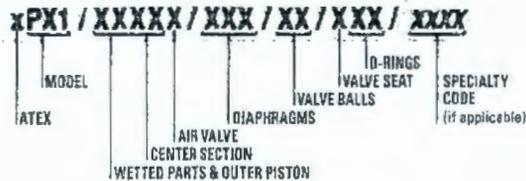


WILDEN PUMP DESIGNATION SYSTEM

P1/PX1 ORIGINAL™
METAL

13 mm (1/2") Pump
Maximum Flow Rate:
62.8 lpm (16.6 gpm)

LEGEND



MATERIAL CODES

MODEL	AIR VALVE	VALVE BALL
P1 = Pro-Flu®	A = ALUMINUM (PX1 only)	BN = BUNA-N (Red Dot)
PX1 = Pro-Flu XT™	G = CONDUCTIVE ACETAL (P1 only)	FS = SANIFLEX™ [Hytre® (Cream)]
XPX1 = ATEX-Pro-Flu XT™	J = CONDUCTIVE POLYPROPYLENE (P1 only)	PU = POLYURETHANE (Brown)
	L = ACETAL (P1 only)	TF = PTFE (White)
	P = POLYPROPYLENE (P1 only)	VT = VITON™ (White Dot)
WETTED PARTS & OUTER PISTON	DIAPHRAGMS	WF = WIL-FLEX™ [Santoprene® (Orange Dot)]
AA = ALUMINUM / ALUMINUM	XBS = CONDUCTIVE BUNA-N (Two Red Dots)	EP = EPDM (Blue Dot)
AZ = ALUMINUM / NO PISTON	BNS = BUNA-N (Red Dot)	VALVE SEAT
SS = STAINLESS STEEL / STAINLESS STEEL	FSS = SANIFLEX™ [Hytre® (Cream)]	A = ALUMINUM
SZ = STAINLESS STEEL / NO PISTON	PUS = POLYURETHANE (Clear)	S = STAINLESS STEEL
CENTER SECTION	TEU = PTFE w/EPDM BACK-UP (White)	V = VITON™ (White Dot)
AA = ALUMINUM (PX1 only)	THU = PTFE W/HIGH-TEMP BUNA-N BACK-UP (White)	VALVE SEAT O-RING
GG = CONDUCTIVE ACETAL (P1 only)	TNU = PTFE W/NEOPRENE BACK-UP (White)	BN = BUNA-N
JJ = CONDUCTIVE POLYPROPYLENE (P1 only)	TNL = PTFE W/NEOPRENE BACK-UP O-RING, IPD (White)	FS = SANIFLEX™ [Hytre® (Cream)]
LL = ACETAL (P1 only)	VTS = VITON™ (White Dot)	PU = POLYURETHANE (Brown)
PP = POLYPROPYLENE (P1 only)	WFS = WIL-FLEX™ [Santoprene® (Orange Dot)]	TF = PTFE (White)
	EPS = EPDM (Blue Dot)	WF = WIL-FLEX™ [Santoprene®]
		EP = EPDM

SPECIALTY CODES

0023 Wing nuts	0120 Saniflo™ FDA, Wil-Gard II™ 110V
0067 Saniflo™ FDA, Wil-Gard II™ 220V	0206 PFA coated hardware, Wil-Gard II™ sensor wires ONLY
0070 Saniflo™ FDA	0390 CSA Approved
0079 Tri-clamp fittings, wing nuts	0495 U.L. Approved
0080 Tri-clamp fittings ONLY	0502 PFA coated hardware
0100 Wil-Gard II™ 110V	0603 PFA coated hardware, Wil Gard 110V
0102 Wil-Gard II™ sensor wires ONLY	0608 PFA coated hardware, Wil Gard 220V
0103 Wil-Gard II™ 220V	

NOTE: The Wilden UL 79 Listed products covered by this manual are PX1 models followed by AA or SS, followed by AA, followed by A, followed by BNS, followed by BN, followed by A or S, followed by BN, followed by 0495. Wilden UL Listed pumps have been evaluated for use at a 25 C (77°F) ambient temperature with a maximum inlet pressure of 3.4 Bar (50 PSI).

Section 3



HOW IT WORKS



The Wilden diaphragm pump is an air-operated, positive displacement, self-priming pump. These drawings show the flow pattern through the pump upon its initial stroke. It is assumed the pump has no fluid in it prior to its initial stroke.

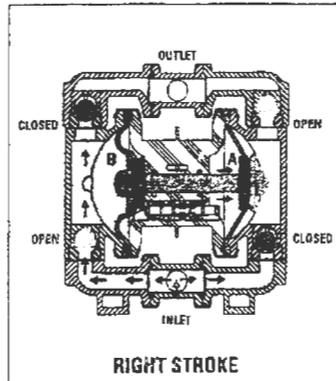


FIGURE 1 The air valve directs pressurized air to the back side of diaphragm A. The compressed air is applied directly to the liquid column separated by elastomeric diaphragms. The diaphragm acts as a separation membrane between the compressed air and liquid, balancing the load and removing mechanical stress from the diaphragm. The compressed air moves the diaphragm away from the center block of the pump. The opposite diaphragm is pulled in by the shaft connected to the pressurized diaphragm. Diaphragm B is on its suction stroke; air behind the diaphragm has been forced out to the atmosphere through the exhaust port of the pump. The movement of diaphragm B toward the center block of the pump creates a vacuum within chamber B. Atmospheric pressure forces fluid into the inlet manifold forcing the inlet valve ball off its seat. Liquid is free to move past the inlet valve ball and fill the liquid chamber (see shaded area).

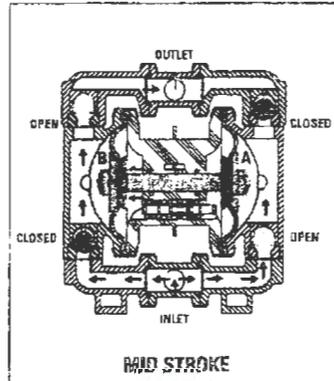


FIGURE 2 When the pressurized diaphragm, diaphragm A, reaches the limit of its discharge stroke, the air valve redirects pressurized air to the back side of diaphragm B. The pressurized air forces diaphragm B away from the center block, pulling diaphragm A to the center block. Diaphragm B is now on its discharge stroke. Diaphragm B forces the inlet valve ball onto its seat due to the hydraulic forces developed in the liquid chamber and manifold of the pump. These same hydraulic forces lift the discharge valve ball off its seat, while the opposite discharge valve ball is forced onto its seat, forcing fluid to flow through the pump discharge. The movement of diaphragm A toward the center block of the pump creates a vacuum within liquid chamber A. Atmospheric pressure forces fluid into the inlet manifold of the pump. The inlet valve ball is forced off its seat allowing the fluid being pumped to fill the liquid chamber.

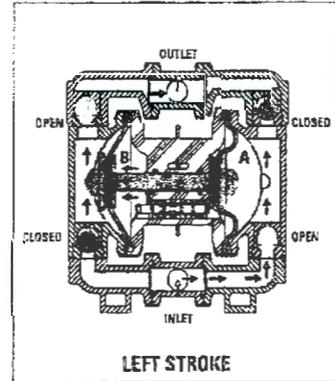
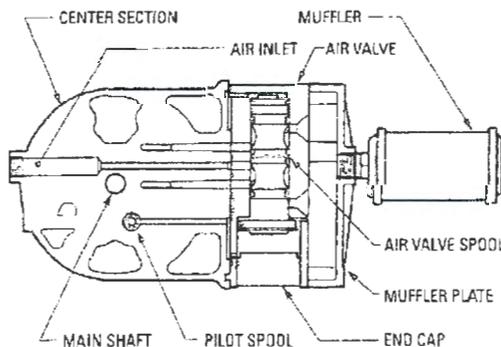


FIGURE 3 At completion of the stroke, the air valve again redirects air to the back side of diaphragm A, which starts diaphragm B on its exhaust stroke. As the pump reaches its original starting point, each diaphragm has gone through one exhaust and one discharge stroke. This constitutes one complete pumping cycle. The pump may take several cycles to completely prime depending on the conditions of the application.



HOW IT WORKS—AIR DISTRIBUTION SYSTEM

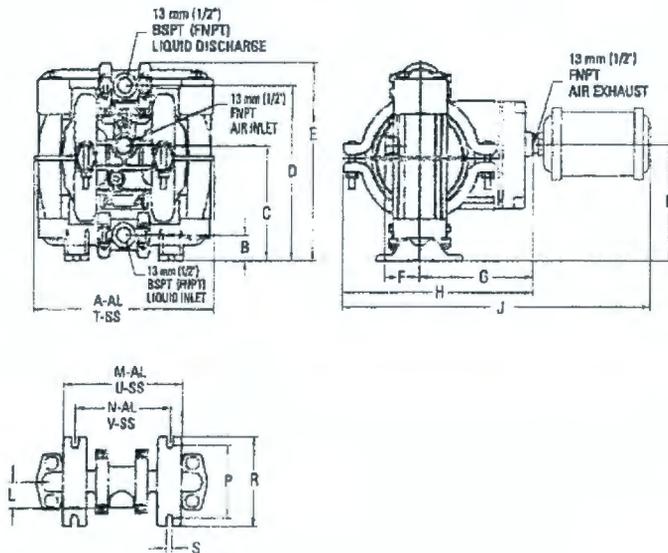


WIL-10000-E-15



DIMENSIONAL DRAWINGS

PX1 METAL



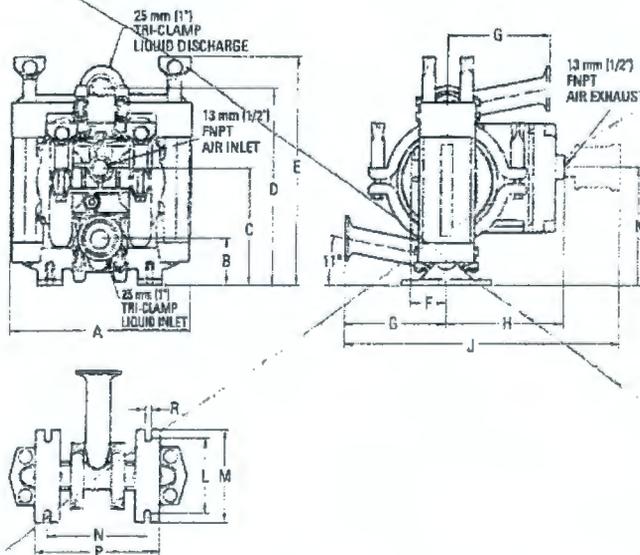
DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	208	8.2
B	28	1.1
C	130	5.1
D	198	7.8
E	224	8.8
F	41	1.6
G	132	5.2
H	221	8.7
J	361	14.2
K	132	5.2
L	30	1.2
M	137	5.4
N	108	4.3
P	84	3.3
R	102	4.0
S	8	0.3
T	203	8.0
U	142	5.6
V	112	4.4

BSPT threads available.

REV. A

PX1 METAL SANIFLO^{FDA}



DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	203	8.0
B	53	2.1
C	130	5.1
D	218	8.6
E	257	10.1
F	41	1.6
G	114	4.5
H	132	5.2
J	366	15.2
K	132	5.2
L	84	3.3
M	102	4.0
N	112	4.4
P	142	5.6
R	8	0.3

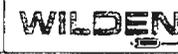
REV. D

WL-10300-E-15

5

WILDEN PUMP & ENGINEERING, LLC

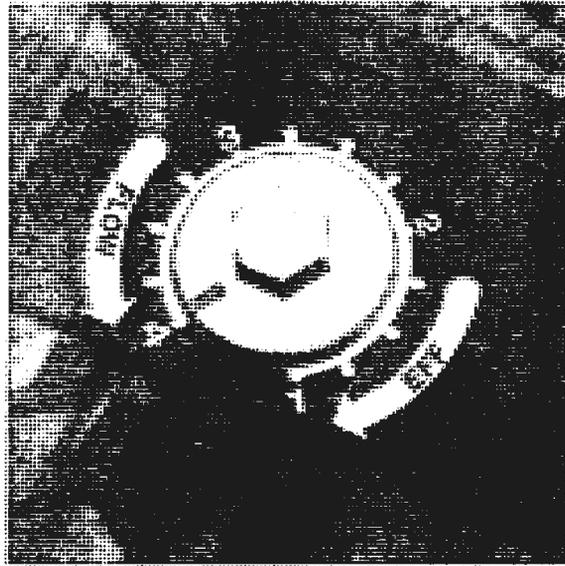
Section 5B
PRO-FLO X



Pro-Flo X™ Operating Principal

The Pro-Flo X™ air distribution system with the revolutionary Efficiency Management System (EMS) offers flexibility never before seen in the world of AODD pumps. The patent-pending EMS is simple and easy to use. With the turn of an integrated control dial, the

operator can select the optimal balance of flow and efficiency that best meets the application needs. Pro-Flo X™ provides higher performance, lower operational costs and flexibility that exceeds previous industry standards.



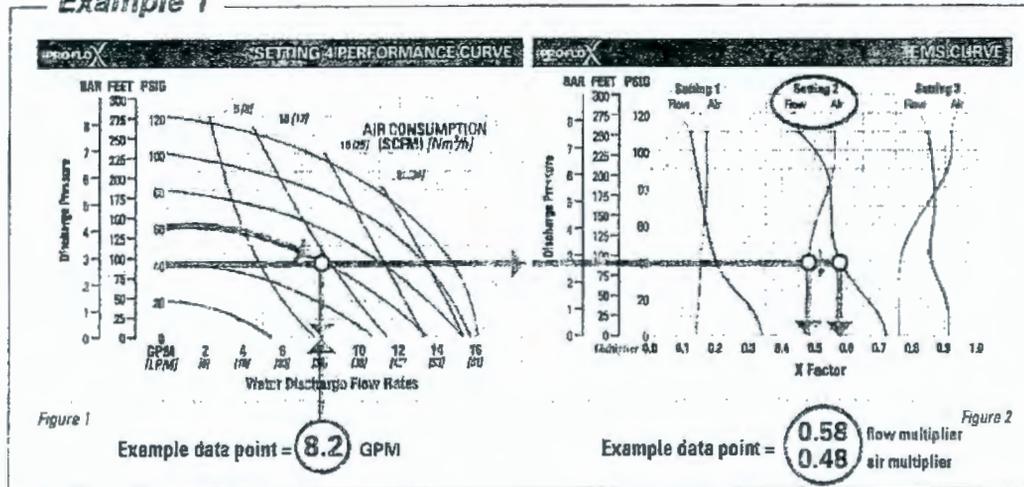
Turning the dial changes the relationship between air inlet and exhaust porting.	Each dial setting represents an entirely different flow curve	Pro-Flo X™ pumps are shipped from the factory on setting 4, which is the highest flow rate setting possible	Moving the dial from setting 4 causes a decrease in flow and an even greater decrease in air consumption.	When the air consumption decreases more than the flow rate, efficiency is improved and operating costs are reduced.



HOW TO USE THIS EMS CURVE



Example 1



This is an example showing how to determine flow rate and air consumption for your Pro-Flo X™ pump using the Efficiency Management System (EMS) curve and the performance curve. For this example we will be using 4.1 bar (60 psig) inlet air pressure and 2.8 bar (40 psig) discharge pressure and EMS setting 2.

Step 1: Identifying performance at setting 4. Locate the curve that represents the flow rate of the pump with 4.1 bar (60 psig) air inlet pressure. Mark the point where this curve crosses the horizontal line representing 2.8 bar (40 psig) discharge pressure. (Figure 1). After locating your performance point on the flow curve, draw a vertical line downward until reaching the bottom scale on the chart. Identify the flow rate (in this case, 8.2 gpm). Observe location of performance point relative to air consumption curves and approximate air consumption value (in this case, 9.8 scfm).

Step 2: Determining flow and air X Factors. Locate your discharge pressure (40 psig) on the vertical axis of the EMS curve (Figure 2). Follow along the 2.8 bar (40 psig) horizontal line until intersecting both flow and air curves for your desired EMS setting (in this case, setting 2). Mark the points where the EMS curves intersect the horizontal discharge pressure line. After locating your EMS points on the EMS

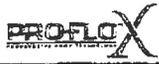
curve, draw vertical lines downward until reaching the bottom scale on the chart. This identifies the flow X Factor (in this case, 0.58) and air X Factor (in this case, 0.48).

Step 3: Calculating performance for specific EMS setting. Multiply the flow rate (8.2 gpm) obtained in Step 1 by the flow X Factor multiplier (0.58) in Step 2 to determine the flow rate at EMS setting 2. Multiply the air consumption (9.8 scfm) obtained in Step 1 by the air X Factor multiplier (0.48) in Step 2 to determine the air consumption at EMS setting 2 (Figure 3).

8.2 gpm	(flow rate for Setting 4)
<u>.58</u>	(Flow X Factor setting 2)
4.8 gpm	(Flow rate for setting 2)
9.8 scfm	(air consumption for setting 4)
<u>.48</u>	(Air X Factor setting 2)
4.7 scfm	(air consumption for setting 2)

Figure 3

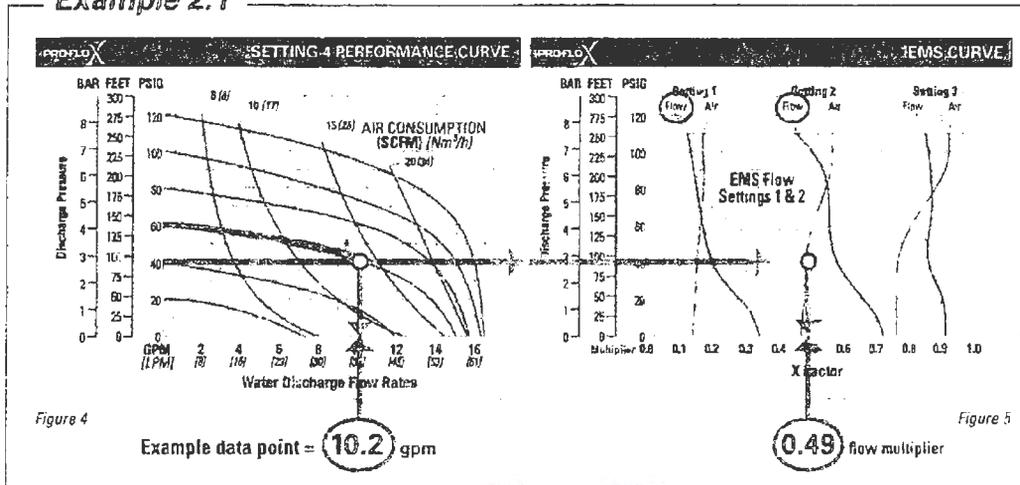
The flow rate and air consumption at Setting 2 are found to be 18.2 lpm (4.8 gpm) and 7.9 Nm³/h (4.7 scfm) respectively.



HOW TO USE THIS EMS CURVE



Example 2.1



This is an example showing how to determine the inlet air pressure and the EMS setting for your Pro-Flo X™ pump to optimize the pump for a specific application. For this example we will be using an application requirement of 18.9 lpm (5 gpm) flow rate against 2.8 bar (40 psig) discharge pressure. This example will illustrate how to calculate the air consumption that could be expected at this operational point.

DETERMINE EMS SETTING

Step 1: Establish inlet air pressure. Higher air pressures will typically allow the pump to run more efficiently, however, available plant air pressure can vary greatly. If an operating pressure of 6.9 bar (100 psig) is chosen when plant air frequently dips to 6.2 bar (90 psig) pump performance will vary. Choose an operating pressure that is within your compressed air systems capabilities. For this example we will choose 4.1 bar (60 psig).

Step 2: Determine performance point at setting 4. For this example an inlet air pressure of 4.1 bar (60 psig) inlet air pressure has been chosen. Locate the curve that represents the performance of the pump with 4.1 bar (60 psig) inlet air pressure. Mark the point where this curve crosses the horizontal line representing 2.8 bar (40 psig) discharge pressure. After locating this point on the flow curve, draw a vertical line downward until reaching the bottom scale on the chart and identify the flow rate.

In our example it is 38.6 lpm (10.2 gpm). This is the setting 4 flow rate. Observe the location of the performance point relative to air consumption curves and approximate air consumption value. In our example setting 4 air consumption is 24 Nm³/h (14 scfm). See figure 4.

Step 3: Determine flow X Factor. Divide the required flow rate 18.9 lpm (5 gpm) by the setting 4 flow rate 38.6 lpm (10.2 gpm) to determine the flow X Factor for the application.

$$5 \text{ gpm} / 10.2 \text{ gpm} = 0.49 \text{ (flow X Factor)}$$

Step 4: Determine EMS setting from the flow X Factor. Plot the point representing the flow X Factor (0.49) and the application discharge pressure 2.8 bar (40 psig) on the EMS curve. This is done by following the horizontal 2.8 bar (40 psig) psig discharge pressure line until it crosses the vertical 0.49 X Factor line. Typically, this point lies between two flow EMS setting curves (in this case, the point lies between the flow curves for EMS setting 1 and 2). Observe the location of the point relative to the two curves it lies between and approximate the EMS setting (figure 5). For more precise results you can mathematically interpolate between the two curves to determine the optimal EMS setting.

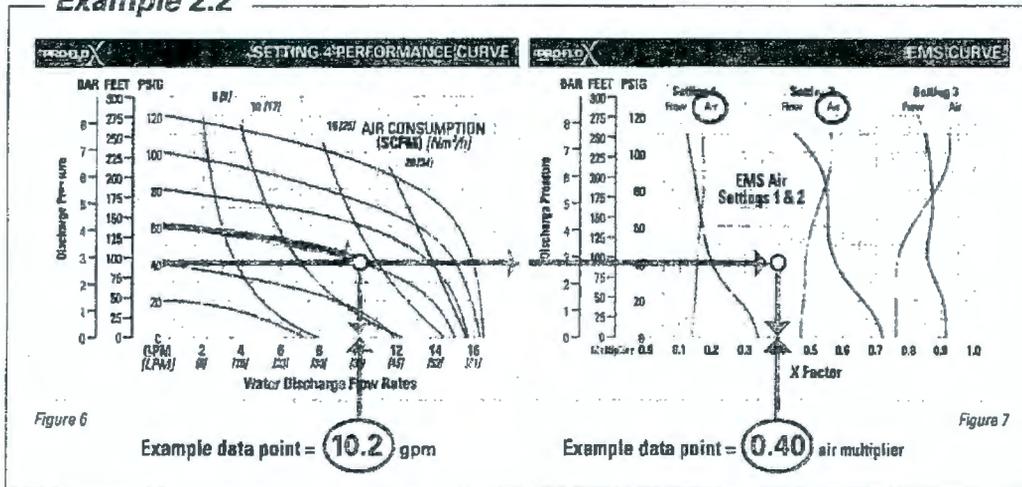
For this example the EMS setting is 1.8.



HOW TO USE THIS EMS CURVE



Example 2.2



Determine air consumption at a specific EMS setting.

Step 1: Determine air X Factor. In order to determine the air X Factor, identify the two air EMS setting curves closest to the EMS setting established in example 2.1 (in this case, the point lies between the air curves for EMS setting 1 and 2). The point representing your EMS setting (1.8) must be approximated and plotted on the EMS curve along the horizontal line representing your discharge pressure (in this case, 40 psig). This air point is different than the flow point plotted in example 2.1. After estimating (or interpolating) this point on the curve, draw a vertical line downward until reaching the bottom scale on the chart and identify the air X Factor (figure 7).

For this example the air X Factor is 0.40

Step 2: Determine air consumption. Multiply your setting 4 air consumption (14 scfm) value by the air X Factor obtained above (0.40) to determine your actual air consumption.

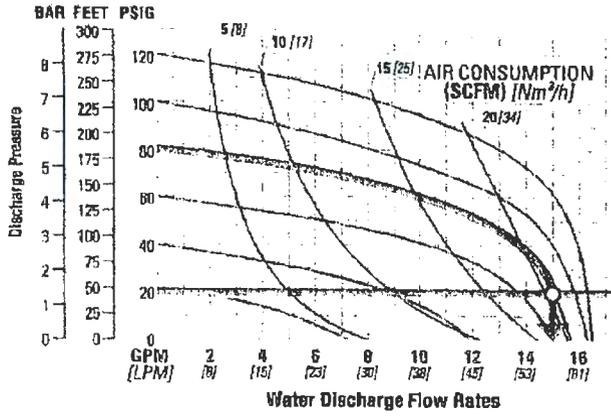
$$14 \text{ scfm} \times 0.40 = 5.6 \text{ SCFM}$$

In summary, for an application requiring 18.9 lpm (5 gpm) against 2.8 bar (40 psig) discharge pressure, the pump inlet air pressure should be set to 4.1 bar (60 psig) and the EMS dial should be set to 1.8. The pump would then consume 9.5 Nm³/h (5.6 scfm) of compressed air.

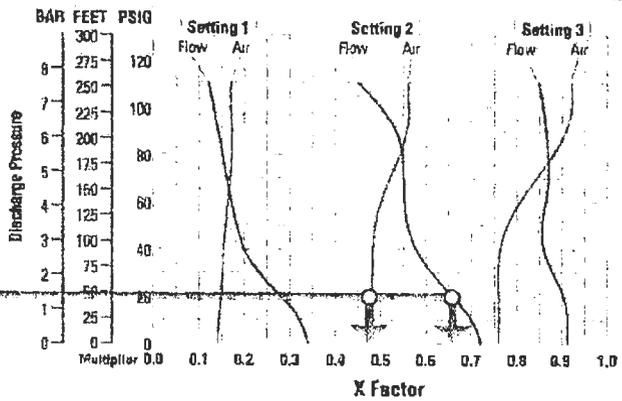
PX1 METAL RUBBER-FITTED

WILDEN PUMP & ENGINEERING, LLC

PROFLOX SETTING 4 PERFORMANCE CURVE



PROFLOX EMS CURVE



14

TECHNICAL DATA

Height	.....	224 mm (8.8")
Width	.....	208 mm (8.2")
Depth	.....	221 mm (8.7")
Ship Weight	.....	Aluminum 6 kg (13 lbs.) 316 Stainless Steel 9 kg (20 lbs.)
Air Inlet	.....	13 mm (1/2")
Inlet	.....	13 mm (1/2")
Outlet	.....	13 mm (1/2")
Suction Lift	.....	5.9 m Dry (19.3') 8.0 m Wet (26.1')
Disp. Per Stroke	.....	0.09 l (0.023 gal.) ¹
Max Flow Rate	.....	62.5 lpm (16.5 gpm)
Max. Size Solids	.....	1.6 mm (1/16")

¹Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

The Efficiency Management System (EMS) can be used to optimize the performance of your Wilden pump for specific applications. The pump is delivered with the EMS adjusted to setting 4, which allows maximum flow.

The EMS curve allows the pump user to determine flow and air consumption at each EMS setting. For any EMS setting and discharge pressure, the "X factor" is used as a multiplier with the original values from the setting 4 performance curve to calculate the actual flow and air consumption values for that specific EMS setting. Note: you can interpolate between the setting curves for operation at intermediate EMS settings.

EXAMPLE

A PX1 metal, Rubber-fitted pump operating at EMS setting 4, achieved a flow rate of 56.8 lpm (15.0 gpm) using 35.7 Nm³/h (12.7 scfm) of air when run at 5.5 bar (80 psig) air inlet pressure and 1.4 bar (20 psig) discharge pressure (See dot on flow chart).

The end user did not require that much flow and wanted to reduce air consumption at his facility. He determined that EMS setting 2 would meet his needs. At 1.4 bar (20 psig) discharge pressure and EMS setting 2, the flow "X factor" is .66 and the air "X factor" is .48.

Multiplying the original setting 4 values by the "X factors" provides the setting 2 flow rate of 37.5 lpm (9.9 gpm) and an air consumption of 17.2 Nm³/h (10.1 scfm). The flow rate was reduced by 34% while the air consumption was reduced by 52%, thus providing increased efficiency.

For a detailed example for how to set your EMS, see beginning of performance curve section.

Caution: Do not exceed 8.6 bar (125 psig) air supply pressure.

Appendix 265

PX1 Performance

PROFLOX
PERFORMANCE

WILDEN

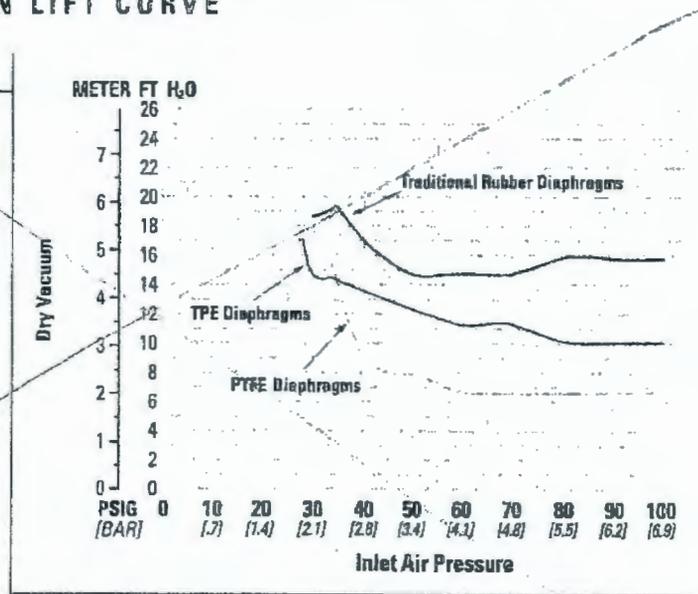
Section 5C

WILDEN

PROFLO
ADVANCED PUMP TECHNOLOGY

SUCTION LIFT CURVE

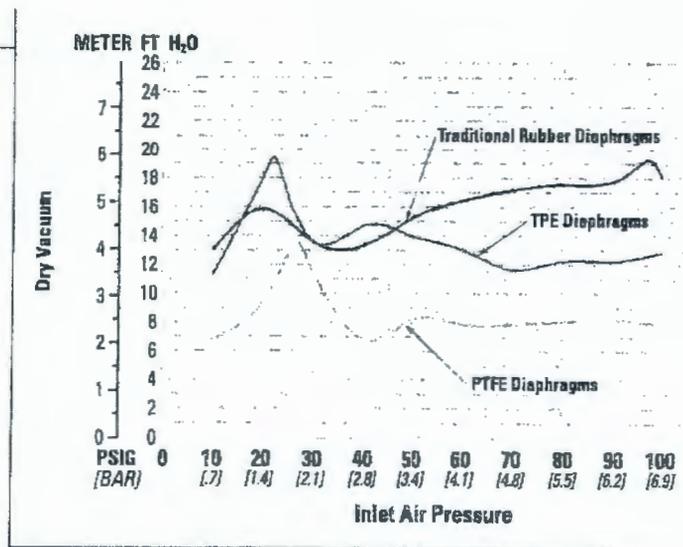
~~P1 METAL~~



PROFLO

SUCTION LIFT CURVE

PX1 METAL ←



Suction lift curves are calibrated for pumps operating at 305 m (1,000') above sea level. This chart is meant to be a guide only. There are many variables which can affect your pump's operating characteristics. The number of intake and dis-

charge elbows, viscosity of pumping fluid, elevation (atmospheric pressure) and pipe friction loss all affect the amount of suction lift your pump will attain.

Section 6



SUGGESTED INSTALLATION

WILDEN

Wilden pumps are designed to meet the performance requirements of even the most demanding pumping applications. They have been designed and manufactured to the highest standards and are available in a variety of liquid path materials to meet your chemical resistance needs. Refer to the performance section of this manual for an in-depth analysis of the performance characteristics of your pump. Wilden offers the widest variety of elastomer options in the industry to satisfy temperature, chemical compatibility, abrasion resistance and flex concerns.

The suction pipe size should be at least the equivalent or larger than the diameter size of the suction inlet on your Wilden pump. The suction hose must be non-collapsible, reinforced type as these pumps are capable of pulling a high vacuum. Discharge piping should also be the equivalent or larger than the diameter of the pump discharge which will help reduce friction losses. It is critical that all fittings and connections are airtight or a reduction or loss of pump suction capability will result.

INSTALLATION: Months of careful planning, study, and selection efforts can result in unsatisfactory pump performance if installation details are left to chance.

Premature failure and long term dissatisfaction can be avoided if reasonable care is exercised throughout the installation process.

LOCATION: Noise, safety, and other logistical factors usually dictate where equipment will be situated on the production floor. Multiple installations with conflicting requirements can result in congestion of utility areas, leaving few choices for additional pumps.

Within the framework of these and other existing conditions, every pump should be located in such a way that six key factors are balanced against each other to maximum advantage.

ACCESS: First of all, the location should be accessible. If it's easy to reach the pump, maintenance personnel will have an easier time carrying out routine inspections and adjustments. Should major repairs become necessary, ease of access can play a key role in speeding the repair process and reducing total downtime.

AIR SUPPLY: Every pump location should have an air line large enough to supply the volume of air necessary to achieve the desired pumping rate. Use air pressure up to a maximum of 8.6 bar (125 psig) depending on pumping requirements.

For best results, the pumps should use a 5µ (micron) air filter, needle valve and regulator. The use of an air filter before the pump will ensure that the majority of any pipeline contaminants will be eliminated.

NOTE: Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100 psig) sweet gas supply pressure. ONLY CSA configured pumps should be operated using gas.

SOLENOID OPERATION: When operation is controlled by a solenoid valve in the air line, three-way valves should be used. This valve allows trapped air between the valve and the pump to bleed off which improves pump performance. Pumping volume can be estimated by counting the number of strokes per minute and then multiplying the figure by the displacement per stroke.

MUFFLER: Sound levels are reduced below OSHA specifications using the standard Wilden muffler. Other mufflers can be used to further reduce sound levels, but they usually reduce pump performance.

ELEVATION: Selecting a site that is well within the pump's dynamic lift capability will assure that loss-of-prime issues will be eliminated. In addition, pump efficiency can be adversely affected if proper attention is not given to site location.

PIPING: Final determination of the pump site should not be made until the piping challenges of each possible location have been evaluated. The impact of current and future installations should be considered ahead of time to make sure that inadvertent restrictions are not created for any remaining sites.

For U.L. listed pumps, all installation must conform with NFPA 30, NFPA 30A, and other applicable codes. All pipe connections are to be made using U.L. classified gasoline-resistant pipe compound. Exhaust port is to be connected to pipe or tubing to be routed outdoors or other location determined to be equivalent.

The best choice possible will be a site involving the shortest and straightest hook-up of suction and discharge piping. Unnecessary elbows, bends, and fittings should be avoided. Pipe sizes should be selected to keep friction losses within practical limits. All piping should be supported independently of the pump. In addition, the piping should be aligned to avoid placing stress on the pump fittings.

Flexible hose can be installed to aid in absorbing the forces created by the natural reciprocating action of the pump. If the pump is to be bolted down to a solid location, a mounting pad placed between the pump and the foundation will assist in minimizing pump vibration. Flexible connections between the pump and rigid piping will also assist in minimizing pump vibration. If quick-closing valves are installed at any point in the discharge system, or if pulsation within a system becomes a problem, a surge suppressor (SD EqualizerSM) should be installed to protect the pump, piping and gauges from surges and water hammer.

If the pump is to be used in a self-priming application, make sure that all connections are airtight and that the suction lift is within the model's ability. Note: Materials of construction and elastomer material have an effect on suction lift parameters. Please refer to the performance section for specifics.

When pumps are installed in applications involving flooded suction or suction head pressures, a gate valve should be installed in the suction line to permit closing of the line for pump service.

Pumps in service with a positive suction head are most efficient when inlet pressure is limited to 0.5-0.7 bar (7-10 psig). Premature diaphragm failure may occur if positive suction is 0.7 bar (10 psig) and higher.

SUBMERSIBLE APPLICATIONS: Pro-Flo XSM pumps can be used for submersible applications, when using the Pro-Flo XSM submersible option. Turbo-FloSM pumps can also be used for submersible applications.

NOTE: Pro-FloSM and Accu-FloSM pumps are not submersible.

ALL WILDEN PUMPS ARE CAPABLE OF PASSING SOLIDS. A STRAINER SHOULD BE USED ON THE PUMP INTAKE TO ENSURE THAT THE PUMP'S RATED SOLIDS CAPACITY IS NOT EXCEEDED.

CAUTION: DO NOT EXCEED 8.6 BAR (125 PSIG) AIR SUPPLY PRESSURE.

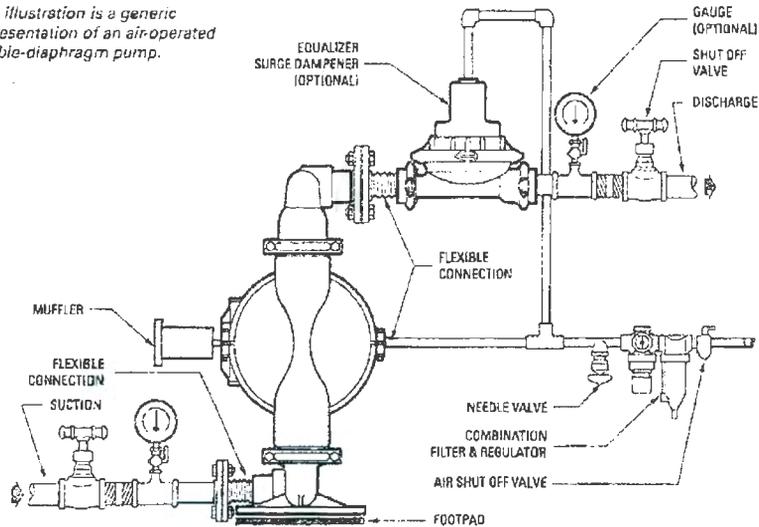
CAUTION: CANADIAN STANDARDS ASSOCIATION (CSA) CONFIGURED PUMPS SHOULD NOT EXCEED 6.9 BAR (100 PSIG) SWEET GAS SUPPLY PRESSURE.

CAUTION: FOR U.L. LISTED PUMPS, DO NOT EXCEED 3.4 BAR (50 PSIG) AIR SUPPLY PRESSURE.



SUGGESTED INSTALLATION

This illustration is a generic representation of an air-operated double-diaphragm pump.



NOTE: In the event of a power failure, the shut off valve should be closed, if the restarting of the pump is not desirable once power is regained.

AIR OPERATED PUMPS: To stop the pump from operating in an emergency situation, simply close the

shut off valve (user supplied) installed in the air supply line. A properly functioning valve will stop the air supply to the pump, therefore stopping output. This shut off valve should be located far enough away from the pumping equipment such that it can be reached safely in an emergency situation.



SUGGESTED OPERATION & MAINTENANCE

OPERATION: P1 and PX1 pumps are pre-lubricated, and do not require in-line lubrication. Additional lubrication will not damage the pump, however if the pump is heavily lubricated by an external source, the pump's internal lubrication may be washed away. If the pump is then moved to a non-lubricated location, it may need to be disassembled and re-lubricated as described in the ASSEMBLY/DISASSEMBLY INSTRUCTIONS.

Pump discharge rate can be controlled by limiting the volume and/or pressure of the air supply to the pump. A regulator is used to control air pressure while a needle valve is used to control volume. Pump discharge rate can also be controlled by throttling the pump discharge by partially closing a valve in the discharge line of the pump. This action increases friction loss which reduces flow rate. (See Section 5.) This is useful when the need exists to control the pump from a remote location. When the pump discharge pressure equals or exceeds the air supply pressure, the pump will stop; no bypass or pressure relief valve is needed, and pump damage will not occur. The pump has reached a "deadhead" situation and can be restarted by reducing the fluid discharge pressure or increasing the air inlet pressure.

The P1 and PX1 pumps run solely on compressed air and do not generate heat, therefore your process fluid temperature will not be affected.

NOTE: Canadian Standards Association (CSA) configured pumps run solely on gas and do not generate heat.

MAINTENANCE AND INSPECTIONS: Since each application is unique, maintenance schedules may be different for every pump. Frequency of use, line pressure, viscosity and abrasiveness of process fluid all affect the parts life of a Wilden pump. Periodic inspections have been found to offer the best means for preventing unscheduled pump downtime. Personnel familiar with the pump's construction and service should be informed of any abnormalities that are detected during operation.

RECORDS: When service is required, a record should be made of all necessary repairs and replacements. Over a period of time, such records can become a valuable tool for predicting and preventing future maintenance problems and unscheduled downtime. In addition, accurate records make it possible to identify pumps that are poorly suited to their applications.

TROUBLESHOOTING

Pump will not run or runs slowly.

1. Ensure that the air inlet pressure is at least 0.3 Bar (5 psig) above startup pressure and that the differential pressure (the difference between air inlet and liquid discharge pressures) is not less than 0.7 Bar (10 psig).
2. Check air inlet filter for debris (see recommended installation).
3. Check for extreme air leakage (blow by) which would indicate worn seals/bores in the air valve, pilot spool, main shaft.
4. Disassemble pump and check for obstructions in the air passageways or objects which would obstruct the movement of internal parts.
5. Check for sticking ball check valves. If material being pumped is not compatible with pump elastomers, swelling may occur. Replace ball check valves and seals with proper elastomers. Also, as the check valve balls wear out, they become smaller and can become stuck in the seats. In this case, replace balls and seats.
6. Check for broken inner piston which will cause the air valve spool to be unable to shift.
7. Remove plug from pilot spool exhaust.

Pump runs but little or no product flows.

1. Check for pump cavitation; slow pump speed down to allow thick material to flow into liquid chambers.

2. Verify that vacuum required to lift liquid is not greater than the vapor pressure of the material being pumped (cavitation).
3. Check for sticking ball check valves. If material being pumped is not compatible with pump elastomers, swelling may occur. Replace ball check valves and seats with proper elastomers. Also, as the check valve balls wear out, they become smaller and can become stuck in the seats. In this case, replace balls and seats.

Pump air valve freezes.

1. Check for excessive moisture in compressed air. Either install a dryer or hot air generator for compressed air. Alternatively, a coalescing filter may be used to remove the water from the compressed air in some applications.

Air bubbles in pump discharge.

1. Check for ruptured diaphragm.
2. Check tightness of outer pistons (refer to Section 7).
3. Check tightness of fasteners and integrity of o-rings and seals, especially at intake manifold.
4. Ensure pipe connections are airtight.

Product comes out air exhaust.

1. Check for diaphragm rupture.
2. Check tightness of outer pistons to shaft.

Section 7

WILDEN



PUMP DISASSEMBLY

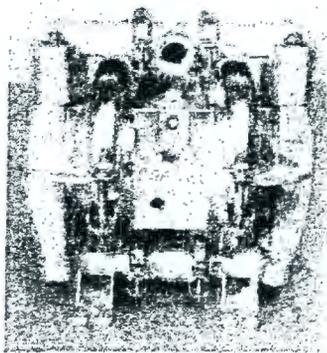
P1 METAL

TOOLS REQUIRED:

- 3/8" Box Wrench
- 7/16" Wrench
- Adjustable Wrench
- Vise equipped with soft jaws (such as plywood, plastic or other suitable material)

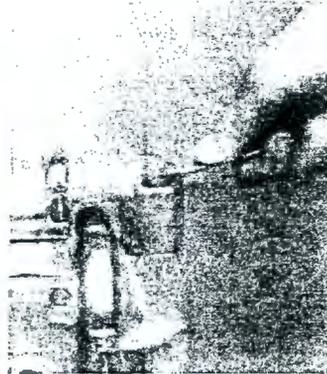
CAUTION: Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from the pump. Disconnect all intake, discharge, and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container. Be aware of any hazardous effects of contact with your process fluid.

NOTE: The model photographed for these instructions is a Pro-FloX™ version and incorporates rubber diaphragms, balls, and seats.



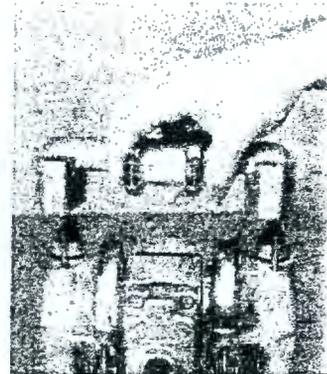
Step 1

Prior to disassembly, alignment marks should be placed on the liquid chambers and air chamber to assist with proper alignment during reassembly.



Step 2

Using a 7/16" box wrench, remove the nuts that connect the inlet and discharge manifolds to the center section assembly.



Step 3

Next, remove the discharge manifold from the pump.



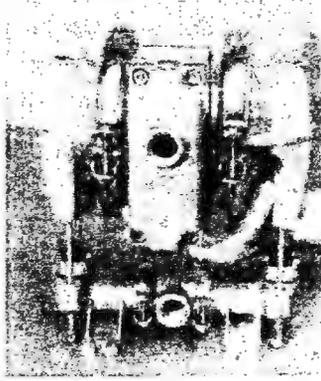
PUMP DISASSEMBLY

WILDEN



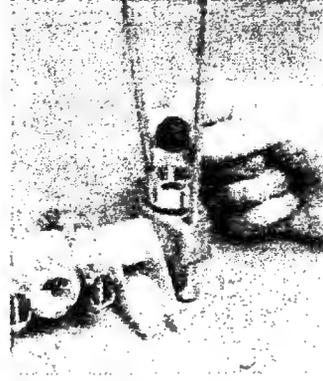
Step 4

Remove the discharge valve ball, valve seat and valve seat o-ring and inspect for signs of wear and replace if necessary.



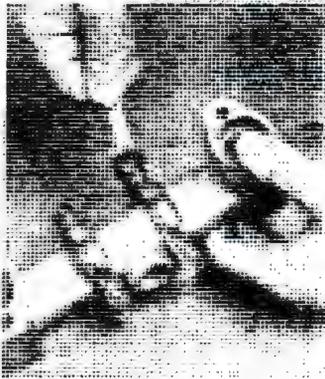
Step 5

Now the center section assembly can be removed from the inlet manifold.



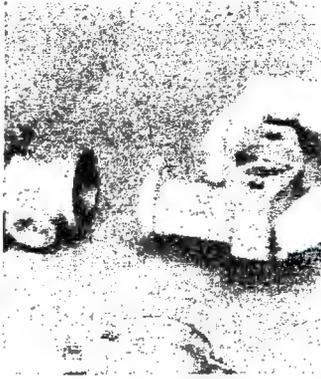
Step 6

Remove the inlet valve ball, valve seat and valve seat o-ring and inspect for signs of wear and/or chemical attack. Replace if necessary.



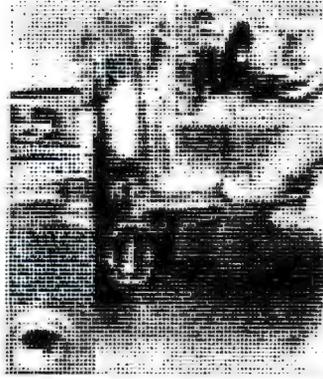
Step 7

Using a 3/8" wrench, remove the small clamp band that connects the manifold elbows to the tee section.



Step 8

Remove the tee section o-rings and inspect for signs of wear and/or chemical attack. Replace if necessary.



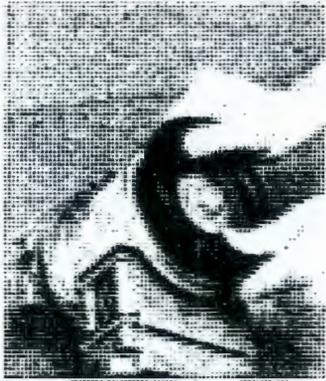
Step 9

Using a 7/16" box and wrench, remove the large clamp bands. With the clamp bands removed, lift the liquid chamber away from the center section.

PROFLO
PROGRESSIVE PUMP TECHNOLOGY

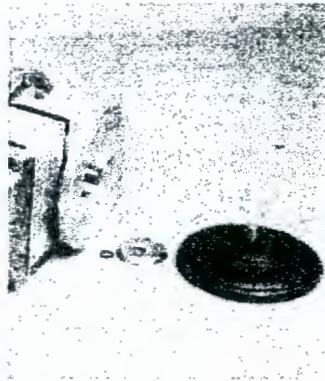
PUMP DISASSEMBLY

WILDEN



Step 10

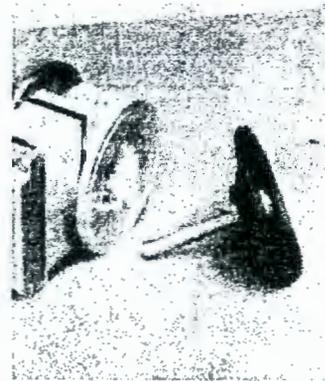
Using an adjustable wrench or rotating the diaphragm by hand, remove the diaphragm assembly from the center section.



Step 11A

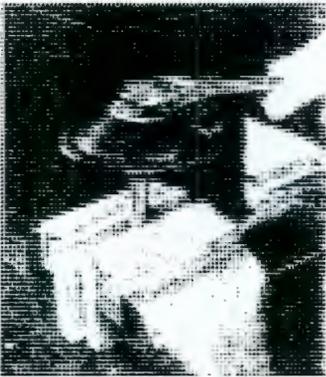
Due to varying torque values, one of the two situations will occur:

A) The outer piston, diaphragm and inner piston will separate from the shaft which remains connected to the opposite side diaphragm assembly.



Step 11B

B) The diaphragm assembly and shaft remain connected leaving the opposite side diaphragm assembly within the opposite side of the center section assembly.



Step 13

To remove the diaphragm assembly from the shaft, secure shaft with soft jaws (a vise fitted with plywood or other suitable material) to ensure shaft is not nicked, scratched, or gouged. Using an adjustable wrench, remove the diaphragm assembly from shaft. Inspect all parts for wear and replace with genuine Wilden parts if necessary.

GROUNDING STRAP FOR CSA PX1 PUMPS

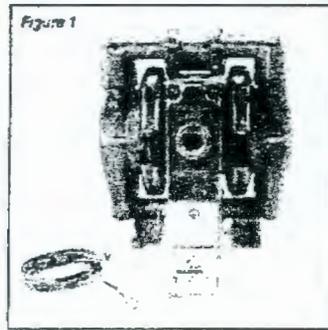


Figure 1



Figure 2

Canadian Standards Association (CSA) configured pumps must be electrically grounded using the grounding strap provided (Figure 1). Improper grounding can cause improper and dangerous operation. To properly attach the grounding strap to a CSA configured PX1 pump, identify the designated grounding location on the muffer plate; using the provided self-tapping screw and grounding wire, thread the grounding screw through the grounding wire lug, into the muffer plate and tighten securely (figure 2). Completion of the pump grounding procedure must be done in accordance with local codes, or in the absence of local codes, an industrial or nationally recognized code having jurisdiction over the specified installation.

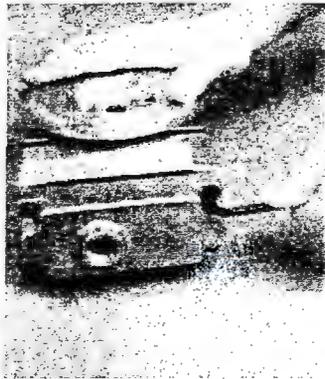


AIR VALVE/CENTER SECTION DISASSEMBLY

TOOLS REQUIRED:

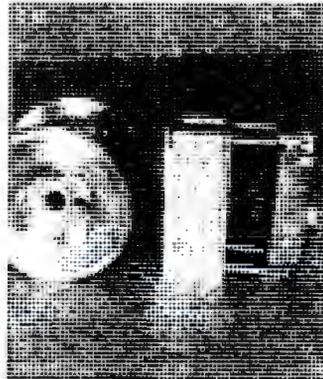
- 3/16" Hex Head Wrench
- 7/32" Hex Head Wrench
- Snap Ring Pliers
- O-Ring Pick

CAUTION: Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from the pump. Disconnect all intake, discharge, and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container. Be aware of hazardous effects of contact with your process fluid.



Step 1

Using a 3/16" hex head wrench, loosen the air valve bolts.



Step 2

Remove the air valve and muffler plate from the center section.



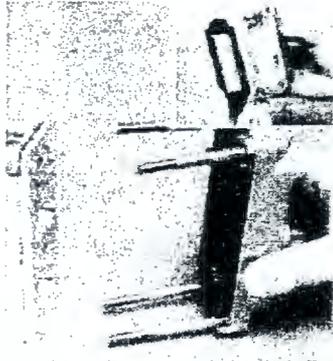
Step 3

Remove the air valve gasket and inspect for nicks, gouges and chemical attack. Replace if necessary with genuine Wilden parts. Note: When installing the air valve gasket onto the center section assembly, position gasket with the grooved side facing away from the center section.

PRO-FLO
PROGRESSIVE PUMP TECHNOLOGY

WILDEN

AIR VALVE/CENTER SECTION DISASSEMBLY



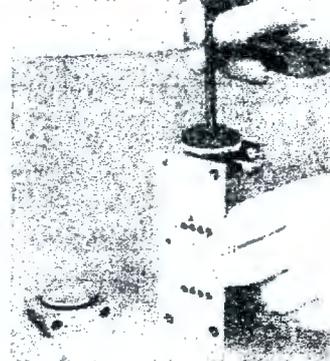
Step 4

Remove muffer plate gasket and inspect. Replace if necessary.



Step 5

Remove air valve end cap to expose air valve spool. NOTE: The end cap cannot be removed until removing air valve bolts.



Step 6

Remove air valve spool from air valve body by threading one air valve bolt into the end of the spool and gently sliding the spool out of the air valve body. Inspect seals for signs of wear and replace entire assembly if necessary. Use caution when handling air valve spool to prevent damaging seals. NOTE: Seals should not be removed from assembly. Seals are not sold separately.



Step 7

Remove pilot spool retaining snap ring on both sides of center section with snap ring pliers.



Step 8

Remove pilot spool assembly from center section.



Step 9

Using an o-ring pick, gently remove the pilot spool retaining o-ring from the opposite side of the notched end of the spool. Gently remove the pilot spool from pilot spool sleeve and inspect for nicks, gouges and other signs of wear. Replace pilot spool assembly or outer sleeve o-rings if necessary. During re-assembly never insert the pilot spool into the sleeve with the "notched" end side first, this end incorporates the urethane o-ring and will be damaged as it slides over the ports cut in the pilot spool sleeve.

Step 10

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AIR VALVE/CENTER SECTION DISASSEMBLY

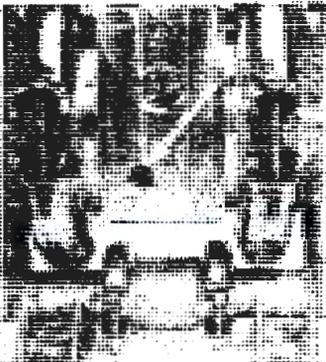


Check center section shaft seals for signs of wear. If necessary, remove the shaft seals with an o-ring pick and replace.

WILDEN
PUMP

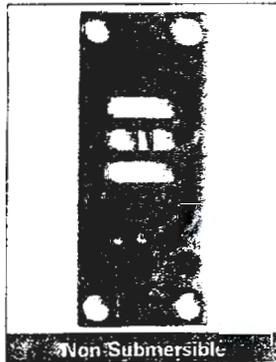
PROFLO X

SUBMERSIBLE PRO-FLO X™



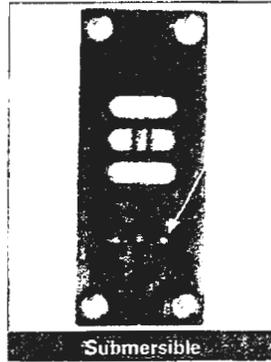
Step 1

Install a 1/4" NPT pipe plug (00-7010-08) into the pilot spool bleed port located at the front of the center section.



Step 2

Next, install an optional submersible air valve gasket (01-2621-52). The submersible air valve gasket can be purchased as a spare part or included with the purchase of a new Pro-Flo X™ pump.





REASSEMBLY HINT & TIPS

ASSEMBLY:

Upon performing applicable maintenance to the air distribution system, the pump can now be reassembled. Please refer to the disassembly instructions for photos and parts placement. To reassemble the pump, follow the disassembly instructions in reverse order. The air distribution system needs to be assembled first, then the diaphragms and finally the wetted part. Please find the applicable torque specifications on this page. The following tips will assist in the assembly process.

- Clean the inside of the center section shaft bore to ensure no damage is done to new seals.
- Stainless bolts should be lubed to reduce the possibility of seizing during tightening.

- Level the water chamber side of the intake/discharge manifold to ensure a proper sealing surface. This is most easily accomplished by placing them on a flat surface prior to tightening their clamp bands to the desired torque (see this page for torque specs).
- Be sure to tighten outer pistons simultaneously on PTFE-fitted pumps to ensure proper torque values.
- Ensure proper mating of liquid chambers to manifolds prior to tightening vertical bolts. Overhang should be equal on both sides.
- Apply a small amount of Loctite 242 to the shaft interval threads before the diaphragm assembly.
- Concave side of disc spring in diaphragm assembly faces toward shaft.

PRO-FLO® MAXIMUM TORQUE SPECIFICATIONS

Description of Part	Maximum Torque
Air Valve, Pro-Flo®	3.1 N·m (27 in-lbs.)
Outer Piston	14.1 N·m (125 in)
Small Clamp Band	1.7 N·m (15 in)
Large Clamp Band (Rubber/TPE-Fitted)	9.0 N·m (80 in)
Large Clamp Band (PTFE-Fitted)	13.8 N·m (120 in)
Vertical Bolts	14.1 N·m (125 in)

PRO-FLO X™ MAXIMUM TORQUE SPECIFICATIONS

Description of Part	Maximum Torque
Air Valve, Pro-Flo X™	11.3 N·m (100 in-lbs.)
Outer Piston	14.1 N·m (125 in)
Small Clamp Band	1.7 N·m (15 in)
Large Clamp Band (Rubber/TPE-Fitted)	9.0 N·m (80 in)
Large Clamp Band (PTFE-Fitted)	13.8 N·m (120 in)
Vertical Bolts	14.1 N·m (125 in)

Your Solutions Wrapped Up

ELASTOMER KITS

Program Details:

- Elastomer & ADS Repair Kits
- All Sizes Available
- PTFE, Rubber & TPE Elastomers
- One Part Number Simplifies Inventory
- Eliminates Order Errors
- Reduces Re-Build Time
- Rejuvenates Your Pump

NOTE: See Section 9.

22069 VAN BUREN STREET • GRAND TERRACE, CA 92313-6607
(909) 422-1730 • FAX (909) 783-3440
www.wildenpump.com



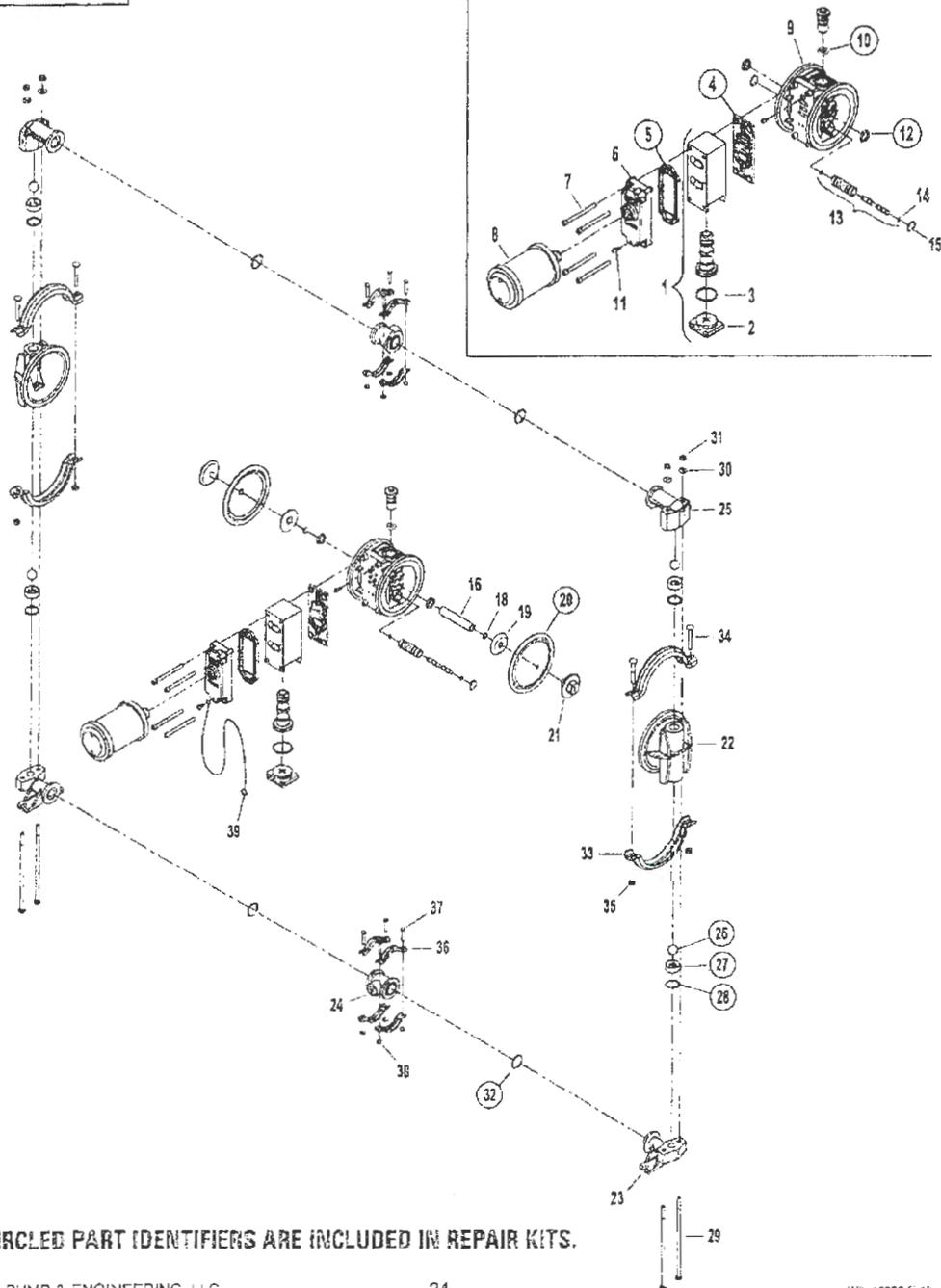
EXPLODED VIEW & PARTS LISTING



PX1 METAL

RUBBER-FITTED

EXPLODED VIEW

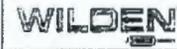


ALL CIRCLED PART IDENTIFIERS ARE INCLUDED IN REPAIR KITS.

WILDEN PUMP & ENGINEERING, LLC

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WL-10300-E-15



WARRANTY

Each and every product manufactured by Wilden Pump and Engineering, LLC is built to meet the highest standards of quality. Every pump is functionally tested to insure integrity of operation.

Wilden Pump and Engineering, LLC warrants that pumps, accessories and parts manufactured or supplied by it to be free from defects in material and workmanship for a period of five (5) years from date of installation or six (6) years from date of manufacture, whichever comes first. Failure due to normal wear, misapplication, or abuse is, of course, excluded from this warranty.

Since the use of Wilden pumps and parts is beyond our control, we cannot guarantee the suitability of any pump or part for a particular application and Wilden Pump and Engineering, LLC shall not be liable for any consequential damage or expense arising from the use or misuse of its products on any application. Responsibility is limited solely to replacement or repair of defective Wilden pumps and parts.

All decisions as to the cause of failure are the sole determination of Wilden Pump and Engineering, LLC.

Prior approval must be obtained from Wilden for return of any items for warranty consideration and must be accompanied by the appropriate MSDS for the product(s) involved. A Return Goods Tag, obtained from an authorized Wilden distributor, must be included with the items which must be shipped freight prepaid.

The foregoing warranty is exclusive and in lieu of all other warranties expressed or implied (whether written or oral) including all implied warranties of merchantability and fitness for any particular purpose. No distributor or other person is authorized to assume any liability or obligation for Wilden Pump and Engineering, LLC other than expressly provided herein.

PLEASE PRINT OR TYPE AND FAX TO WILDEN

PUMP INFORMATION			
Item #		Serial #	
Company Where Purchased			
YOUR INFORMATION			
Company Name			
Industry			
Name		Title	
Street Address			
City	State	Postal Code	Country
Telephone	Fax	E-mail	Web Address
Number of pumps in facility?		Number of Wilden pumps?	
Types of pumps in facility (check all that apply): <input type="checkbox"/> Diaphragm <input type="checkbox"/> Centrifugal <input type="checkbox"/> Gear <input type="checkbox"/> Submersible <input type="checkbox"/> Lobe			
<input type="checkbox"/> Other _____			
Media being pumped? _____			
How did you hear of Wilden Pump? <input type="checkbox"/> Trade Journal <input type="checkbox"/> Trade Show <input type="checkbox"/> Internet/E-mail <input type="checkbox"/> Distributor			
<input type="checkbox"/> Other _____			

ONCE COMPLETE, FAX TO (909) 783-3440

NOTE: WARRANTY VOID IF PAGE IS NOT FAXED TO WILDEN
WILDEN PUMP & ENGINEERING, LLC

Attachment D-8
Wilden PX-200

P200/PX200

EOM
Engineering
Operation &
Maintenance

Advanced™ Series **METAL Pumps**

Advance your process

Submittal #71
Equipment as specified and by
Specified manufacturer.

UL
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79

DESIGN
CERTIFIED

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PROFLO

PROFLO X

WILDEN
A ZIMMER LINDSEY COMPANY

CE

WIL-11000-E-13
REPLACES WIL-11000-E-12

WIL-11000-E



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Section 1

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PROFLO
PUMP & ENGINEERING, LLC

CAUTIONS—READ FIRST!

 **CAUTION:** Do not apply compressed air to the exhaust port — pump will not function.

 **CAUTION:** Do not, under any circumstance loosen the set screw located at the adjuster dial of the Pro-Flo X™ pump. If the set screw is loose when the pump is pressurized, it could eject and cause injury to anyone in the area.

 **CAUTION:** Do not over-lubricate air supply — excess lubrication will reduce pump performance. Pump is pre-lubed.

 **Temperature Limits:**

Neoprene	-18°C to 83°C	0°F to 200°F
Buna-N	-12°C to 82°C	10°F to 180°F
EPDM	-51°C to 138°C	-80°F to 280°F
Viton®	-40°C to 177°C	-40°F to 350°F
Saniflex™	-29°C to 104°C	-20°F to 220°F
Polytetrafluoroethylene (PTFE)		
	4°C to 104°C	40°F to 220°F
Polyurethane	-12°C to 66°C	10°F to 150°F
WII-Flex™	-40°C to 107.2°C	(-40°F to 225°F)

NOTE: Not all materials are available for all models. Refer to Section 2 for material options for your pump.

NOTE: UL listed configured pumps have the following temperature limits:

UL 79 Buna-	-12.2°C (10°F) to 52°C (125°F)
UL 79 PTFE-	4.4°C (40°F) to 52°C (125°F)

 **CAUTION:** Canadian Standards Association (CSA) configured pumps should not be used in temperatures lower than 0.0°C to 51.6°C (32°F to 125°F).

 **CAUTION:** When choosing pump materials, be sure to check the temperature limits for all wetted components. Example: Viton® has a maximum limit of 177°C (350°F) but polypropylene has a maximum limit of only 79°C (175°F).

 **CAUTION:** Maximum temperature limits are based upon mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperatures. Consult Chemical Resistance Guide (E4) for chemical compatibility and temperature limits.

 **WARNING:** Prevention of static sparking — If static sparking occurs, fire or explosion could result. Pump, valves, and containers must be grounded to a proper grounding point when handling flammable fluids and whenever discharge of static electricity is a hazard.

 **CAUTION:** Canadian Standards Association (CSA) configured pumps must be electrically grounded using the grounding conductor provided. Improper grounding can cause improper and dangerous operation.

 **CAUTION:** For U.L. listed pumps, do not exceed 3.4 bar (50 psig) air supply pressure.

 **CAUTION:** Do not exceed 8.6 bar (125 psig) air supply pressure.

 **CAUTION:** Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100 psig) natural gas supply pressure.

 **CAUTION:** The process fluid and cleaning fluids must be chemically compatible with all wetted pump components. Consult Chemical Resistance Guide (E4).

 **CAUTION:** Do not exceed 82°C (180°F) air inlet temperature for Pro-Flo X™ models.

 **CAUTION:** Pumps should be thoroughly flushed before installing into process lines. FDA and USDA approved pumps should be cleaned and/or sanitized before being used.

 **CAUTION:** Always wear safety glasses when operating pump. If diaphragm rupture occurs, material being pumped may be forced out air exhaust.

 **CAUTION:** Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from pump. Disconnect all intake, discharge and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container.

 **CAUTION:** Blow out air line for 10 to 20 seconds before attaching to pump to make sure all pipeline debris is clear. Use an in-line air filter. A 5µ (micron) air filter is recommended.

 **NOTE:** When installing PTFE diaphragms, it is important to tighten outer pistons simultaneously (turning in opposite directions) to ensure tight fit. (See torque specifications in Section 7.)

 **NOTE:** Cast Iron PTFE-fitted pumps come standard from the factory with expanded PTFE gaskets installed in the diaphragm head of the liquid chamber. Teflon® gaskets cannot be re-used. Consult PS-TG for installation instructions during reassembly. This excludes Pro-Flo® P200 Advanced™ metal pumps.

 **NOTE:** Before starting disassembly, mark a line from each liquid chamber to its corresponding air chamber. This line will assist in proper alignment during reassembly.

 **CAUTION:** Pro-Flo X™ pumps can be used for submersible applications, when using the Pro-Flo X™ submersible option. Turbo-Flo™ pumps can also be used for submersible applications when using the Turbo-Flo™ submersible option.

CAUTION: Tighten all hardware prior to installation.

 **CAUTION:** The gas outlet of CSA configured pumps must be vented to a safe location in accordance with local codes or, in the absence of local codes, an industry or nationally recognized code having jurisdiction over the specified installation.

 **CAUTION:** For U.L. listed pumps, all pipe connections are to be made using U.L. classified gasoline-resistant pipe compound.

 **CAUTION:** For U.L. listed pumps all installations must conform to NFPA 30, NFPA 30A, and all other applicable codes.

 **CAUTION:** For U.L. listed pumps, air exhaust port is to be connected to pipe or tubing to be routed outdoors or other location determined to be equivalent.

 **CAUTION:** For U.L. listed pumps, pump is to be grounded using the jam-nut located at the top of the long vertical carriage bolt. The ground connection is marked with a tag having the grounding symbol.



Grounding Symbol

WILDEN PUMP & ENGINEERING, LLC

Section 2



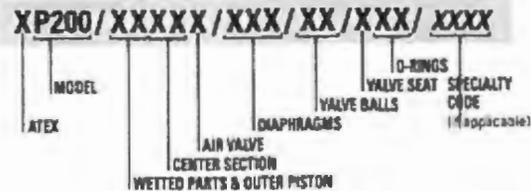
WILDEN PUMP DESIGNATION SYSTEM



**P200 & PX200
ADVANCED™
METAL**

**25 mm (1") Pump
Maximum Flow Rate:
212 lpm (56 gpm)**

LEGEND



MATERIAL CODES

MODEL

- P200 = PRO-FLO®
- XP200 = ATEX PRO-FLO X™
- PX200 = PRO-FLO X™
- XPX200 = ATEX PRO-FLO X™

WETTED PARTS & OUTER PISTON

- AA = ALUMINUM / ALUMINUM
- SS = STAINLESS STEEL / STAINLESS STEEL
- WW = DUCTILE IRON / DUCTILE IRON

CENTER SECTION

- AA = ALUMINUM
- PP = POLYPROPYLENE
- LL = ACETAL
- JJ = CONDUCTIVE POLYPROPYLENE

AIR VALVE

- A = ALUMINUM
- P = POLYPROPYLENE
- L = ACETAL
- J = CONDUCTIVE POLYPROPYLENE

DIAPHRAGMS

- BNS = BUNA-N (Red Dot)
- EPS = EPDM (Blue Dot)
- FSS = SANIFLEX™ (Hytre® (Cream))
- NES = NEOPRENE (Green Dot)
- PUS = POLYURETHANE (Clear)
- TEU = PTFE w/EPDM BACK-UP (White)
- TNU = PTFE w/NEOPRENE BACK-UP (White)
- TSU = PTFE w/SANIFLEX™ BACK-UP (White)
- VTS = VITON® (White Dot)
- WFS = WIL-FLEX™ (Santoprene® (Orange Dot))
- XBS = CONDUCTIVE BUNA-N (Two Red Dots)
- TXU = PTFE w/CONDUCTIVE BUNA-N BACK-UP
- ESD = BUNA-N
- TSS = FULL STROKE PTFE w/SANIFLEX™ BACK-UP
- TWS = FULL STROKE PTFE w/WIL-FLEX™ BACK-UP

VALVE BALL

- BN = BUNA-N (Red Dot)
- FS = SANIFLEX™ (Hytre® (Cream))
- EP = EPDM (Blue Dot)
- NE = NEOPRENE (Green Dot)
- PU = POLYURETHANE (Clear)
- TF = PTFE (White)
- VT = VITON® (White Dot)
- WF = WIL-FLEX™ (Santoprene® (Orange Dot))

VALVE SEAT

- A = ALUMINUM
- M = MILD STEEL
- S = STAINLESS STEEL

VALVE SEAT & MANIFOLD D-RING

- BN = BUNA-N
- FS = SANIFLEX™ (Hytre® (Cream))
- EP = EPDM
- NE = NEOPRENE
- PU = POLYURETHANE (Brown)
- TF = PTFE (White)
- VT = VITON®
- WF = WIL-FLEX™ (Santoprene®)

SPECIALTY CODES

0316 25 mm (1") BSPT side-ported inlet and discharge	0677 25 mm (1") NPT center-ported inlet and discharge manifold	0688 19 mm (3/4") BSPT center-ported discharge manifold (Pro-Flu "Drop-in")
0329 Single-point exhaust	0678 25 mm (1") BSPT center-ported inlet and discharge manifold	0730 25 mm (1") NPT side-ported inlet and discharge manifold
0391 25 mm (1") NPT center-ported inlet and discharge manifold, CSA	0687 25 mm (1") NPT center-ported inlet and discharge manifold, Submersible Center Section	0735 19 mm (3/4") NPT center-ported discharge manifold (Turbo-Flu "Drop-in"), Submersible Center Section
0397 25 mm (1") NPT side-ported inlet and discharge manifold, CSA	0688 25 mm (1") BSPT center-ported inlet and discharge manifold, Submersible Center Section	0736 19 mm (3/4") BSPT center-ported discharge manifold (Turbo-Flu "Drop-in"), Submersible Center Section
0492 U.L. Approved, Side-ported (1") inlet and discharge manifold)	0695 19 mm (3/4") NPT center-ported discharge manifold (Turbo-Flu "Drop-in")	0737 19 mm (3/4") NPT center-ported discharge manifold (Pro-Flu "Drop-in"), Submersible Center Section
0493 U.L. Approved, Center Ported NPT, Turbo "drop-in" (1" inlet facing air inlet, 3/4" discharge facing exhaust)	0696 19 mm (3/4") BSPT center-ported discharge manifold (Turbo-Flu "Drop-in")	0738 19 mm (3/4") BSPT center-ported discharge manifold (Pro-Flu "Drop-in"), Submersible Center Section
0494 U.L. Approved, Center Ported NPT, Pro-Flu "drop-in" (1" inlet facing exhaust, 3/4" discharge facing air inlet)	0687 19 mm (3/4") NPT center-ported discharge manifold (Pro-Flu "Drop-in")	

NOTE: The Wilden UL 79 Listed products covered by this manual are PX200 models followed by AA or SS, followed by AA, followed by A, followed by BNS or TNU, followed by BN or TF, followed by A or S, followed by BN or TF, followed by 0492, 0493, or 0494. Wilden UL Listed pumps have been evaluated for use at a 25 C (77F) ambient temperature with a maximum inlet pressure of 3.4 Bar (50 PSI).

NOTE: MOST ELASTOMERIC MATERIALS USE COLORED DOT FOR IDENTIFICATION

Norde® and Viton® is a registered trademark of Dupont Dow Elastomers.

WILDEN PUMP & ENGINEERING, LLC

Section 3

WILDEN

PROFLO[®]
PROGRESSIVE PUMP TECHNOLOGY

HOW IT WORKS—PUMP

The Wilden diaphragm pump is an air-operated, positive displacement, self-priming pump. These drawings show flow pattern through the pump upon its initial stroke. It is assumed the pump has no fluid in it prior to its initial stroke.

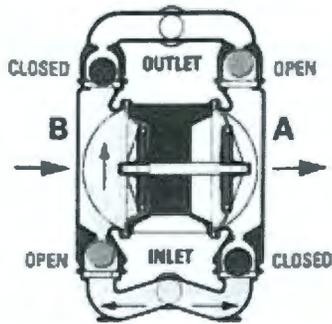


FIGURE 1 The air valve directs pressurized air to the back side of diaphragm A. The compressed air is applied directly to the liquid column separated by elastomeric diaphragms. The diaphragm acts as a separation membrane between the compressed air and liquid, balancing the load and removing mechanical stress from the diaphragm. The compressed air moves the diaphragm away from the center of the pump. The opposite diaphragm is pulled in by the shaft connected to the pressurized diaphragm. Diaphragm B is on its suction stroke; air behind the diaphragm has been forced out to atmosphere through the exhaust port of the pump. The movement of diaphragm B toward the center of the pump creates a vacuum within chamber B. Atmospheric pressure forces fluid into the inlet manifold forcing the inlet valve ball off its seat. Liquid is free to move past the inlet valve ball and fill the liquid chamber (see shaded area).

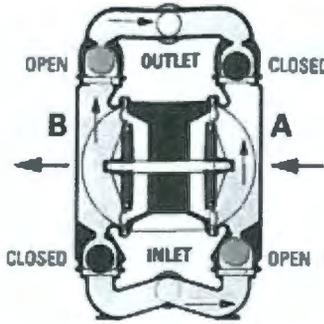


FIGURE 2 When the pressurized diaphragm, diaphragm A, reaches the limit of its discharge stroke, the air valve redirects pressurized air to the back side of diaphragm B. The pressurized air forces diaphragm B away from the center while pulling diaphragm A to the center. Diaphragm B is now on its discharge stroke. Diaphragm B forces the inlet valve ball onto its seat due to the hydraulic forces developed in the liquid chamber and manifold of the pump. These same hydraulic forces lift the discharge valve ball off its seat, while the opposite discharge valve ball is forced onto its seat, forcing fluid to flow through the pump discharge. The movement of diaphragm A toward the center of the pump creates a vacuum within liquid chamber A. Atmospheric pressure forces fluid into the inlet manifold of the pump. The inlet valve ball is forced off its seat allowing the fluid being pumped to fill the liquid chamber.

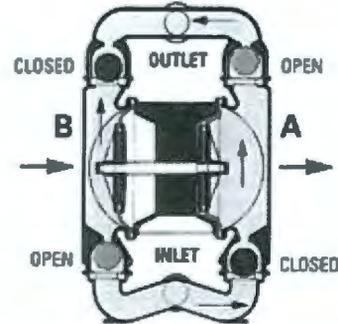
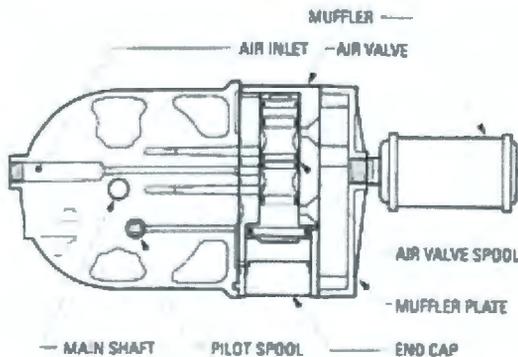


FIGURE 3 At completion of the stroke, the air valve again redirects air to the back side of diaphragm A, which starts diaphragm B on its suction stroke. As the pump reaches its original starting point, each diaphragm has gone through one suction and one discharge stroke. This constitutes one complete pumping cycle. The pump may take several cycles to completely prime depending on the conditions of the application.

PROFLO[®]
PROGRESSIVE PUMP TECHNOLOGY

HOW IT WORKS—AIR DISTRIBUTION SYSTEM



The Pro-Flo[®] patented air distribution system incorporates two moving parts: the air valve spool and the pilot spool. The heart of the system is the air valve spool and air valve. This valve design incorporates an unbalanced spool. The smaller end of the spool is pressurized continuously, while the large end is alternately pressurized then exhausted to move the spool. The spool directs pressurized air to one air chamber while exhausting the other. The air causes the main shaft/diaphragm assembly to shift to one side — discharging liquid on that side and pulling liquid in on the other side. When the shaft reaches the end of its stroke, the inner platen actuates the pilot spool, which pressurizes and exhausts the large end of the air valve spool. The repositioning of the air valve spool routes the air to the other air chamber.

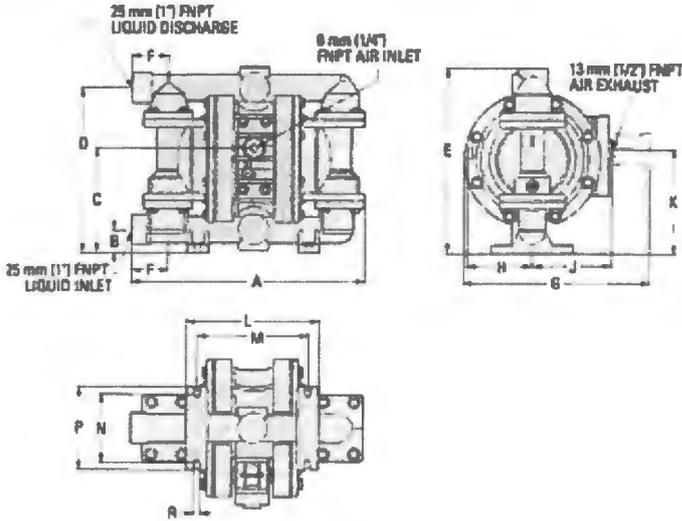
Section 4



DIMENSIONAL DRAWINGS



P200 Advanced™ Metal – Threaded

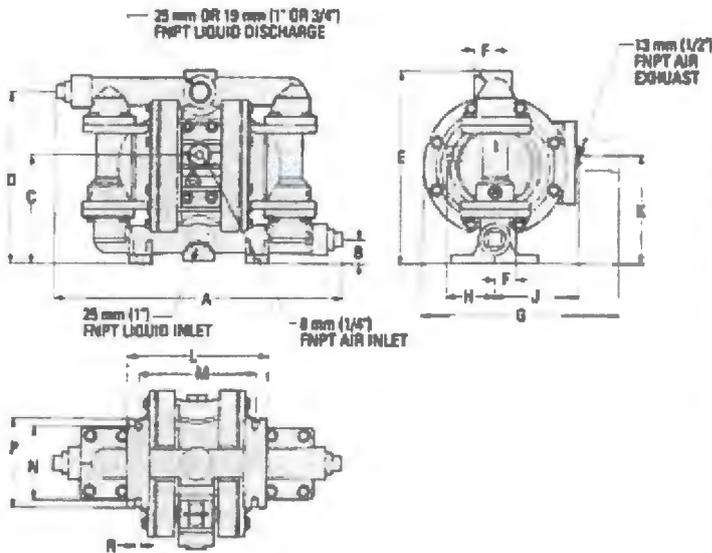


DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	361	14.2
B	36	1.4
C	163	6.4
D	254	10.0
E	287	11.3
F	50	2.2
G	287	11.3
H	99	3.8
J	122	4.8
K	160	6.3
L	206	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	0.4

REV C

P200 Advanced™ Metal – Center-Ported



DIMENSIONS

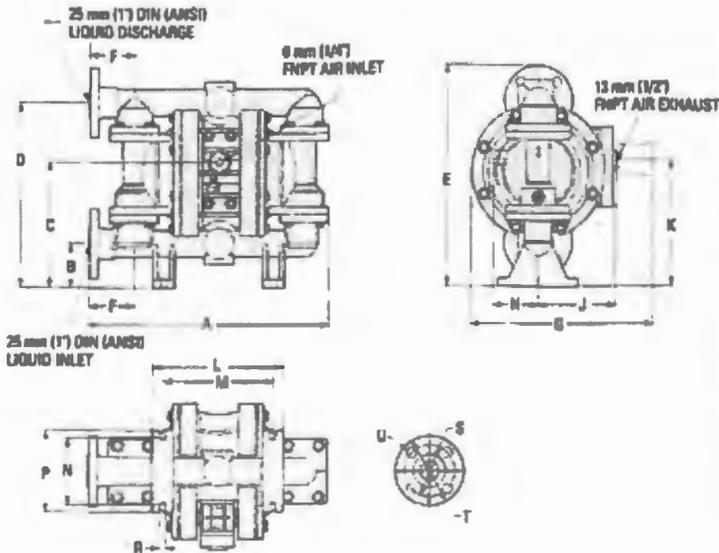
ITEM	METRIC (mm)	STANDARD (inch)
A	422	16.6
B	36	1.4
C	190	6.3
D	254	10.0
E	287	11.3
F	33	1.3
G	287	11.3
H	71	2.8
J	122	4.8
K	163	6.4
L	206	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	0.4

REV C



DIMENSIONAL DRAWINGS

P200 Advanced™ Stainless Steel – Flanged



DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	373	14.7
B	69	2.7
C	195	7.6
D	287	11.3
E	340	13.4
F	71	2.8
G	287	11.3
H	71	2.8
J	122	4.8
K	193	7.6
L	208	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	
DIN FLANGE		
S	85 DIA.	3.3 DIA.
T	115 DIA.	4.5 DIA.
U	14 DIA.	.5 DIA.
ANSI FLANGE		
S	79 DIA.	3.1 DIA.
T	109 DIA.	4.3 DIA.
U	14 DIA.	.5 DIA.

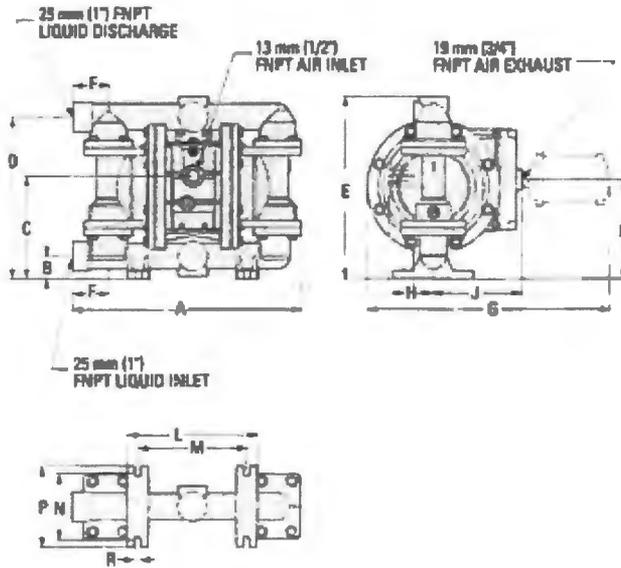
REV B



DIMENSIONAL DRAWINGS



PX200 Advanced™ Metal—Threaded

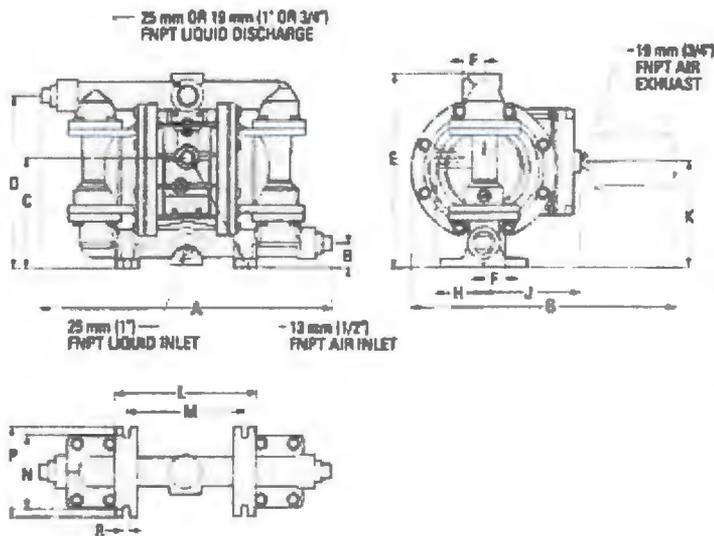


DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	361	14.2
B	36	1.4
C	163	6.4
D	254	10.0
E	287	11.3
F	58	2.2
G	384	15.1
H	71	2.8
J	148	5.5
K	155	6.1
L	208	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	0.4

REV 8

PX200 Advanced™ Metal—Center-Ported



DIMENSIONS

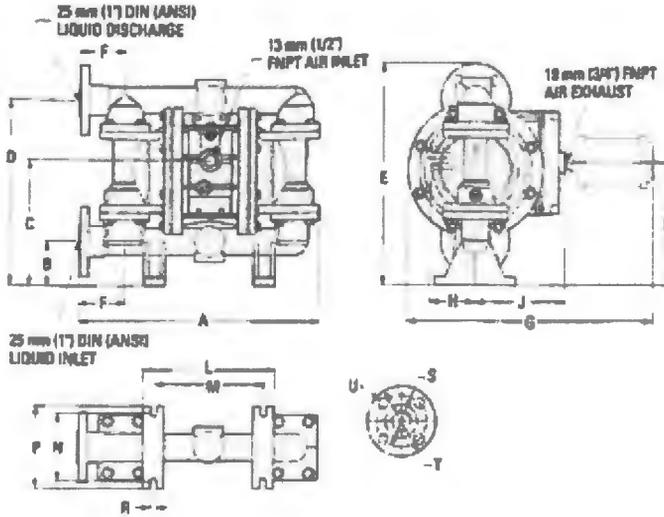
ITEM	METRIC (mm)	STANDARD (inch)
A	422	16.6
B	36	1.4
C	163	6.4
D	254	10.0
E	287	11.3
F	33	1.3
G	384	15.1
H	71	2.8
J	140	5.5
K	155	6.1
L	208	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	0.4



DIMENSIONAL DRAWINGS



**PX200 Advanced™
Stainless Steel—Flanged**



DIMENSIONS

ITEM	METRIC (mm)	STANDARD (inch)
A	373	14.7
B	68	2.7
C	195	7.6
D	287	11.3
E	340	13.4
F	71	2.8
G	384	15.1
H	71	2.8
J	140	5.5
K	188	7.4
L	206	8.1
M	173	6.8
N	104	4.1
P	127	5.0
R	10	0.4
DIN FLANGE		
S	85 DIA.	3.3 DIA.
T	115 DIA.	4.5 DIA.
U	14 DIA.	.6 DIA.
ANSI FLANGE		
S	79 DIA.	3.1 DIA.
T	109 DIA.	4.3 DIA.
U	14 DIA.	.6 DIA.

Section 5A



PERFORMANCE

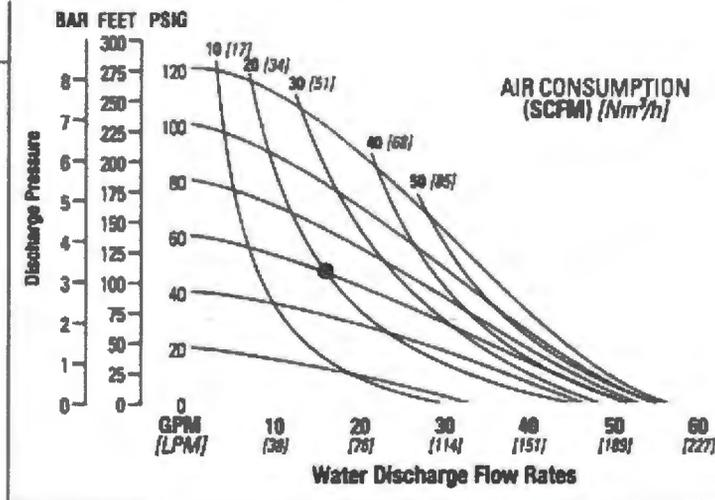


**P200 ADVANCED™ METAL
RUBBER-FITTED**

Height	340 mm (13.4")
Width	343 mm (14.7")
Depth	229 mm (9.0")
Ship Weight	Aluminum 11 kg (24 lbs.)
	Ductile Iron 21 kg (47 lbs.)
	316 Stainless Steel 23 kg (51 lbs.)
Air Inlet	6 mm (1/4")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	5.4 m Dry (17.6')
	9.3 m Wet (30.6')
Displacement Per Stroke	0.30 l (0.08 gal.) ¹
Max. Flow Rate	212 lpm (56 gpm)
Max. Size Solids	6.4 mm (1/4")

¹Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

Example: To pump 56.8 lpm (15 gpm) against a discharge pressure head of 3.3 bar (48 psig) requires 4.1 bar (60 psig) and 34.0 Nm³/h (20 scfm) air consumption. (See dot on chart.)



Flow rates indicated on chart were determined by pumping water.
For optimum life and performance, pumps should be specified so that daily operation parameters will fall in the center of the pump performance curve.

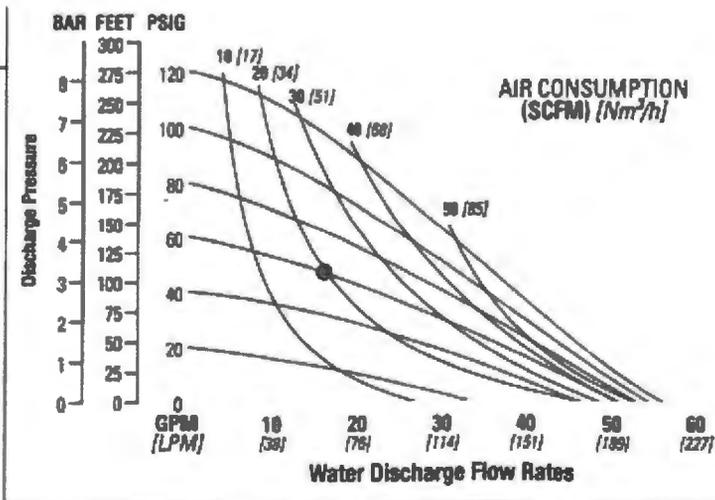
Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

**P200 ADVANCED™ METAL
TPE-FITTED**

Height	340 mm (13.4")
Width	373 mm (14.7")
Depth	229 mm (9.0")
Ship Weight	Aluminum 11 kg (24 lbs.)
	Ductile Iron 21 kg (47 lbs.)
	316 Stainless Steel 23 kg (51 lbs.)
Air Inlet	6 mm (1/4")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	4.1 m Dry (13.6')
	9.3 m Wet (30.6')
Displacement Per Stroke	0.34 l (0.09 gal.) ¹
Max. Flow Rate	212 lpm (56 gpm)
Max. Size Solids	6.4 mm (1/4")

¹Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

Example: To pump 60.8 lpm (16 gpm) against a discharge pressure head of 3.2 bar (47 psig) requires 4.1 bar (60 psig) and 34.0 Nm³/h (20 scfm) air consumption. (See dot on chart.)



Flow rates indicated on chart were determined by pumping water.
For optimum life and performance, pumps should be specified so that daily operation parameters will fall in the center of the pump performance curve.

Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.



PERFORMANCE

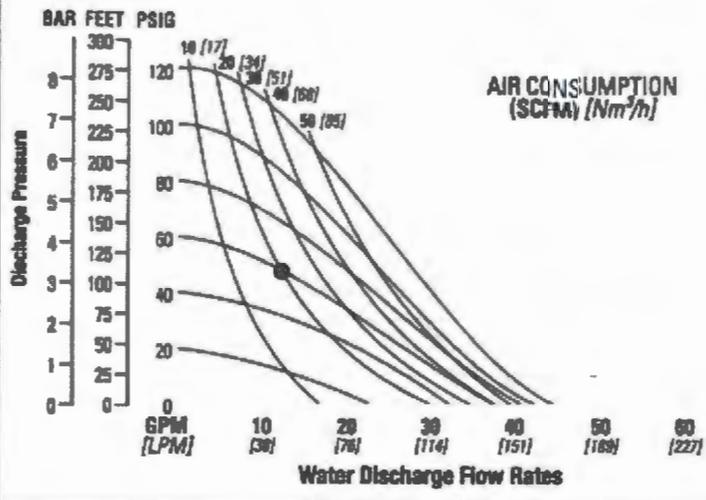


P200 ADVANCED™ METAL REDUCED STROKE PTFE-FITTED

Height	340 mm (13.4")
Width	373 mm (14.7")
Depth	229 mm (9.0")
Ship Weight	Aluminum 11 kg (24 lbs.) Ductile Iron 21 kg (47 lbs.) 316 Stainless Steel 23 kg (51 lbs.)
Air Inlet	6 mm (1/4")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	3.5 m Dry (11.4") 9.3 m Wet (30.6")
Displacement Per Stroke	0.23 l (0.06 gal.)
Max. Flow Rate	168 lpm (44 gpm)
Max. Size Solids	6.4 mm (1/4")

*Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

Example: To pump 45.4 lpm (12 gpm) against a discharge pressure head of 3.2 bar (47 psig) requires 4.1 bar (60 psig) and 34.0 Nm³/h (20 scfm) air consumption. (See dot on chart.)



Flow rates indicated on chart were determined by pumping water.

For optimum life and performance, pumps should be specified so that daily operation parameters will fall in the center of the pump performance curves.

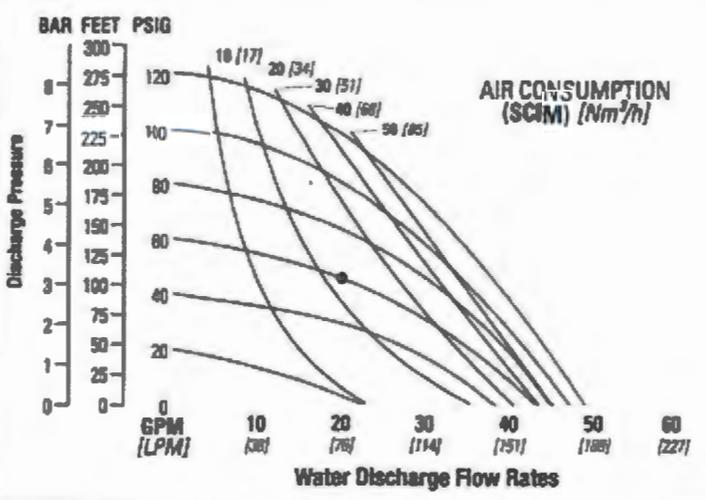
Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 8.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

P200 ADVANCED™ METAL FULL STROKE PTFE-FITTED

Height	340 mm (13.4")
Width	378 mm (14.7")
Depth	244 mm (9.6")
Ship Weight	Stainless Steel 23 kg (51 lbs.) Aluminum 11 kg (24 lbs.) Cast Iron 21 kg (47 lbs.)
Air Inlet	6 mm (1/4")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	5.5 m Dry (18.2") 9.0 m Wet (29.5")
Disp. Per Stroke	0.3 l (0.8 gal.)
Max. Flow Rate	185 lpm (49.0 gpm)
Max. Size Solids	6.4 mm (1/4")

*Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2.1 bar (30 psig) head pressure.

Example: To pump 20 GPM against a discharge head of 45 psig requires 60 psig and 23 scfm air consumption.



Flow rates indicated on chart were determined by pumping water.

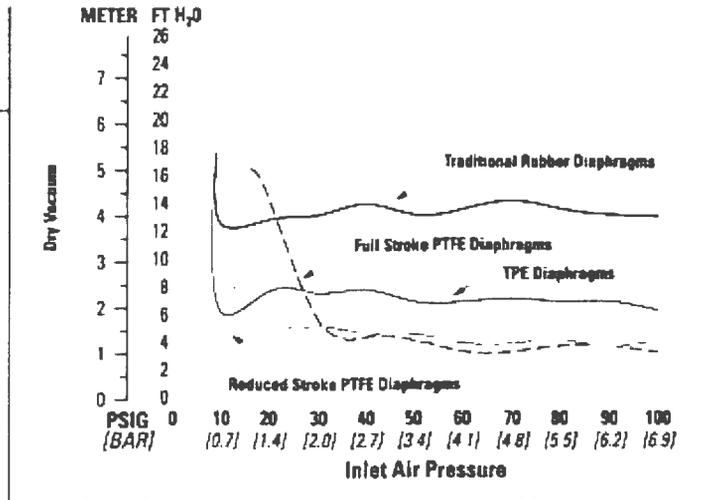
For optimum life and performance, pumps should be specified so that daily operation parameters will fall in the center of the pump performance curves.

Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 8.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.



SUCTION LIFT CURVE

**P200 ADVANCED™
METAL SUCTION LIFT
CAPABILITY**



PX200

M E T A L

WILDEN®

BAR FEET PSIG



PROFLO X
PROGRESSIVE PUMP TECHNOLOGY

PX200 PERFORMANCE

Section 5B

WILDEN



Pro-Flo X™ Operating Principal

The Pro-Flo X™ air distribution system with the revolutionary Efficiency Management System (EMS) offers flexibility never before seen in the world of AODD pumps. The patent-pending EMS is simple and easy to use. With the turn of an integrated

control dial, the operator can select the optimal balance of flow and efficiency that best meets the application needs. Pro-Flo X™ provides higher performance, lower operational costs and flexibility that exceeds previous industry standards.



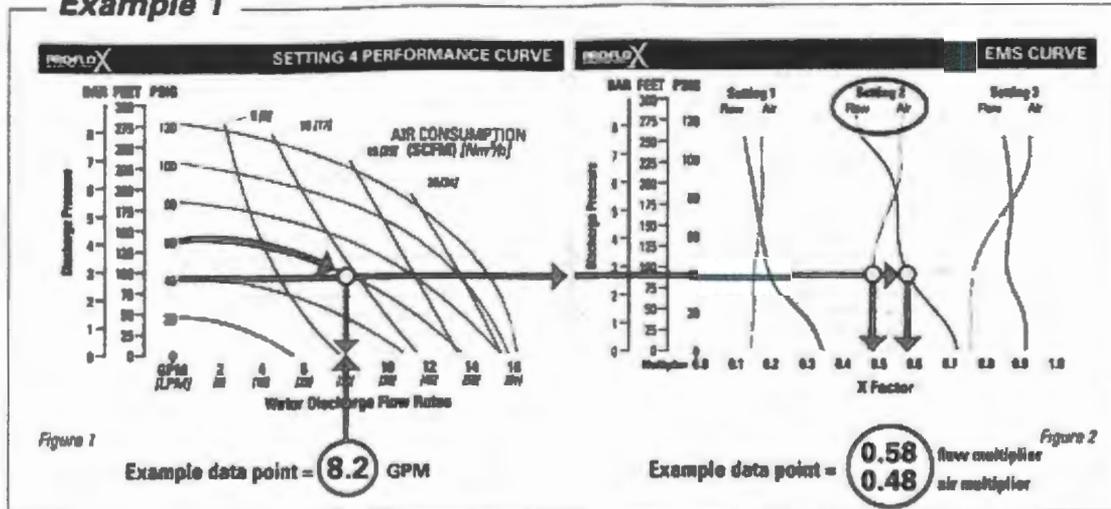
<p>Turning the dial changes the relationship between air inlet and exhaust porting.</p>	<p>Each dial setting represents an entirely different flow curve</p>	<p>Pro-Flo X™ pumps are shipped from the factory on setting 4, which is the highest flow rate setting possible</p>	<p>Moving the dial from setting 4 causes a decrease in flow and an even greater decrease in air consumption.</p>	<p>When the air consumption decreases more than the flow rate, efficiency is improved and operating costs are reduced.</p>



HOW TO USE THIS EMS CURVE



Example 1



This is an example showing how to determine flow rate and air consumption for your Pro-Flo X™ pump using the Efficiency Management System (EMS) curves and the performance curve. For this example we will be using 4.1 bar (60 psig) inlet air pressure and 2.8 bar (40 psig) discharge pressure and EMS setting 2.

Step 1: Identifying performance at setting 4. Locate the curve that represents the flow rate of the pump with 4.1 bar (60 psig) air inlet pressure. Mark the point where this curve crosses the horizontal line representing 2.8 bar (40 psig) discharge pressure. (Figure 1). After locating your performance point on the flow curve, draw a vertical line downward until reaching the bottom scale on the chart. Identify the flow rate (in this case, 8.2 gpm). Observe location of performance point relative to air consumption curves and approximate air consumption value (in this case, 9.8 scfm).

Step 2: Determining flow and air X Factors. Locate your discharge pressure (40 psig) on the vertical axis of the EMS curve (Figure 2). Follow along the 2.8 bar (40 psig) horizontal line until intersecting both flow and air curves for your desired EMS setting (in this case, setting 2). Mark the points where the EMS curves intersect the horizontal discharge pressure line. After locating your EMS points on the EMS

curve, draw vertical lines downward until reaching the bottom scale on the chart. This identifies the flow X Factor (in this case, 0.58) and air X Factor (in this case, 0.48).

Step 3: Calculating performance for specific EMS setting. Multiply the flow rate (8.2 gpm) obtained in Step 1 by the flow X Factor multiplier (0.58) in Step 2 to determine the flow rate at EMS setting 2. Multiply the air consumption (9.8 scfm) obtained in Step 1 by the air X Factor multiplier (0.48) in Step 2 to determine the air consumption at EMS setting 2 (Figure 3).

8.2 gpm	(flow rate for Setting 4)
<u>.58</u>	(Flow X Factor setting 2)
4.8 gpm	(Flow rate for setting 2)
9.8 scfm	(air consumption for setting 4)
<u>.48</u>	(Air X Factor setting 2)
4.7 scfm	(air consumption for setting 2)

Figure 3

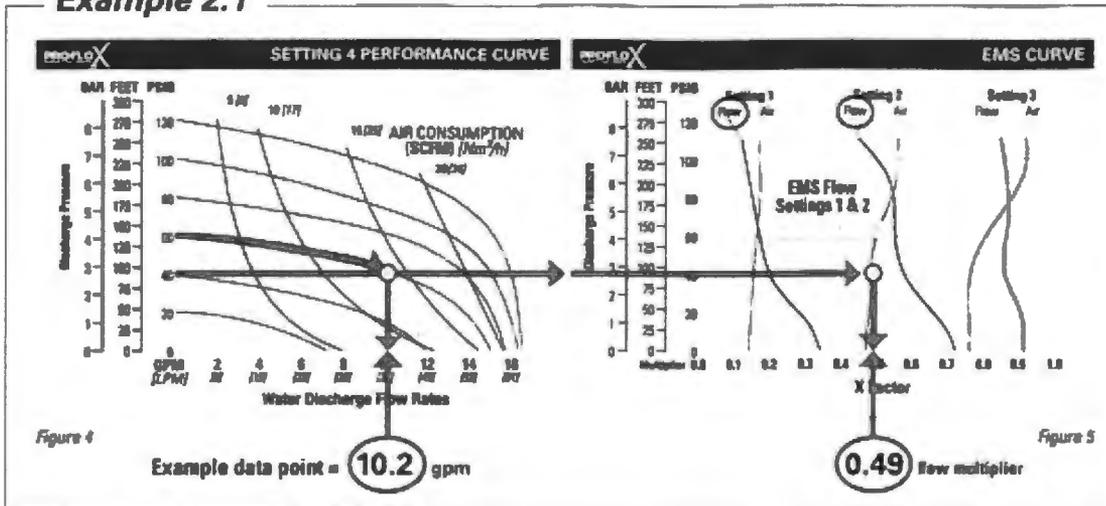
The flow rate and air consumption at Setting 2 are found to be 18.2 lpm (4.8 gpm) and 7.9 Nm³/h (4.7 scfm) respectively.



HOW TO USE THIS EMS CURVE



Example 2.1



This is an example showing how to determine the inlet air pressure and the EMS setting for your Pro-Flo X™ pump to optimize the pump for a specific application. For this example we will be using an application requirement of 18.9 lpm (5 gpm) flow rate against 2.8 bar (40 psig) discharge pressure. This example will illustrate how to calculate the air consumption that could be expected at this operational point.

DETERMINE EMS SETTING

Step 1: Establish inlet air pressure. Higher air pressures will typically allow the pump to run more efficiently, however, available plant air pressure can vary greatly. If an operating pressure of 6.9 bar (100 psig) is chosen when plant air frequently dips to 6.2 bar (90 psig) pump performance will vary. Choose an operating pressure that is within your compressed air system's capabilities. For this example we will choose 4.1 bar (60 psig).

Step 2: Determine performance point at setting 4. For this example an inlet air pressure of 4.1 bar (60 psig) inlet air pressure has been chosen. Locate the curve that represents the performance of the pump with 4.1 bar (60 psig) inlet air pressure. Mark the point where this curve crosses the horizontal line representing 2.8 bar (40 psig) discharge pressure. After locating this point on the flow curve, draw a vertical line downward until reaching the bottom scale on the chart and identify the flow rate.

In our example it is 38.6 lpm (10.2 gpm). This is the setting 4 flow rate. Observe the location of the performance point relative to air consumption curves and approximate air consumption value. In our example setting 4 air consumption is 24 Nm³/h (14 scfm). See figure 4.

Step 3: Determine flow X Factor. Divide the required flow rate 18.9 lpm (5 gpm) by the setting 4 flow rate 38.6 lpm (10.2 gpm) to determine the flow X Factor for the application.

$$5 \text{ gpm} / 10.2 \text{ gpm} = 0.49 \text{ (flow X Factor)}$$

Step 4: Determine EMS setting from the flow X Factor. Plot the point representing the flow X Factor (0.49) and the application discharge pressure 2.8 bar (40 psig) on the EMS curve. This is done by following the horizontal 2.8 bar (40 psig) psig discharge pressure line until it crosses the vertical 0.49 X Factor line. Typically, this point lies between two flow EMS setting curves (in this case, the point lies between the flow curves for EMS setting 1 and 2). Observe the location of the point relative to the two curves it lies between and approximate the EMS setting (figure 5). For more precise results you can mathematically interpolate between the two curves to determine the optimal EMS setting.

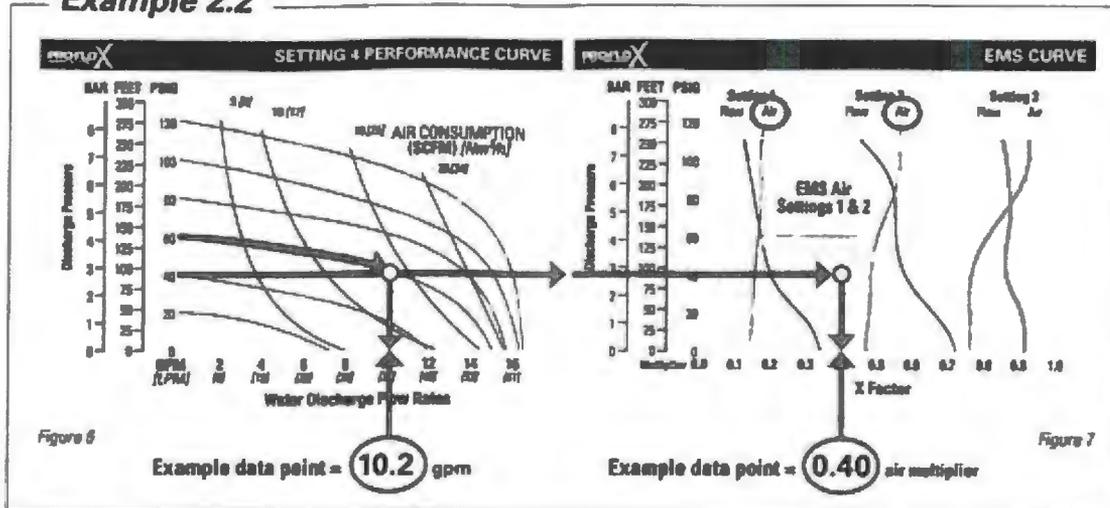
For this example the EMS setting is 1.8.



HOW TO USE THIS EMS CURVE



Example 2.2



Determine air consumption at a specific EMS setting.

Step 1: Determine air X Factor. In order to determine the air X Factor, identify the two air EMS setting curves closest to the EMS setting established in example 2.1 (in this case, the point lies between the air curves for EMS setting 1 and 2). The point representing your EMS setting (1.8) must be approximated and plotted on the EMS curve along the horizontal line representing your discharge pressure (in this case, 40 psig). This air point is different than the flow point plotted in example 2.1. After estimating (or interpolating) this point on the curve, draw a vertical line downward until reaching the bottom scale on the chart and identify the air X Factor (figure 7).

For this example the air X Factor is 0.40

Step 2: Determine air consumption. Multiply your setting 4 air consumption (14 scfm) value by the air X Factor obtained above (0.40) to determine your actual air consumption.

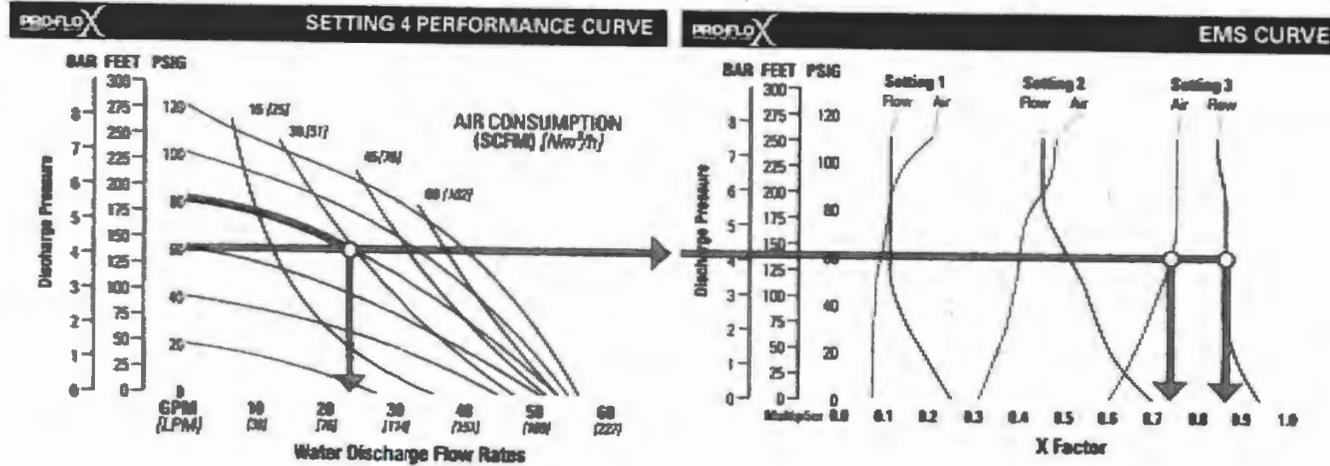
$$14 \text{ scfm} \times 0.40 = 5.6 \text{ SCFM}$$

In summary, for an application requiring 18.9 lpm (5 gpm) against 2.8 bar (40 psig) discharge pressure, the pump inlet air pressure should be set to 4.1 bar (60 psig) and the EMS dial should be set to 1.8. The pump would then consume 9.5 Nm³/h (5.6 scfm) of compressed air.

WILDEN PUMP & ENGINEERING, LLC

18

PX200 METAL RUBBER-FITTED



TECHNICAL DATA

Height	340 mm (13.4")
Width	378 mm (14.7")
Depth	244 mm (9.6")
Ship Weight	Aluminum 15 kg (34 lbs.)
	Ductile Iron 26 kg (57 lbs.)
	316 Stainless Steel 28 kg (61 lbs.)
Air Inlet	13 mm (1/2")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	5.9 m Dry (19.3')
	9.0 m Wet (29.5')
Disp. Per Stroke	0.30 l (0.08 gal.)
Max. Flow Rate	212.0 lpm (58.0 gpm)
Max. Size Solids	6.4 mm (1/4")

Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

PX200 Performance

The Efficiency Management System (EMS) can be used to optimize the performance of your Wilden pump for specific applications. The pump is delivered with the EMS adjusted to setting 4, which allows maximum flow.

The EMS curve allows the pump user to determine flow and air consumption at each EMS setting. For any EMS setting and discharge pressure, the "X factor" is used as a multiplier with the original values from the setting 4 performance curve to calculate the actual flow and air consumption values for that specific EMS setting. Note: you can interpolate between the setting curves for operation at intermediate EMS settings.

EXAMPLE

A PX200 metal, Rubber-fitted pump operating at EMS setting 4, achieved a flow rate of 87 lpm (23 gpm) using 49 Nm³/h (29 scfm) of air when run at 5.5 bar (80 psig) air inlet pressure and 4.1 bar (60 psig) discharge pressure (See dot on performance curve).

The end user did not require that much flow and wanted to reduce air consumption at his facility. He determined that EMS setting 3 would meet his needs. At 4.1 bar (60 psig) discharge pressure and EMS setting 3, the flow "X factor" is 0.86 and the air "X factor" is 0.74 (see dots on EMS curve).

Multiplying the original setting 4 values by the "X factors" provides the setting 3 flow rate of 75 lpm (20 gpm) and an air consumption of 36 Nm³/h (21 scfm). The flow rate was reduced by 14% while the air consumption was reduced by 26%, thus providing increased efficiency.

For a detailed example for how to set your EMS, see beginning of performance curve section.

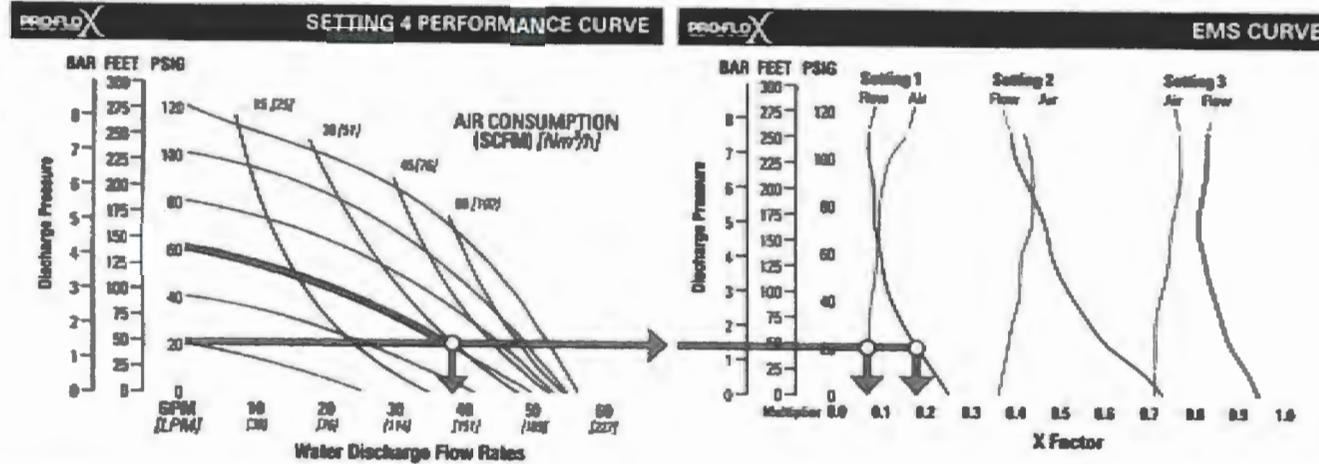
Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

PROFLO X PERFORMANCE

WILDEN

PX200 Performance

PX200 METAL TPE-FITTED



17

TECHNICAL DATA

Height	340 mm (13.4")
Width	378 mm (14.7")
Depth	244 mm (9.6")
Ship Weight	Aluminum 15 kg (34 lbs.)
	Ductile Iron 28 kg (61 lbs.)
	316 Stainless Steel 28 kg (61 lbs.)
Air Inlet	13 mm (1/2")
Inlet	25 mm (1")
Outlet	25 mm (1")
Suction Lift	5.5 m Dry (18.2')
	9.0 m Wet (29.5')
Disp. Per Stroke	0.34 l (0.09 gal.)
Max. Flow Rate	212.0 lpm (58.0 gpm)
Max. Size Solids	6.4 mm (1/4")
Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure	

WILDEN PUMP & ENGINEERING, LLC

The Efficiency Management System (EMS) can be used to optimize the performance of your Wilden pump for specific applications. The pump is delivered with the EMS adjusted to setting 4, which allows maximum flow.

The EMS curve allows the pump user to determine flow and air consumption at each EMS setting. For any EMS setting and discharge pressure, the "X factor" is used as a multiplier with the original values from the setting 4 performance curve to calculate the actual flow and air consumption values for that specific EMS setting. Note: you can interpolate between the setting curves for operation at intermediate EMS settings.

EXAMPLE

A PX200 metal, TPE-fitted pump operating at EMS setting 4, achieved a flow rate of 142 lpm (38 gpm) using 49 Nm³/h (23 scfm) of air when run at 4.1 bar (60 psig) air inlet pressure and 1.4 bar (20 psig) discharge pressure (See dot on performance curve).

The end user did not require that much flow and wanted to reduce air consumption at his facility. He determined that EMS setting 1 would meet his needs. At 1.4 bar (20 psig) discharge pressure and EMS setting 1, the flow "X factor" is 0.18 and the air "X factor" is 0.67 (see dots on EMS curve).

Multiplying the original setting 4 values by the "X factors" provides the setting 1 flow rate of 26 lpm (7 gpm) and an air consumption of 3 Nm³/h (2 scfm). The flow rate was reduced by 82% while the air consumption was reduced by 93%, thus providing increased efficiency.

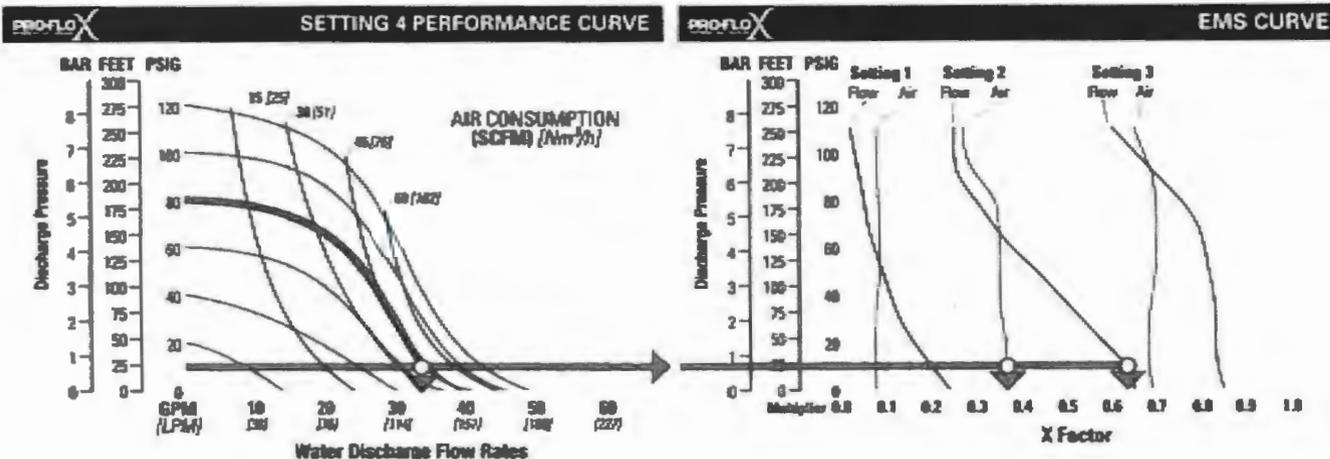
For a detailed example on how to set your EMS, see beginning of performance curve section.

Caution: Do not exceed 8.6 bar (125 psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100 psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

PROFLO
PERFORMANCE

WILDEN

PX200 METAL REDUCED STROKE PTFE-FITTED



TECHNICAL DATA

Height	.....	340 mm (13.4")
Width	.....	378 mm (14.7")
Depth	.....	244 mm (9.6")
Ship Weight	.....	Aluminum 15 kg (34 lbs.) Ductile Iron 26 kg (57 lbs.) 316 Stainless Steel 28 kg (61 lbs.)
Air Inlet	.....	13 mm (1/2")
Inlet	.....	25 mm (1")
Outlet	.....	25 mm (1")
Suction Lift	.....	4.3 m Dry (14.2') 9.0 m Wet (29.5')
Disp. Per Stroke	.....	0.23 l (0.06 gal.)
Max. Flow Rate	.....	185.4 lpm (49.0 gpm)
Max. Solids	.....	6.4 mm (1/4")

*Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2 bar (30 psig) head pressure.

The Efficiency Management System (EMS) can be used to optimize the performance of your Wilden pump for specific applications. The pump is delivered with the EMS adjusted to setting 4, which allows maximum flow.

The EMS curve allows the pump user to determine flow and air consumption at each EMS setting. For any EMS setting and discharge pressure, the "X factor" is used as a multiplier with the original values from the setting 4 performance curve to calculate the actual flow and air consumption values for that specific EMS setting. Note: you can interpolate between the setting curves for operation at intermediate EMS settings.

EXAMPLE

A PX200 metal, reduced stroke PTFE-fitted pump operating at EMS setting 4, achieved a flow rate of 129 lpm (34 gpm) using 75 Nm³/h (44 scfm) of air when run at 5.5 bar (80 psig) air inlet pressure and 0.7 bar (10 psig) discharge pressure (See dot on performance curve).

The end user did not require that much flow and wanted to reduce air consumption at his facility. He determined that EMS setting 2 would meet his needs. At 0.7 bar (10 psig) discharge pressure and EMS setting 2, the flow "X factor" is 0.63 and the air "X factor" is 0.36 (see dots on EMS curve).

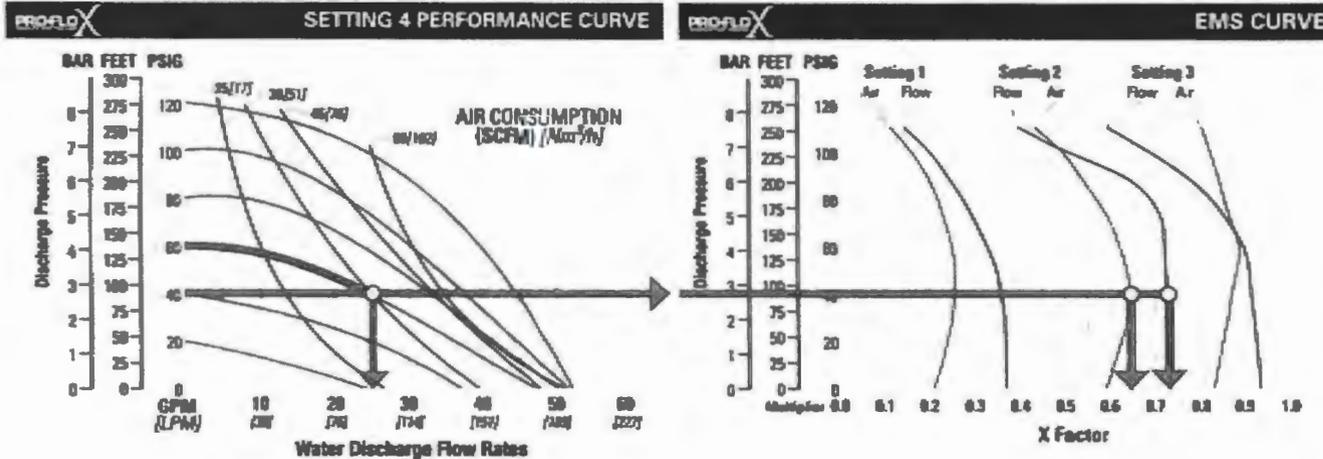
Multiplying the original setting 4 values by the "X factors" provides the setting 2 flow rate of 81 lpm (21 gpm) and an air consumption of 27 Nm³/h (16 scfm). The flow rate was reduced by 37% while the air consumption was reduced by 64%, thus providing increased efficiency.

For a detailed example for how to set your EMS, see beginning of performance curve section.

Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.3 bar (90psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

PX200 Performance

PX200 METAL FULL STROKE PTFE-FITTED



19

TECHNICAL DATA

Height	340 mm (13.4")
Width	378 mm (14.7")
Depth	344 mm (13.5")
Ship Weight	Stainless Steel 28 kg (61 lbs.)
	Aluminum 15 kg (34 lbs.)
	Cast Iron 26 kg (57 lbs.)
Air Inlet	13 mm (1/2")
Inlet	25 mm (1")
Outlet	25 mm (1")
Section Lift	5.5m Dry (18.2')
	9.0 m Wet (29.5')
Disp. Per Stroke	0.41 (0.11 gal.)
Max. Flow Rate	198 lpm (52.3 gpm)
Max. Size Solids	6.4 mm (1/4")

Displacement per stroke was calculated at 4.8 bar (70 psig) air inlet pressure against a 2.1 bar (30 psig) head pressure.

The Efficiency Management System (EMS) can be used to optimize the performance of your Wilden pump for specific applications. The pump is delivered with the EMS adjusted to setting 4, which allows maximum flow.

The EMS curve allows the pump user to determine flow and air consumption at each EMS setting. For any EMS setting and discharge pressure, the "X factor" is used as a multiplier with the original values from the setting 4 performance curve to calculate the actual flow and air consumption values for that specific EMS setting. Note: you can interpolate between the setting curves for operation at intermediate EMS settings.

EXAMPLE

A PX200 metal, full stroke PTFE fitted pump operating at EMS setting 4, achieved a flow rate of 95 lpm (25 gpm) using 51 Nm³/h (30 scfm) of air when run at 4.1 bar (60 psig) air inlet pressure and 2.8 bar (40 psig) discharge pressure (See dot on performance curve).

The end user did not require that much flow and wanted to reduce air consumption at his facility. He determined that EMS setting 2 would meet his needs. At 2.8 bar (40 psig) discharge pressure and EMS setting 2, the flow "X factor" is 0.73 and the air "X factor" is 0.64 (see dots on EMS curve).

Multiplying the original setting 4 values by the "X factors" provides the setting 2 flow rate of 69 lpm (18 gpm) and an air consumption of 33 Nm³/h (19 scfm). The flow rate was reduced by 27% while the air consumption was reduced by 36%, thus providing increased efficiency.

For a detailed example for how to set your EMS, see beginning of performance curve section.

Caution: Do not exceed 8.6 bar (125psig) air supply pressure. Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100psig) natural gas supply pressure. Please read all cautions and suggested installation sections before operating any Wilden product.

WILDEN PUMP & ENGINEERING, LLC

PERFORMANCE

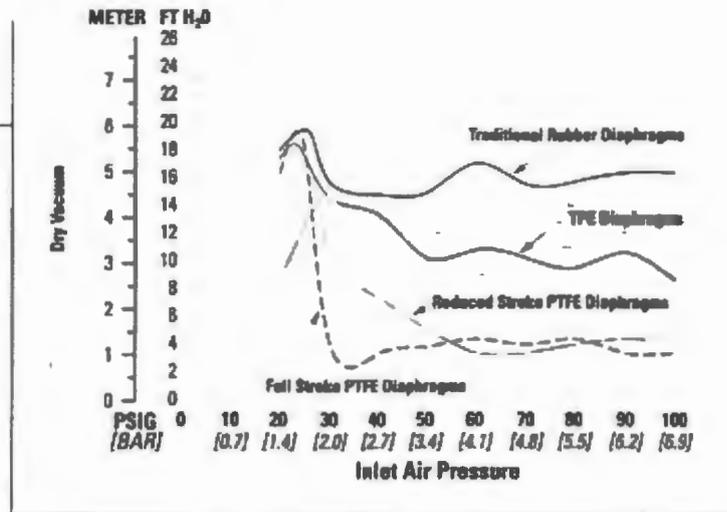
WILDEN



SUCTION LIFT CURVE



PX200 ADVANCED™
METAL SUCTION LIFT
CAPABILITY



Section 6

PRO-FLO
DESIGNED TO PUMP... TOUGH...

SUGGESTED INSTALLATION

WILDEN

Wilden pumps are designed to meet the performance requirements of even the most demanding pumping applications. They have been designed and manufactured to the highest standards and are available in a variety of liquid path materials to meet your chemical resistance needs. Refer to the performance section of this manual for an in-depth analysis of the performance characteristics of your pump. Wilden offers the widest variety of elastomer options in the industry to satisfy temperature, chemical compatibility, abrasion resistance and flex concerns.

The suction pipe size should be at least the equivalent or larger than the diameter size of the suction inlet on your Wilden pump. The suction hose must be non-collapseable, reinforced type as these pumps are capable of pulling a high vacuum. Discharge piping should also be the equivalent or larger than the diameter of the pump discharge which will help reduce friction losses. It is critical that all fittings and connections are airtight or a reduction or loss of pump suction capability will result.

INSTALLATION: Months of careful planning, study, and selection efforts can result in unsatisfactory pump performance if installation details are left to chance.

Premature failure and long term dissatisfaction can be avoided if reasonable care is exercised throughout the installation process.

LOCATION. Noise, safety, and other logistical factors usually dictate where equipment will be situated on the production floor. Multiple installations with conflicting requirements can result in congestion of utility areas, leaving few choices for additional pumps.

Within the framework of these and other existing conditions, every pump should be located in such a way that six key factors are balanced against each other to maximum advantage.

ACCESS: First of all, the location should be accessible. If it's easy to reach the pump, maintenance personnel will have an easier time carrying out routine inspections and adjustments. Should major repairs become necessary, ease of access can play a key role in speeding the repair process and reducing total downtime.

AIR SUPPLY: Every pump location should have an air line large enough to supply the volume of air necessary to achieve the desired pumping rate. Use air pressure up to a maximum of 8.6 bar (125 psig) depending on pumping requirements.

For best results, the pumps should use a 5µ (micron) air filter, needle valve and regulator. The use of an air filter before the pump will ensure that the majority of any pipeline contaminants will be eliminated.

NOTE: Canadian Standards Association (CSA) configured pumps should not exceed 6.9 bar (100psig) natural gas supply pressure. Only CSA configured pumps should be operated using natural gas.

SOLENOID OPERATION: When operation is controlled by a solenoid valve in the air line, three-way valves should be used. This valve allows trapped air between the valve and the pump to bleed off which improves pump performance. Pumping volume can be estimated by counting the number of strokes per minute and then multiplying the figure by the displacement per stroke.

MUFFLER: Sound levels are reduced below OSHA specifications using the standard Wilden muffler. Other mufflers can be used to further reduce sound levels, but they usually reduce pump performance.

ELEVATION: Selecting a site that is well within the pump's dynamic lift capability will assure that loss-of-prime issues will be eliminated. In addition, pump efficiency can be adversely affected if proper station is not given to site location.

PIPING: Final determination of the pump site should not be made until the piping challenges of each possible location have been evaluated. The impact of current and future installations should be considered ahead of time to make sure that inadvertent restrictions are not created for any remaining sites.

For U.L. listed pumps, all installation must conform with NFPA 30, NFPA 30A, and other applicable codes. All pipe connections are to be made using U.L. classified gasoline-resistant pipe compound. Exhaust port is to be connected to pipe or tubing to be routed outdoors or other location determined to be equivalent.

The best choice possible will be a site involving the shortest and straightest hook-up of suction and discharge piping. Unnecessary elbows, bends, and fittings should be avoided. Pipe sizes should be selected to keep friction losses within practical limits. All piping should be supported independently of the pump. In addition, the piping should be aligned to avoid placing stress on the pump fittings.

Flexible hose can be installed to aid in absorbing the forces created by the natural reciprocating action of the pump. If the pump is to be bolted down to a solid location, a mounting pad placed between the pump and the foundation will assist in minimizing pump vibration. Flexible connections between the pump and rigid piping will also assist in minimizing pump vibration. If quick-closing valves are installed at any point in the discharge system, or if pulsation within a system becomes a problem, a surge suppressor (SD Equalizer™) should be installed to protect the pump, piping and gauges from surges and water hammer.

If the pump is to be used in a self-priming application, make sure that all connections are airtight and that the suction lift is within the model's ability. Note: Materials of construction and elastomer material have an effect on suction lift parameters. Please refer to the performance section for specifics.

When pumps are installed in applications involving flooded suction or suction head pressures, a gate valve should be installed in the suction line to permit closing of the line for pump service.

Pumps in service with a positive suction head are most efficient when inlet pressure is limited to 0.5-0.7 bar (7-10 psig). Premature diaphragm failure may occur if positive suction is 0.7 bar (10 psig) and higher.

SUBMERSIBLE APPLICATIONS: Pro-Flo X™ pumps can be used for submersible applications, when using the Pro-Flo X™ submersible option. Turbo-Flo™ pumps can also be used for submersible applications when using the Turbo-Flo™ submersible option.

NOTE: Pro-Flo⁺ and Accu-Flo™ pumps are not submersible.

ALL WILDEN PUMPS ARE CAPABLE OF PASSING SOLIDS. A STRAINER SHOULD BE USED ON THE PUMP INTAKE TO ENSURE THAT THE PUMP'S RATED SOLIDS CAPACITY IS NOT EXCEEDED.

CAUTION: DO NOT EXCEED 8.6 BAR (125 PSIG) AIR SUPPLY PRESSURE.

CAUTION: CANADIAN STANDARDS ASSOCIATION (CSA) CONFIGURED PUMPS SHOULD NOT EXCEED 6.9 BAR (100PSIG) NATURAL GAS SUPPLY PRESSURE.

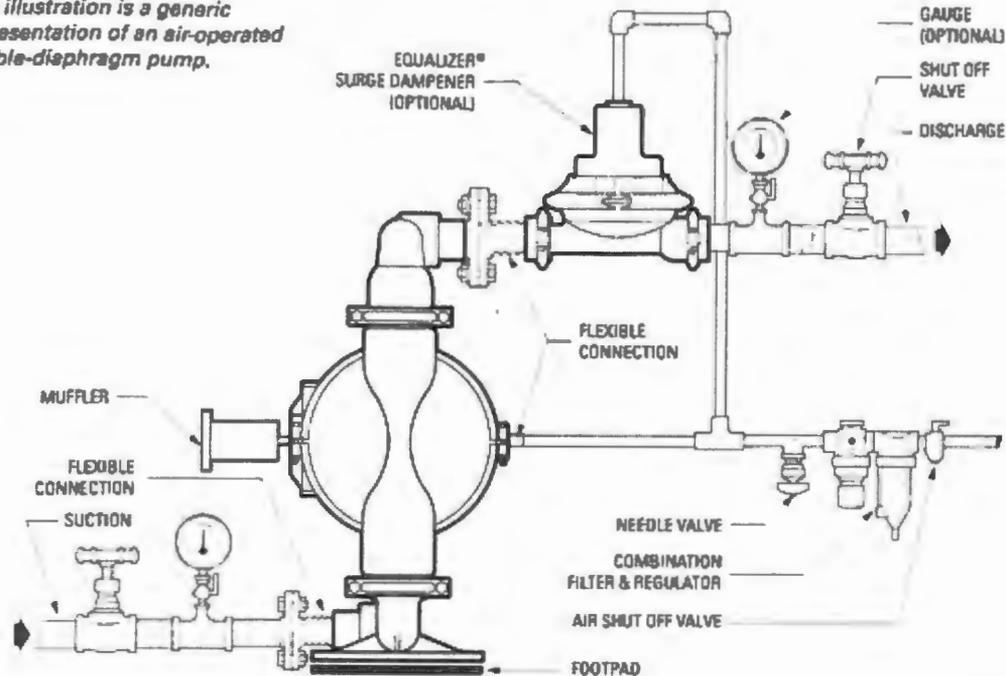
CAUTION: FOR U.L. LISTED PUMPS, DO NOT EXCEED 3.4 BAR (50 PSIG) AIR SUPPLY PRESSURE.

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SUGGESTED INSTALLATION

WILDEN

This illustration is a generic representation of an air-operated double-diaphragm pump.



NOTE: In the event of a power failure, the shut off valve should be closed, if the restarting of the pump is not desirable once power is regained.

AIR OPERATED PUMPS: To stop the pump from operating in an emergency situation, simply close the

shut off valve (user supplied) installed in the air supply line. A properly functioning valve will stop the air supply to the pump, therefore stopping output. This shut off valve should be located far enough away from the pumping equipment such that it can be reached safely in an emergency situation.



SUGGESTED OPERATION & MAINTENANCE

WILDEN

OPERATION: The Pro-Flo⁺ and Pro-Flo X[™] pumps are pre-lubricated, and do not require in-line lubrication. Additional lubrication will not damage the pump, however if the pump is heavily lubricated by an external source, the pump's internal lubrication may be washed away. If the pump is then moved to a non-lubricated location, it may need to be disassembled and re-lubricated as described in the ASSEMBLY/DISASSEMBLY INSTRUCTIONS.

Pump discharge rate can be controlled by limiting the volume and/or pressure of the air supply to the pump. A regulator is used to control air pressure while a needle valve is used to control volume. Pump discharge rate can also be controlled by throttling the pump discharge by partially closing a valve in the discharge line of the pump. This action increases friction loss which reduces flow rate. (See Section 5.) This is useful when the need exists to control the pump from a remote location. When the pump discharge pressure equals or exceeds the air supply pressure, the pump will stop; no bypass or pressure relief valve is needed, and pump damage will not occur. The pump has reached a "deadhead"

situation and can be restarted by reducing the fluid discharge pressure or increasing the air inlet pressure. The Pro-Flo and Pro-Flo X[™] pumps run solely on compressed air and do not generate heat, therefore your process fluid temperature will not be affected.

MAINTENANCE AND INSPECTIONS: Since each application is unique, maintenance schedules may be different for every pump. Frequency of use, line pressure, viscosity and abrasiveness of process fluid all affect the parts life of a Wilden pump. Periodic inspections have been found to offer the best means for preventing unscheduled pump downtime. Personnel familiar with the pump's construction and service should be informed of any abnormalities that are detected during operation.

RECORDS. When service is required, a record should be made of all necessary repairs and replacements. Over a period of time, such records can become a valuable tool for predicting and preventing future maintenance problems and unscheduled downtime. In addition, accurate records make it possible to identify pumps that are poorly suited to their applications.

TROUBLESHOOTING

Pump will not run or runs slowly.

1. Ensure that the air inlet pressure is at least 0.3 Bar (5 psig) above startup pressure and that the differential pressure (the difference between air inlet and liquid discharge pressures) is not less than 0.7 Bar (10 psig).
2. Check air inlet filter for debris (see recommended installation).
3. Check for extreme air leakage (blow by) which would indicate worn seals/bores in the air valve, pilot spool, main shaft.
4. Disassemble pump and check for obstructions in the air passageways or objects which would obstruct the movement of internal parts.
5. Check for sticking ball check valves. If material being pumped is not compatible with pump elastomers, swelling may occur. Replace ball check valves and seals with proper elastomers. Also, as the check valve balls wear out, they become smaller and can become stuck in the seats. In this case, replace balls and seats.
6. Check for broken inner piston which will cause the air valve spool to be unable to shift.
7. Remove plug from pilot spool exhaust.

Pump runs but little or no product flows.

1. Check for pump cavitation; slow pump speed down to allow thick material to flow into liquid chambers.

2. Verify that vacuum required to lift liquid is not greater than the vapor pressure of the material being pumped (cavitation).
3. Check for sticking ball check valves. If material being pumped is not compatible with pump elastomers, swelling may occur. Replace ball check valves and seats with proper elastomers. Also, as the check valve balls wear out, they become smaller and can become stuck in the seats. In this case, replace balls and seats.

Pump air valve freezes.

1. Check for excessive moisture in compressed air. Either install a dryer or hot air generator for compressed air. Alternatively, a coalescing filter may be used to remove the water from the compressed air in some applications.

Air bubbles in pump discharge.

1. Check for ruptured diaphragm.
2. Check tightness of outer pistons (refer to Section 7).
3. Check tightness of fasteners and integrity of o-rings and seals, especially at intake manifold.
4. Ensure pipe connections are airtight.

Product comes out air exhaust.

1. Check for diaphragm rupture.
2. Check tightness of outer pistons to shaft.

Section 7

WILDEN
PUMP

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PUMP DISASSEMBLY

Tools Required:

- 13 mm (1/2") Box Wrench
- 2 - 25 mm (1") Sockets or Adjustable Wrench
- Adjustable Wrench
- Vise equipped with soft jaws (such as plywood, plastic or other suitable material)

CAUTION: Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from the pump. Disconnect all intake, discharge, and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container. Be aware of any hazardous effects of contact with your process fluid.

NOTE: The model used for these instructions incorporates rubber diaphragms and balls. Models with PTFE diaphragms and balls are the same except where noted.



Step 1

Please note alignment marks on center section. Use to properly align liquid chamber to center section.



Step 2

Using a 13 mm (1/2") wrench, loosen the discharge manifold from the liquid chambers.



Step 3

Remove the discharge manifold to expose the valve balls, valve seats and valve seat O-rings.

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PUMP & ENGINEERING

PUMP DISASSEMBLY

WILDEN



Step 4

Remove the discharge valve balls, seats and valve seat o-rings from the discharge manifold and liquid chamber, inspect for nicks, gouges, chemical attack or abrasive wear. Note: Replace worn parts with genuine Wilden part for reliable performance.



Step 5

Using a 13 mm (1/2") wrench, remove the inlet manifold.



Step 6

Remove the inlet valve balls, seats and valve seat o-rings from the liquid chamber and inlet manifold, inspect for nicks, gouges, chemical attack or abrasive wear.



Step 7

Using a 13 mm (1/2") wrench, remove the liquid chambers from the center section.



Step 8

The liquid chamber should be removed to expose the diaphragm and outer piston. Rotate center section and remove the opposite liquid chamber.



Step 9

Using two adjustable wrenches or 25 mm (1") sockets, remove diaphragm assembly from center section assembly.

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PUMP TECHNOLOGY

PUMP DISASSEMBLY



Step 10

After loosening and removing the outer piston the diaphragm assembly can be disassembled.



Step 11

To remove the remaining diaphragm assembly from the shaft, secure shaft with soft jaws (a vise fitted with plywood or other suitable material) to ensure shaft is not nicked, scratched, or gouged. Using an adjustable wrench, remove diaphragm assembly from shaft. Inspect all parts for wear and replace with genuine Wilden parts if necessary.



Step 12

Inspect diaphragms, outer and inner pistons for signs of wear. Replace with genuine Wilden parts if necessary.

GROUNDING STRAP FOR CSA PX200 PUMPS

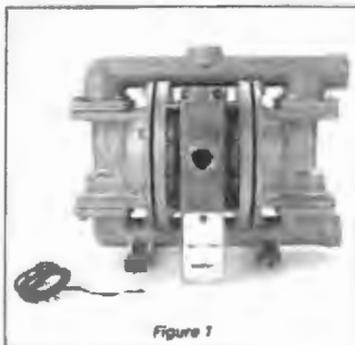


Figure 1



Figure 2

Canadian Standards Association (CSA) configured pumps must be electrically grounded using the grounding strap provided (Figure 1). Improper grounding can cause improper and dangerous operation. To properly attach the grounding strap to a CSA configured PX200 pump, identify the designated grounding location on the muffer plate; using the provided self-tapping screw and grounding wire, thread the grounding screw through the grounding wire lug, into the muffer plate and tighten securely (figure 2). Completion of the pump grounding procedure must be done in accordance with local codes, or in the absence of local codes, an industrial or nationally recognized code having jurisdiction over the specified installation.

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AIR VALVE DISASSEMBLY

Tools Required:

- 5 mm (3/16") Allen Wrench
- Snap Ring Pliers
- O-Ring Pick

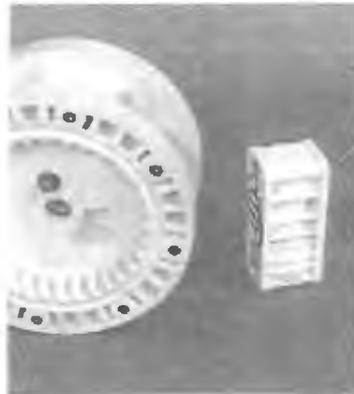
CAUTION: Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from the pump. Disconnect all intake, discharge, and air lines. Drain the pump by turning it upside down and allowing any fluid to flow into a suitable container. Be aware of hazardous effects of contact with your process fluid.

The Wilden P200 Advanced™ metal pump uses the revolutionary Pro-Flo® air distribution system. The PX200 Advanced™ metal pump uses the Pro-Flo X™ air distribution system. A 6 mm (1/4") air inlet connects the air supply to the center section. Proprietary composite seals reduce the coefficient of friction and allow the P200 to run lube-free. Constructed of polypropylene, the Pro-Flo® air distribution system is designed to perform in on/off, non-freezing, non-stalling, tough duty applications.



Step 1

Loosen the air valve bolts utilizing a 5 mm (3/16") Allen wrench.



Step 2

Remove muffer plate and air valve bolts from air valve assembly exposing muffer gasket for inspection. Replace if necessary.



Step 3

Lift away air valve assembly and remove air valve gasket for inspection. Replace if necessary.



AIR VALVE DISASSEMBLY

WILDEN



Step 4

Remove air valve end cap to expose air valve spool by simply lifting up on end cap once air valve bolts are removed.



Step 5

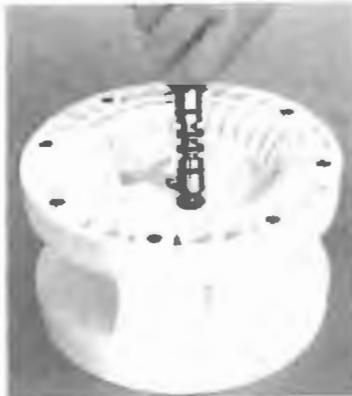
Remove air valve spool from air valve body by threading one air valve bolt into the end of the spool and gently sliding the spool out of the air valve body. Inspect seals for signs of wear and replace entire assembly if necessary. Use caution when handling air valve spool to prevent damaging seals.

NOTE: Seals should not be removed from assembly. Seals are not sold separately.



Step 6

Remove pilot spool sleeve retaining snap ring on both sides of center section with snap ring pliers.



Step 7

Remove pilot spool sleeve from center section.



Step 8

With o-ring pick, gently remove the o-ring from the opposite side of the "center hole cut" on the spool. Gently remove the pilot spool from sleeve and inspect for nicks or gouges and other signs of wear. Replace pilot sleeve assembly or outer sleeve o-rings if necessary. During re-assembly never insert the pilot spool into the sleeve with the "center cut" side first, this end incorporates the urethane o-ring and will be damaged as it slides over the ports cut in the sleeve.

NOTE: Seals should not be removed from pilot spool.

Seals are not sold separately.



AIR VALVE DISASSEMBLY

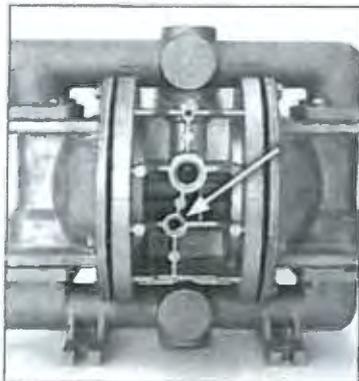


Step 9

Check center section Glyd™ rings for signs of wear. If necessary, remove Glyd™ rings with o-ring pick and replace.

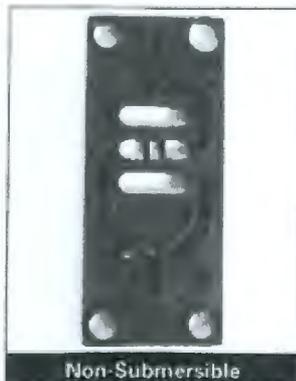


SUBMERSIBLE PRO-FLO X™

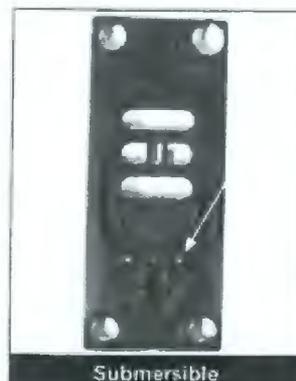


Step 1

Install a 1/4" NPT pipe plug (00-7010-08 or 00-7010-03) into the pilot spool bleed port located at the front of the center section.



Non-Submersible



Submersible

Step 2

Next, install an optional submersible air valve gasket (02-2621-52). The submersible air valve gasket can be purchased as a spare part or included with the purchase of a new Pro-Flo X™ pump.



REASSEMBLY HINTS & TIPS



ASSEMBLY:

Upon performing applicable maintenance to the air distribution system, the pump can now be reassembled. Please refer to the disassembly instructions for photos and parts placement. To reassemble the pump, follow the disassembly instructions in reverse order. The air distribution system needs to be assembled first, then the diaphragms and finally the wetted path. Please find the applicable torque specifications on this page. The following tips will assist in the assembly process.

- Lubricate air valve bore, center section shaft and pilot spool bore with NLGI grade 2 white EP bearing grease or equivalent.
- Clean the inside of the center section shaft bore to ensure no damage is done to new shaft seals.
- A small amount NLGI grade 2 white EP bearing grease can be applied to the muffler and air valve gaskets to locate gaskets during assembly.
- Make sure that the exhaust port on the muffler plate is centered between the two exhaust ports on the center section.
- Stainless bolts should be lubed to reduce the possibility of seizing during tightening.

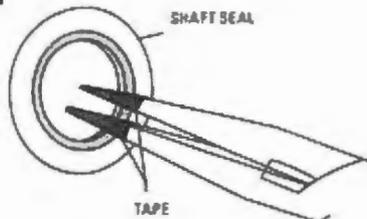
PRO-FLO[®] MAXIMUM TORQUE SPECIFICATIONS

Description of Part	Torque
Air Valve	3.1 N•m (27 in-lbs)
Outer Pistons, All Diaphragms	40.7 N•m (30 ft-lbs)
Top and Bottom Manifold	8.5 N•m (75 in-lbs)
Liquid Chamber to Center Section	8.5 N•m (75 in-lbs)

PRO-FLO X[™] MAXIMUM TORQUE SPECIFICATIONS

Description of Part	Torque
Air Valve	11.3 N•m (100 in-lbs)
Dial Set Screw	11.3 N•m (100 in-lbs)
Outer Pistons, All diaphragms	47.1 N•m (30 ft-lbs)
Top and Bottom Manifold	8.5 N•m (75 in-lbs)
Liquid Chamber to Center Section	8.5 N•m (75 in-lbs)

Figure A



WIL-11080-E-13

SHAFT SEAL INSTALLATION:

PRE-INSTALLATION

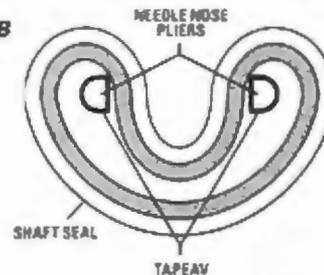
- Once all of the old seals have been removed, the inside of the bushing should be cleaned to ensure no debris is left that may cause premature damage to the new seals.

INSTALLATION

The following tools can be used to aid in the installation of the new seals:

- Needle Nose Pliers
- Phillips Screwdriver
- Electrical Tape
- Wrap electrical tape around each leg of the needle nose pliers (heat shrink tubing may also be used). This is done to prevent damaging the inside surface of the new seal.
- With a new seal in hand, place the two legs of the needle nose pliers inside the seal ring. (See Figure A.)
- Open the pliers as wide as the seal diameter will allow, then with two fingers pull down on the top portion of the seal to form kidney bean shape. (See Figure B.)
- Lightly clamp the pliers together to hold the seal into the kidney shape. Be sure to pull the seal into as tight of a kidney shape as possible, this will allow the seal to travel down the bushing bore easier.
- With the seal clamped in the pliers, insert the seal into the bushing bore and position the bottom of the seal into the correct groove. Once the bottom of the seal is seated in the groove, release the clamp pressure on the pliers. This will allow the seal to partially snap back to its original shape.
- After the pliers are removed, you will notice a slight bump in the seal shape. Before the seal can be properly resized, the bump in the seal should be removed as much as possible. This can be done with either the Phillips screwdriver or your finger. With either the side of the screwdriver or your finger, apply light pressure to the peak of the bump. This pressure will cause the bump to be almost completely eliminated.
- Lubricate the edge of the shaft with NLGI grade 2 white EP bearing grease.
- Slowly insert the center shaft with a rotating motion. This will complete the resizing of the seal.
- Perform these steps for the remaining seals.

Figure B



WILDEN PUMP & ENGINEERING, LLC

Section 8

WILDEN

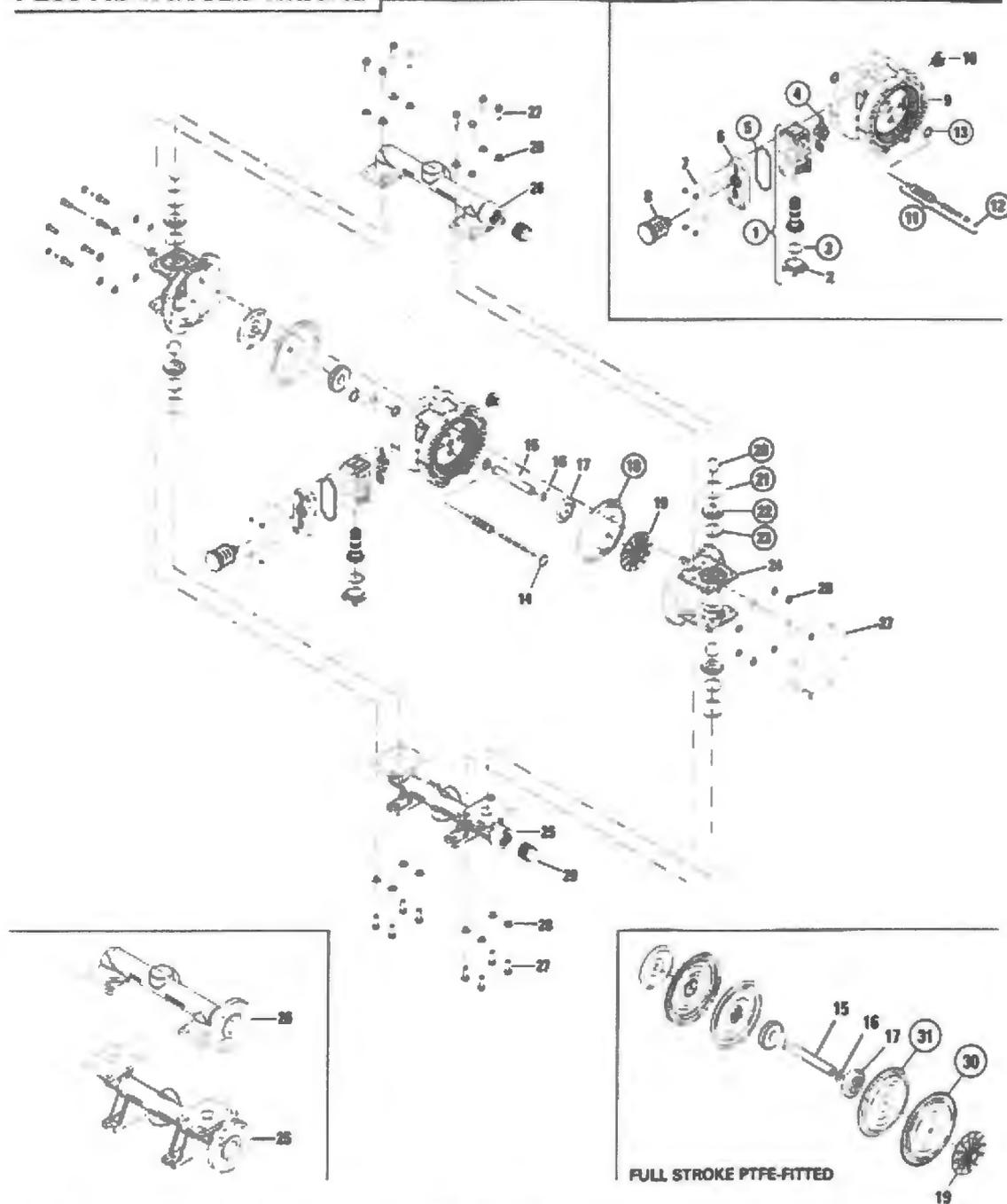
PROFLO
ADVANCED PUMP TECHNOLOGY

EXPLODED VIEW & PARTS LISTING

P200 ADVANCED METAL

Full Stroke Diaphragm-Fitted

EXPLODED VIEW



ALL CIRCLED PART IDENTIFIERS ARE INCLUDED IN REPAIR KITS (see section 9).



EXPLODED VIEW & PARTS LISTING

P200 ADVANCED METAL | Full Stroke Diaphragm-Fitted | PARTS LISTING

No.	Description	Qty.	P200/AAPPP P/N	P200/WSPPP P/N	P200/SSPPP P/N
1	Pro-Flo® Air Valve Assembly¹	1	01-2010-20	01-2010-20	01-2010-20
2	End Cap	1	01-2332-20	01-2332-20	01-2332-20
3	End Cap O-ring	1	01-2395-52	01-2395-52	01-2395-52
4	Air Valve Gasket	1	01-2615-52	01-2615-52	01-2615-52
5	Muffler Plate Gasket	1	01-3505-52	01-3505-52	01-3505-52
6	Muffler Plate	1	01-3181-20	01-3181-20	01-3181-20
7	Screw, SHC, 1/4"-20 x 3"	4	01-6001-03	01-6001-03	01-6001-03
8	Muffler	1	02-3510-99	02-3510-99	02-3510-99
9	Center Section	1	02-3142-20	02-3142-20	02-3142-20
10	Reducer Bushing	1	01-6950-20	01-6950-20	01-6950-20
11	Removable Pilot Sleeve Assy.	1	02-3880-99	02-3880-99	02-3880-99
12	Pilot Spool Retaining O-ring	2	04-2050-09-700	04-2050-09-700	04-2050-09-700
13	Shaft Seal	2	02-3210-55-225	02-3210-55-225	02-3210-55-225
14	Retaining Snap Ring	2	00-2650-03	00-2650-03	00-2650-03
15	Shaft	1	02-3810-03	02-3810-03	02-3810-03
16	Disc Spring	2	02-6802-08	02-6802-08	02-6802-08
17	Inner Piston	2	02-3701-01	02-3701-01	02-3701-01
18	Diaphragm	2	*	*	*
19	Outer Piston	2	02-4550-03	02-4550-03	02-4550-03
20	Valve Ball	4	*	*	*
21	Manifold O-ring	4	*	*	*
22	Valve Seat	4	02-1125-01	02-1125-08	02-1125-03
23	Valve Seat O-ring	4	*	*	*
24	Liquid Chamber	2	02-5015-01	02-5015-02	02-5015-03
25	Inlet Manifold, ANSI Flange	1	02-5090-01	02-5090-02	02-5090-03
	Inlet Manifold, DIN Flange	1	02-5081-01	02-5081-02	02-5081-03
	Inlet Manifold, Side Ported, 1" NPT	1	02-5095-01	02-5095-02	02-5095-03
	Inlet Manifold, Side Ported, 1" BSPT	1	02-5086-01	02-5096-02	02-5096-03
	Inlet Manifold, Center Ported, 1" NPT	1	02-5095-01-677	02-5095-02-677	02-5095-03-677
	Inlet Manifold, Center Ported, 1" BSPT	1	02-5096-01-678	02-5096-02-678	02-5096-03-678
26	Discharge Manifold, ANSI Flange	1	02-5030-01	02-5030-02	02-5030-03
	Discharge Manifold, DIN Flange	1	02-5031-01	02-5031-02	02-5031-03
	Discharge Manifold, Side Ported, 1" NPT	1	02-5035-01	02-5035-02	02-5035-03
	Discharge Manifold, Side Ported, 1" BSPT	1	02-5036-01	02-5036-02	02-5036-03
	Discharge Manifold, Center Ported, 3/4" NPT	1	02-5036-01-697	02-5036-02-697	02-5036-03-697
	Discharge Manifold, Center Ported, 3/4" BSPT	1	02-5036-01-698	02-5036-02-698	02-5036-03-698
	Discharge Manifold, Center Ported, 1" NPT	1	02-5035-01-677	02-5035-02-677	02-5035-03-677
	Discharge Manifold, Center Ported, 1" BSPT	1	02-5036-01-678	02-5036-02-678	02-5036-03-678
27	Screw, HNC, 5/16"-18 x 1"	32	08-6180-03-42	08-6180-03-42	08-6180-03-42
28	Washer, 5/16"	32	02-6731-03	02-6731-03	02-6731-03
29	Pipe Plug, 1" NPT	2	02-7010-01	02-7010-02	02-7010-03
	Pipe Plug, 1" BSP	2	02-7011-01	02-7011-02	02-7011-03
30	Diaphragm, Primary Full Stroke PTFE	2	*	*	*
31	Diaphragm, Backup Full Stroke PTFE	2	*	*	*

* Refer to Elastomer Options in Section 9.
¹ Air Valve Assembly includes items 2 and 3.
All boldface items are primary wear parts.



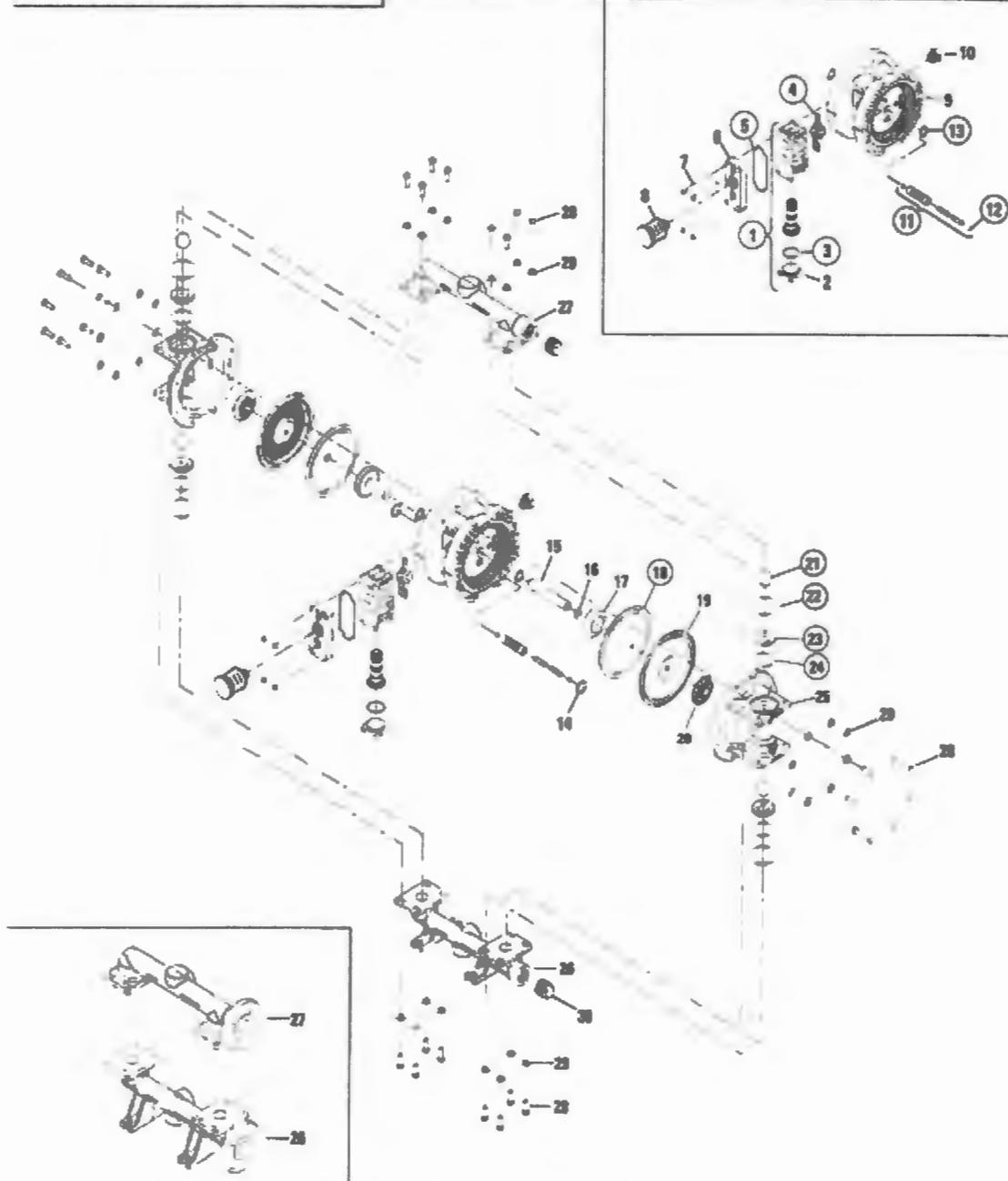
EXPLODED VIEW & PARTS LISTING



P200 ADVANCED METAL

Reduced Stroke Diaphragm-Fitted

EXPLODED VIEW



ALL CIRCLED PART IDENTIFIERS ARE INCLUDED IN REPAIR KITS (see section 9).



EXPLODED VIEW & PARTS LISTING



P200 ADVANCED METAL Reduced Stroke Diaphragm-Fitted PARTS LISTING

No.	Description	Qty.	P200/AAPPP P/N	P200/WSPPP P/N	P200/SSPPP P/N
1	Pro-Flo® Air Valve Assembly*	1	01-2010-20	01-2010-20	01-2010-20
2	End Cap	1	01-2332-20	01-2332-20	01-2332-20
3	End Cap O-ring	1	01-2395-52	01-2395-52	01-2395-52
4	Air Valve Gasket	1	01-2615-52	01-2615-52	01-2615-52
5	Muffler Plate Gasket	1	01-3505-52	01-3505-52	01-3505-52
6	Muffler Plate	1	01-3181-20	01-3181-20	01-3181-20
7	Screw, SHC, 1/4"-20 x 3"	4	01-6001-03	01-6001-03	01-6001-03
8	Muffler	1	02-3510-99	02-3510-99	02-3510-99
9	Center Section	1	02-3142-20	02-3142-20	02-3142-20
10	Reducer Bushing	1	01-6950-20	01-6950-20	01-6950-20
11	Removable Pilot Sleeve Assy.	1	02-3880-99	02-3880-99	02-3880-99
12	Pilot Spool Retaining O-ring	2	04-2650-49-700	04-2650-49-700	04-2650-49-700
13	Shaft Seal	2	02-3210-55-225	02-3210-55-225	02-3210-55-225
14	Retaining Snap Ring	2	00-2650-03	00-2650-03	00-2650-03
15	Shaft	1	02-3840-83	02-3840-83	02-3840-83
16	Disc Spring	2	02-6802-08	02-6802-08	02-6802-08
17	Inner Piston	2	02-3751-01	02-3751-01	02-3751-01
18	Back-up Diaphragm	2	.	.	.
19	Diaphragm	2	02-1010-55	02-1010-55	02-1010-55
20	Outer Piston	2	02-4600-01	02-4600-03	02-4600-03
21	Valve Ball	4	02-1085-55	02-1085-55	02-1085-55
22	Manifold O-ring	4	70-1280-55	70-1280-55	70-1280-55
23	Valve Seat	4	02-1125-01	02-1125-08	02-1125-03
24	Valve Seat O-ring	4	02-1285-55	02-1285-55	02-1285-55
25	Liquid Chamber	2	02-5015-01	02-5015-02	02-5015-03
26	Inlet Manifold, ANSI Flange	1	02-5090-01	02-5090-02	02-5090-03
	Inlet Manifold, DIN Flange	1	02-5091-01	02-5091-02	02-5091-03
	Inlet Manifold, Side Ported, 1" NPT	1	02-5095-01	02-5095-02	02-5095-03
	Inlet Manifold, Side Ported, 1" BSPT	1	02-5096-01	02-5096-02	02-5096-03
	Inlet Manifold, Center Ported, 1" NPT	1	02-5095-01-677	02-5095-02-677	02-5095-03-677
	Inlet Manifold, Center Ported, 1" BSPT	1	02-5096-01-678	02-5096-02-678	02-5096-03-678
27	Discharge Manifold, ANSI Flange	1	02-5030-01	02-5030-02	02-5030-03
	Discharge Manifold, DIN Flange	1	02-5031-01	02-5031-02	02-5031-03
	Discharge Manifold, Side Ported, 1" NPT	1	02-5035-01	02-5035-02	02-5035-03
	Discharge Manifold, Side Ported, 1" BSPT	1	02-5036-01	02-5036-02	02-5036-03
	Discharge Manifold, Center Ported, 1/4" NPT	1	02-5035-01-697	02-5035-02-697	02-5035-03-697
	Discharge Manifold, Center Ported, 3/4" BSPT	1	02-5036-01-698	02-5036-02-698	02-5036-03-698
	Discharge Manifold, Center Ported, 1" NPT	1	02-5035-01-677	02-5035-02-677	02-5035-03-677
	Discharge Manifold, Center Ported, 1" BSPT	1	02-5036-01-678	02-5036-02-678	02-5036-03-678
28	Screw, HHC, 5/16"-18 x 1"	32	08-8180-03-42	08-8180-03-42	08-8180-03-42
29	Washer, 5/16"	32	02-6731-03	02-6731-03	02-6731-03
30	Pipe Plug, 1" NPT	2	02-7010-01	02-7010-02	02-7010-03
	Pipe Plug, 1" BSP	2	02-7011-01	02-7011-02	02-7011-03

*Air Valve Assembly includes items 2 and 3
All boldface items are primary wear parts.

PRO-FLO X

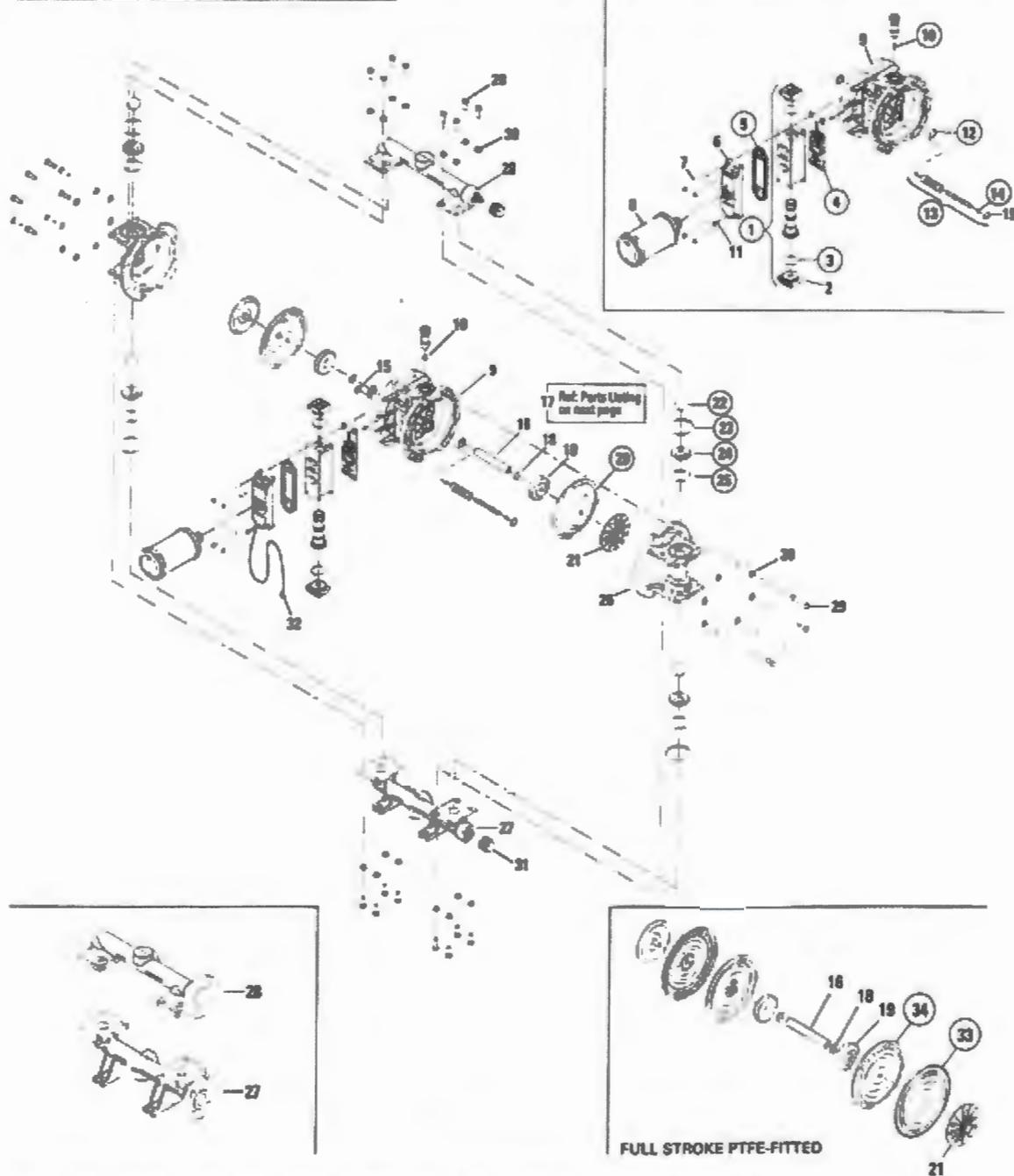
WILDEN

EXPLODED VIEW & PARTS LISTING

PX200 ADVANCED METAL

Full Stroke Diaphragm-Fitted

EXPLODED VIEW



ALL CIRCLED PART IDENTIFIERS ARE INCLUDED IN REPAIR KITS (see section 9).



EXPLODED VIEW & PARTS LISTING

PX200 ADVANCED METAL Full Stroke Diaphragm-Fitted PARTS LISTING

Item	Description	Qty	XPX200/AAAAA P/N	XPX200/VVWAAA P/N	XPX200/SSAAA P/N
1	Pro-Flo X [®] Air Valve Assembly ¹	1	02-2030-01	02-2030-01	02-2030-01
2	End Cap	2	01-2340-01	01-2340-01	01-2340-01
3	O-Ring (-126), End Cap (Ø1.362 x Ø.103)	2	01-2395-52	01-2395-52	01-2395-52
4	Gasket, Air Valve, Pro-Flo X [®]	1	02-2620-52	02-2620-52	02-2620-52
5	Gasket, Muffler Plate, Pro-Flo X [®]	1	02-3502-52	02-3502-52	02-3502-52
6	Muffler Plate, Pro-Flo X [®]	1	02-3185-01	02-3185-01	02-3185-01
7	Screw, SHC, Air Valve (1/4"-20 x 3")	4	01-6001-03	01-6001-03	01-6001-03
8	Muffler ²	1	08-3510-99R	08-3510-99R	08-3510-99R
9	Center Section Assembly, Pro-Flo X [®] ³	1	02-3148-01	02-3148-01	02-3148-01
10	O-Ring (-206), Air Adjustment Pin (Ø.094 x Ø.130)	1	00-1300-52	00-1300-52	00-1300-52
11	Screw, 10-32 x .50 Self-Tapping Grounding	1	04-6345-08	04-6345-08	04-6345-08
12	Shaft Seal	2	02-3210-55-225	02-3210-55-225	02-3210-55-225
13	Pilot Sleeve Assembly	1	02-3880-99	02-3880-99	02-3880-99
14	Pilot Spool Retaining O-Ring	1	04-2650-49-700	04-2650-49-700	04-2650-49-700
15	Retaining Ring	1	00-2650-03	00-2650-03	00-2650-03
16	Shaft	1	02-3810-03	02-3810-03	02-3810-03
17	Stud, 3/8-16 x 1 1/4" (not shown)	2	N/A	02-6150-08	02-6150-08
18	Disc Spring	2	02-6802-08	02-6802-08	02-6802-08
19	Inner Piston	2	02-3701-01	02-3701-01	02-3701-01
20	Diaphragm	2	*	*	*
21	Outer Piston	2	02-4550-01	02-4550-02	02-4550-03
22	Valve Ball	4	*	*	*
23	Manifold O-ring	4	*	*	*
24	Valve Seat	4	02-1125-01	02-1125-06	02-1125-03
25	Valve Seat O-ring	4	*	*	*
26	Liquid Chamber	2	02-5015-01	02-5015-02	02-5015-03
27	Inlet Manifold, ANSI Flange	1	02-5090-01	02-5090-02	02-5090-03
	Inlet Manifold, DIN Flange	1	02-5091-01	02-5091-02	02-5091-03
	Inlet Manifold, Side Ported, 1" NPT	1	02-5095-01	02-5095-02	02-5095-03
	Inlet Manifold, Side Ported, 1" BSPT	1	02-5096-01	02-5096-02	02-5096-03
	Inlet Manifold, Center Ported, 1" NPT	1	02-5095-01-677	02-5095-02-677	02-5095-03-677
	Inlet Manifold, Center Ported, 1" BSPT	1	02-5096-01-678	02-5096-02-678	02-5096-03-678
28	Discharge Manifold, ANSI Flange	1	02-5030-01	02-5030-02	02-5030-03
	Discharge Manifold, DIN Flange	1	02-5031-01	02-5031-02	02-5031-03
	Discharge Manifold, Side Ported, 1" NPT	1	02-5035-01	02-5035-02	02-5035-03
	Discharge Manifold, Side Ported, 1" BSPT	1	02-5036-01	02-5036-02	02-5036-03
	Discharge Manifold, Center Ported, 3/4" NPT	1	02-5035-01-697	02-5035-02-697	02-5035-03-697
	Discharge Manifold, Center Ported, 3/4" BSPT	1	02-5036-01-698	02-5036-02-698	02-5036-03-698
	Discharge Manifold, Center Ported, 1" NPT	1	02-5035-01-677	02-5035-02-677	02-5035-03-677
	Discharge Manifold, Center Ported, 1" BSPT	1	02-5036-01-678	02-5036-02-678	02-5036-03-678
29	Screw, HNC, 5/16-18 x 1"	32	08-6180-03-42	08-6180-03-42	08-6180-03-42
30	Washer, 5/16	32	02-6731-03	02-6731-03	02-6731-03
31	Pipe Plug, 1" NPT	2	02-7010-01	02-7010-02	02-7010-03
	Pipe Plug, 1" BSPT	2	02-7011-03	02-7011-02	02-7011-03
32	Grounding Strap, CSA ⁴	1	01-8303-99	01-8303-99	01-8303-99
33	Diaphragm, Primary Full Stroke PTFE	2	02-1040-55	02-1040-55	02-1040-55
34	Diaphragm, Backup Full Stroke PTFE	2	*	*	*

* Refer to Elastomer Options in Section 9.

¹Air Valve Assembly includes item numbers 2 and 3

²Center Section Assembly includes items 10, 11 and 12

³CSA pumps to use grounding strap.

For submersible Pro-Flo X[™] pump, use air valve gasket 01-2621-52 and pipe plug 00-7010-08 or 00-7010-03.

All boldface items are primary wear items.

*NOTE: Muffler should not be used with Canadian Standards Association (CSA) pumps. The gas outlet of CSA configured pumps must be vented to a safe location in accordance with local or, in the absence of local codes, an industry or nationally recognized code having jurisdiction over the specified installation.

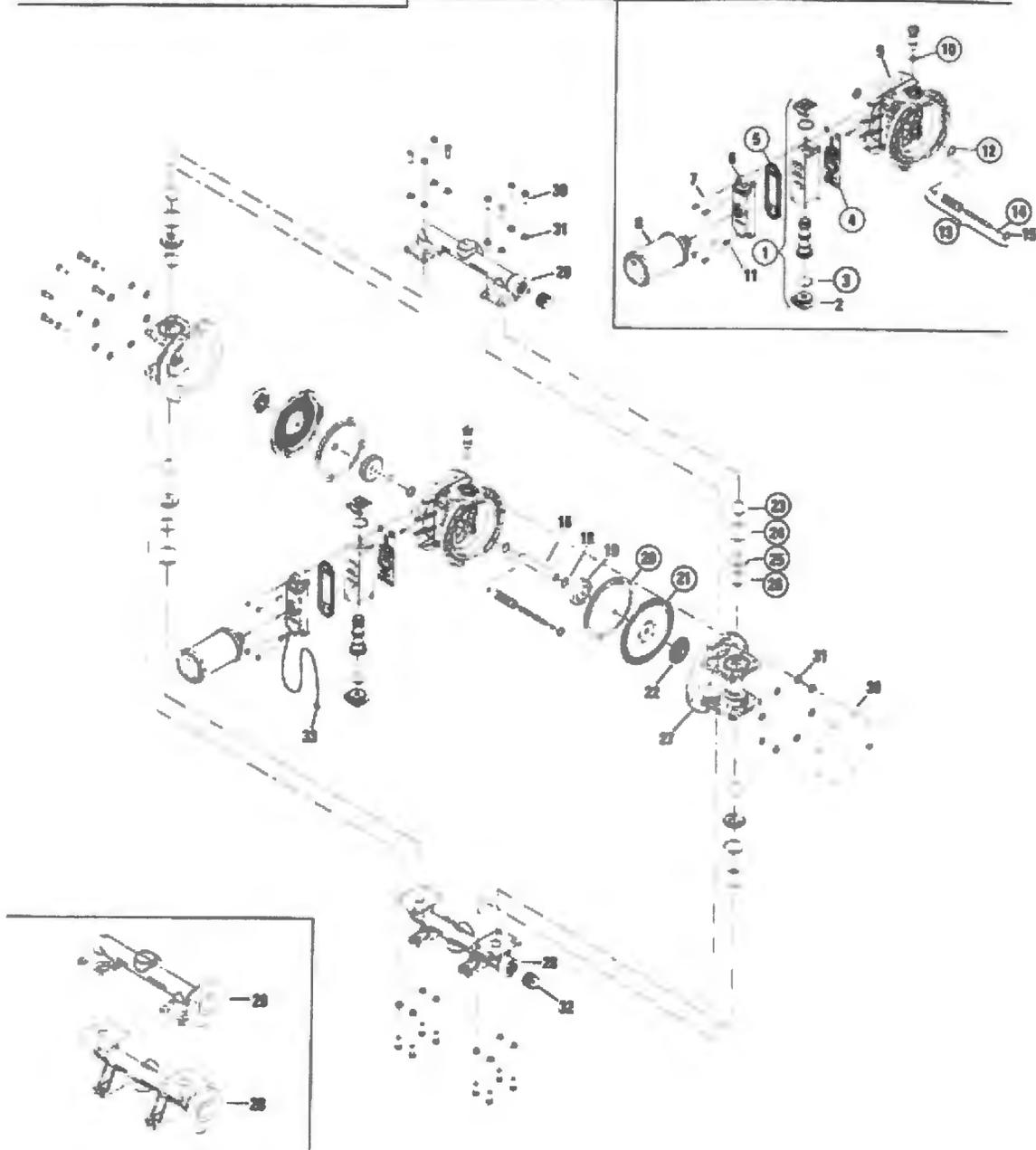


EXPLODED VIEW & PARTS LISTING

PX200 ADVANCED METAL

Reduced Stroke Diaphragm-Fitted

EXPLODED VIEW



ALL CIRCLED PART IDENTIFIERS ARE INCLUDED IN REPAIR KITS (see section 9).



EXPLODED VIEW & PARTS LISTING

PX200 ADVANCED METAL | Reduced Stroke Diaphragm-Fitted | PARTS LISTING

Item	Description	Qty	XPX200/AAAAA P/N	XPX200/WWAAA P/N	XPX200/SSAAA P/N
1	Pro-Flo X® Air Valve Assembly¹	1	02-2030-01	02-2030-01	02-2030-01
2	End Cap	2	01-2340-01	01-2340-01	01-2340-01
3	O-Ring (-126), End Cap (Ø1.362 x Ø.103)	2	01-2395-52	01-2395-52	01-2395-52
4	Gasket, Air Valve, Pro-Flo X®	1	02-2620-52	02-2620-52	02-2620-52
5	Gasket, Muffler Plate, Pro-Flo X®	1	02-3502-52	02-3502-52	02-3502-52
6	Muffler Plate, Pro-Flo X®	1	02-3185-01	02-3185-01	02-3185-01
7	Screw, SHC, Air Valve (1/4"-20 x 3")	4	01-6001-03	01-6001-03	01-6001-03
8	Muffler²	1	08-3510-99R	08-3510-99R	08-3510-99R
9	Center Section Assembly, Pro-Flo X®¹	1	02-3148-01	02-3148-01	02-3148-01
10	O-Ring (-208), Air Adjustment Pin (Ø.484 x Ø.139)	1	00-1300-52	00-1300-52	00-1300-52
11	Screw, 10-32 x .50 Self-Tapping Grounding	1	04-6345-08	04-6345-08	04-6345-08
12	Shaft Seal	2	02-3210-55-225	02-3210-55-225	02-3210-55-225
13	Pilot Sleeve Assembly	1	02-3880-99	02-3880-99	02-3880-99
14	Pilot Spool Retaining O-Ring	1	04-2650-49-700	04-2650-49-700	04-2650-49-700
15	Retaining Ring	1	00-2650-03	00-2650-03	00-2650-03
16	Shaft	1	02-3840-03	02-3840-03	02-3840-03
17	Stud, 3/8-16 x 1 1/4" (not shown)	2	N/A	02-6150-08	02-6150-08
18	Disc Spring	2	02-6802-08	02-6802-08	02-6802-08
19	Inner Piston	2	02-3751-01	02-3751-01	02-3751-01
20	Back-up Diaphragm	2	.	.	.
21	Diaphragm	2	02-1010-55	02-1010-55	02-1010-55
22	Outer Piston	2	02-4601-01	02-4600-02	02-4600-03
23	Valve Ball	4	02-1085-55	02-1085-55	02-1085-55
24	Manifold O-ring	4	70-1280-55	70-1280-55	70-1280-55
25	Valve Seat	4	02-1125-01	02-1125-08	02-1125-03
26	Valve Seat O-ring	4	02-1205-55	02-1205-55	02-1205-55
27	Liquid Chamber	2	02-5015-01	02-5015-02	02-5015-03
28	Inlet Manifold, ANSI Flange	1	02-5090-01	02-5090-02	02-5090-03
	Inlet Manifold, DIN Flange	1	02-5091-01	02-5091-02	02-5091-03
	Inlet Manifold, Side Ported, 1" NPT	1	02-5095-01	02-5095-02	02-5095-03
	Inlet Manifold, Side Ported, 1" BSPT	1	02-5096-01	02-5096-02	02-5096-03
	Inlet Manifold, Center Ported, 1" NPT	1	02-5095-01-677	02-5095-02-677	02-5095-03-677
	Inlet Manifold, Center Ported, 1" BSPT	1	02-5096-01-678	02-5096-02-678	02-5096-03-678
28	Discharge Manifold, ANSI Flange	1	02-5030-01	02-5030-02	02-5030-03
	Discharge Manifold, DIN Flange	1	02-5031-01	02-5031-02	02-5031-03
	Discharge Manifold, Side Ported, 1" NPT	1	02-5035-01	02-5035-02	02-5035-03
	Discharge Manifold, Side Ported, 1" BSPT	1	02-5036-01	02-5036-02	02-5036-03
	Discharge Manifold, Center Ported, 3/4" NPT	1	02-5035-01-687	02-5035-02-687	02-5035-03-687
	Discharge Manifold, Center Ported, 3/4" BSPT	1	02-5036-01-688	02-5036-02-688	02-5036-03-688
	Discharge Manifold, Center Ported, 1" NPT	1	02-5035-01-677	02-5035-02-677	02-5035-03-677
	Discharge Manifold, Center Ported, 1" BSPT	1	02-5036-01-678	02-5036-02-678	02-5036-03-678
30	Screw, HHC, 5/16-18 x 1"	32	08-6180-03-42	08-6180-03-42	08-6180-03-42
31	Washer, 5/16	32	02-6731-03	02-6731-03	02-6731-03
32	Pipe Plug, 1" NPT	2	02-7010-01	02-7010-02	02-7010-03
	Pipe Plug, 1" BSPT	2	02-7011-03	02-7011-02	02-7011-03
33	Grounding Strap, CSA³	1	01-6303-98	01-6303-99	01-6303-98

¹ Refer to Elastomer Options in Section 9.

² Air Valve Assembly includes item numbers 2 and 3.

³ Center Section Assembly includes items 10, 11 and 12.

⁴ CSA pumps to use grounding strap.

For submersible Pro-Flo X™ pump, use air valve gasket 01-2621-52 and pipe plug 00-7010-08 or 00-7010-03.

All boldface items are primary wear items.

*NOTE: Muffler should not be used with Canadian Standards Association (CSA) pumps. The gas outlet of CSA configured pumps must be vented to a safe location in accordance with local or, in the absence of local codes, an industry or nationally recognized code having jurisdiction over the specified installation.

Section 9



ELASTOMER OPTIONS

P200 Advanced™ Metal Pumps

MATERIAL	DIAPHRAGM (2)	REDUCED STROKE BACK-UP DIAPHRAGM (2)	FULL STROKE BACK-UP DIAPHRAGM (2)	VALVE BALL (4)	MANIFOLD O-RING (6)	VALVE SEAT O-RING (6)
Polyurethane	02-1010-50	N/A	N/A	02-1085-50	02-1372-50	02-1205-50
Neoprene	02-1010-51	02-1080-51	N/A	02-1085-51	02-1372-51	02-1205-51
Buna	02-1010-52	N/A	N/A	02-1085-52	70-1280-52	02-1205-52
Viton	02-1010-53	N/A	N/A	02-1085-53	02-1372-53	02-1205-53
Nordel	02-1010-54	02-1080-54	N/A	02-1085-54	02-1372-54	02-1205-54
PTFE	02-1010-55	N/A	N/A	02-1085-55	70-1280-55	02-1205-55
Full Stroke PTFE	02-1040-56	N/A	N/A	02-1085-55	70-1200-55	02-1205-55
Saniflex™	02-1010-58	02-1080-58	02-1085-56	02-1085-58	02-1372-58	02-1205-58
Wil-Flex™	02-1010-58	N/A	02-1085-57	02-1085-58	02-1372-58	02-1205-58

Neoprene and Nordel back-up diaphragms are available upon request. Please consult your local distributor.

ELASTOMER KIT OPTIONS

P200

NEOPRENE	BUNA	VITON	EPDM
02-9572-51	02-9572-52	02-9572-53	02-9572-54

PTFE	FULL STROKE PTFE	WIL-FLEX	SANIFLEX	POLYURETHANE
02-9572-55	Consult Factory	02-9572-58	02-9572-56	02-9572-50

PX200

NEOPRENE	BUNA	VITON	EPDM
02-9582-51	02-9582-52	02-9582-53	02-9582-54

PTFE	FULL STROKE PTFE	WIL-FLEX	SANIFLEX	POLYURETHANE
02-9578-55	Consult Factory	02-9582-58	02-9582-56	02-9582-50



WARRANTY

Each and every product manufactured by Wilden Pump and Engineering, LLC is built to meet the highest standards of quality. Every pump is functionally tested to insure integrity of operation.

Wilden Pump and Engineering, LLC warrants that pumps, accessories and parts manufactured or supplied by it to be free from defects in material and workmanship for a period of five (5) years from date of installation or six (6) years from date of manufacture, whichever comes first. Failure due to normal wear, misapplication, or abuse is, of course, excluded from this warranty.

Since the use of Wilden pumps and parts is beyond our control, we cannot guarantee the suitability of any pump or part for a particular application and Wilden Pump and Engineering, LLC shall not be liable for any consequential damage or expense arising from the use or misuse of its products on any application. Responsibility is limited solely to replacement or repair of defective Wilden pumps and parts.

All decisions as to the cause of failure are the sole determination of Wilden Pump and Engineering, LLC.

Prior approval must be obtained from Wilden for return of any items for warranty consideration and must be accompanied by the appropriate MSDS for the product(s) involved. A Return Goods Tag, obtained from an authorized Wilden distributor, must be included with the items which must be shipped freight prepaid.

The foregoing warranty is exclusive and in lieu of all other warranties expressed or implied (whether written or oral) including all implied warranties of merchantability and fitness for any particular purpose. No distributor or other person is authorized to assume any liability or obligation for Wilden Pump and Engineering, LLC other than expressly provided herein.

PLEASE PRINT OR TYPE AND FAX TO WILDEN

PUMP INFORMATION			
Item # _____		Serial # _____	
Company Where Purchased _____			
YOUR INFORMATION			
Company Name _____			
Industry _____			
Name _____		Title _____	
Street Address _____			
City _____	State _____	Postal Code _____	Country _____
Telephone _____	Fax _____	E-mail _____	Web Address _____
Number of pumps in facility? _____		Number of Wilden pumps? _____	
Types of pumps in facility (check all that apply): <input type="checkbox"/> Diaphragm <input type="checkbox"/> Centrifugal <input type="checkbox"/> Gear <input type="checkbox"/> Submersible <input type="checkbox"/> Lobe			
<input type="checkbox"/> Other _____			
Media being pumped? _____			
How did you hear of Wilden Pump? <input type="checkbox"/> Trade Journal <input type="checkbox"/> Trade Show <input type="checkbox"/> Internet/E-mail <input type="checkbox"/> Distributor			
<input type="checkbox"/> Other _____			

ONCE COMPLETE, FAX TO (909) 783-3440
NOTE: WARRANTY VOID IF PAGE IS NOT FAXED TO WILDEN
WILDEN PUMP & ENGINEERING, LLC



ADVANCED SERIES

Advance Your Process

- Advanced wetted path designs
- Lower the cost of operation
- Maximize product containment
- Longer MTBF (Mean Time Between Failures)
- Enhanced internal clearance
- The result of advanced thought

UNITEC INTEGRITY

Enrich Your Process

- Simplicity of design
- Unique Technology
- Reliable, leak-free & quiet
- Validated & certified
- Intrinsically safe
- The result of unique thought



SANIFLO

Refine Your Process

- Designed for sanitary applications
- Minimize product degradation
- Improved production yields
- Easy to inspect, clean & assemble
- Minimized water requirements
- The result of progressive thought

ACCESSORIES

Maximize Your Process

- Electronic control & monitoring
- Level control & containment
- Pulsation dampening
- Drum unloading systems
- Complete system solutions
- The result of innovative thought



ORIGINAL SERIES

Simplify Your Process

- Long standing design simplicity
- Portable & submersible
- Variable connection options
- Fewest parts in industry
- Solutions since 1955
- The result of original thought



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Your Local Authorized Distributor:



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MODEL B2

OWNER'S MANUAL

BASICS - The *Model B2*TM controller is engineered to provide control of the number of cycles produced by a solenoid-controlled AODD pump in a "Batch". It also determine at what pump speed those cycles will be accomplished, how many "Batches" are to be incorporated in a single operation and the interval of time between the batches. A cycle is defined as the pumping of both pump "water" chambers. The system requires 110 volts AC (220 also available) to power it and delivers 12 volts DC to the pump solenoid. You must use the appropriate pump 12 volt DC solenoid when using a *Model B2*. The system is programmed using the 8-button keypad on the cover. The system is operated using the keypad on the cover of the unit and can be remotely paused or stopped using dry contacts, via a Switch terminal strip on the circuit board. The enclosure is a NEMA 4X but common sense dictates avoiding hosing the unit etc.. The unit always powers up in the "Continuous" mode and switches to batching when the **Batch** switch is pressed. The unit stores programs for three different batches as well as the continuous speed.



PROGRAMMING - It's very simple: first, enter the Batch you wish to program (i.e. Batch 1, Batch 2 or Batch 3) hit the **Set** button to enter Setup mode and display the number of strokes per batch. Hit **Set** again and set the pump speed in Sec/Stroke. Hit the **Set** button again display the number of batches in this program (zero makes the batch run an infinite number of times). Hit **Set** again to display the hours, minutes and seconds between batches using the **Set** button between each segment. Lastly hit the **Set** one more time to get out of the programming mode. The system is now ready to **Run**. To program the other batches just press the batch button until the desired batch is displayed and repeat the process. To set the **Constant** speed just press the **Set** button when the unit is displaying that it is in the "Constant" mode. Use the **Up** and **Down** buttons to set the speed and then press the **Set** button to escape the programming mode. Not much job security here, it's that straightforward.

BATCH - To run the system, just momentarily press the **Run** button.. To stop the pump, momentarily push the **Stop** button. To stop the unit but be able to pick up where you left off, press the **Pause** button. You can then press either the **Pause** or **Run** buttons to start back up.

CONSTANT - First press the **Const** button to get into the proper mode and then press the **Run**, **Pause** and **Stop** buttons in the same way as the **Batch** mode.

If you have any questions or comments, please pass them onto to your Polytrace Systems distributor and we will be happy to address them.

QUICK TOUR

A- The **Display** control changes the contrast on the LCD display. You will probably never touch it unless the temperature around the unit is unusually high or low. If there is no information on the display, someone probably fiddled with the control. Just bring it full counter-clockwise and then back off until you have the desired contrast.

B- The **Solenoid** output provides 12 volts DC for the pumps integral solenoid. You must use the correct pump solenoid in order for the pump to operate properly.

C- The **Switch** terminal connects the control switches to the system. You can remotely **Run, Pause** and **Stop** the system by connecting remote dry contacts to the appropriate terminals.

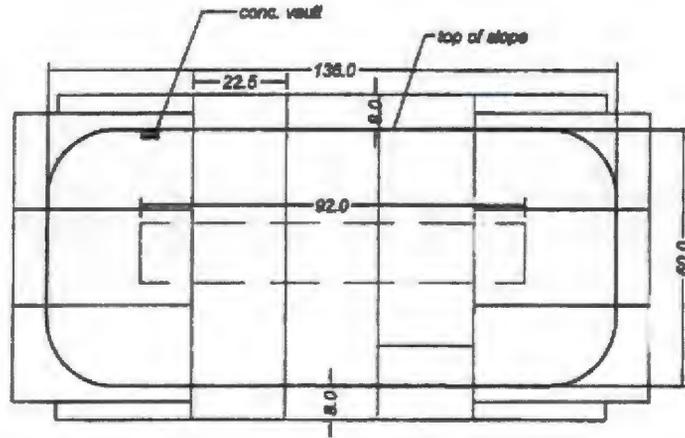
D- The **110 VAC** (also available in a 220 volt version) input is the only way to power the unit. Just make sure the connections are neat and that for safety reasons no conductor is exposed. This is the only location on the circuit board where more than 12 volts is present.



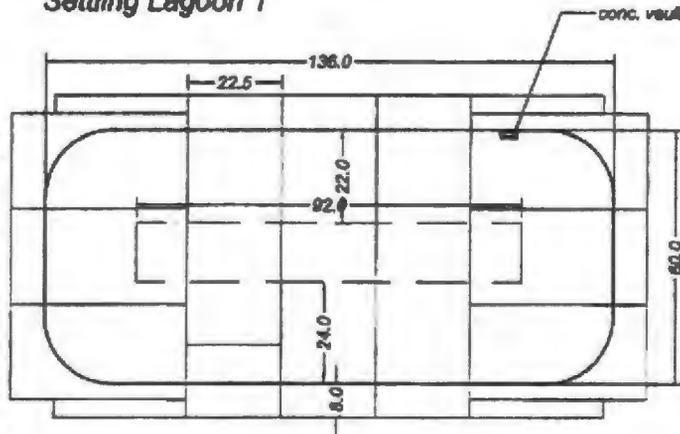
A-Display Contrast
B-Solenoid Output (12 volts DC)
C-Switch Terminal
D-Power Terminal

POLYTRACE SYSTEMS INC.

APPENDIX E
Liners



**Proposed 60-mil Smooth HDPE Primary liner panel layout
Settling Lagoon 1**



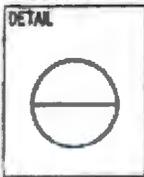
**Proposed 60-mil Smooth HDPE Primary liner panel layout
Settling Lagoon 2**

Note:

The Primary liner panel layout will be installed similar in configuration with the Secondary liner panel layout.
Std. roll width & length of 60-mil Smooth HDPE geomembrane liner is 23' x 540'. No shop welding will be done. Liner will be field cut, field weld & deployed according to prevailing field conditions & pond configurations. Seam overlap is 6". PIs. refer to note below.

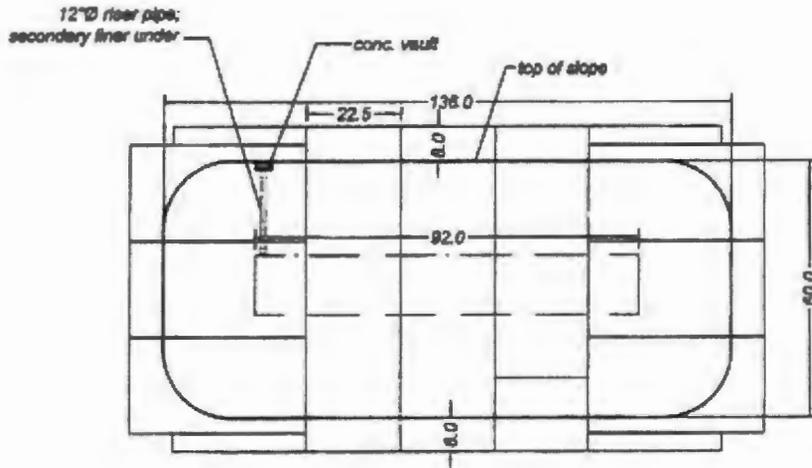
note: exact number, position and sequence of panel installation will be determined in the field by the field site supervisor.

SHEET NO.

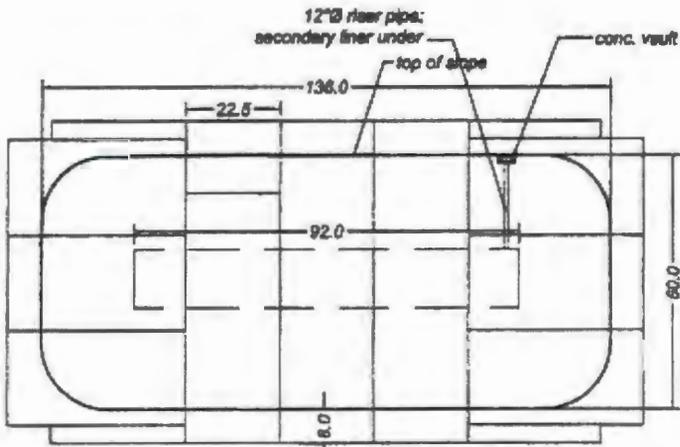


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www.northwestlinings.com
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KENT, WA. 98032
(253) 875-4244 (253) 875-0245 FAX

JOB NAME:	Harford L-691 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N 1 1 0 9 5		
DATE:	8 18 11	CHECKED:	KL
BY:	SG	SCALE:	AS SHOWN



Proposed 60-mil Smooth HDPE Secondary liner panel layout
Settling Lagoon 1

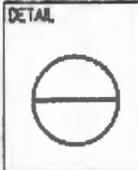


Proposed 60-mil Smooth HDPE Secondary liner panel layout
Settling Lagoon 2

Note:
The Primary liner panel layout will be installed similar in configuration with the Secondary liner panel layout.
Std. roll width & length of 60-mil Smooth HDPE geomembrane liner is 23' x 540'. No shop welding will be done. Liner will be field cut, field weld & deployed according to prevailing field conditions & pond configurations. Seam overlap is 6". PIs. refer to note below.

note: exact number, position and sequence of panel installation will be determined in the field by the on site supervisor.

SHEET NO.

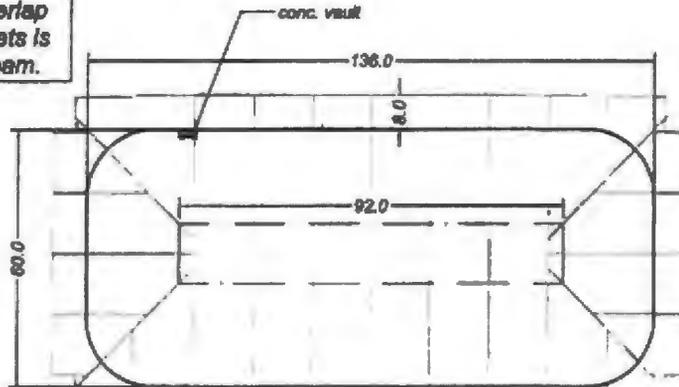


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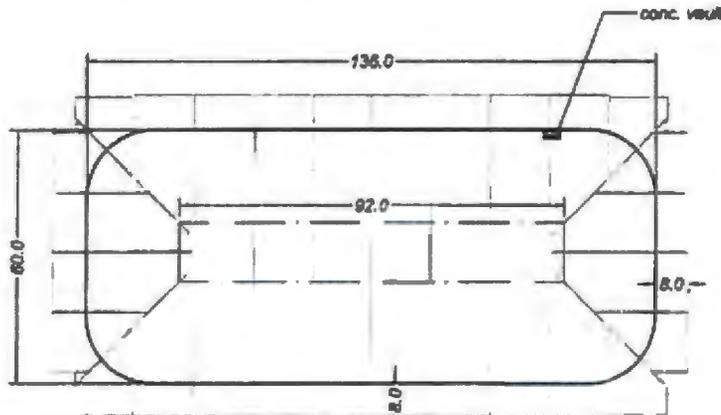
JOB NAME:	Hastors L-887 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N 11096		
DATE:	8 18 11	CHECKED:	KL
BY:	SG	SCALE:	AS SHOWN

Note:

Std. roll width & length of 200-mil HDPE Geonet is 14.5' x 300'. Deployment will be similar in configuration with the Geomembrane liner. Overlap between adjacent geonets is 4" and 12" at end butt seam.



*Proposed 60-mil Smooth HDPE Primary liner panel layout
Settling Lagoon 1*



*Proposed 60-mil Smooth HDPE Primary liner panel layout
Settling Lagoon 2*

Note: exact number, position and sequence of panel installation will be determined in the field by the soil site supervisor.

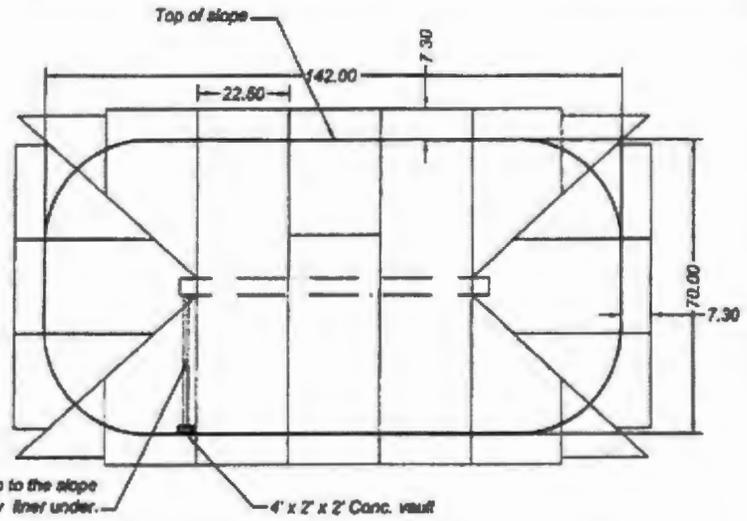
SHEET NO.

DETAIL

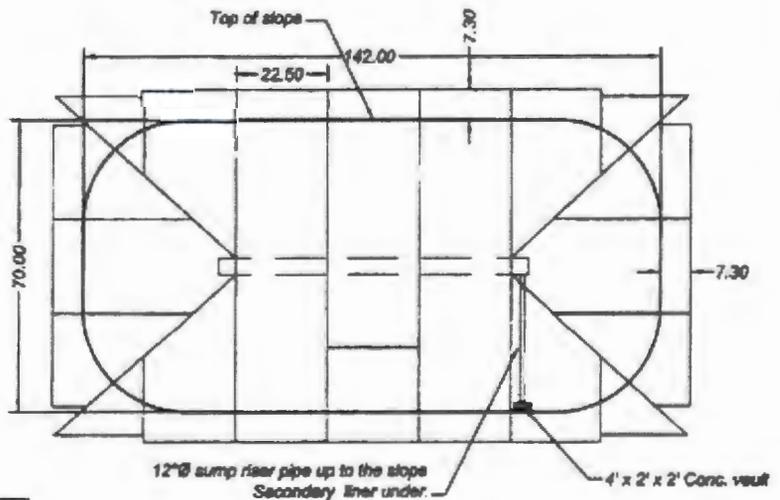
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(253) 872-0244 (253) 872-0245 FAX

JOB NAME:	Hanford L-401 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N 1 1 0 9 6		
DATE:	8 18 11	CHECKED:	KL
BY:	SC	SCALE:	AS SHOWN

Note:
The Primary liner panel layout will be installed similar in configuration with the Secondary liner panel layout. Std. roll width & length of 60-mil Smooth HDPE geomembrane liner is 23' x 540'. No shop welding will be done. Liner will be field cut, field weld & deployed according to prevailing field conditions & pond configurations. Seam overlap is 6". Pts. refer to note below.



**Proposed 60-mil Smooth HDPE Secondary liner panel layout
Aeration Lagoon 1**



**Proposed 60-mil Smooth HDPE Secondary liner panel layout
Aeration Lagoon 2**

note: exact number, position and sequence of panel installation will be determined in the field by the real site supervisor.

SHEET NO.

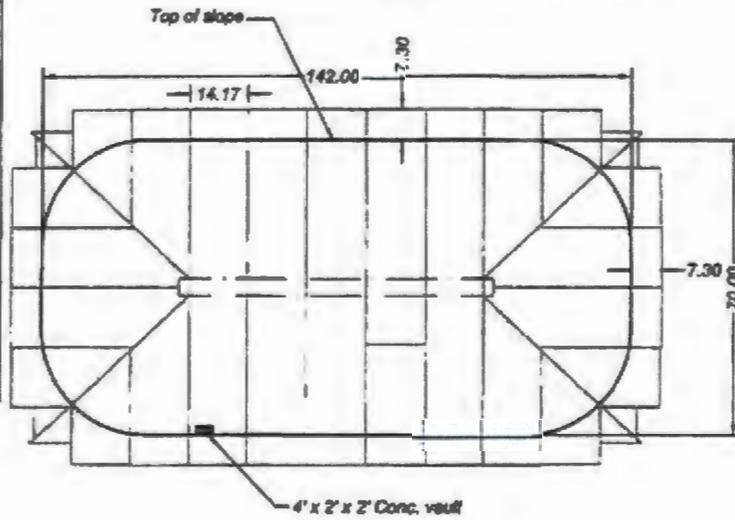


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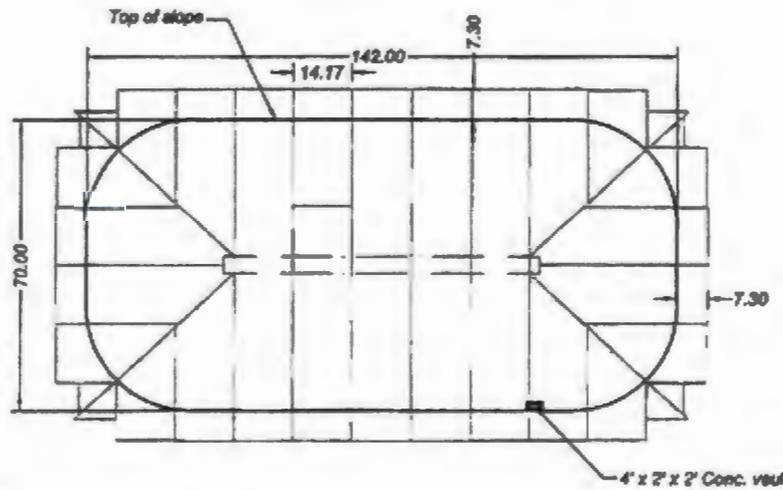
JOB NAME:	Master L-881 200 West Area Evaporative Sewer Lagoon		
JOB NO.	H 1 0 9 6		
DATE:	6 25 11	CHECKED:	KL
BY:	SC	SCALE:	AS SHOWN

Note:

Std. roll width & length
of 200-mil HDPE
Geonet is 14.5' x 300'.
Deployment will be
similar in configuration
with the Geomembrane
liner. Overlap between
adjacent geonets is 4"
and 12" at end butt
seam.



Proposed 200-mil HDPE Geonet panel layout
Aeration Lagoon 1



Proposed 200-mil HDPE Geonet panel layout
Aeration Lagoon 2

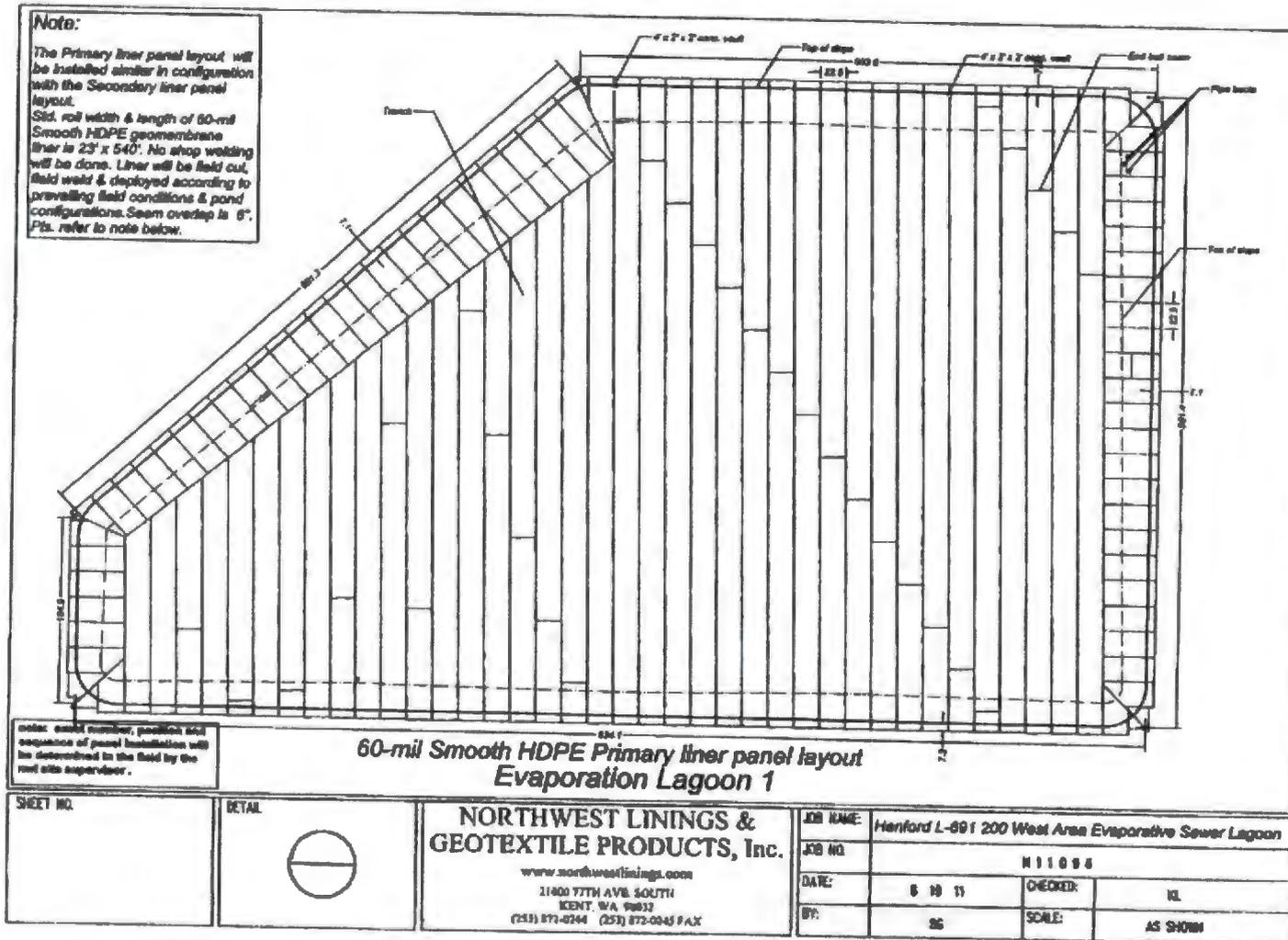
note: exact number, position and
sequence of panel installation will
be determined in the field by the
net site supervisor.

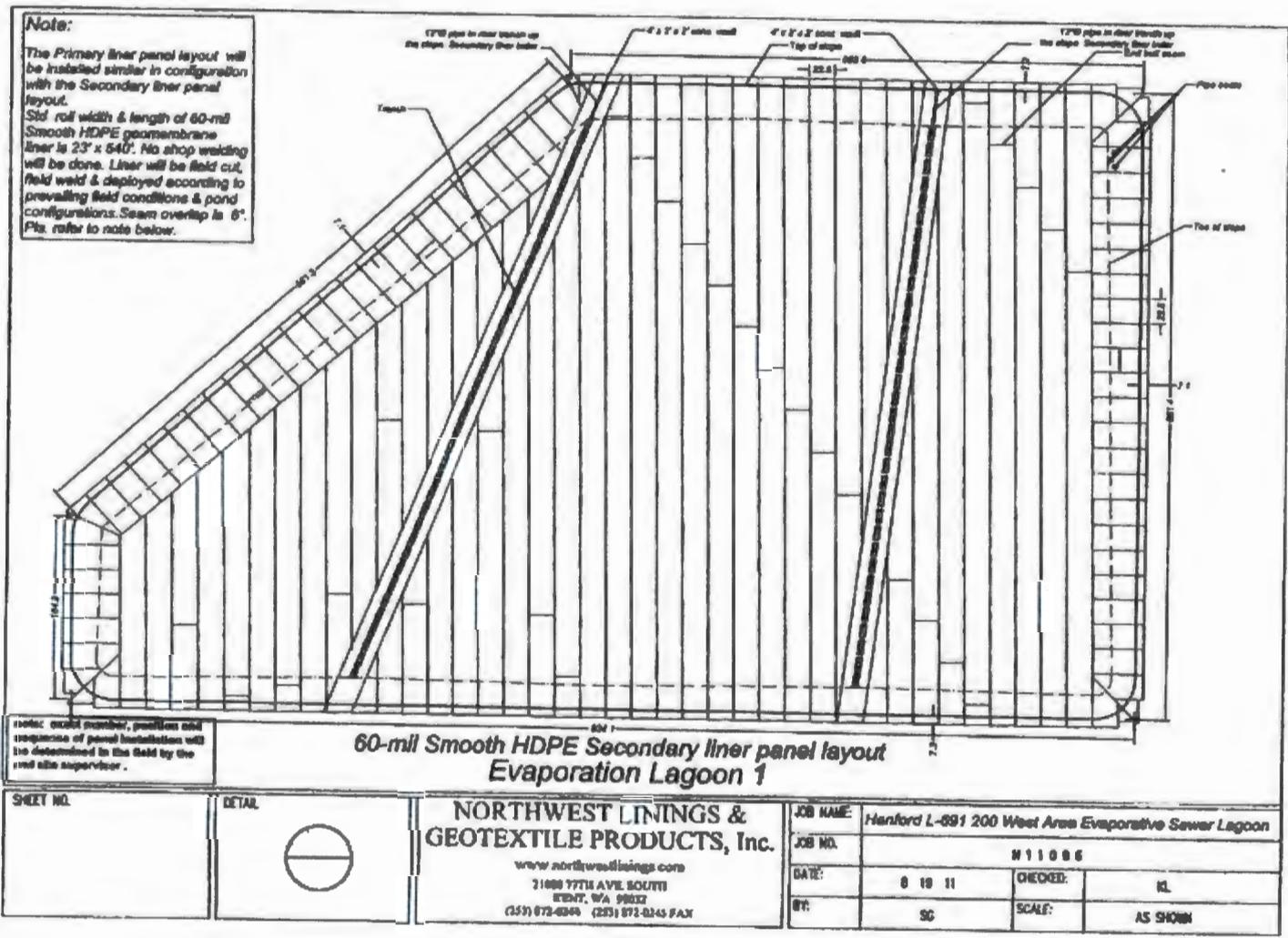
SHEET NO.

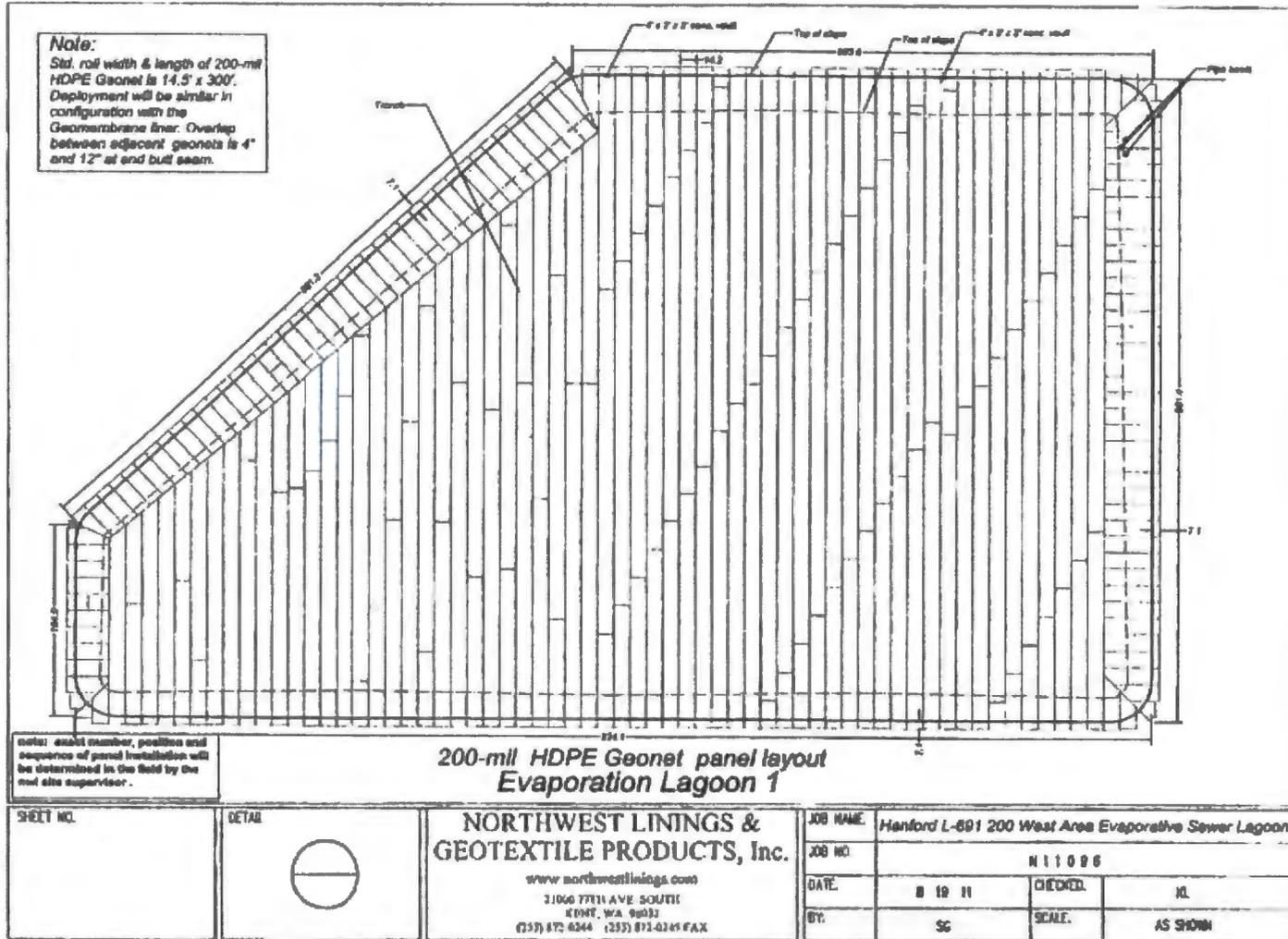


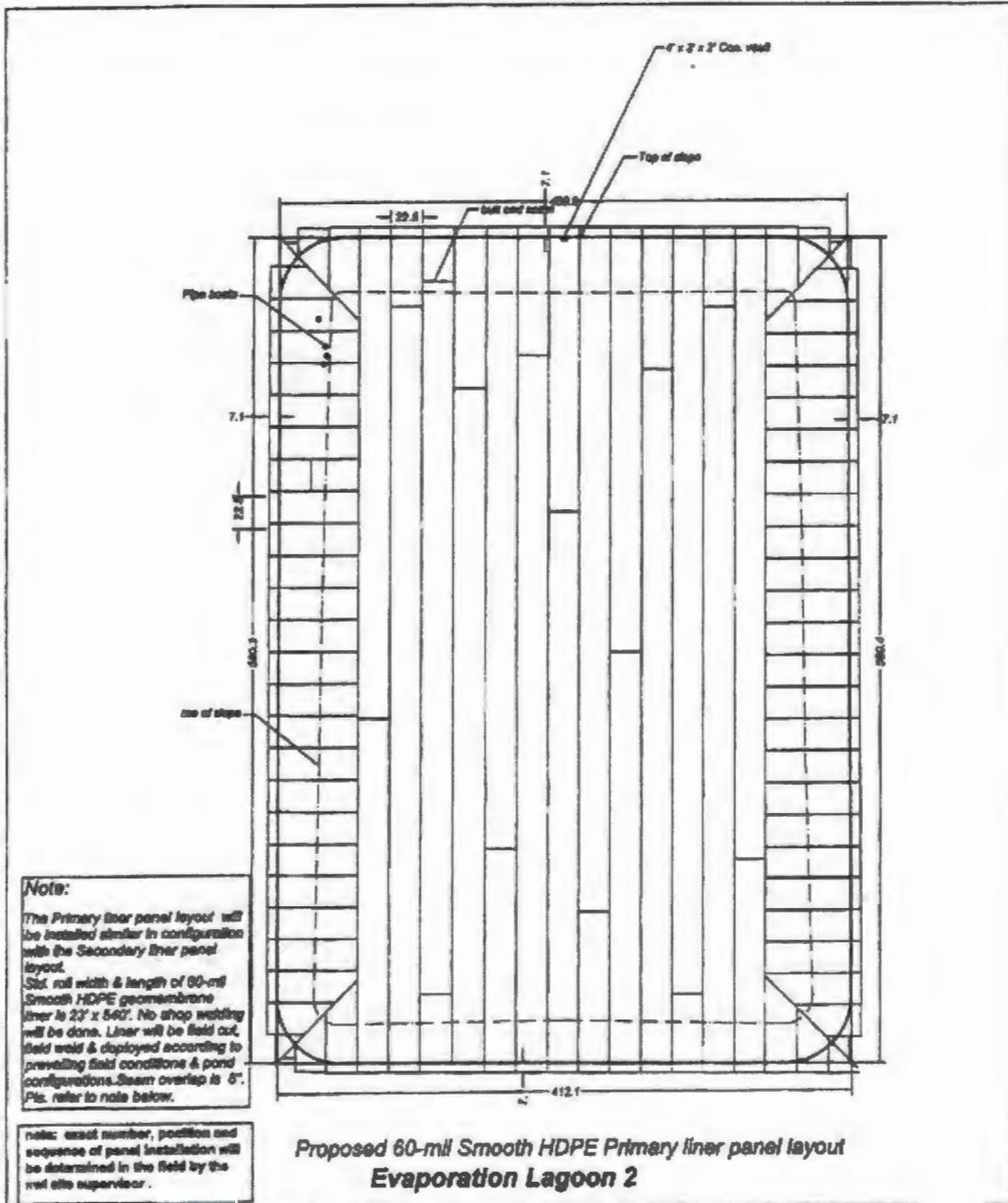
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JOB NAME:	Harford L-091 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N11098		
DATE:	8 25 11	CHECKED:	KL
BY:	SG	SCALE:	AS SHOWN

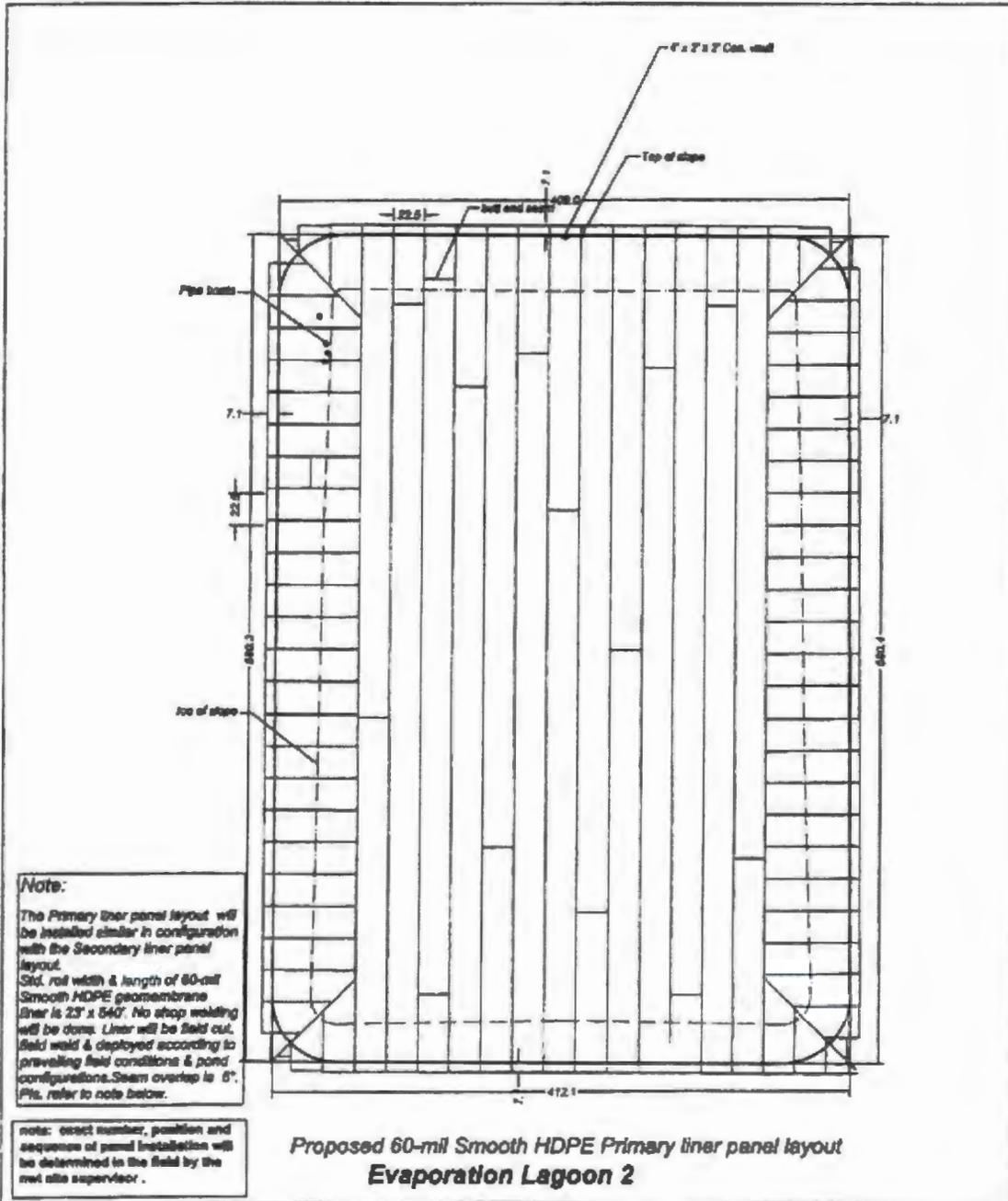




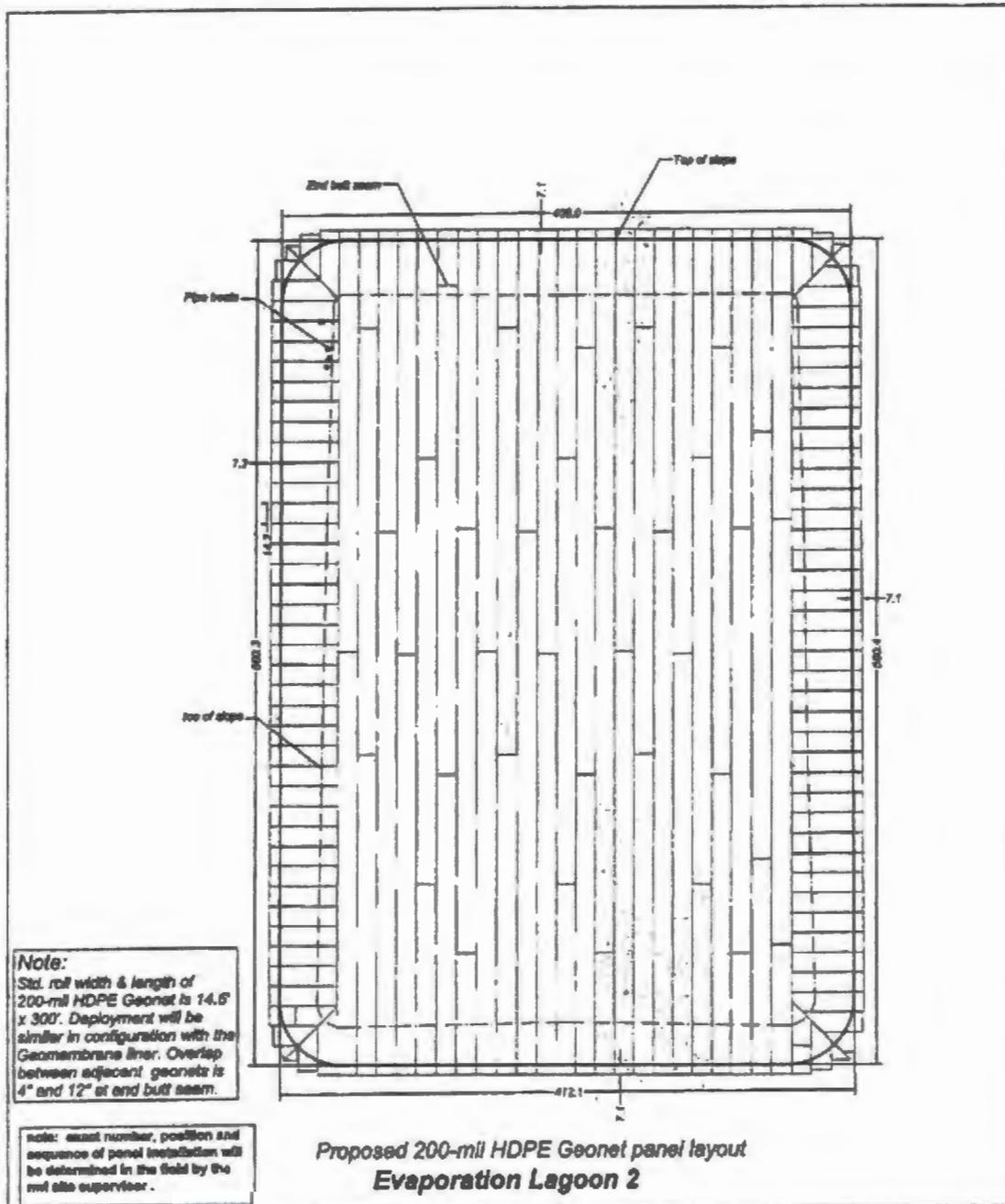




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					JOB NO. N11096	
					DATE: 6 18 11	CHECKED: KL
					BY: SG	SCALE: AS SHOWN



SHEET NO.	DETAIL 	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc.		JOB NAME: <i>Plant L-001 200 West Area Evaporative Sewer Lagoon</i>		
		www.northwestlinings.com		JOB NO. H11095		
		21080 77TH AVE. SOUTH		DATE: 8 18 11	CHECKED:	KL
		KENT, WA. 98032 (253) 872-0244 (253) 872-0245 FAX		BY: SC	SCALE:	AS SHOWN



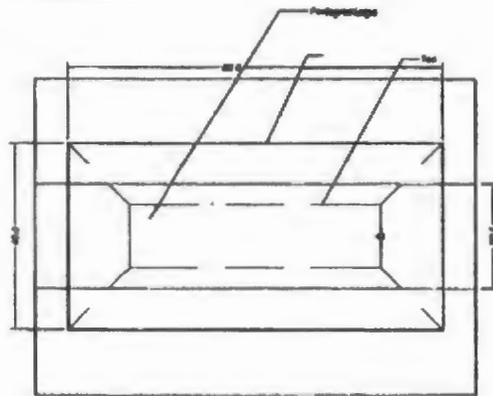
Note:
Std. roll width & length of
200-mil HDPE Geonet is 14.6'
x 300'. Deployment will be
similar in configuration with the
Geomembrane liner. Overlap
between adjacent geonets is
4" and 12" at end butt seam.

note: exact number, position and
sequence of panel installation will
be determined in the field by the
on site supervisor.

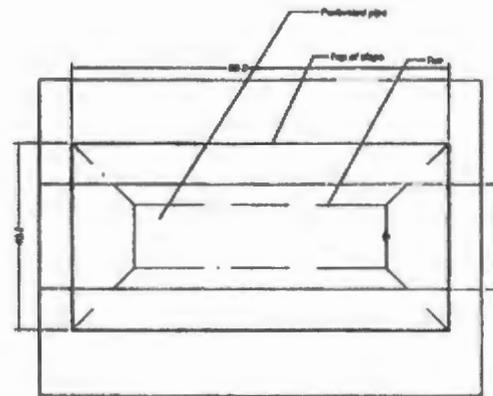
**Proposed 200-mil HDPE Geonet panel layout
Evaporation Lagoon 2**

SHEET NO.	DETAIL 	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc. www.northwestlinings.com 21000 77TH AVE. SOUTH KENT, WA 98032 (253) 872-0344 (253) 872-0245 FAX		JOB NAME: <i>Master L-001 200 West Area Evaporative Sewer Lagoon</i>	
				JOB NO. N 11090	
		DATE: 8 18 11	CHECKED:	<i>IL</i>	
		BY: SG	SCALE:	AS SHOWN	

Note:
The Primary liner panel layout will be installed similar in configuration with the Secondary liner panel layout.
Std. roll width & length of 60-mil Smooth HDPE geomembrane liner is 23' x 540'. No shop welding will be done. Liner will be field cut, field weld & deployed according to prevailing field conditions & pond configurations. Seam overlap is 6". Pts. refer to note below.



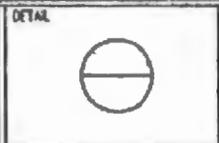
60-mil Smooth HDPE Primary liner panel layout
Filter Basin 1



60-mil Smooth HDPE Primary liner panel layout
Filter Basin 2

note: exact number, position and sequence of panel installation will be determined in the field by the rest site supervisor.

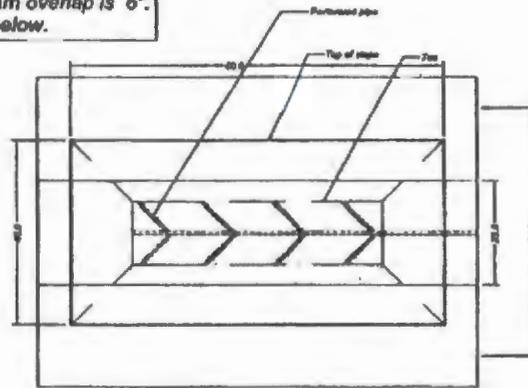
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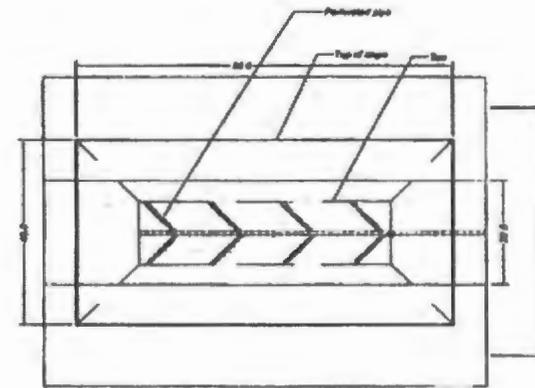
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(253) 872-0204 (253) 872-0243 FAX

JOB NAME:	Hanford L-691 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N11006		
DATE:	8 19 11	DRAWN:	XL
BY:	SC	SCALE:	AS SHOWN

Note:
The Primary liner panel layout will be installed similar in configuration with the Secondary liner panel layout.
Std. roll width & length of 60-mil Smooth HDPE geomembrane liner is 23' x 540'. No shop welding will be done. Liner will be field cut, field weld & deployed according to prevailing field conditions & pond configurations. Seam overlap is 6". Pts. refer to note below.



60-mil Smooth HDPE Secondary liner panel layout
Filter Basin 1



60-mil Smooth HDPE Secondary liner panel layout
Filter Basin 2

note: exact number, position and sequence of panel installation will be determined in the field by the rest site supervisor.

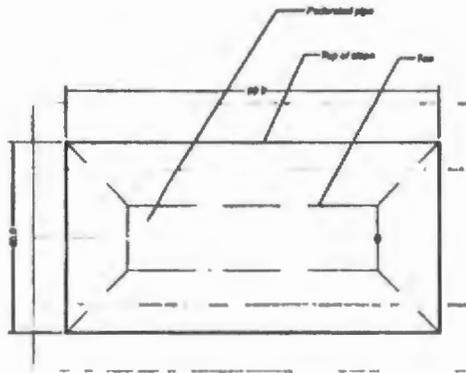
SHEET NO.



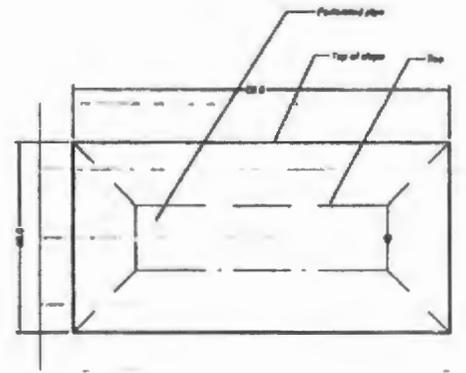
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KENNY, WA. 98032
(253) 872-8244 (253) 872-8245 FAX

JOB NAME:	Hanford L-691 200 West Area Evaporative Sewer Lagoon		
JOB NO.	N11095		
DATE:	8 19 11	CHECKED:	JL
BY:	SC	SCALE:	AS SHOWN

Note:
Std. roll width & length of 200-mil
HDPE Geonet is 14.6' x 300'.
Deployment will be similar in
configuration with the
Geomembrane liner. Overlap
between adjacent geonets is 4"
and 12" at end butt seam.



Proposed 200-mil HDPE Geonet panel layout
Filter Basin 1



Proposed 200-mil HDPE Geonet panel layout
Filter Basin 2

note: exact number, position and
sequence of panel installation will
be determined in the field by the
on-site supervisor.

SHEET NO.	DETAIL 	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc. www.northwestlinings.com 21000 77TH AVE, SUITE 111 WENT, WA. 98032 (157) 872-8044 (253) 872-8345 FAX	JOB NAME: Hanford L-891 200 West Area Evaporative Sewer Lagoon		
			JOB NO. N11088		
			DATE: 8 18 11	DESIGN: RL	
			BY: JC	SCALE: AS SHOWN	

APPENDIX F
Flume & Sluice Ways

Attachment F-1
Plasti-Fab Palmer-Bowlus Flume



9665 S.W. TUALATIN-SHERWOOD ROAD
PO BOX 100 □ TUALATIN OR 97068
PHONE: (503) 692-5460 FAX: (503) 692-1145

E-MAIL: sales@plasti-fab.com
WEB: <http://www.plasti-fab.com>

FLUMES: **OPERATION AND MAINTENANCE SUGGESTIONS**

The purpose of this manual is to provide information to the engineers, contractors, plant operators and associated personnel involved with installation, operation and maintenance of equipment supplied by Plasti-Fab, Inc. for this project. Although every care is taken in our factory to insure top quality, we cannot be responsible for damage caused by negligence during or after shipping. Herein are Plasti-Fab's recommendations for handling, storage, installation, and initial operation in standard situations. These suggestions should be used in conjunction with the approved installation drawings provided by Plasti-Fab, Inc. if proper care and accuracy are exercised in the field, the flume(s) will operate as designed at maximum efficiency.

Your Plasti-Fab flume is manufactured of fiberglass reinforced polyester (FRP) which includes a white pigmented interior layer of pure resin that is highly resistant to weathering, water and sewerage, detergents and acidic fluids. Under most conditions there should be no maintenance required. In some instances you may wish to wash the surface of the flume if it has become heavily coated with oil or various sludge buildups. In this case we suggest the use of water and a strong industrial detergent.

In operation, the flume acts as a restrictive venturi causing the water to dam up on the upstream end of the flume, thereby increasing flow velocity as it passes through the throat to the downstream channel. Measurement of the depth of the water in the upstream end of the flume provides a means by which the rate of flow may be determined from flow charts. Many flumes are equipped with instruments which sense water depth and record the rate of flow on a chart. Please see the instrument manufacturer's manual for calibration and operating instructions on this equipment.

Proper operation and performance of the flume is based on:

- 1) Proper selection of the type and size of flume
- 2) Proper installation.
- 3) Flow entering the flume at subcritical velocity. High velocity is generally caused by excessive slope, pumped flow, or a pressure head.
- 4) Flow surface being smooth, non-turbulent, in straight filaments.
- 5) Proper sizing of downstream conduit to take flow away from the flume.
- 6) Proper location and calibration of the flow instrument.

Since there are no moving parts or wearing surfaces in the flume, there are no further suggestions for maintenance of this device.



9665 S.W. TUALATIN-SHERWOOD ROAD
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E-MAIL: sales@plasti-fab.com
WEB: <http://www.plasti-fab.com>

PALMER-BOWLUS FLUME GENERAL FLOW RANGES

<u>Conversions:</u>		
CFS x 448.8 = GPM	MGD x 694.4 = GPM	MGD x 1.55 = CFS
GPM ÷ 448.8 = CFS	GPM ÷ 694.4 = MGD	CFS x 0.646 = MGD

Palmer-Bowlus	Flow Range	Equations H = Head in Feet Q = CFS
4"	2 – 80 *(55)	$Q = 1.73 \times (H + .00588)^{1.9573}$ **
6"	3 – 230 (130)	$Q = 2.071 \times (H + .005421)^{1.9025}$
8"	4 – 470 (310)	$Q = 2.537 \times (H + .01456)^{1.9724}$
10"	5 – 825 (500)	$Q = 2.843 \times (H + .01610)^{1.9530}$
12"	10 – 1,300 (750)	$Q = 3.142 \times (H + .017)^{1.9362}$
15"	15 – 2,290 (1,385)	$Q = 3.574 \times (H + .01682)^{1.9062}$
18"	25 – 3,190 (2,070)	$Q = 3.988 \times (H + .01875)^{1.8977}$
21"	30 – 4,690 (3,160)	$Q = 4.223 \times (H + .039)^{1.9619}$
24"	45 – 6,550 (4,250)	$Q = 4.574 \times (H + .0408)^{1.9497}$

* When the downstream channel or pipe is larger than flume, you could experience a progressive over-discharge. The number in parentheses is the conservative cut-off point to maintain high accuracy.

**Short power equation (a) is off by 3 to 5% at both ends of flow range. See polynomial (b) on Palmer-Bowlus Equations page for best overall curve fitting.

Attachment F-2
Plasti-Fab Slide Gate



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PLASTI-FAB SLIDE GATES

MANUAL FOR

INSTALLATION – OPERATION – MAINTENANCE

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FORWARD

This manual covers the full range of gates manufactured by Plasti-Fab, Inc. Therefore, some information may not apply to your particular style of gate. Please keep this in mind as you read this manual.

This manual provides information for engineers, contractors and plant operators involved with installation, operation and maintenance of equipment supplied by Plasti-Fab, Inc. Every care is taken in our factory to insure equipment of top quality. However, we cannot be responsible for damage caused by negligence during or after shipping. Therefore, described herein are Plasti-Fab, Inc.'s recommended methods of handling, storage, installation, adjustment and initial operation for standard situations. This information should be used in conjunction with the approved installation drawings provided by Plasti-Fab, Inc. If proper care and accuracy are exercised in the field during installation, the gates will operate as designed at maximum efficiency.

RECEIVING:

CHECK AND COUNT all parts when you receive shipment. All individually shipped parts or assemblages are listed on the packing list. Should a shortage exist, notify Plasti-Fab immediately. We cannot be responsible for any shortages reported more than 30 days after receipt of shipment. Special care should be taken in accounting for and safely storing all bolts, nuts and small items which are often misplaced at job sites.

Unless your contract with Plasti-Fab, Inc. states otherwise, all equipment is shipped F.O.B. factory. If any equipment has been damaged in transit, the purchaser will be responsible for filing a freight claim with the transportation company. For assistance in filing any claim and/or replacing equipment, please contact Plasti-Fab, Inc. directly.

HANDLING AND STORAGE:

All Plasti-Fab gates and appurtenances are precision machinery and should be handled accordingly. While all parts are of rugged design, it is still possible to damage surfaces, stems, etc., through improper storage and handling. To avoid all problems of this nature, we recommend the following:

1. Support full length of stems at all times, being sure not to damage threads.
2. Store equipment on an even, clean, dry surface to prevent distortion.
3. Cover all equipment to protect surfaces.
4. **DO NOT** stack equipment without protection.
5. Handle lifts as you would any precision machinery.
6. See Electric Motor Operator instructions for storage of electric motor operators.

SECTION I - INSTALLATION

GATE AND GUIDE INSTALLATION:

Some gates can be removed from guides to make guide mounting easier. Do so when practically possible. If they must be dismantled, see "Disassembly of Gates". See product bulletins for description of various types of guide frames offered by Plasti-Fab, Inc.

NOTE: We recommend leaving self contained gates in the guides during installation.

SURFACE MOUNTED GUIDES:

Placement of anchor bolts is critical for an easy and proper guide installation. Be sure placement is identical to print. Check hole spacing on guide with anchor bolt placement before attempting to mount the guide on the wall. If bolts do not align with holes, it may require adjustment of bolts or redrilling holes. Consult factory before boring out an existing hole. **DO NOT** hammer the guide onto the bolts. This may damage the guide frame. Be sure to maintain integrity of dimensions.

Once guide is mounted on the anchor bolts, adjust to a flat plane and grout or seal between the guide and the wall. Be sure all bolts have washers before tightening nuts. **DO NOT OVER TIGHTEN**. Over-tightening on fiberglass guides can result in compression fractures or other possible damage to the guide frames.

Before operating, be sure all guides are clean and free of debris.

EMBEDDED GUIDES:

Embedded frames may be installed in one of two ways. If you have the guide on-site before pouring, you can mount them in the concrete forms and pour around them. Be sure they are level, well fastened and all inside grooved surfaces are protected from concrete or debris.

NOTE: PROPER GUIDE DIMENSIONS MUST BE MAINTAINED AT ALL TIMES, AND CARE MUST BE TAKEN TO PROTECT GROOVED SLIDING SURFACES FROM DEBRIS.

The second method may be used if the guide is not on the job site at the time of the pour. At the location where the guide is to be mounted, build a block out into the forms that is larger than the guide frame. Allow at least 1" of space around sides and back of the guide frame for grouting purposes. Secure the frame firmly and protect against debris.

STEM INSTALLATION, STEM GUIDE ADJUSTMENTS AND LIMIT NUT POSITIONING:

Most of Plasti-Fab gates are self-contained units. The gate is mounted in the guide with the Stainless steel stem attached and threaded through the lift on the head frame. Limit nuts are factory set on all self-contained gates. For those units not having a self-contained frame, read the following sections on Stem Installation, Stem Guide Adjustment and Limit Nut Positioning.

STEM INSTALLATION:

1. Take care not to bend stem or damage threads. This is especially true on electric operated lifts. Extra care should be taken with stems for these operators.
NOTE: When a limit nut is used to stop the upward travel of a gate, the limit nut must be installed prior to the lift. See "Installation of Limit Nuts", Pg. 4.
2. After the gate, guide frame assembly and stem guides have been mounted, feed the stem down (or up, as required) through the head frame, stem guides and stem mounting bracket on the gate. Bolt stem to the mount.
3. At this point, the lift or lift nut may be threaded onto the stem by one of two methods depending on the circumstances and type of lift being used. The first way is to bolt the stem to the gate mounting plate and then thread the lift or lift nut down from the top of the stem to its proper mounting position. The second way is to position the lift over the stem and screw the stem into the lift until the stem is properly positioned to be bolted to the gate mounting plate.
4. Thoroughly clean and grease stem threads with heavy duty grease, such as Mobilox grease #3EP or equal. (See Maintenance section for equivalent greases.)

STEM GUIDE ADJUSTMENT:

After the stem is installed and the lift is bolted into position, check stem guides for proper alignment with the stem. The stem should not ride with direct pressure against the walls of the stem guide. If the stem is forcing against the stem guide, loosen the stem guide mounting bolts and position the guide so the stem is centered in the guide hole.

If enough adjustment cannot be made at the stem guide, move to the next guide or to the lift on the head frame to obtain needed adjustment. Loosen bolts and center as previously outlined. If the stem continues to ride on the guide, consult the local representative or manufacturer.

After stem guides are properly aligned, secure all bolts on guides, lifts and stem mount. Rotate the stem several times and make careful note of any stem wobble or rubbing. If either of these conditions exist, readjust as previously described. If further adjustment does not resolve the problem, consult the local representative or Plasti-Fab, Inc.

Please consult your local representative or contact Plasti-Fab, Inc., PO Box 100, Tualatin, Oregon, 97062.
Ph: 503-692-5460 Fax: 503-692-1145 e-mail: sales@plasti-fab.com web: www.plasti-fab.com

NOTE: BEFORE OPERATING GATE, READ OPERATING INSTRUCTIONS IN SECTION II OF THE MANUAL.

INSTALLATION OF LIMIT NUTS AND STEM COVERS:

1. **IMPORTANT:** In those cases where a limit nut is used to stop upward gate travel and a pedestal lift is also used, the limit nut must be installed on the stem prior to installing lift.
2. After lift is installed, with gate in closed position, screw top limit nut down on stem until it just starts to bottom out on top of the lift nut. Tighten set screws.
3. Screw stem cover into threaded bracket on top of lift. A thread sealant should be used on threads. Cover should be approximately four inches longer than gate height.

LIMIT NUT ADJUSTMENT

Setting and maintaining correct limit nut placement is vital to the protection and operation of the gate, guide and lift assembly. Limit nuts that are factory set should need no adjustment.

1. To regulate the upward opening ability of the gate, place the limit nut on the stem between the gate and lift. Open gate to desired height, screw the limit nut up the stem until it is against the lift, and secure allen screws on limit nut against stem.
2. To limit the downward closing ability of the gate, place the limit nut on the stem above the lift. Close the gate to the desired position, screw the limit nut down against the lift and secure allen screws on limit nut against the stem.
3. For a non-rising stem, make same adjustments as mentioned above, except place the limit nut in reference to the gate rather than the lift.

INSTALLATION OF ELECTRIC MOTOR OPERATORS:

1. Install motor operated lifts in same manner as the manual lifts described in "Stem Installation".
2. **IMPORTANT:** Alignment of lift and stem is of critical importance. Double check all components (stem, stem guides, brackets, pedestal, lift, etc.) to insure all are as perfectly aligned as possible.
3. **USING EMERGENCY HANDWHEEL, MANUALLY OPEN GATE A MINIMUM OF THREE INCHES PRIOR TO USING ANY ELECTRICAL CONTROLS. DOUBLE CHECK HANDWHEEL FOR PROPER ROTATION INDICATION.**
4. Connect electrical power and any remote wiring in accordance with wiring diagrams. During wiring installation, should it become necessary to leave unit, close and tighten limit switch compartment and any open conduit taps so no electrical components are left unprotected.
5. With gate open a minimum of three inches, check electric operator for proper rotation and wiring. By having gate open, the direction of rotation can be checked without damaging the stem, stem cover or hoisting unit.
6. Once the unit has been installed, the electric operator manufacturer's directions should be followed closely in setting the closing and opening limit switches. (See "Installation, Inspection and Adjustment".) The torque switches have been properly set at the factory and should not need adjustment. Follow the manufacturer's instructions if it appears that adjustment is necessary.
7. Lifts are factory lubricated and do not need lubrication at the time of installation.

SECTION II - OPERATING INSTRUCTIONS

INITIAL OPERATION OF GATES:

1. After gate, stem guides, stem, lifting mechanism and other necessary hardware has been installed, check the following before operation.
 - a. Check all assembly and mounting hardware for proper tightness.
 - b. Apply tension to stem and check for proper alignment.
 - c. Remove any shipping stops on gates.
 - d. Check guide grooves for any foreign matter. Clean all dirt, paint, concrete splatter or other foreign material from seating surfaces, wedges, flushbottom seals, etc.
2. If not done previously, or if gate stem has not been used for some time after installation, thoroughly clean stem threads and lubricate in accordance with stem installation instruction.
3. Raise gate to full open position. All lifts are factory lubricated, so there is no need for additional lubrication.
 - a. For manually operated lifts, turn handwheel or handcrank in direction noted on handwheel or lift housing.
 - b. Electric operators should be opened manually for the first three (3) inches and the last three (3) inches of gate travel until all limit and torque switches are set and checked. Electrical operation is accomplished by actuating push buttons on operator.

In those cases where operator has both local and remote controls, operator should be operated only with local controls. Maximum caution must be exercised during this phase.
 - c. For pneumatic operators, pressure must be applied to bottom side of cylinder piston to raise the gate. This should be done with manually actuated controls, rather than automatic controls. Pressure must be applied very slowly and carefully.

For pneumatic operators, gate may "jump" out of closed position then begin steady rising movement. There is no way to prevent this.

Regardless of operator type, operation should be easy and unlabored. If not, check for binding or other causes by reviewing previously mentioned installation and start-up procedures. Do not apply excessive force to handwheel or handcranks on operators. In most cases, they are designed to operate at 40 lb. maximum pull.
4. Seating surfaces of fiberglass slide gates require no lubrication. NOTE: **DO NOT** apply any petroleum product to neoprene seals as a lubricant.
5. Close gate completely and check for proper closure.

CAUTION: Be extremely careful when closing gate. The stem can buckle (bow) under a compressive load if excessive force is applied to the operator.

- a. Check to see that slide fits flat against seating surface.
- b. Check to be sure frame is not warped.

- c. Check and reset any limit nuts or position indicators as required. (See Limit Nut Adjustment).
- d. Cycle gates with operators to insure proper installation, alignment and operation.

INITIAL TEST OPERATION OF ELECTRIC MOTOR OPERATORS:

The following test procedure is to be performed in addition to "Initial Operating" requirements previously specified. The purpose of this test is to check for proper installation and alignment of stem and operator. This test should be performed as soon after installation and as long before final inspection acceptance as possible.

If the stem is mis-aligned, warped or the threads have been damaged, the stem will cut the threads out of the lift nut, eventually causing the gate to fall. If there is a problem, evidence usually begins showing up after three to five gate cycles. On large gates failure can occur as soon as 12 to 15 cycles. For this reason, we recommend that each gate with an electric operator be cycled electrically about fifteen (15) times.

The following test procedure should be performed over a time period of a few hours to a few days. During start-up, remember to avoid running the gate operator continuously. Most electric operators have a 15 or 30 minute duty cycle. Depending on motor, operating times should be limited to fifteen (15) to thirty (30) minutes per hour.

TEST PROCEDURE:

1. Check to make certain stem has been thoroughly cleaned and has clean coating of grease, then cycle gate three (3) times.
2. Check grease for any signs of bronze. These may be chips or small filings. A few pin head size pieces of bronze or some discoloration of stem is normal.
3. Clean stem and re-lubricate with fresh, clean grease.
4. If there were quite a few chips, recheck installation and alignment, then cycle gate three (3) more times. If there are very few chips, no checks are required and gate can be cycled five (5) times.

During these tests, be aware of any strange noises from operator or stem which could indicate trouble. Stop tests and locate trouble.

5. After cycling gates, recheck for evidence of bronze stripping from nut.
 - a. If stem and grease is fairly clean and free of bronze chips or shavings, clean stem, re-lubricate and cycle five (5) more times. Recheck final time and if only minute amounts of bronze show, installation is alright.
 - b. If the appearance of the bronze is not too great, the stems should be cleaned and re-lubricated. Double check entire installation, especially alignment. Repeat checking,

cleaning and cycling for a minimum of fifteen (15) cycles. If there still appears to be a problem, call the factory.

- c. If the amount of bronze is excessive, test should be stopped and factory called. See "Field Service" for on-site inspection by a factory service representative to evaluate problem and determine whether any equipment needs to be replaced. Gate should not be operated further until it can be checked out.

Things to look for if problems are encountered.

1. Observe stem from below operator while gate is being cycled.
 - a. If stem seems to move back and forth or side-to-side, stem may be warped or bent.
 - b. Check to see if stem is rubbing or binding on stem guides or other structure. May indicate alignment problems.
2. Check stem threads.
 - a. If thread crests appear to be mushroomed or slightly rolled over on one side of stem while opposite side (180° away) looks alright, check for alignment problem.
 - b. Stem threads appear rough, chipped or galled. Possibility of damaged threads.

OPERATION WITH PORTABLE ELECTRIC OPERATOR:

1. With handcrank, open the gate slightly.
2. Loosen set screw on handcrank and remove handcrank from lift.
3. Position portable operator support so socket of operator lines up with input shaft. Adjust height as necessary.
4. Slip socket on input shaft until fully engaged (minimum 1 inch) and tighten set screw on socket.
5. Plug operator into 115V, 60HZ power source. Be sure outlet is grounded type.
6. Set forward/reverse switch as required for proper gate operation. Direction to open gate is shown on lift above input shaft.
7. Depress trigger switch on portable operator handle to start unit. Operator will continue to run as long as switch is depressed.
8. When limit nut is reached or if overload occurs, overload release clutch will automatically release so no further torque is applied to input shaft.
9. To reset clutch, either reverse rotation or disengage and remove portable operator from lift and electrically "jog" operator. Clutch will automatically reset after several revolutions.

SECTION III - MAINTENANCE

MAINTENANCE OF FIBERGLASS GATES AND GUIDES:

Other than periodic cleaning to maintain smooth operation of the gates and general sanitation throughout the plant, maintenance of the fiberglass portions of the gates is not required. If desired, the fiberglass material may be cleaned with detergent or water.

Periodic inspection of guides and gates is recommended to insure trouble-free operation. Check for debris that may have caught or collected on the gate and clean accordingly.

MAINTENANCE OF OPERATING STEMS:

1. Operating stems **MUST** be cleaned and greased periodically. Some environmental conditions are harsher than others. The use of stem covers will protect stems, but they still need to be cleaned and greased with Mobilux grease #2EP or equal at least once every six months (see Lubrication Chart for equivalent brand names). Lubricate more often if the grease becomes dirty.
2. **WARNING!!** Gates with non-rising stems generally require a special maintenance program. If the level of the water or sewage rises above the top of the gate, the threads on the stem may become coated with grit. Under this condition, frequent cycling of the gate can wear the threads in the thrust nut and create a potentially dangerous situation. Therefore, the following maintenance procedure should be followed:
 - a. The stem should be inspected at least monthly.
 - b. The stem should be kept clean and greased. Regular hose downs are recommended.
 - c. If the gate is cycled on the average of once a week, the thrust nut should be removed every year and inspected for wear. (More frequently after the first signs of wear or if operating conditions are more severe).
3. The stem should be inspected at least monthly.
 - a. The stem should be kept clean and greased. Regular hose downs are recommended.
 - b. If the gate is cycled on the average of once a week, the thrust nut should be removed every year and inspected for wear. (More frequently after the first signs of wear or if operating conditions are more severe).

MAINTENANCE OF GATE OPERATORS:

1. The manual crank operators contain ball or roller bearings and should be lubricated at least three (3) times a year. All grease fittings on manual floor stands should be lubricated with a small amount of heavy duty grease such as Zenaplex II, manufactured by Pennwalt Keystone Company, or equal (see Lubrication Chart for equivalent lubricants).
2. **CAUTION:** DO NOT OVERFILL when lubricating pinion shafts on manual 3EP series lifts.
3. For electric motor operators or cylinder lifts, see separate manufacturer's O & M manuals.

MAINTENANCE OF PORTABLE ELECTRIC OPERATOR:

1. When not in use, portable operator should be stored in a dry protected area, out of the weather, with the cord neatly coiled or looped and off the floor.
2. Should operator be used in inclement weather, the operator and cord should be thoroughly cleaned and dried prior to storage.
3. See Manufacturer's Operating and Maintenance Instructions for lubrication.
4. In time, as clutch is run and parts become worn, the torque release setting may decrease making it necessary to reset the clutch. See Manufacturer's Operating and Maintenance Instructions for adjustment instructions.

MAINTENANCE OF SEALS:

If desired, neoprene J-seals may be lubricated using a silicone "grease" such as G. E. Silicone Compound G661 or equal.

CAUTION: DO NOT APPLY ANY PETROLEUM PRODUCT TO THESE SEALS AS A LUBRICANT.

Neoprene seals rarely need replacement. However, if the seals become improperly positioned or damaged, they may be serviced by one of the following procedures.

GATES SERVICED IN GUIDES:

Gates that are readily accessible can be worked on while still mounted in their guide by:

1. For repair or replacement of J-seals remove all bolts holding clamping bars with a properly sized wrench. Remove clamping bars/ J-seals and carefully label each part to record proper location and positioning.

NOTE: Do not throw old J-seal away. Use the old J-seal as a pattern for marking hole locations and lengths on replacement parts. Be sure to label new parts in the same manner as the ones being replaced. If necessary, new seals directly from our factory.

4. Make sure gate or guide surfaces are clean and clear of obstructions. Mount new J-seal in reverse order of dismounting instructions listed above. Remember, clamping bar always goes against J-seal.
5. Before final tightening be sure is properly set and seated against the gate. For seals mounted on the guide be sure to push the gate over in the groove as much as possible and then seat the seal firmly against the gate surface.

GATES SERVICED OUT OF GUIDES:

Gates not accessible for maintenance may be removed from the guide and then serviced by the following steps: NOTE: Not all gate and guide assemblies are equipped with each of these parts. Follow the appropriate instructions for the given equipment and situation.

1. Using properly sized wrenches, remove stem cover, limit nut, handwheel, electric operator and lift nut assembly.
2. Some operators require the stem to be backed out of the threaded lift nut. This will require unbolting the stem from the gate and possibly unbolting the stem guides as well as pedestal anchorage. Once the stem has been backed out of the lift nut, remove the lift and the stem.
3. Standard handwheel lifts may be removed by unbolting from the head frame and unscrewing the lift nut off the top of the stem. Now the stem may be removed by detaching from the gate.
4. Once the lift assembly and stem have been removed, unbolt head frame r top plate. Also remove any remaining stem guides
5. Using a suitable strong device (e.g. chain, cable, etc.) for the size and location of the gate, bolt to the stem mounting hardware on the gate and pull gate from guide. Be sure lifting device is properly situated and strong enough to handle the gate. Also, handle the gate with care so as not to damage the surface.
6. For repair or replacement of J-seal see Steps 3 and 4 of "Gates Serviced in Guides".

SECTION IV - SERVICE NOTES

CALL PLASTI-FAB FIRST!!!

If a problem develops either in the installation, operation or performance of the equipment, the installation manual and drawings should be checked to determine if the equipment has been properly installed. If proper performance and operation cannot be obtained contact Plasti-Fab immediately. **ALWAYS REFERENCE THE JOB NUMBER** so that we may locate the project records and better assist you.

Company may be contacted at:

Plasti-Fab, Inc.
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Tualatin, OR 97062
(503) 692-5460 Ph:
(503) 692-1145 Fax
e-mail: sales@plasti-fab.com
web: www.plasti-fab.com

Our area representative is:

FIELD SERVICE:

If necessary arrangements can be made to send a technician to the job site. This man will make a thorough examination of the problem and if the equipment is defective in workmanship or material, the necessary repairs or adjustment will be made by the factory at no cost to the purchaser. If, however, the problem is due to faulty installation or adjustment, the cost of field service will be charged to the purchaser.

UNAUTHORIZED REPAIRS OR BACK-CHARGES:

Plasti-Fab, Inc. will not accept any unauthorized alterations, repairs or back-charges to its equipment without prior written notice and agreement.

The company will not be liable for contingent costs or costs of delay due to faulty equipment or the repairs thereof.

SPARE PARTS:

Unless required by project specifications and shown on appendix attached, no spare parts have been supplied for this equipment. Should it become necessary to replace a part, refer to enclosed installation and detail drawings for appropriate part. If electric motor operated lifts or cylinder operators have been supplied, see separate Manufacturer's O & M Manual for details. See section on "Field Service" for telephone number to call when ordering parts.

SPECIAL TOOLS:

The installation and adjustment of Plasti-Fab gates and equipment requires no special tools and can be accomplished using a minimum of the following standard tools:

- 10" or 12" crescent wrench (2 required)
- Open and box end wrenches are preferred
- Allen wrenches

While these are the minimum tools required, installation time can be greatly decreased with such standard tools as socket wrenches and box wrenches.

If electric motor operated lifts or cylinder operators are supplied, see separate Manufacturer's O & M manual for special tools

LUBRICATION CROSS REFERENCE CHART

STEMS

LUBRICANT

Molykote Type G
Valvoline Wal-Lith #2EP
No. 52 grease
Dura Lith #2
Lubriplate #630-2
Gulf Crown EP2
Mobilox Grease #2EP
Mobil Grease #4
Alvania #2EP
MultiFak #2EP
Tycol Azepto #11

MANUFACTURER

Alpha Molykote Co.
Ashland Oil & Refining Co.
Atlantic Richfield (ARCO)
Chevron Oil Co.
Fiske Brothers Refining Co.
Gulf Oil Co.
Mobil Oil Co.
Mobile Oil Co.
Shell Oil Co.
Texaco Oil Co.
Tiedwater Oil Co.

LIFTS

(Also Aux. Gearboxes and Universal Couplings)

LUBRICANT

Lubriplate Type 630-AA
Mobilplex #45
Mobil Grease Special
Zencplex II

MANUFACTURER

Fiske Brothers Refining Co.
Mobil Oil Co.
Mobil Oil Co.
Pennwalt Keystone Co.

LIMITED WARRANTY

Every effort is made to assure that our customers receive the highest quality merchandise, free of any defects in materials and workmanship, designed for use in accordance with the project specifications and the standards and/or instructions recommended by this catalog or other written quotation of this firm. However, no warranty, expressed or implied, is made other than as follows:

Products manufactured by Plasti-Fab, Inc. are warranted against defects in material and workmanship for one full year from date of purchase. Such warranty can only be enforced by the original consumer/purchaser. During the warranty period, any defects in material or workmanship will be repaired or replaced at Plasti-Fab, Inc.'s option at no cost to the purchaser. Warranty specifically excludes damage due to improper handling, storage, misuse or neglect.

Measure of damage is the price of defective material only. No charges for labor or expense required to remove or replace defective material, or for any consequential damages, will be allowed.

Any implied warranty or merchantability or fitness is limited to the one year duration of this written warranty. To the extent allowed by law, neither Plasti-Fab, Inc. nor its selling dealer or agent shall have any responsibility for loss of use of the product, loss of time, commercial loss or consequential damages.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

In the event a warranted product is believed defective, please notify Plasti-Fab, Inc. Refer to Plasti-Fab job number, print number, location, address and telephone numbers listed in catalog when requesting assistance. Provide date purchased and copy of invoice or shipping documents if possible.

It is the policy of this company to encourage the settlement of disputes in an informal manner, and if such disputes arise over a warranty claim, an informal dispute settlement mechanism can be agreed upon at that time.

APPENDIX G
Grinders

Attachment G-1
Franklin-Miller TM 8512

Additional information vendor information can be found in Hanford Site
Integrated Document Management System (IDMS)

21. DRIVE DATA, INCLUDING MOTOR & REDUCER



260.02/1199 E

INSTALLATION AND MAINTENANCE MANUAL FOR NEMA LOW VOLTAGE ELECTRIC MOTORS



***T**he electric motor is the item of equipment most widely used by man in his pursuit of progress, as virtually all machines and many renowned inventions depend upon it. By virtue of the prominent role the electric motor plays in the comfort and welfare of mankind, it must be regarded and treated as a prime power unit embodying features that merit special attention, including its installation and maintenance.*

This means that the electric motor should receive proper attention.

Its installation and routine maintenance require specific care to ensure perfect operation and longer life of the unit.

THE WEG ELECTRIC MOTOR INSTALLATION AND MAINTENANCE MANUAL provides the necessary information to properly install, maintain and preserve the most important component of all equipment:

THE ELECTRIC MOTOR!

WEG

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1. Introduction

INSTALLATION AND MAINTENANCE MANUAL FOR NEMA LOW VOLTAGE ELECTRIC MOTORS



This manual covers all the three-phase and single-phase asynchronous squirrel-cage induction motors, from 140T to 580T frame sizes.

The motors mentioned in this manual are subject to continuous improvement, therefore, information is subject to change without notice. For further details, please consult WEG.



2. Basic Instructions



2.1 Safety Instructions

All personnel involved with electrical installations, either handling, lifting, operation and maintenance, should be well-informed and up-to-dated concerning the safety standard and principles that govern the work and carefully follow them. Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and to alert his personnel of the inherent hazards of the job in hand.

It is recommended that these tasks be undertaken only by qualified personnel and they should be instructed to:

- avoid contact with energized circuits or rotating parts,
- avoid by-passing or rendering inoperative any safeguards or protective devices,
- avoid extended exposure in close proximity to machinery with high noise levels,
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment, and
- follow consistently any instructions and product documentation supplied when they do such work.

Before initiating maintenance procedures, be sure that all power sources are disconnected from the motor and accessories to avoid electric shock.

Fire fighting equipment and notices concerning first aid should not be lacking at the job site; these should be visible and accessible at all times.

2.2 Delivery

Prior to shipment, motors are factory-tested and balanced. They are packed in boxes or bolted to a wooden base.

Upon receipt, we recommend careful handling and a physical examination for damage which may have occurred during transportation.

In the event of damage and in order to guaranty insurance coverage, both the nearest WEG sales office and the carrier should be notified without delay.

2.3 Storage

Motors should be raised by their eyebolts and never by their shafts. It is important that high rating three-phase motors be raised by their eyebolts. Raising and lowering must be steady and joltless, otherwise bearings may be harmed.

When motors are not immediately installed, they should be stored in their normal upright position in a dry even temperature place, free of dust, gases and corrosive atmosphere.

Other objects should not be placed on or against them. Motors stored over long periods are subject to loss of insulation resistance and oxidations of bearings.

Bearings and the lubricant deserve special attention during prolonged periods of storage. Depending on the length and conditions of storage it may be necessary to regrease or

change rusted bearings. The weight of the rotor in an inactive motor tends to expel grease from between the bearing surfaces thereby removing the protective film that impedes metal-to-metal contact.

As a preventive measure against the formation of corrosion by contact, motors should not be stored near machines which cause vibrations, and every 3 month their shafts should be rotated manually.

Insulation resistance fluctuates widely with temperature and humidity variations and the cleanliness of components. When a motor is not immediately put into service it should be protected against moist, high temperatures and impurities, thus avoiding damage to insulation resistance.

If the motor has been in storage more than six month or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmmeter.

If the resistance is lower than ten megohms the windings should be dried in one of the two following ways:

- 1) Bake in oven at temperatures not exceeding 194 degree F until insulation resistance becomes constant.
- 2) With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194 degree F. Do not exceed this temperature.

If the motor is stored for an extensive period, the rotor must be periodically rotated.

Should the ambient conditions be very humid, a periodical inspection is recommended during storage. It is difficult to prescribe rules for the true insulation resistance value of a machine as the resistance vary according to the type, size and rated voltage and the state of the insulation material used, method of construction and the machine's insulation antecedents. A lot of experience is necessary in order to decide when a machine is ready or not to be put into service. Periodical records are useful in making this decision.

The following guidelines show the approximate values that can be expected of a clean and dry motor, at 40°C test voltage in applied during one minute.

Insulation resistance R_m is obtained by the formula:

$$R_m = V_n + 1$$

Where: R_m - minimum recommended insulation resistance in $M \Omega$ with winding at 40°C
 V_n - rated machine voltage in kV

In case that the test is carried out at a temperature other than 40°C, the value must be corrected to 40°C using a approximated curve of insulation resistance v.s temperature of the winding with the aid of Figure 2.1; it's possible verify that resistance practically doubles every 10°C that insulating temperature is lowered.



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Example:

Ambient temperature = 50°C
Motor winding resistance at 50°C = 1.02 M Ω
Correction to 40°C

$$R_{40^{\circ}\text{C}} = R_{50^{\circ}\text{C}} \times K_{50^{\circ}\text{C}}$$

$$R_{40^{\circ}\text{C}} = 1.02 \times 1.3$$

$$R_{40^{\circ}\text{C}} = 1.326 \text{ M } \Omega$$

The minimum resistance Rm will be:

$$R_m = V_n + 1$$

$$R_m = 0.440 + 1$$

$$R_m = 1.440 \text{ M } \Omega$$

On new motors, lower values are often attained due to solvents present in the insulating varnishes that later evaporate during normal operation. This does not necessarily mean that the motor is not operational, since insulating resistance will increase after a period of service.

On motor which have been in service for a period of time much larger values are often attained. A comparison of the values recorded in previous tests on the same motor under similar load, temperature and humidity conditions, serves as a better indication of insulation condition than that of the value derived from a single test. Any substantial or sudden reduction is suspect and the cause determined and corrective action taken. Insulation resistance is usually measured with a MEGGER. In the event that insulation resistance be inferior to the values derived from the above formula, motors should be subjected to a drying process.

2.3.1 Drying the Windings

This operation should be carried out with maximum care, and by only qualified personnel. The rate of temperature rise should not exceed 5°C per hour and the temperature of the winding should not exceed 105°C. An overly high final temperature as well as a fast temperature increase rate can both generate vapour harmful to the insulation.

Temperature should be accurately controlled during the drying process and the insulation resistance measured at regular intervals.

During the early stages of the drying process, insulation resistance will decrease as a result of the temperature increase, but the resistance will increase again when the insulation becomes dryer.

The drying process should be extended until successive measurements of insulation resistance indicate that a constant value above the minimum acceptable value has been attained. It is extremely important that the interior of the motor be well ventilated during the drying operation to ensure that the dampness is really removed.

Heat for drying can be obtained from outside sources (an oven), energization of the space heater (optional), or introducing a current through the actual winding of the moto be dried.

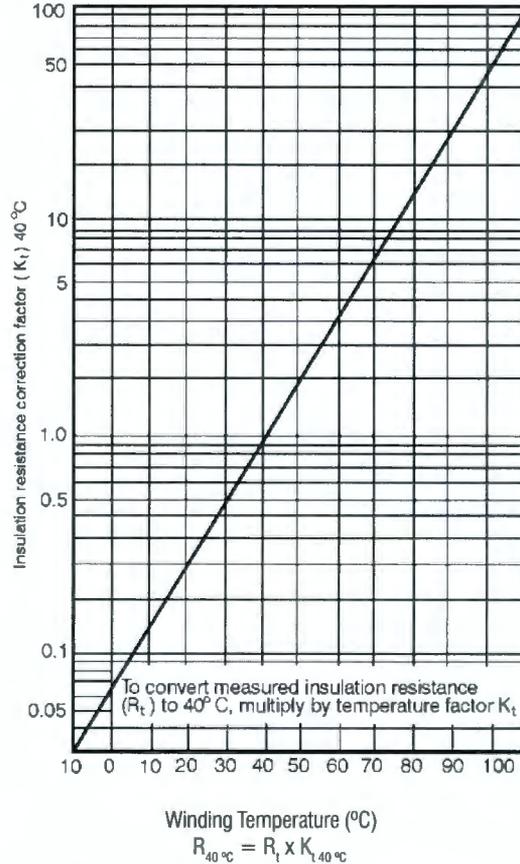


Figure 2.1.

3. Installation

Electric machines should be installed in order to allow an easy access for inspection and maintenance. Should the surrounding atmosphere be humid, corrosive or contain flammable substances or particles, it is essential to ensure an adequate degree of protection.

The installation of motors in ambients where there are vapours, gases or dusts, flammable or combustible materials, subject to fire or explosion, should be undertaken according to appropriate and governing codes, such as NEC Art. 500 (National Electrical Code) and UL-674 (Underwriters Laboratories, Inc.) Standards.

Under no circumstances can motors be enclosed in boxes or covered with materials which may impede or reduce the free circulation of ventilating air. Machines fitted with external ventilation should be at least 50cm from the wall to permit the passage of air.

The opening for the entry and exit of air flow should never be obstructed or reduced by conductors, pipes or other objects. The place of installation should allow for air renewal at a rate of 700 cubic feet per minute for each 75 HP motor capacity.

3.1 Mechanical Aspects

3.1.1 Foundation

The motor base must be levelled and as far as possible free of vibrations. A concrete foundation is recommended for motors over 100 HP. The choice of base will depend upon the nature of the soil at the place of erection or of the floor capacity in the case of buildings.

When dimensioning the motor base, keep in mind that the motor may occasionally be run at a torque above that of the rated full load torque.

Based upon Figure 3.1, foundation stresses can be calculated by using the following formula:

$$F1 = 0.2247 \frac{(0.009 \times g \times G - 213 \text{ T}_{max})}{A}$$

$$F2 = 0.2247 \frac{(0.009 \times g \times G + 213 \text{ T}_{max})}{A}$$

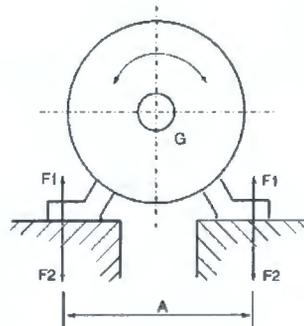


Figure 3.1 - Base stresses

Where:

- F1 and F2 - Lateral stress (Lb)
- g - Force of gravity (32.18 ft/s²)
- G - Weight of motor (Lb)
- T_{max} - Maximum torque (Lb . Ft)
- A - Obtained from the dimensional drawing of the motor (in)

Sunken bolts or metallic base plates should be used to secure the motor to the base.

3.1.2 Types of Bases

a) Slide Rails

When motor drive is by pulleys the motor should be mounted on slide rails and the lower part of the belt should be pulling. The rail nearest the drive pulley is positioned in such a manner that the adjusting bolt be between the motor and the driven machine. The other rail should be positioned with the bolt in the opposite position, as shown in Figure 3.2.

The motor is bolted to the rails and set on the base. The drive pulley is aligned such that its center is on a plane with the center of the driven pulley and the motor shaft and that of the machine be parallel.

The belt should not be overly stretched, see Figure 3.11. After the alignment, the rails are fixed.

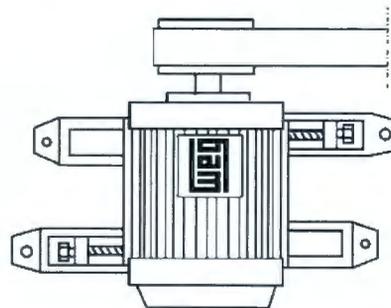


Figure 3.2 - Positioning of slide rails for motor alignment



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b) Foundation Studs

Very often, particularly when drive is by flexible coupling the motor is anchored directly to the base with foundation studs. It is recommended that shim plates of approximately 0.8 inches be used between the foundation studs and the feet of the motor for replacement purposes. These shim plates are useful when exchanging one motor for another of larger shaft height due to variations allowed by standard tolerances. Foundation studs should neither be painted nor rusted as both interfere with the adherence of the concrete, and bring about loosening.

After accurate alignment and levelling of the motor, the foundation studs are cemented and their screws tightened to secure the motor.

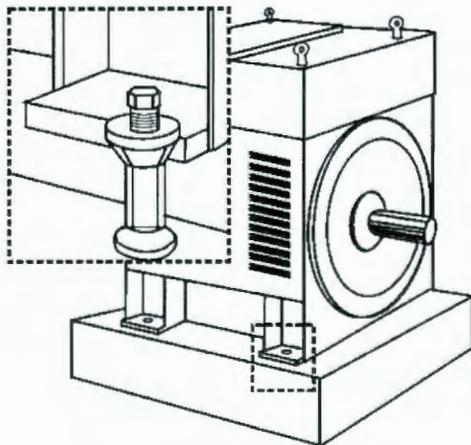


Figure 3.3 - Motor mounted on a concrete base with foundation studs

c) Metallic Base

Motor-generator sets are assembled and tested at the factory prior to delivery. However, before putting into service at site, coupling alignment should be carefully checked as the metallic base could have suffered dislocation during transit due to internal stresses of the material.

The metallic base is susceptible to distortion if secured to a foundation that is not truly flat.

Machines should not be removed from their common metallic base for alignment; the metallic base should be levelled on the actual foundation with the aid of a spirit level (or similar instrument).

When a metallic base is used to adjust the height of the motor shaft end with the machine shaft end, the latter should be levelled on the concrete base.

After the base has been levelled, foundation studs tightened, and the coupling checked, the metal base and the studs are cemented.



Figure 3.4 - Three-phase motor mounted on a metallic base

3.1.3 Alignment

The electric motor should be accurately aligned with the driven machine, particularly in cases of direct coupling. An incorrect alignment can cause bearing failure vibrations and even shaft rupture.

The best way to ensure correct alignment is to use dial gauges placed on each coupling half, one reading radially and the other axially - Figure 3.5.



Figure 3.5 - Alignment with dial gauges

Thus, simultaneous readings are possible and allow for checking for any parallel (Figure 3.6a) and concentricity deviations (Figure 3.6b) by rotating the shafts one turn. Gauge readings should not exceed 0.02 inches. If the installer is sufficiently skilled, he can obtain alignment with feeler gauges and a steel ruler, providing that the couplings are perfect and centered - Figure 3.6c.

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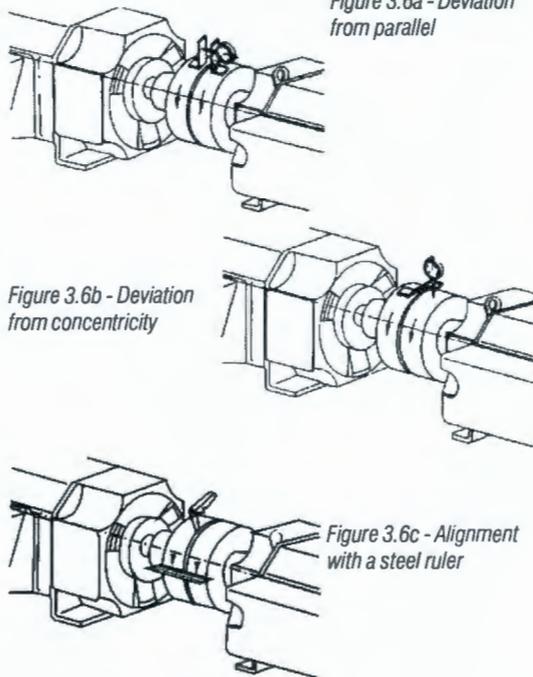


Figure 3.6a - Deviation from parallel

Figure 3.6b - Deviation from concentricity

Figure 3.6c - Alignment with a steel ruler

3.1.4 Coupling

a) Direct Coupling

Direct coupling is always preferable due to its lower cost, space economy, no belt slippage and lower accident risk. In the case of speed ratio drives, it is also common to use a direct coupling with a reducer (gear box).

CAUTION: Carefully align the shaft ends using, whenever feasible, a flexible coupling.



Figure 3.7 - A type of direct coupling

b) Gear Coupling

Poorly aligned gear couplings are the cause of jerking motions which bring about the vibration of the actual drive and vibrations within the motor. Therefore, due care must be given to perfect shaft alignment: exactly parallel in the case of straight gears, and at the correct angle for bevel or helical gears.

Perfect gear engagement can be checked by the insertion of a strip of paper on which the teeth marks will be traced after a single rotation.

c) Belt and Pulley Coupling

Belt coupling is most commonly used when a speed ratio is required.

Assembly of Pulleys: To assemble pulleys on shaft ends with a keyway and threaded end holes the pulley should be inserted halfway up the keyway merely by manual pressure.

On shafts without threaded end holes the heating of the pulley to about 80°C is recommended, or alternatively, the devices illustrated in Figure 3.8 may be employed.

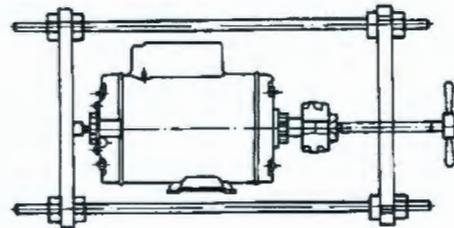


Figure 3.8 - Pulley mounting device

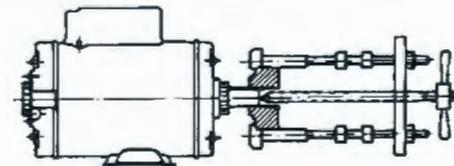


Figure 3.8a - Pulley extractor

Hammers should be avoided during the fitting of pulleys and bearings. The fitting of bearings with the aid of hammers leaves blemishes on the bearing races. These initially small flaws increase with usage and can develop to a stage that completely impairs the bearing.

The correct positioning of a pulley is shown in Figure 3.9.

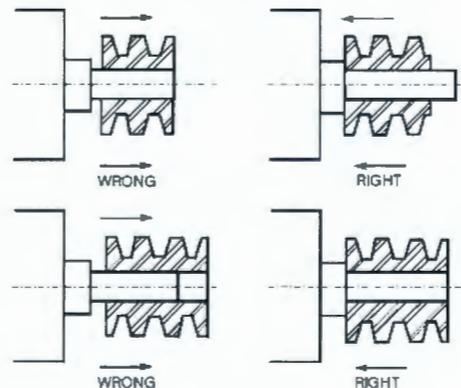


Figure 3.9 - Correct positioning of pulley on the shaft



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RUNNING: To avoid needless radial stresses on the bearings it is imperative that shafts are parallel and the pulleys perfectly aligned. (Figure 3.10).

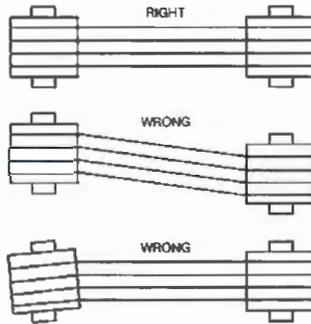


Figure 3.10 - Correct pulley alignment

Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin (rosin for example).

Belt tension should be sufficient to avoid slippage during operation (Figure 3.11). Pulleys that are too small should be avoided; these cause shaft flexion because belt traction increases in proportion to a decrease in the pulley size. Table 1 determines minimum pulley diameters, and Tables 2 and 3 refer to the maximum stresses acceptable on motor bearings up to frame 580. Beyond frame size 600, an analysis should be requested from the WEG engineering.

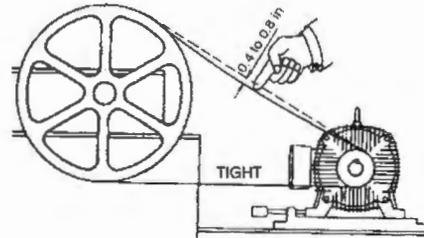
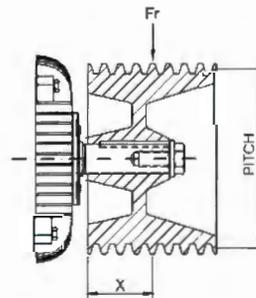


Figure 3.11 - Belt tensions

Table 1 - Minimum pitch diameter of pulleys

Frame	Bearing	Ball bearings					
		Size X Inches					
		0.79	1.57	2.36	3.15	3.94	4.72
140	6205-Z	1.7	1.85	2			
W 180	6206-Z	3.03	3.23	3.46			
180	6307-Z	1.69	1.81	1.93			
W 210	6308-Z		2.86	3.00	3.16		
210	6308-Z		2.90	3.06	3.22		
W 250	6309 C3		4.37	4.54	4.72	4.92	
250	6309 C3		4.41	4.59	4.77	4.97	
280	6311 C3			5.08	5.19	5.47	5.65
320	6312 C3			7.44	7.76	7.94	8.18
360	6314 C3			8.73	9.00	9.28	9.57



Frame	Poles	Bearing	Ball Bearing				Roller Bearing						
			Size X Inches				Bearing	Size X Inches					
			1.97	3.15	4.33	5.51		1.97	3.15	4.33	5.51	6.69	8.27
400	II	6314 C3	7.3	7.62	7.94	8.24	NU 316	4.13	4.31	4.49	4.67	4.85	-
	IV-VI-VII	6314 C3						-	-	-	-	-	-
440	II	6314 C3	11.75	12.16	12.61	13.08	NU 319	4.02	4.17	4.32	4.47	4.62	4.82
	IV-VI-VIII	6319 C3						-	-	-	-	-	-
500	II	6314 C3	23.54	24.34	25.12	25.87	NU 319	6.52	6.73	6.95	7.17	7.39	7.67
	IV-VI-VIII	6319 C3						-	-	-	-	-	-
5008	II	6314 C3	44.66	45.79	46.98	48.23	NU 322	8.73	8.95	9.96	11.34	12.87	14.82
	IV-VI-VIII	6322 C3						-	-	-	-	-	-
580	II	6314 C3	57	58	59	60	NU 322	10.72	10.91	11.11	11.31	11.50	11.76
	IV-VI-VIII	6322 C3						-	-	-	-	-	-

- Important:
- 1) Peripheral speeds for solid grey cast iron pulleys FC 200 is $V = 115$ ft/s
 - 2) Use steel pulleys when peripheral speed is higher than 115 ft/s
 - 3) V-belt speed should not exceed 115 ft/s.

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Table 2 - Maximum acceptable radial load (Lbf)

Nema 56 Motors				
Frame	Poles	Radial Force (Lbf)		
		Distance X		
		1	1,18	2
56A	II	88	-	59
	IV	88	-	59
56B	II	88	-	59
	IV	86	-	59
56D	II	127	-	70
	IV	141	-	70

Saw Arbor Motors				
80 LMS	II	-	355	-
80 MMS	II	-	359	-
80 SMS	II	-	357	-
90 LMS	II	-	427	-
	IV	-	555	-

Table 3 - Maximum acceptable axial load (Lbf)

IP55 Totally Enclosed Motors - 60Hz Position / Construction Form																
F R A M E																
	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII
140	103	141	167	187	112	152	185	207	99	132	158	178	105	143	174	198
W 180	108	145	180	202	154	209	255	286	94	130	165	183	141	194	240	269
180	149	207	249	286	269	370	443	500	136	189	229	266	253	352	421	480
W 210	196	264	326	368	329	447	544	610	176	238	297	339	310	421	518	582
210	189	257	315	357	324	443	533	599	160	220	275	310	295	405	493	553
W 250	282	372	443	485	471	620	734	811	240	317	394	414	430	564	685	743
250	273	368	436	485	463	615	727	813	220	310	379	421	410	557	672	749
280	355	480	551	624	621	826	959	1,082	275	388	427	502	540	736	838	961
320	374	498	588	668	703	930	1,091	1,232	266	366	432	511	597	793	937	1,078
360	890	1,181	1,144	1,323	890	1,181	1,375	1,552	745	985	1,144	1,323	745	985	1,144	1,323
400	877	1,148	1,347	1,521	877	1,148	1,347	1,521	705	890	1,060	1,241	705	890	1,060	1,241
440	842	1,303	1,563	1,821	842	1,303	1,563	1,821	568	884	1,109	1,488	568	884	1,109	1,488
500	769	1,250	1,481	1,728	769	1,250	1,481	1,728	355	721	844	1,190	355	721	844	1,109
5008	791	1,624	1,909	2,137	791	1,624	1,909	2,137	728	1,548	1,808	2,029	728	1,548	1,808	2,029
580	679	1,406	1,649	1,865	679	1,406	1,649	1,865	033	474	549	597	033	474	549	597

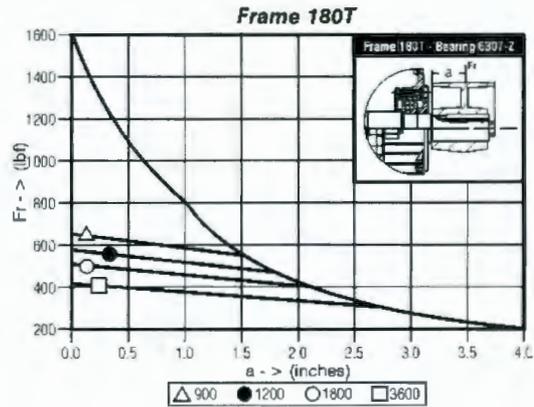
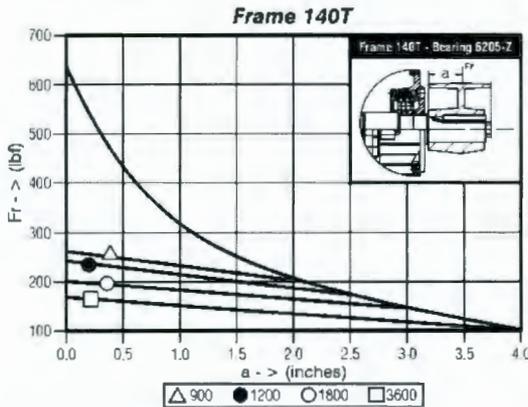
Open Motors - NEMA 56 Frames - 60Hz Position / Construction Form									
F R A M E									
	II	IV	II	IV	II	IV	II	IV	
56 A	68	90	83	112	63	85	79	108	
56 B	66	90	81	110	63	83	77	105	
56 D	63	88	105	145	59	81	101	138	



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The maximum radial load for each frame are determined, by graphs.

INSTRUCTIONS ON HOW TO USE THE GRAPHS



- 1 - Maximum radial load on shaft.
- 2 - Maximum radial load on bearings.

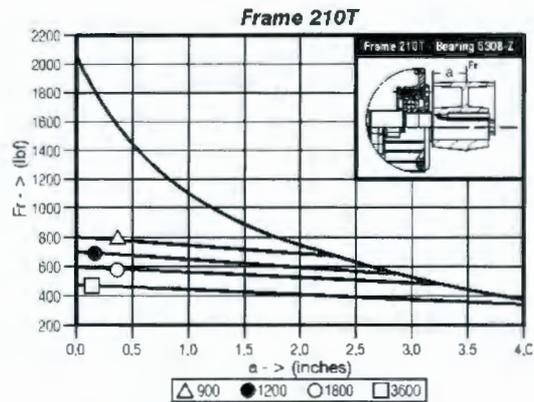
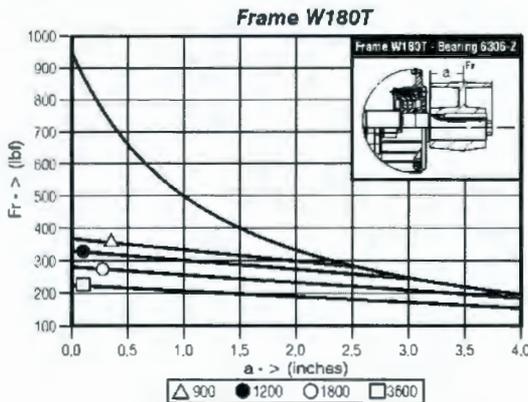
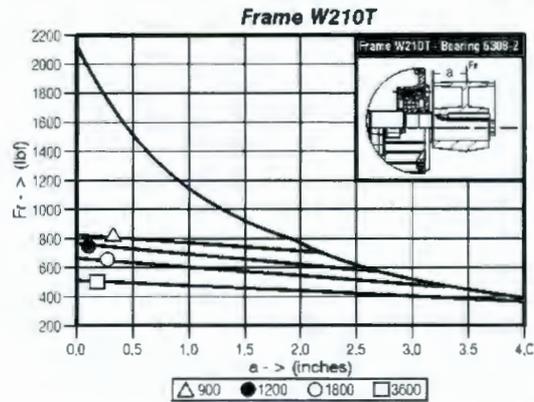
Where: X - Half of pulley width (inches)
Fr - Maximum radial load in relation to the diameter and pulley width.

Example:
Verify whether a 2HP motor, II Pole, 60Hz withstands a radial load of 110Lb, considering a pulley width of 4 inches.

Frame : 145T
Fr : 110Lb
X : 2 inches

- 1 - Mark the distance X
- 2 - Find out line N = 3600 for bearing

Based on the above, this bearing withstands a radial load of 130Lb.





3.2 Electrical Aspects

3.2.1 Feed System

Proper electric power supply is very important. The choice of motor feed conductors, whether branch or distribution circuits, should be based on the rated current of the motors as per NFPA-70 Standard article 430.

Tables 4, 5 and 6 show minimum conductor gauges sized according to maximum current capacity and maximum voltage drop in relation to the distance from the distribution center to the motor, and to the type of installation (Overhead or in ducts).

To determine the conductor gauge proceed as follows:

a) Determine the current by multiplying the current indicated on the motor nameplate by 1.25 and then locate the resulting value on the corresponding table.

If the conductor feeds more than one motor, the value to be sought on the table should be equal 1.25 times the rated current of the largest motor plus the rated current of the other motors. In the case of variable speed motors, the highest value among the rated currents should be considered.

When motor operation is intermittent, the conductors should have a current carrying capacity equal or greater, to the product of the motor rated current times the running cycle factor shown on Table 7.

Table 7 - Running cycle factor

Duty Classification	Motor short time rating			
	5min	15min	30 at 60min	Continuous
Short (operating valves, activating contacts etc)	1.10	1.20	1.50	-
Intermittent (passenger or freight elevators, tools, pumps, rolling bridges etc)	0.85	0.85	0.90	1.40
Cyclic (rolling mills, mining machines etc)	0.85	0.90	0.95	1.40
Variable	1.10	1.20	1.50	2.00

b) Locate the rated voltage of the motor and the feed network distance in the upper part of the corresponding table. The point of intersection of the distance column and the line referring to current will indicate the minimum required gauge of the conductor.

Example:

Size the conductors for a 15 HP, three-phase, 230V, 42A, motor located 200 feet from the main supply with cables laid in conduits.

- Current to be located: $1.25 \times 42A = 52.5A$
- Closest value on table 6:55A
- Minimum gauge: 6 AWG

3.2.2 Starting of Electric Motor

Induction motors can be started by the following methods:

Direct Starting

Whenever possible a three-phase motor with a squirrel cage rotor should be started directly at full supply voltage by means of a contactor (Connection diagram a). This method is called Direct-on-Line (DoL) starting.

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Table 4 - Wire and cable gauges for single-phase motor installation (voltage drop < 5%) (in conduits)

Supply Voltage	Distance of motor from distribution centre (feet)														
	34	51	69	85	102	137	171	205	240	273	308	342	428	514	
115	34	51	69	85	102	137	171	205	240	273	308	342	428	514	
230	69	102	138	170	204	274	342	410	480	546	616	684	856	1028	
460	138	204	276	340	408	548	684	820	960	1092	1232	1368	1712	2056	
575	170	250	338	420	501	670	840	1010	1181	1342	1515	1680	2105	2530	
Current (A)	Cable gauge (conductor)														
5	14	14	14	14	14	14	14	12	12	12	12	10	10	8	
10	14	14	14	14	14	12	12	10	10	10	8	8	6	6	
15	12	12	12	12	12	10	8	8	6	6	6	6	4	2	
20	12	12	12	10	10	8	8	6	6	6	4	4	4	2	
30	10	10	10	8	8	6	6	6	4	4	2	2	2	1/0	
40	8	8	8	8	6	6	4	4	2	2	2	2	1/0	2/0	
55	6	6	6	6	6	4	4	2	2	1/0	1/0	1/0	1/0	2/0	
70	4	4	4	4	4	2	2	1/0	1/0	1/0	2/0	2/0	2/0	2/0	
95	2	2	2	2	2	2	1/0	1/0	1/0	2/0	3/0	3/0	4/0	250M	

Table 5 - Wire and cable gauges for three-phase motor installation - aerial conductors with 25cm spacing (voltage drop < 5%)

Supply Voltage	Distance of motor from distribution centre (feet)														
	51	69	85	102	137	171	205	240	273	308	342	428	514	685	
115	51	69	85	102	137	171	205	240	273	308	342	428	514	685	
230	102	138	170	204	274	342	410	480	546	616	684	856	1028	1370	
460	204	276	340	408	547	684	820	960	1092	1232	1368	1712	2056	2740	
575	250	338	420	501	670	840	1010	1181	1342	1515	1680	2105	2530	3350	
Current (A)	Cable gauge (conductor)														
15	14	14	14	12	12	10	10	10	8	8	8	6	6	4	
20	14	14	12	12	10	10	8	8	6	6	6	4	4	2	
30	14	12	10	8	8	8	6	6	4	4	4	2	2	1/0	
40	12	10	10	8	8	6	4	4	4	2	2	2	1/0	2/0	
55	10	10	8	8	6	4	4	2	2	1/0	1/0	2/0	3/0	--	
70	8	8	6	6	4	2	2	2	1/0	1/0	2/0	3/0	--	--	
100	6	6	4	4	2	2	1/0	2/0	3/0	4/0	4/0	--	--	--	
130	4	4	4	2	1/0	1/0	2/0	4/0	--	--	--	--	--	--	
175	2	2	2	1/0	2/0	3/0	--	--	--	--	--	--	--	--	
225	1/0	1/0	1/0	2/0	3/0	-	--	--	--	--	--	--	--	-	
275	2/0	2/0	2/0	4/0	--	--	--	--	--	--	4/0	--	--	--	
320	3/0	3/0	3/0	4/0	-	--	--	--	--	--	--	--	--	--	

Table 6 - Wire and cable gauges for three-phase motor installation (voltage drop < 5%) (in conduits)

Supply Voltage	Distance of motor from distribution centre (feet)											
	85	102	120	137	171	205	240	273	308	342	428	514
115	85	102	120	137	171	205	240	273	308	342	428	514
230	170	204	240	274	342	410	480	546	616	684	856	1028
460	340	408	480	548	684	820	960	1092	1232	1368	1712	2056
575	420	501	590	670	840	1010	1181	1342	1515	1680	2105	2530
Current (A)	Cable gauge (conductor)											
15	12	12	12	10	10	8	8	8	6	6	6	4
20	12	10	10	10	8	8	6	6	6	6	4	4
30	10	8	8	8	6	6	6	4	4	4	2	2
40	8	8	6	6	6	4	4	4	4	2	2	1/0
55	6	6	6	4	4	4	2	2	2	1/0	1/0	1/0
70	4	4	4	4	2	2	2	1/0	1/0	1/0	2/0	2/0
95	2	2	2	2	2	1/0	1/0	1/0	1/0	2/0	3/0	4/0
125	1/0	1/0	1/0	1/0	1/0	1/0	2/0	2/0	3/0	3/0	4/0	250M
145	2/0	2/0	2/0	2/0	2/0	2/0	2/0	3/0	3/0	4/0	250M	300M
165	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	4/0	4/0	250M	350M
195	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	250M	250M	300M	350M
215	250M	250M	250M	250M	250M	250M	250M	250M	250M	300M	350M	400M
240	300M	300M	300M	300M	300M	300M	300M	300M	300M	300M	400M	500M
265	350M	350M	350M	350M	350M	350M	350M	350M	350M	350M	500M	500M
280	400M	400M	400M	400M	400M	400M	400M	400M	400M	400M	400M	--
320	500M	500M	500M	500M	500M	500M	500M	500M	500M	500M	500M	--

Note: The above indicated values are orientative. For guaranteed values, contact the Local Power Company.



There are DOL starter assemblies available combining a three-pole contactor, a bimetal relay (overload protection device), and a fuse (short circuit protection on branch circuit).

DOL starting is the simplest method, only feasible however, when the locked rotor current (LRC) does not influence the main electric supply lines.

Initial locked rotor current (LRC) in induction motors reach values six to eight times the value of the full load current. During starting by the DOL method, starting current can reach these high levels. The main electrical supply should be rated sufficiently, such that during the starting cycle no supply disturbance to others on the power network is caused by the voltage drop in the main supply.

This can be achieved under one of the following situations:

- The rated main supply current is high enough for the locked rotor current not to be proportionally high;
- Motor locked rotor current is low with no effect on the networks.
- The motor is started under no-load conditions with a short starting cycle and, consequently, a low locked rotor current with a transient voltage drop tolerable to other consumers.

Starting with a compensating switch (auto-transformer starting)

Should direct on line starting not be possible, either due to restrictions imposed by the power supply authority or due to the installation itself, reduced voltage indirect starting methods can be employed to lower the locked rotor current. The single line connection diagram (C) shows the basic components of a compensating switch featuring a transformer (usually an auto-transformer) with a series of taps corresponding to the different values of the reduced voltage. Only three terminals of the motor are connected to the switch, the other being interconnected as per diagram, for the indicated voltage.

Star-Delta starting

It is fundamental to star-delta starting that the three-phase motor has the necessary numbers of leads for both connections:

- 6 leads for Y/D
- or 12 leads for YY/DD

All the connections for the various voltages are made through terminals in the terminal box in accordance with the wiring diagram that accompanies the motor. This diagram may be shown on the nameplate or in the terminal box.

The star-delta connection is usually used only in low-voltage motors due to normally available control and protection devices in this method of starting the locked rotor current is approximately 30% of the original LRC, as well as the locked rotor torque is reduced proportionally. For this reason, is very important before the decision to use star-delta starting, to verify if the reduced locked rotor torque in "STAR" connection is enough to accelerate the load.

Three-Phase slip ring motors with rheostat starting

On starting slip ring motors an external rheostat is connected to the rotor circuit by means of a set of brushes and sliding rings (connection diagram d). The extra rotor resistance is held in the circuit during the starting cycle to reduce the starting current and increase torque. Furthermore, it is possible to regulate external resistance so as to have a starting torque equal to, or close to the maximum motor torque value.

3.2.3 Motor Protection

Motor circuits have, in principle, two types of protection: motor overload, locked rotor and protection of branch circuit from short circuits. Motors in continuous use should be protected from overloading by means of a device incorporated into the motor, or by an independent device, usually a fixed or adjustable thermal relay equal or less than to the value derived from multiplying the rated feed current at full load by:

- 1.25 for motors with a service factor equal or superior to 1.15;

or

- 1.15 for motors with service factor equal to 1.0.

Some motors are optionally fitted with overheating protective detectors (in the event of overload, locked rotor, low voltage, inadequate motor ventilation) such as a thermostat (thermal probe), thermistor (PTC), RTD type resistance which dispense with independent devices.

THERMOSTAT (THERMAL PROBE): bimetallic thermal detectors with normally closed silver contacts. These open at pre-determined temperatures. Thermostats are series connected directly to the contactor coil circuit by two conductors.

THERMISTORS: Semi-conductor heat detectors positive temperature coefficient (PTC) that sharply change their resistance upon reaching a set temperature. Thermistors, depending upon the type, are series or parallel-connected to a control unit that cuts out the motor feed, or actuates an alarm system, in response to the thermistors reaction.

Resistance temperature detectors (RTD) - PT 100

The resistance type heat detector (RTD) is a resistance element usually manufactured of copper or platinum. The RTD operates on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. The detector terminals are connected to a control panel, usually fitted with a temperature gauge, a test resistance and a terminal changeover switch.

Subject to the desired degree of safety and the client's specification, three (one per phase) or six (two per phase) protective devices can be fitted to a motor for the alarm systems, circuit breaker or combined alarm and circuit breaker, with two leads from the terminal box to the alarm or

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circuit breaker system and four for the combined system (alarm and circuit breaker).

Table 9 compares the two methods of protection.

3.3 Start-up

3.3.1 Preliminary Inspection

Before starting a motor for the first time, it will be necessary to:

- a) Remove all locking devices and blocks used in transit and check that the motor rotates freely;
- b) Check that the motor is firmly secured and that coupling elements are correctly mounted and aligned.;
- c) Ascertain that voltage and frequency correspond to those indicated on the nameplate. Motor performance will be satisfactory with mains supply voltage fluctuation within ten per cent of the value indicated on the nameplate or a frequency fluctuation within five per cent or, yet, with a combined voltage and frequency variance within ten per cent;
- d) Check that connections are in accordance with the connection diagram shown on the nameplate and be sure that all terminal screws and nuts are tight;
- e) Check the motor for proper grounding. Providing that there are no specifications calling for ground-insulated installation, the motor must be grounded in accordance with prevalent standard for grounding electrical machines. The screw identified by the symbol \perp should be used for this purpose. This screw is generally to be found in the terminal box or on one foot of the frame;
- f) Check that motor leads connecting with the mains, as well as the control wires and the overload protection device, are in accordance with Nema Standards;
- g) If the motor has been stored in a damp place, or has been stopped for some time, measure the insulating resistance as recommended under the item covering storage instructions;
- h) Start the motor uncoupled to ascertain that it is turning in the desired direction. To reverse the rotation of a three-phase motor, invert two terminal leads of the mains supply. High voltage motors bearing an arrow on the frame indicating rotation direction can only turn in the direction shown;
- i) Prior to slip ring motors entering into service the brush holder assembly screws require tightening.

The gap between brush holders and slip ring surfaces should be between 0.8 inches and 1.6 inches.

Table 9 - Comparison between motor protection system

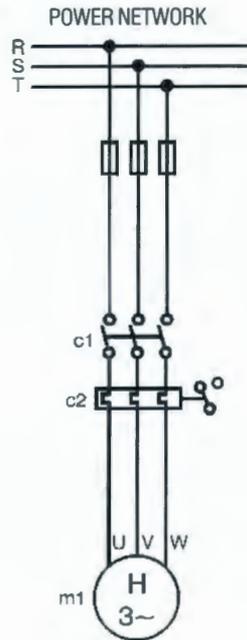
Causes of overheating	Current-based protection		Protection with probe thermistor in motor
	Fuse only	Fuse and thermal protector	
1. Overload with 1.2 times rated current	○	●	●
2. Duty cycles S1 to S8 IEC 34, EB 120	○	◐	●
3. Brakings, reversals and frequent starts	○	◐	●
4. Operating with more than 15 starts p/hour	○	◐	●
5. Locked rotor	◐	◐	●
6. Fault on one phase	○	◐	●
7. Excessive voltage fluctuation	○	●	●
8. Frequency fluctuation on main supply	○	●	●
9. Excessive ambient temperature	○	●	●
10. External heating caused by bearings, belts, pulleys etc.	○	○	●
11. Obstructed ventilation	○	○	●

Caption: ○ unprotected
◐ partially protected
● totally protected

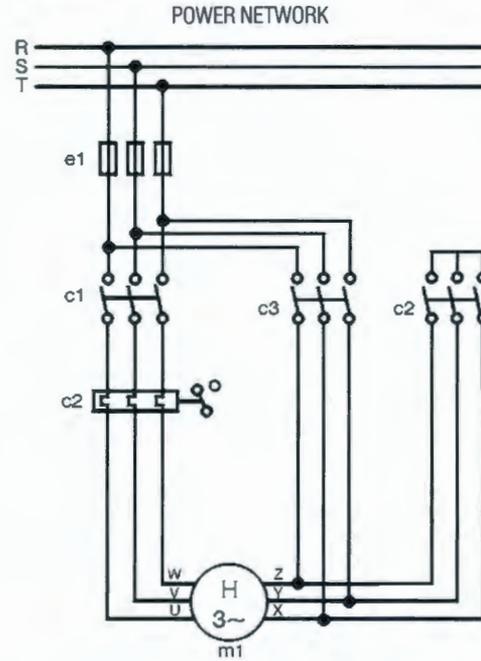


CONNECTION DIAGRAMS

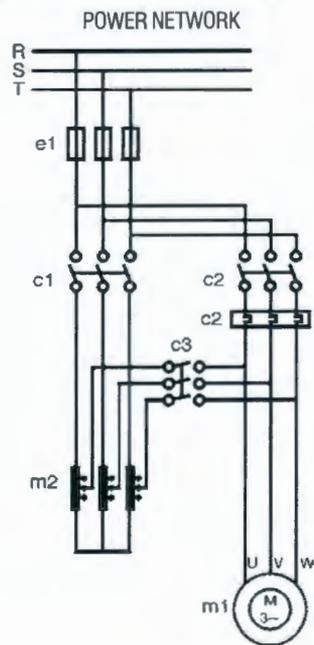
a) Direct starting



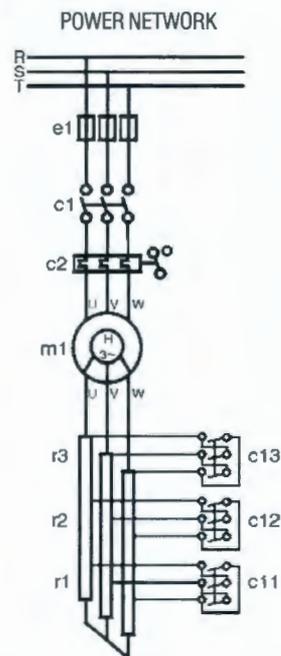
b) Star-Delta starting



c) Auto-transformer starting



d) Multi-stage automatic starting of slip ring motors



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Brush pressure on the slip ring should be in accordance with Table 10.
For radial type, brushes, incidence to the contact surface should be perpendicular;

- j) Bronze slip rings are often supplied with a protective coating of varnish. Prior to entering into service this coating should be removed. It is advisable to make sure that all surfaces are smooth and clean.

Table 10 - Brush characteristics

Brush type	Brush characteristics	Pressure Lb/Inc ²
EGO	High conductivity, applicable to low voltage and high current machines	2.6
CM 1S	Copper and graphite alloy	2.0
CM 3H	Bronze graphite alloy	3.0

3.3.2 The First Start-up

Three-Phase Motor with Cage Rotor

After careful examination of the motor, follow the normal sequence of starting operations listed in the control instructions for the initial start-up.

Three-Phase Slip Ring Motor

Before running the motor verify that the starter rheostat is in the "start" position, and that the brushes are correctly set against the slip rings.

If the rheostat tap positions are numbered, the lowest usually corresponds to the "start" position, and the highest to the normal running position.

Next, close the stator circuit switch. The ammeter needle should deflect sharply and then returning to a fixed lower value after motor start.

When the needle is almost stationary, the rheostat should be quickly moved to the next tapping position.

Coincident with speed increases, the rheostat should be moved to each successive position until normal running position is reached, stopping at each tapping stage until the current indication shows no visible current drop.

On motors with brushes in permanent contact, the starter rheostat remains in the "run" position while the motor is running.

Special speed control rheostats designed for permanent connection to resistance contacts within a given range of settings are an exception to the above.

3.3.3 Operation

Drive the motor coupled to the load for a period of at least one hour while watching for abnormal noises or signs of overheating.

Compare the line current with the value shown on the nameplate.

Under continuous running conditions without load fluctuations this should not exceed the rated current times the service factor, also shown on the nameplate.

All measuring and control instruments and apparatus should be continuously checked for anomalies, and any irregularities corrected.

3.3.4 Stopping

Warning:

To touch any moving part of a running motor, even though disconnected, is a danger to life and limb.

- a) Three-phase motor with cage rotor:
Open the stator circuit switch. With the motor at a complete stop, reset the auto-transformer, if any, to the "start" position;
- b) Three-phase slip ring motor:
Open the stator circuit switch. When the motor is at a complete stop reset the rheostat to the "start" position.



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Table 11 - Bearing specifications by type of motor

NEMA Frames	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
Open drip proof motors			
B48 and C48	ALL FORMS	6203 Z	6202 Z
56 and A56		6203 Z	6202 Z
B56 and C56		6203 Z	6202 Z
D56 and F56H/G56H		6204 Z	6202 Z / 6203 Z
Totally enclosed fan cooled motors			
143 T	ALL FORMS	6205 ZZ	6204 ZZ
145 T		6205 ZZ	6204 ZZ
182 T		6307 ZZ	6206 ZZ
184 T		6307 ZZ	6206 ZZ
W 182 T		6206 ZZ	6205 ZZ
W 184 T		6206 ZZ	6205 ZZ
213 T		6308 ZZ	6207 ZZ
215 T		6308 ZZ	6207 ZZ
W 213 T		6308 ZZ	6207 ZZ
W 215 T		6308 ZZ	6207 ZZ
254 T		6309-C3	6209 Z-C3
256 T		6309-C3	6209 Z-C3
W 254 T		6309-C3	6209 Z-C3
W 256 T		6309-C3	6209 Z-C3
284 T and TS		6311-C3	6211 Z-C3
286 T and TS		6311-C3	6211 Z-C3
324 T and TS		6312-C3	6212 Z-C3
326 T and TS		6312-C3	6212 Z-C3
364 T and TS		6314-C3	6314-C3
365 T and TS		6314-C3	6314-C3
404 T		NU 316-C3	6314-C3
404 TS		6314-C3	6314-C3
405 T		NU 316-C3	6314-C3
405 TS		6314-C3	6414-C3
444 T		NU 319-C3	6316-C3
444 TS		6314-C3	6314-C3
445 T		NU 319-C3	6316-C3
445 TS		6314-C3	6314-C3
447 T		NU 319-C3	6316-C3
447 TS		6314-C3	6314-C3
449 T		NU 322-C3	6319-C3
449 TS		6314-C3	6314-C3
504 T		NU 319-C3	6316-C3
504 TS		6314-C3	6314-C3
505 T		NU 319-C3	6316-C3
505 TS		6314-C3	6314-C3
5008 T		NU 322-C3	6319-C3
5008TS		6314-C3	6314-C3
586 T		NU 322-C3	6319-C3
586 TS		6314-C3	6314-C3
587 T	NU 322-C3	6319-C3	
587 TS	6314-C3	6314-C3	
Bearings			
Saw Arbor motor frame	Mounting	Front (D.E.)	Rear (O.D.E.)
80 S MS	B3	6307 ZZ	6207 ZZ
80 M MS		6307 ZZ	6207 ZZ
80 L MS		6307 ZZ	6207 ZZ
90 L MS		6308 ZZ	6208 ZZ

ODP Motors Nema-T frames	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
E143/5T	HORIZONTAL MOUNTING ONLY	6205 ZZ	6204 ZZ
F143/5T		6205 ZZ	6204 ZZ
182 T		6206 ZZ	6205 ZZ
184 T		6202 ZZ	6205 ZZ
213/5T		6208 ZZ	6206 ZZ
254 T		6309 Z-C3	6209 Z-C3
256 T		6309 Z-C3	6209 Z-C3
284 T		6311 Z-C3	6211 Z-C3
284 TS		6311 Z-C3	6211 Z-C3
286 T		6311 Z-C3	6211 Z-C3
286 TS		6311 Z-C3	6211 Z-C3
324 T		6312 Z-C3	6212 Z-C3
324 TS		6312 Z-C3	6212 Z-C3
326 T		6312 Z-C3	6212 Z-C3
326 TS		6312 Z-C3	6212 Z-C3
364 T		6314 C3	6314 C3
364 TS		6314 C3	6314 C3
365 T		6314 C3	6314 C3
365 TS		6314 C3	6314 C3
404 T		NU 316 C3	6314 C3
404 TS		6314 C3	6314 C3
405 T		NU 316 C3	6314 C3
405 TS		6314 C3	6314 C3
444 T		NU 319 C3	6316 C3
444 TS		6314 C3	6314 C3
445 T		NU 319 C3	6316 C3
445 TS		6314 C3	6314 C3

IEC frame	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
Totally enclosed fan cooled motors			
63	B3	6201 ZZ	6201 ZZ
71		6203 ZZ	6202 ZZ
80		6204 ZZ	6203 ZZ
90 S - L		6205 ZZ	6204 ZZ
100 L		6206 ZZ	6205 ZZ
112 M		6307 ZZ	6206 ZZ
132 S - M		6308 ZZ	6207 ZZ
160 M - L		6309-C3	6209 Z-C3
180 M - L		6311-C3	6211 Z-C3
200 M - L		6312-C3	6212 Z-C3
225 S/M		6314-C3	6314-C3
250 S/M		6314-C3	6314-C3
280 S/M		6314-C3	6314-C3
		6316-C3	6316-C3
315 S/M		6314-C3	6314-C3
		6319-C3	6316-C3
		6314-C3	6314-C3
355 M/L		NU 322-C3	6319-C3

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Table 12 - Bearing lubrication intervals and amount of grease

1 - SINGLE-ROW FIXED BALL BEARINGS

Bearings	Lubrication intervals (running hours)												Amount of grease (oz)	
	II Pole		IV Pole		VI Pole		VIII Pole		X Pole		XII Pole			
	60Hz 3600 rpm	50Hz 3000 rpm	60Hz 1800 rpm	50Hz 1500 rpm	60Hz 1200 rpm	50Hz 1000 rpm	60Hz 900 rpm	50Hz 750 rpm	60Hz 720 rpm	50Hz 600 rpm	60Hz 600 rpm	50Hz 500 rpm		
6 2 S E R I E S	6200	12500	13800										0,07	
	6201	11700	13000	16600	18400								0,07	
	6202	10500	11900	15400	17100	19500							0,07	
	6203	9800	11200	14500	16200	18500							0,11	
	6204	8700	10100	13300	14800	17100	19100			> 20000			0,14	
	6205	8000	9400	12600	14100	16200	18200	19300						0,14
	6206	7300	8700	12000	13400	15400	17200	18300						0,18
	6207	6600	8100	11400	12700	14500	16300	17300	19200					0,25
	6208	5900	7400	10800	12000	13700	15300	16300	18200					0,29
	6209	5300	6900	10400	11600	13400	15000	16000	17800					0,29
	6210	4900	6400	9700	11000	12900	14600	15600	17300					0,32
	6211	4300	5900	9500	10900	12700	14400	15300	17000					0,39
	6212	3800	5400	9300	10300	12400	14300	15200	16500					0,46
	6213	3100	4900	8900	10100	12200	14000	14800	16100					0,50
	6214	1100	2000	4100	5000	5900	6500	6900	7600					0,54
	6215	1000	1800	4400	5000	5600	6300	6700	7600					0,61
6216	700	1600	4100	4700	5700	6500	6800	7500					0,68	

6 3 S E R I E S	6304	8700	10100	13300	14800	17100	19100						0,14
	6305	8000	9400	12600	14100	16200	18200	19300					0,21
	6306	7300	8700	12000	13400	15400	17200	18300			> 20000		0,25
	6307	6600	8100	11400	12700	14500	16300	17300	19200				0,32
	6308	5900	7400	10800	12000	13700	15300	16300	18200	18600			0,39
	6309	5300	6900	10400	11600	13400	15000	16000	17800	18200	19900		0,46
	6310	4900	6400	9700	11000	12900	14600	19500	17300	17700	19500	19500	0,54
	6311	4300	5900	9500	10900	12700	14400	15300	17000	17400	19000	19000	0,64
	6312	3800	5400	9300	10300	12400	14300	15200	16500	16800	18200	18200	0,75
	6313	3100	4900	8900	10100	12200	14000	14800	16100	16400	17900	17900	0,86
	6314	1100	2000	4100	5000	5900	6500	6900	7600	7700	8600	8600	0,96
	6315	1000	1800	4400	5000	5600	6300	6700	7600	7900	8900	8900	1,07
	6316	700	1600	4100	4700	5700	6500	6800	7500	7700	8500	8500	1,22
	6317	800	1300	3900	4700	5600	6300	6700	7400	7500	8300	8300	1,32
	6318	-	1000	3800	4600	5500	6200	6600	7200	7400	8200	8200	1,47
	6319	-	800	3700	4500	5400	6100	6500	7100	7300	8000	8000	1,61
6320	-	-	3600	4300	5300	6000	6300	7000	7100	7900	7900	1,82	
6321	-	-	3400	4200	5100	5800	6200	6800	7000	7800	7800	2,00	
6322	-	-	3100	4000	5000	5700	6100	6700	6900	7700	7700	2,14	

1) Lubrication periodicity valid for NLG 1 and lithium based bearing lubricant.
2) Bearings for motors of X and XII poles - Lubrication Intervals > 20,000.



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Table 13 - Bearing lubrication intervals and amount of grease

2 - CYLINDRICAL ROLLER BEARINGS

Bearings		Lubrication intervals (running hours)												Amount of grease (oz)
		II Pole		IV Pole		VI Pole		VIII Pole		X Pole		XII Pole		
		60Hz 3600 rpm	50Hz 3000 rpm	60Hz 1800 rpm	50Hz 1500 rpm	60Hz 1200 rpm	50Hz 1000 rpm	60Hz 900 rpm	50Hz 750 rpm	60Hz 720 rpm	50Hz 600 rpm	60Hz 600 rpm	50Hz 500 rpm	
N	NU309	2800	4000	8300	9500	10700	11800	12500	14100	14500	16300	16300	18200	0,46
	NU310	2400	3600	7900	9100	10300	11400	12200	13700	14000	15800	15800	17700	0,54
U	NU311	2000	3200	7400	8700	10000	11000	11800	13300	13600	15400	15400	17200	0,64
	NU312	1600	2700	6900	8300	9600	10700	11400	12800	13200	14900	14900	16800	0,75
3	NU313	1500	2500	6600	8100	9400	10500	11200	12700	13000	14700	14700	16500	0,86
	NU314	700	1100	3100	3900	4600	5200	5500	6200	6400	7200	7200	8100	0,96
S	NU315	-	900	2900	3800	4500	5100	5500	6200	6300	7100	7100	7900	1,07
	NU316	-	800	2800	3600	4400	5000	5400	6100	6200	7000	7000	7800	1,22
E	NU317	-	600	2600	3500	4300	4900	5300	6000	6100	6900	6900	7700	1,32
	NU318	-	-	2100	3300	4300	4900	5300	5900	6000	6700	6700	7500	1,47
I	NU319	-	-	2300	3200	4100	4700	5100	5800	6000	6700	6700	7500	1,61
	NU320	-	-	2000	3000	4000	4700	5000	5700	5900	6600	6600	7300	1,82
S	NU321	-	-	1900	2800	4000	4600	4900	5600	5700	6500	6500	7200	2,00
	NU322	-	-	1900	2600	3900	4400	4800	5500	5600	6400	6400	7100	2,14

1) Lubrication periodicity valid for NLG 1 and 2 lithium based bearing lubricant.

4. Maintenance

A well-designed maintenance program for electric motors can be summed up as: periodical inspection of insulation levels, temperature rise, wear, bearing lubrication and the occasional checking of fan air flow. Inspection cycles depend upon the type of motor and the conditions under which it operates.

4.1 Cleanliness

Motors should be kept clean, free of dust, debris and oil. Soft brushes or clean cotton rags should be used for cleaning. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins.

Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.

Terminal boxes fitted to motors with IP55 protection should be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free.

Motors with IPW 55 protection are recommended for use under unfavourable ambient conditions.

4.2 . Lubrication

Proper lubrication extends bearing life.

Lubrication Maintenance Includes:

- a) Attention to the overall state of the bearings;
- b) Cleaning and lubrication;
- c) Critical inspection of the bearings.

Motor noise should be measured at regular intervals of one to four months. A well-tuned ear is perfectly capable of distinguishing unusual noises, even with rudimentary tools such as a screw driver, etc., without recourse to sophisticated listening aids or stethoscopes that are available on the market. A uniform hum is a sign that a bearing is running perfectly.

Bearing temperature control is also part of routine maintenance. The temperature of bearings lubricated as recommended under item 4.2.2 should not exceed 70°C.

Constant temperature control is possible with the aid of external thermometers or by embedded thermal elements.

WEG motors are normally equipped with grease lubricated ball or roller bearings.

Bearings should be lubricated to avoid the metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and mechanical operation and, furthermore, all lubricants are subject to contamination under working conditions.

For this reason lubricants must be renewed and any lubricant consumed needs replacing from time to time.

4.2.1 Periodical Lubrication

WEG motors are supplied with sufficient grease for a long running period. Lubrication intervals, the amount of grease and

the type of bearing used in frames 140T to 580T are to be found in Tables 11, 12 and 13.

Lubrication intervals depend upon the size of the motor, speed, working conditions and the type of grease used.

4.2.2 . Quality and Quantity of Grease

Correct lubrication is important!

Grease must be applied correctly and in sufficient quantity as both insufficient or excessive greasing are harmful.

Excessive greasing causes overheating brought about by the greater resistance encountered by the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.

This can cause seepage with the grease penetrating the motor and dripping on the coils.

A lithium based grease is commonly used for the lubrication of electric motor bearings as it has good mechanical stability, insoluble in water and has a drip point of approximately 200°C. This grease should never be mixed with sodium or calcium based greases.

GREASES FOR MOTOR BEARINGS

For operating temperatures from - 20 to 130°C			
Supplier	Grease F	Supplier	Grease
Esso	Beacon 2	Atlantic	Litholine 2
Shell	Alvania R3	Texaco	Multifak 2
For use in freezing chambers			
Supplier	Grease	Temperature range	
Esso	Unirex N2	-30 to 165 °C	
Molikote	BG 20	-45 to 180 °C	
Unisilikon	L5012	-20 to 200 °C	

4.2.3 Lubricating Instructions

a) Frame 140T to 210T motors

Frame 140T to 210T size motors are not fitted with grease nipples.

Lubrication is carried out during periodical overhauls when the motor is taken apart.

Cleaning and Lubrication of Bearings

With the motor dismantled and without extracting the bearings from the shaft, all existing grease should be removed and the bearings cleaned with Diesel oil, kerosene or other solvent, until thoroughly clean.

Refill the spaces between the balls or rollers and the bearing cages with grease immediately after washing. Never rotate bearings in their dry state after washing.

For inspection purposes apply a few drops of machine oil. During these operations maximum care and cleanliness is recommended to avoid the penetration of any impurities or dust



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that could harm the bearings. Clean all external parts prior to reassembly.

b) Frame 360T to 580T Motors

Motors above: 360T frame size are fitted with regreasable bearing system.

The lubrication system from this frame size upwards was designed to allow the removal of all grease from the bearing races through a bleeder outlet which at the same time impedes the entry of dust or other contaminants harmful to the bearing. This outlet also avoids injury to the bearings from the well-known problem of over-greasing.

It is advisable to lubricate while the motor is running, to allow the renewal of grease in the bearing case.

Should this procedure not be possible because of rotating parts in the proximity of the nipple (pulleys, coupling sleeves, etc.) that are hazardous to the maintainer the following procedure should be followed:

- Inject about half the estimated amount of grease and run the motor at full speed for approximately a minute; switch off the motor and inject the remaining grease.

The injection of all the grease with the motor at rest could cause penetration of a portion of the lubricant through the internal seal of the bearing case and hence into the motor.

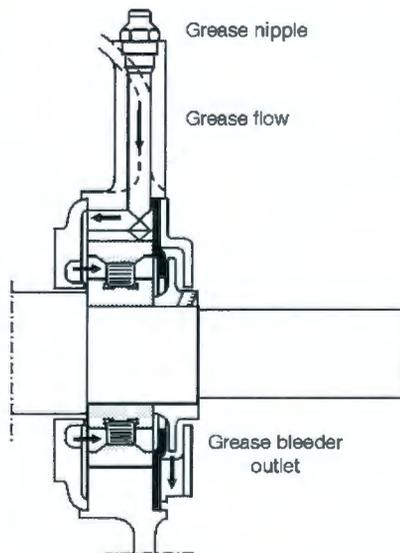


Figure 4.1 - Bearings and lubrication system

Nipples must be clean prior to introduction of grease to avoid entry of any alien bodies into the bearing.
For lubricating use only a manual grease gun.

Bearing Lubrication Steps

1. Cleanse the area around the grease nipples with clean

cotton fabric.

2. With the motor running, add grease with a manual grease gun until the lubricant commences to be expelled from the bleeder outlet, or until the quantity of grease recommended in Tables 12 or 13 has been applied.
3. Allow the motor to run long enough to eject all excess of grease.

4.2.4 Replacement of Bearings

The opening of a motor to replace a bearing should only be carried out by qualified personnel.

Damage to the core after the removal of the bearing cover is avoided by filling the gap between the rotor and the stator with stiff paper of a proper thickness.

Providing suitable tooling is employed, disassembly of a bearing is not difficult.

The extractor grips should be applied to the sidewall of the inner ring to be stripped, or to an adjacent part.

To ensure perfect functioning and no injury to the bearing parts, it is essential that the assembly be undertaken under conditions of complete cleanliness and by competent personnel.

New bearings should not be removed from their packages until the moment of assembly.

Prior to fitting a new bearing, ascertain that the shaft has no rough edges or signs of hammering.

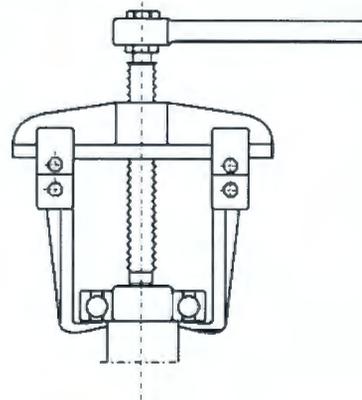


Figure 4.2 - A bearing extractor

During assembly bearings cannot be subjected to direct blows. The aid used to press or strike the bearing should be applied to the inner ring.

4.3 Air Gap Checking (Large Rating Open Motors)

Upon the completion of any work on the bearings check of the gap measurement between the stator and the rotor using the appropriate gages.

The gap variation at any two vertically opposite points must be less than 10% of the average gap measurement.

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4.4 Explosion Proof Motor Repair Steps

4.4.1 Objective

In view of the heavy liability associated with burning of motors of this type, this product has been designed and manufactured to high technical standards, under rigid controls. In addition, in many areas it is required that explosion proof motors **ONLY** be repaired by licensed personnel or in licensed facilities recognized to do this type of work.

The following general procedures, safeguards, and guidelines must be followed in order to ensure repaired explosion proof motors operate as intended.

4.4.2 Repair Procedure and Precautions

Dismantle the damaged motor with appropriate tooling without hammering and/or pitting machined surfaces such as enclosure joints, fastening holes and all joints in general. The position of the fan cover should be suitably marked prior to removal so as to facilitate reassembly later on. Examine the motor's general condition and, if necessary, disassemble all parts and clean them with kerosene. Under no circumstances should scrapers, emery papers or tools be used that could affect the dimensions of any part during cleaning.

Protect all machined parts against oxidation by applying a coating of vaseline or oil immediately after cleaning.

STRIPPING OF WINDINGS

This step requires great care to avoid knocking and/or denting of enclosure joints and, when removing the sealing compound from the terminal box, damage or cracking of the frame.

IMPREGNATION

Protect all frame threads by inserting corresponding bolts, and the joint between terminal box and frame, by coating it with a non-adhesive varnish (ISO 287 - ISOLASIL). Protective varnish on machined parts should be removed soon after treating with impregnating varnish. This operation should be carried out manually without using tools.

ASSEMBLY

Inspect all parts for defects, such as cracks, joint incrustations, damaged threads and other potential problems. Assemble using a rubber headed mallet and a bronze bushing after ascertaining that all parts are perfect by fitted. Bolts should be positioned with corresponding spring washers and evenly tightened.

TESTING

Rotate the shaft by hand while examining for any drag problems on covers or fastening rings. Carry out running tests as for standard motors.

MOUNTING THE TERMINAL BOX

Prior to fitting the terminal box all cable outlet on the frame should be sealed with a sealing compound (1st layer) and an Epoxy resin (ISO 340) mixed with ground quartz (2nd layer) in the following proportions:

340A resin	50 parts
340B resin	50 parts
Ground quartz	100 parts

Drying time for this mixture is two hours during which the frame should not be handled and cable outlets should be upwards.

When dry, see that the outlets and areas around the cables are perfectly sealed.

Mount the terminal box and paint the motor.

4.4.3 Miscellaneous Recommendations

- Any damaged parts (cracks, pittings in machined surfaces, defective threads) must be replaced and under no circumstances should attempts be made to recover them.
- Upon reassembling explosion proof motors IPW55 the substitution of all seals is mandatory.
- Should any doubts arise, consult WEG.



5. Malfunctioning

The greater part of the malfunctions affecting the normal running of electric motors can be avoided by maintenance and precautions of a preventive nature.

Wide ventilation, cleanliness and careful maintenance are the main factors ensuring long motor life. A further essential factor is the prompt attention to any malfunctioning as signalled by vibrations, shaft knock, declining insulation resistance, smoke or fire, sparking or unusual slip ring or brush wear, sudden changes of bearing temperatures.

When failures of an electric or mechanical nature arise, the first step to be taken is to stop the motor and subsequent examination of all mechanical and electrical parts of the installation.

In the event of fire, the installation should be isolated from the mains supply, which is normally done by turning off the respective switches.

In the event of fire within the motor itself, steps should be taken to restrain and suffocate it by covering the ventilation vents.

To extinguish a fire, dry chemical or CO₂ extinguishers should be used - never water.

5.1 Standard Three-Phase Motor Failures

Owing to the widespread usage of asynchronous three-phase motors in industry which are more often repaired in the plant workshops, there follows a summary of possible failures and their probable causes, detection and repairs.

Motors are generally designed to Class B or F insulation and for ambient temperatures up to 40°C.

Most winding defects arise when temperature limits, due to current overload, are surpassed throughout the winding or even in only portions thereof. These defects are identified by the darkening or carbonizing of wire insulation.

5.1.1 Short Circuits Between Turns

A short circuit between turns can be a consequent of two coincident insulation defects, or the result of defects arising simultaneously on two adjacent wires. As wires are randomly tested, even the best quality wires can have weak spots. Weak spots can, on occasion, tolerate a voltage surge of 30% at the time of testing for shorting between turns, and later fail due to humidity, dust or vibration.

Depending on the intensity of the short, a magnetic hum becomes audible.

In some cases, the three-phase current imbalance can be so insignificant that the motor protective device fails to react. A short circuit between turns, and phases to ground due to insulation failure is rare, and even so, it nearly always occurs during the early stages of operation.

5.1.2 Winding Failures

a) One burnt winding phase

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This failure arises when a motor runs wired in delta and current fails in one main conductor.

Current rises from 2 to 2.5 times in the remaining winding with a simultaneous marked fall in speed. If the motor stops, the current will increase from 3.5 to 4 times its rated value.

In most instances, this defect is due to the absence of a protective switch, or else, the switch has been set too high.

b) Two burnt winding phases

This failure arises when current fails in one main conductor and the motor winding is star-connected. One of the winding phases remains currentless while the others absorb the full voltage and carry an excessive current.

The slip almost doubles.

c) Three burnt winding phases

Probable cause 1

Motor only protected by fuses; an overload on the motor will be the cause of the trouble.

Consequently, progressive carbonizing of the wires and insulation culminate in a short circuit between turns, or a short against the frame occurs.

A protective switch placed before the motor would easily solve this problem.

Probable cause 2

Motor incorrectly connected. For example: A motor with windings designed for 230/400V is connected through a star-delta switch to 400V connection.

The absorbed current will be so high that the winding will burn out in a few seconds if the fuses or a wrongly set protective switch fail to react promptly.

Probable cause 3

The star-delta switch is not commutated and the motor continues to run for a time connected to the star under overload conditions.

As it only develops 1/3 of its torque, the motor cannot reach rated speed. The increased slip results in higher ohmic losses arising from the Joule effect. As the stator current, consistent with the load, may not exceed the rated value for the delta connection, the protective switch will not react. Consequent to increased winding and rotor losses the motor will overheat and the winding burn out.

Probable cause 4

Failures from this cause arise from thermal overload, due to too many starts under intermittent operation or to an overly long starting cycle. The perfect functioning of motor operating under these conditions is only assured when the following values are heeded:

- number of starts per hour;
- starting with or without load;
- mechanical brake or current inversion;
- acceleration of rotating masses connected to motor shaft
- load torque vs. speed during acceleration and braking.

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The continuous effort exerted by the rotor during intermittent starting brings about heavier losses which provoke overheating.

Under certain circumstances with the motor idle there is a possibility that the stator winding is subjected to damage as a result of the heating of the motor. In such a case, a slip ring motor is recommended as a large portion of the heat (due to rotor losses) is dissipated in the rheostat.

5.1.3 Rotor Failures

If a motor running under load conditions produces a noise of varying intensity and decreasing frequency while the load is increased, the reason, in most cases, will be an unsymmetrical rotor winding.

In squirrel-cage motors the cause will nearly always be a break in one or more of the rotor bars; simultaneously, periodical stator current fluctuations may be recorded. As a rule, this defect appears only in molded or die cast aluminum cages.

Failures due to spot heating in one or another of the bars in the rotor stack are identified by the blue coloration at the affected points.

Should there be failures in various contiguous bars, vibrations and shuddering can occur as if due to an unbalance, and are often interpreted as such. When the rotor stack acquires a blue or violet coloration, it is a sign of overloading.

This can be caused by overly high slip, by too many starts or overlong starting cycles. This failure can also arise from insufficient main voltage.

5.1.4 Bearing Failures

Bearing damage is a result of overloading brought about by an overly taut belt or axial impacts and stresses.

Underestimating the distance between the drive pulley and the driven pulley is a common occurrence.

The arc of contact of the belt on the drive pulley thus becomes inadmissibly small and thereby belt tension is insufficient for torque transmission.

In spite of this it is quite usual to increase belt tension in order to attain sufficient drive.

Admittably, this is feasible with the latest belt types reinforced by synthetic materials.

However, this practice fails to consider the load on the bearing and the result is bearing failure within a short time.

Additionally there is the possibility of the shaft being subjected to unacceptably high loads when the motor is fitted with a pulley that is too wide.

5.1.5 Shaft Fractures

Although bearings traditionally constitute the weaker part, and the shafts are designed with wide safety margins, it is not beyond the realms of possibility that a shaft may fracture by fatigue from bending stress brought about by excessive belt tension.

In most cases, fractures occur right behind the drive end bearing.

As a consequence of alternating bending stress induced by a rotating shaft, fractures travel inwards from the outside of the shaft until the point of rupture is reached when resistance of the remaining shaft cross-section no longer suffices.

Avoid additional drilling the shaft (fastening screw holes) as such operations tend to cause stress concentration.

5.1.6 Unbalanced V-Belt Drives

The substitution of only one or other of various parallel belts of a drive is frequently the cause of shaft fractures, as well as being malpractice.

Any used, and consequently stretched belts retained on the drive, especially those closest to the motor, while new and unstretched belts are placed on the same drive turning farther from the bearing can augment shaft stress.

5.1.7 Damage Arising from Poorly Fitted Transmission Parts or Improper Motor Alignment

Damage to bearing and fracture in shafts often ensue from inadequate fitting of pulleys, couplings or pinions. These parts "knock" when rotating. The defect is recognized by the scratches that appear on the shaft or the eventual scalelike flaking of the shaft end.

Keyways with edges pitted by loosely fitted keys can also bring about shaft failures.

Poorly aligned couplings cause knocks and radial and axial shaking to shaft and bearings.

Within a short while these malpractices cause the deterioration of the bearings and the enlargement of the bearing cover bracket located on the drive end side.

Shaft fracture can occur in more serious cases.



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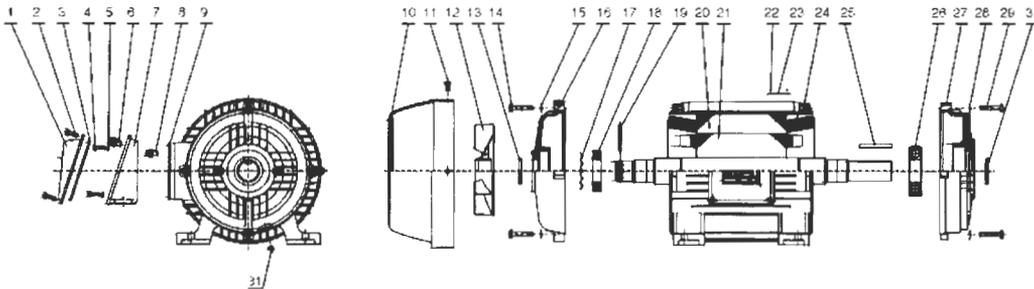
5.2 Troubleshooting chart

FAILURE	PROBABLE CAUSE	CORRECTIVE MEASURES
Motor fails to start	<ol style="list-style-type: none"> 1. No voltage supply 2. Low voltage supply 3. Wrong control connections 4. Loose connection at some terminal lug 5. Overload 	<ul style="list-style-type: none"> · Check feed connections to control system and from this to motor. · Check voltage supply and ascertain that voltage remains within 10% of the rated voltage shown on the motor nameplate. · Compare connections with the wiring diagram on the motor nameplate. · Tighten all connections. · Try to start motor under no-load conditions. If it starts, there may be an overload condition or a blocking of the starting mechanism. Reduce load to rated load level and increase torque.
High noise level	<ol style="list-style-type: none"> 1. Unbalance 2. Distorted shaft 3. Incorrect alignment 4. Uneven air gap 5. Dirt in the air gap 6. Extraneous matter stuck between fan and motor casing 7. Loose motor foundation 8. Worn bearings 	<ul style="list-style-type: none"> · Vibrations can be eliminated by balancing rotor. If load is coupled directly to motor shaft, the load can be unbalanced. · Shaft can be bent; check rotor balance and eccentricity. · Check motor alignment with machine running. · Check shaft for warping or bearing wear. · Dismantle motor and remove dirt or dust with jet of dry air. · Dismantle motor and clean. Remove trash or debris from motor vicinity. · Tighten all foundation studs. If necessary, realign motor. · Check lubrication. Replace bearing if noise is excessive and continuous.
Overheating of bearings	<ol style="list-style-type: none"> 1. Excessive grease 2. Excessive axial or radial strain on belt 3. Deformed shaft 4. Rough bearing surface 5. Loose or poorly fitted motor end shields 6. Lack of grease 7. Hardened grease cause locking of balls 8. Foreign material in grease 	<ul style="list-style-type: none"> · Remove grease bleeder plug and run motor until excess grease is expelled. · Reduce belt tension. · Have shaft straightened and check rotor balance. · Replace bearings before they damage shaft. · Check end shields for close fit around circumference and tightness. · Add grease to bearing. · Replace bearings. · Flush out housings and relubricate.
Intense bearing vibration	<ol style="list-style-type: none"> 1. Unbalanced rotor 2. Dirty or worn bearing 3. Bearing rings too tight on shaft and/or bearing housing 4. Extraneous solid particles in bearing 	<ul style="list-style-type: none"> · Balance rotor statically and dynamically. · If bearing rings are in perfect condition, clean and relubricate the bearing, otherwise, replace bearing. · Before altering shaft or housing dimensions, it is advisable to ascertain that bearing dimensions correspond to manufacturer's specifications. · Take bearing apart and clean. Reassemble only if rotating and support surfaces are unharmed.
Overheating of motor	<ol style="list-style-type: none"> 1. Obstructed cooling system 2. Overload 3. Incorrect voltages and frequencies 4. Frequent inversions 5. Rotor dragging on stator 6. Unbalanced electrical load (burnt fuse, incorrect control) 	<ul style="list-style-type: none"> · Clean and dry motor; inspect air vents and windings periodically. · Check application, measuring voltage and current under normal running conditions. · Compare values on motor nameplate with those of mains supply. Also check voltage at motor terminals under full load. · Exchange motor for another that meets needs. · Check bearing wear and shaft curvature. · Check for unbalanced voltages or operation under single-phase condition.

6. Spare Parts and Component Terminology

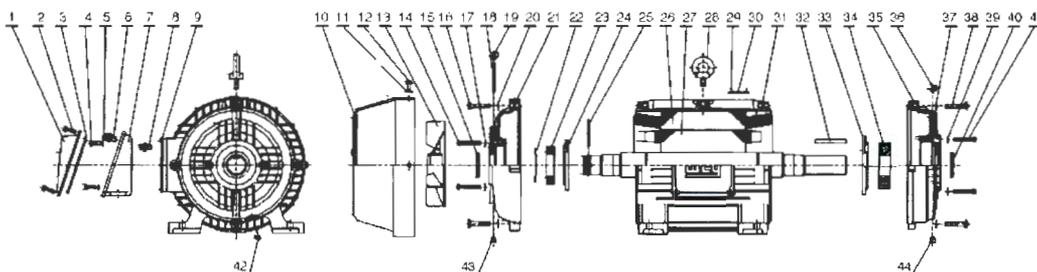


THREE-PHASE MOTORS IP55 NEMA - Frames 140T - W180T - 180T - 210T and W210T



Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	13	V'Ring	25	Shaft key
2	Terminal box cover fixing bolt	14	Non-drive end endshield fixing bolt	26	Drive end bearing
3	Terminal box cover gasket	15	Non-drive end endshield washer	27	Drive endshield
4	Terminal box fixing bolt	16	Non-drive endshield	28	Drive endshield washer
5	Terminal box fixing washer	17	Spring washer	29	Drive end endshield fixing bolt
6	Terminal box grounding lug	18	Non-drive bearing	33	V'Ring
7	Terminal box	19	Fan fixing pin	31	Drain plug
8	Frame grounding lug	20	Wound stator		
9	Terminal box o'ring gasket	21	Rotor / shaft assembly		
10	Fan cover	22	Nameplate fixing rivet		
11	Fan cover fixing bolt	23	Nameplate		
12	Fan	24	Frame		

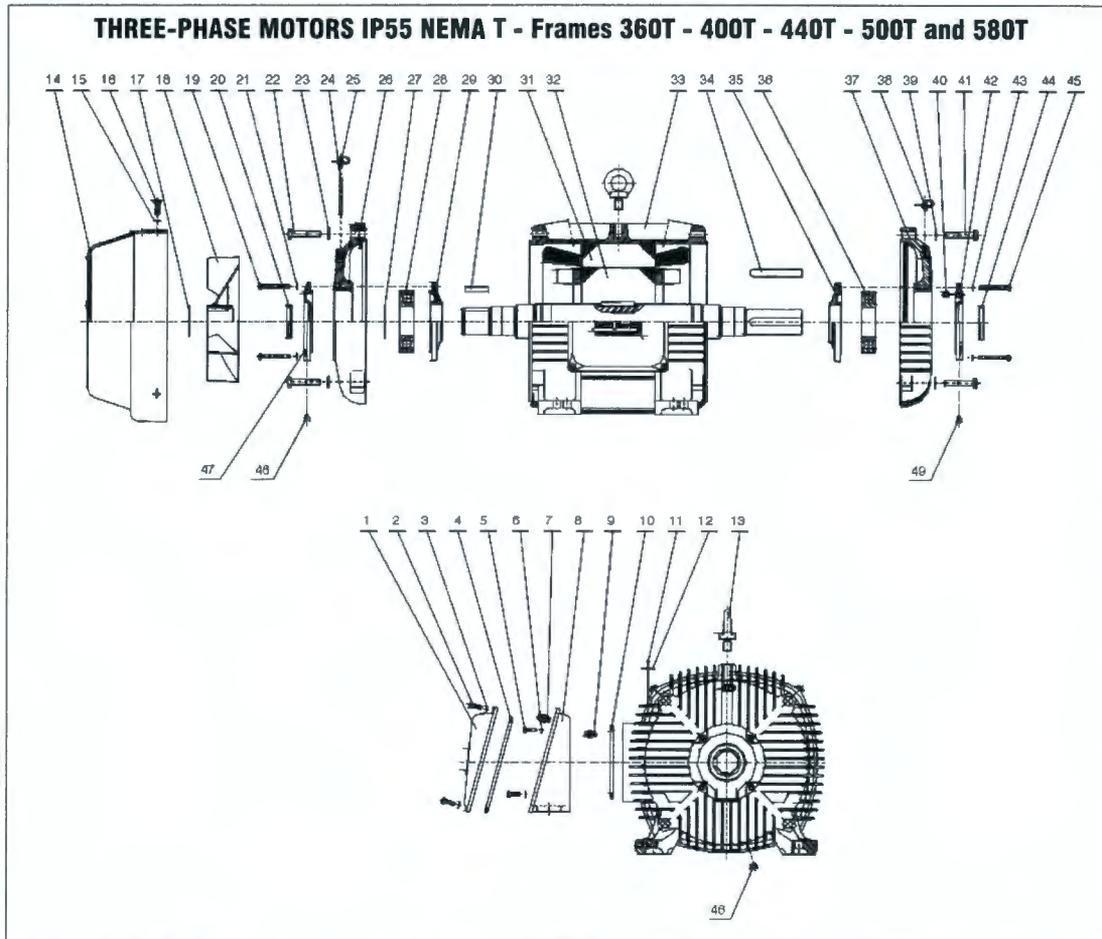
THREE-PHASE MOTORS IP55 NEMA - Frames 250T - W250T - 280T and 320T



Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	16	Non-drive end endshield fixing bolt	30	Nameplate
2	Terminal box cover fixing bolt	17	Non-drive end bearing cap washer	31	Frame
3	Terminal box cover gasket	18	Non-drive end grease nipple	32	Shaft key
4	Terminal box fixing bolt	19	Non-drive end grease nipple cover	33	Drive end bearing cap
5	Terminal box fixing washer	20	Non-drive end endshield washer	34	Drive end bearing
6	Terminal box grounding lug	21	Non-drive endshield	35	Drive andshield
7	Terminal box	22	Spring washer	36	Drive end grease nipple cover
8	Frame grounding lug	23	Non-drive end bearing	37	Drive endshield washer
9	Terminal box o'ring gasket	24	Non-drive end bearing cap	38	Drive end endshield fixing bolt
10	Fan cover	25	Fan fixing pin	39	Drive end bearing cap washer
11	Fan cover washer	26	Wound stator	40	V'Ring
12	Fan cover fixing bolt	27	Rotor and shaft	41	Drive end bearing cap fixing bolt
13	Fan	28	Eyebolt	42	Drain plug
14	Non-drive end bearing cap bolt	29	Nameplate fixing rivet	43	Non-drive end grease relief
15	V'Ring			44	Drive end grease relief



INSTALLATION AND MAINTENANCE MANUAL
FOR NEMA LOW VOLTAGE ELECTRIC MOTORS



Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	18	Fan	34	Shaft key
2	Terminal box cover fixing bolt	19	Non-drive end bearing cap bolt	35	Internal drive end bearing cap
3	Terminal box cover washer	20	V'Ring	36	Drive end bearing
4	Terminal box cover gasket	21	Non-drive end bearing cap washer	37	Drive endshield
5	Terminal box fixing bolt	22	Non-drive end endshield fixing bolt	38	Drive end grease nipple cover
6	Terminal box fixing washer	23	Non-drive end endshield washer	39	Drive endshield washer
7	Terminal box grounding lug	24	Non-drive end grease nipple	40	Pre-load spring
8	Terminal box	25	Non-drive end grease nipple cover	41	Drive end endshield fixing bolt
9	Frame grounding lug	26	Non-drive endshield	42	External drive end bearing cap
10	Terminal box o'ring gasket	27	Bearing cap	43	Drive end bearing cap washer
11	Nameplate fixing rivet	28	Non-drive bearing	44	V'Ring
12	Nameplate	29	Internal non-drive end bearing cap	45	Drive end bearing cap fixing bolt
13	Eyebolt	30	Fan fixing key	46	Drain plug
14	Fan cover	31	Wound stator	47	External non-drive end bearing cap
15	Fan cover washer	32	Rotor / shaft assembly	48	Non drive end grease relief
16	Fan cover fixing bolt	33	Frame	49	Non-drive end grease relief
17	Fan fixing ring				

INSTALLATION AND MAINTENANCE MANUAL
FOR NEMA LOW VOLTAGE ELECTRIC MOTORS



THREE-PHASE MOTORS NEMA 56 - Frames A56 - B56 - D56 - F56H and G56H

Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Sticker	8	Non-drive end bearing	14	Fan
2	Terminal box cover fixing bolt	9	Wound stator	15	Drive end bearing fastening washer
3	Terminal box cover	10	Rotor / shaft assembly	16	Drive end bearing
4	Grounding lug	11	Frame	17	Drive endshield
5	Through bolt fastening nut	12	Through bolt		
6	Non-drive endshield	13	Shaft key		
7	Spring washer				

SINGLE-PHASE MOTORS NEMA 56 - Frames B48 - C48 - C56 - A56 - B56 - D56 - F56H - G56H

Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Sticker	12	Stationary switch fastening bolt	23	Drive end bearing fastening washer
2	Capacitor cover fixing bolt	13	Centrifugal switch	24	Drive end bearing
3	Terminal box cover fixing bolt	14	Rubber ring for lead passing hole to capacitor	25	Drive endshield
4	Terminal box cover	15	Capacitor cover	26	Overload thermal protector fixing ring
5	Grounding lug	16	Capacitor	27	Overload thermal protector
6	Through bolt fastening nut	17	Wound stator		
7	Non-drive endshield	18	Rotor / shaft assembly		
8	Spring washer	19	Frame		
9	Non-drive end bearing	20	Through bolt		
10	Non-drive end bearing fastening washer	21	Shaft key		
11	Stationary switch	22	Fan		

Note: For F56H and G56H frame motors: 1) Part nr. 3 = 3 pieces; 2) Part nr. 4 and 5 = 2 pieces



**YOU MAY NEED TO READ OTHER WEG
INSTALLATION AND MAINTENANCE MANUALS:**

For Low and High Voltage Large Motors
Induction, Slip Ring, H Line, M Line, A Line Manual Nr 673

For DC Motors Manual Nr 1005

For Tacho Generator Dynamo Manual Nr 1007

For Generators 'GTA' Line Manual Nr 1035

YOU CAN REQUEST THE ABOVE MANUALS FROM
YOUR NEAREST WEG SALES OFFICE OR
DIRECTLY WITH WEG HEADQUARTER.



WEG INDUSTRIAS S.A.
Av. Pref. Waldemar Grubba, 3000
89256-900 JARAGUÁ DO SUL - SC - BRAZIL
PHONE: (55) (47) 372-4000 PABX
FAX: (55) (47) 372-4060

Application, Installation,
and Operation Of
Reliance®
Tandem Seal Single and
Polyphase Duty Master® A-C
Submersible Pump Motors

UL Listed for Class I
Groups C and D
in Water or Sewage

A-C MOTORS

*“Solutions
You Can
Trust”*

Instruction Manual B-3629-12
April, 1996

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IMPORTANT

It is important that these instructions be studied by the personnel installing and operating this equipment. Read thoroughly before starting. Keep these instructions for future reference.



IMPORTANT

The motors specified in this instruction book are U/L listed for application in Class I Groups C and D explosion-proof environments. All repairs, other than lead reconnects and outer seal replacement, shall be performed by an authorized Reliance service facility. Any other repairs performed by the customer or non-Reliance service facilities negates the U/L listing and motor warranty.

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Revisions to this manual require Hazardous Approval Engineering and/or UL approval.

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RECEIVING AND HANDLING

ACCEPTANCE

Thoroughly inspect this equipment before accepting shipment from the transportation company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept them until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent at once and request him to make an inspection. We will assist you in collecting claims for loss or damage in shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the Reliance Electric invoice, nor should payment of the Reliance Electric invoice, be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest Reliance Electric Sales Office for assistance. Please keep a written record of all such communications.

UNPACKING

If facilities for the shelter of equipment are not available, repack motor and store shaft down until ready for use.

After unpacking and inspecting to see that all parts have been received in good condition, turn the motor shaft by hand to be sure that there are no obstructions to free rotation.

The motor should be checked for oil leaks after being removed from the crate. If positive indication of an oil leak is found around the shaft seal or drive end bracket, notify the nearest Reliance Electric Sales Office.

APPLICATION

All Reliance Submersible Pump Motors include thermal devices as standard. These devices are

required by UL on all motors 1 HP and larger listed Class I, Groups C and D. These devices are not recognized by UL for motors less than 1 HP but are included by Reliance for additional motor protection. **Motors less than 1 HP are supplied with a cautionary label and are suitable on applications where vapor or gas ignition temperatures exceed 280°C. These motors are listed for Class I, Group D only.**

Continuous In Air Designs have a 1.0 Service Factor

Normally, there are four conditions during which a submersible sewage pump may be operated in gases or vapors.

1. When the wet well is being dewatered.
2. When the pump motor assembly is being lowered down the guiderails. The flow from the pump is needed during the installation process to insure that solids are cleared from the discharge flange area to insure proper seating.
3. When low-level cutoff controls fail.
4. When low-level sensors are positioned at the bottom of the pump assembly.

NOTE: Outer shaft seal must be in liquid when motor is operated, whether motor is submerged or in air.

Seals cannot be run in a dry environment without a significant reduction in seal life. If seal is to be run in a dry environment, a special design seal must be supplied. Standard seals applied in dry seal applications will not be covered by warranty.

CONTINUOUS OPERATION GASES OR VAPORS

It is the driven equipment manufacturer's responsibility to insure this motor product is properly applied.

Horsepower requirements are a function of pump design, impeller size & head and flow conditions. In gas operating time is a function of pit size, pump capacity, and flow conditions. Only the pump manufacturer can insure that the pump motor is properly applied for continuous in-gas or vapor operation. As with any motor product, it is essential that proper consideration be given to the load characteristics to insure the motor product will not be overloaded. Should such an overload occur, thermostats embedded in the windings will provide a signal to deenergize the motor. However, proper consideration of the application will prevent such an overload.

With reference to the diagram in figure 1, the following load conditions should be noted:

- A. Below level #1 (bottom of the pump) fluid is not pumped and no load is reflected to the motor.
- B. One pump should always be sized sufficiently large to draw the well down (even under maximum flow conditions). The maximum amount of time the motor will operate fully loaded and uncovered is the amount of time required to draw the well down from level #2 (top of the motor) to the bottom of the pump.
- C. Time described in B above should not be greater than 15 minutes if full motor nameplate horsepower is required for this operation. (See Application Instructions).

D. The above application notes do not make allowance for:

- (a) The heat exchanger effect of the attached pump. It is pumping a relatively cool fluid and will remove some heat.
- (b) The motor does not operate fully loaded *completely* in gas. It is fully loaded as the motor is being uncovered.
- (c) If the well is being drawn down from the top of the motor and maximum flow conditions exist, the influent flow will usually provide excellent cooling of the pump motor.



FIGURE 1

INSTALLATION

IMPORTANT

Read this manual thoroughly before installation.

1. The user must select a motor starter and over-current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other local codes.
2. Maximum submergence of motor is not to exceed 200 feet in depth and/or 200 P.S.I. at motor seal.

3. Thermal Protectors must be connected. Leads marked P1 and P2 (See Figure 2).
4. Moisture Sensing Probes must be connected. Leads marked W1 and W2. (See Figure 3).
5. Check your power supply against final nameplate connection voltage.

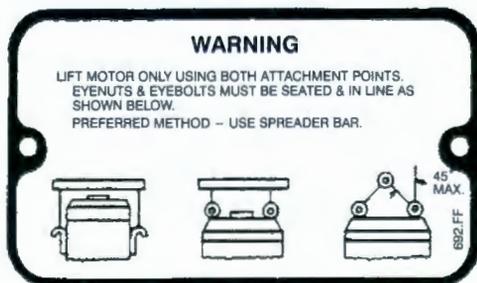
If required, the impeller should be heated slightly before pressing it on the shaft. *Under no circumstances should the impeller be driven on*

by pounding as this will damage the seal. When removing impeller warm slightly with a torch and pry impeller off evenly with either small pry bars or a wheel puller.

When the submersible pump motor leaves the factory it is ready for installation. No adjustment, venting or oil filling is required. For THREE PHASE motors the only connection to the motor lead cable is the power supply. For SINGLE PHASE motors the motor lead cable and power supply must be properly connected at the Control Box. Motor will operate successfully with frequency not more than 5% and voltage not more than 10% above or below nameplate data. Performance within this range will not necessarily be the same as the established performance at exact rated voltage and frequency.

All submersible pump motors will operate in either direction of rotation. To reverse direction of a THREE PHASE motor, interchange any two motor leads at the starter. To reverse direction of rotation of a SINGLE PHASE motor the proper connections must be made in the motor connection chamber; refer to the W/D's supplied in the motor connection chamber and Control Box.

Lifting eyes are supplied for purpose of installation and servicing. **(Do not use motor lead cables for lifting means.)** Normal care should be exercised to prevent mechanical damage to the seal, the frame and the insulated cable.



STARTING

CAUTION: Surface temperature of motor enclosure may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. (When installing, protection should be provided by user to protect against accidental contact with hot surface).

On initial start up the motor and pump should be checked for proper rotation prior to final application.

The unit is designed to protect all power connections against moisture. All Reliance Submersible Pump Motors have a lead connection chamber. - THREE PHASE dual voltage motors have 9 motor leads and SINGLE PHASE dual voltage motors have 8 motor leads in this chamber. All Submersible Pump Motors have 2 thermal protector leads and 2 moisture sensing probe leads in this chamber.

Leads are tagged for easy identification. A connection diagram is provided in the lead chamber. Motors can be connected for either high or low voltages. (Some motor ratings are built as single voltage units and as such are not reconnectable).

The motor lead cable assembly for all Submersible Pump Motors has 3 marked power leads plus two ground leads, two thermal leads and two moisture sensing probe leads in standard cable lengths of 25 feet.

Leads are brought through an epoxy sealed connector providing a mechanically strong water tight seal. The cap and cable assembly are available from Reliance Electric as a replacement part assembly. When replacing the lead wire cap, care should be taken not to nick or damage the "O" ring seal. Replace any damaged or nicked "O" rings.

WHEN REPLACEMENT CABLE ASSEMBLY IS REQUIRED, ORDER FROM RELIANCE ELECTRIC CO. USING MOTOR IDENTIFICATION NUMBER.

MAINTENANCE

With proper application and installation of monitoring devices, periodic inspection of motor seals is not required. Should a malfunction occur the motor has been equipped with a moisture detection system and thermal protection which will provide advance warning of impending failure allowing the user to plan a maintenance program before failure occurs.

GENERAL NOTES: ALL PARTS

1. Reliance® Submersible Motors utilize an explosion-proof Class I, Groups C and D, tandem seal design, with an oil chamber separate from the winding area.
2. Wound Stators – Reliance Submersible Motors utilize a wound stator which has been pressed into the frame. The stator insulation system has been designed for the temperature and electrical rating involved. If the motor failure is analyzed to encompass a winding failure, return the motor to an authorized Reliance Electric Service Shop.
3. Encapsulated Lead Connector Assembly – The lead connector assembly has been especially encapsulated to insure integrity of the motor. The connector can be removed from the motor in order to reconnect leads. Should the lead connector assembly be damaged or the integrity of the encapsulation be in question, it is required that a replacement lead connector assembly be ordered from Reliance Electric Company.

 WARNING
MOTOR MAY CONTAIN GAS UNDER PRESSURE DUE TO HIGH TEMPERATURES FROM OPERATION WITHOUT BEING SUBMERGED. DISASSEMBLY MAY CAUSE BODILY INJURY. FOR ASSISTANCE CONTACT A RELIANCE OFFICE.

4. Hardware – All hardware is stainless steel and should be replaced with the same type.
5. If the Conduit Connection is used, a corrosion resistant conduit such as stainless steel is recommended.

6. When replacement cable assembly is required, order from Reliance Electric Industrial Co. using motor identification number.

MECHANICAL REPAIRS

U/L listed motors must be returned to an authorized Reliance Electric Service Facility for repairs other than to replace the outer seal. (See note on Table of Content page.)

To inspect the outer seal proceed as follows:

1. Remove outer snap ring (3), replace as needed.
2. Remove rotating outer seal (4), replace as needed.
3. Approved lubricating and insulating oil shall meet Reliance approved source sheet 4824-18-AF. Manufacturer's materials currently meeting this specification are as follows:

ITEM	MANUFACTURER	MANUFACTURER'S IDENTIFICATION OF MATERIAL
1	Sun Oil Company	Sun Fleet Regular SAE 10W
2	Standard Oil Co.	Sohio 62 SAE 10W
3	Shell Oil Company	Rotella 10 SAE 10W

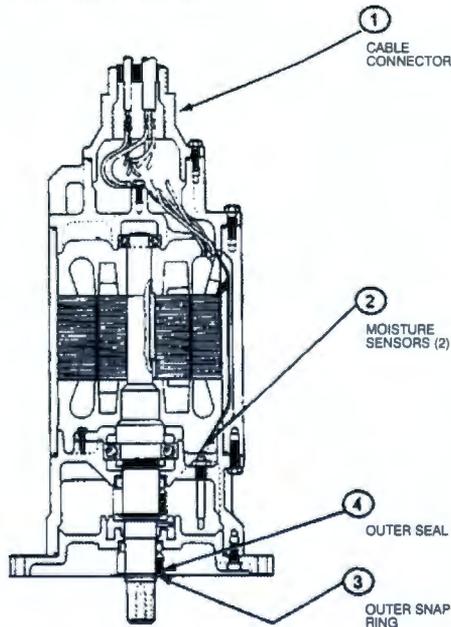
MOTOR INSPECTION

After assembly, run motor in shaft down position for 30 seconds minimum to one minute maximum to allow seals to seat; then check for oil leakage. In some cases, a slight oil mist will appear around the seal. Wipe clean after test.

PAINTING AND SHIPPING

Before painting motor, cover exposed seal. Remove any paper, tape, etc., from seal area before crating motor. These motors can be shipped in shaft up or shaft down position. Care must be taken that exposed seal is not damaged during shipment. Carton must protect exposed seal from dirt, dust and damage.

ELECTRICAL REPAIRS



LEAD RECONNECT

The cable connector assembly may be removed to reconnect the leads without negating the U/L listing or the warranty.

! WARNING
MOTOR MAY CONTAIN GAS UNDER PRESSURE DUE TO HIGH TEMPERATURES FROM OPERATION WITHOUT BEING SUBMERGED. DISASSEMBLY MAY CAUSE BODILY INJURY. FOR ASSISTANCE CONTACT A RELIANCE OFFICE.

PROCEDURE

1. Loosen four bolts, securing lead cable connector (1), two complete turns.
2. Attempt to break the cable connector seal thus relieving gas pressure within the motor. If gas pressure is not relieved loosen the bolts another turn and try again. Continue this process until the pressure is relieved and/or the cap is removed. Be extremely careful until the cable connector assembly is removed.
3. Remove cable connector and reconnect to desired voltage as shown on connection diagram inside the cable connector.
4. Insulate connectors with 4824-13-AU heat shrinkable plastic. If the 4824-13-AU shrinkable plastic is not available, tape may be used, but it should be an oil resistant type. Enough wraps should be used to insure the buildup will be sufficient to prevent the connector from breaking through the insulation. The following procedure should be employed: Five layers of plastic electrical tape followed by two layers electrical grade woven adhesive tape, such as Mystik 7020 or 3M #27, for oil and abrasion resistance.
5. Place "O" ring over fit and coat fit with Chevron SRI grease (not excessive).
6. Place cable connector back on motor, install four bolts, and tighten.

THERMAL PROTECTION SYSTEM

THERMAL PROTECTION

! IMPORTANT
Reliance Submersible Pump Motors are equipped with thermal protection devices. Failure to properly connect or utilize this system voids motor warranty.

Thermostat leads marked P1 & P2 must be connected in series with the stop button of the 3-wire pilot circuit of the magnetic motor controller, so that the thermostat will open the circuit before dangerous temperatures are reached.

Thermostats are automatic reset for use in a normally closed circuit where the thermostat is connected in series with the holding coil of the magnetic starter. Thermostats provide "Over Temperature Protection 2" in accordance with NEMA MG 1-12.53. When the motor is so marked locked rotor protection is not provided by the winding over temperature protector. It is suggested that over current protection be used in the motor starter to insure locked rotor protection.

! WARNING

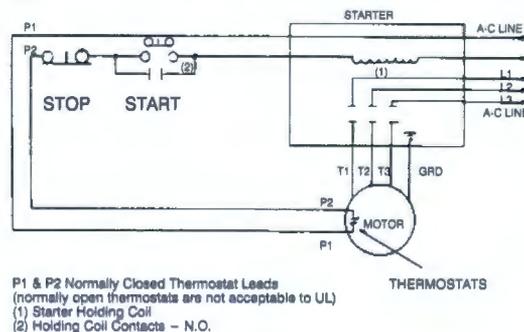
MOTOR CONTROLLER MAY HAVE AUTOMATIC OR MANUAL OVERLOAD RESET. DISCONNECT ALL POWER LEADS TO MOTOR WHEN PERFORMING ANY WORK ON MOTOR OR DRIVEN EQUIPMENT.

A MANUAL, MOMENTARY START SWITCH IS REQUIRED TO PREVENT AUTOMATIC RESTART OF MOTOR WHEN THERMOSTAT RESETS.

If current through the thermostat will exceed the values listed in Figure 2 an intermediate control circuit relay must be used to reduce the current or the thermostat will not work properly.

Alternating Current

Volts	Continuous Amperes	Inrush Amperes
110-120	3.0	30
220-240	1.5	15
440-480	0.75	7.5
550-600	0.6	6.0



**FIGURE 2
TYPICAL THERMAL PROTECTOR
WIRING DIAGRAM**

MOISTURE DETECTION SYSTEM

MOISTURE SENSING PROBES

! IMPORTANT

Reliance Submersible Pump Motors are equipped with moisture detection devices. Failure to properly connect or utilize this system voids motor warranty.

Moisture sensing probes, leads marked W₁, and W₂, must be used in conjunction with an induction relay. This device will detect moisture entering the oil chamber due to failure of the outer seal and, when properly connected to a

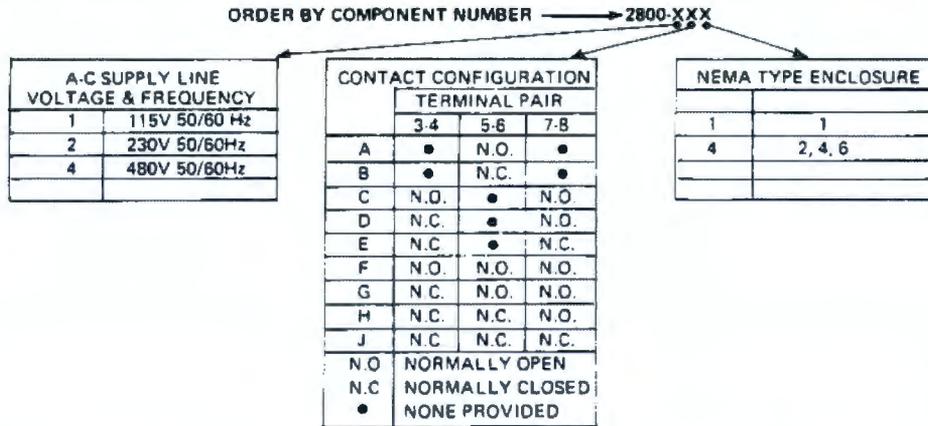
warning device, will provide notification of needed maintenance. Integrity of system requires periodic test.

CONTROLS AND SIGNAL DEVICES

A control and signal device (not supplied by Reliance) must be installed at the job site to complete the moisture detection system.

Compatible controls are available from: Charles F. Warrick Co., Normandy Court, Royal Oak, Michigan 48073, (810) 549-4900.

CONTROL SELECTION AND ORDERING FOR CHARLES F. WARRICK CO. CONTROLS



Line voltages are nominal values and may be anywhere from nominal minus 15% to nominal plus 10%.

TYPE 2800-XXX MOTOR MOISTURE DETECTOR CONTROL

INSTALLATION

All type 2800-XXX controls are identified by a specific component number which follows the format 2800-XXX where the X's are replaced by numbers and letters indicative of the A-C supply line voltage and frequency, contact configuration and enclosure. Each control has a data label on the right hand side of the terminal block. In addition, each enclosed control has another data label on the outside of the enclosure cover.

Mount the control on a vertical surface with the transformer on the left hand side and accomplish all indicated wiring. Terminals on the control are numbered and are in the same relative position as the terminals shown on the wiring diagram.

Terminal pair 1-2 must be continuously energized from an A-C supply line of electrical characteristics shown on the data label.

Contacts must be wired into the electrical load circuit(s) of the warning devices as required. Each contact used for load duty must be wired in series with the load and that series branch circuit connected across a power source compatible with the load.

Wiring must be provided from the moisture detector sensor probe leads of the RELIANCE ELECTRIC motor designated W1 and W2 to terminals 9 and 10 of the 2800-XXX control.

Control leads should not be installed in the same conduit as power leads. Induced voltage can cause false moisture signals.

CONTACT OPERATION

Normally open load contacts close and normally closed load contacts open when the sensor probes detect the influx of moisture within the motor.

TEST PROCEDURE

A normally closed pushbutton and neon indicating lamp are provided as means of checking the moisture sensing components.

When the pushbutton is depressed, the indicating lamp will be illuminated to indicate (A) power is supplied to the control, (B) the control is operative, and (C) wiring to the moisture sensing probes in the motor is intact. This procedure should be performed periodically to confirm integrity of circuit.

SIGNAL DEVICES

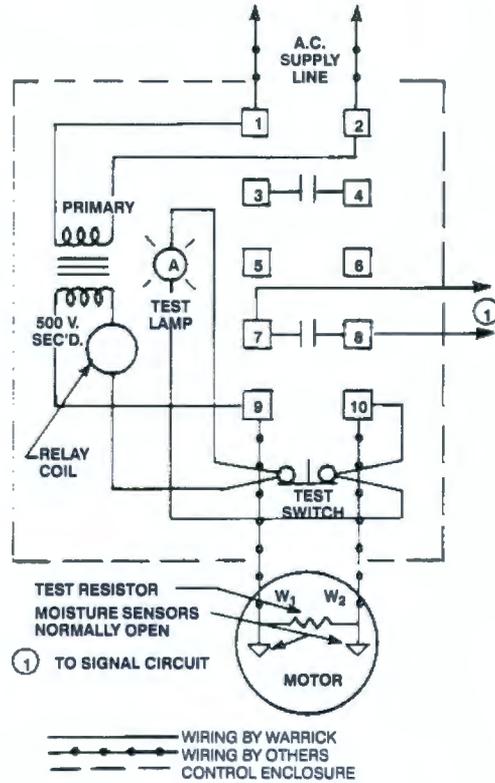
The signal device may be audible (bell, buzzer, horn or siren) or visible (incandescent or neon lamp) or both – a signal device of your choice may be obtained from your local electrical supply house.

SYSTEM OPERATION

It is recommended that upon indication (by warning light, etc.) of outer seal failure that the motor be removed from the installation and the oil and outer seal be replaced as soon as possible.

If reconditioning is not performed within a 30 day period it is recommended that the inner seal be thoroughly inspected and replaced if required.

When ordering parts or reporting trouble give Sales Office complete Nameplate Data.

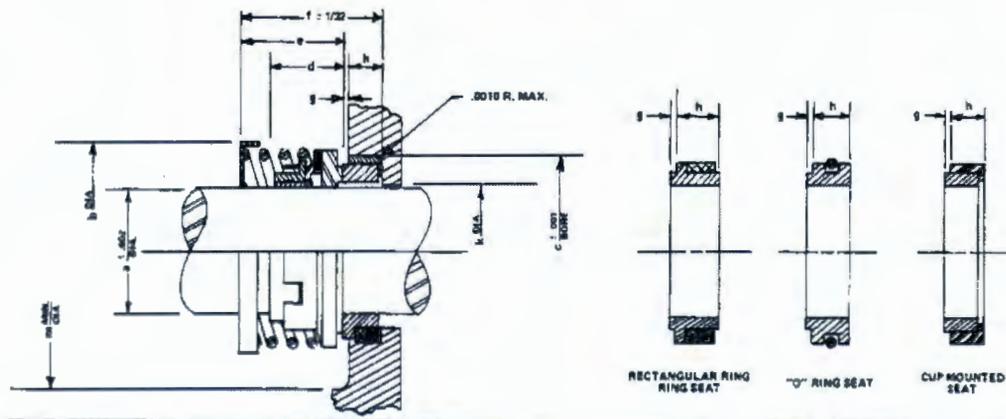


**FIGURE 3
MOISTURE SENSING CIRCUIT
TYPICAL WIRING DIAGRAM**

LEAD COLOR CODING

		BLACK LEAD	WHITE LEAD	RED LEAD	ORANGE LEAD	GREEN LEAD
Power Cable	Polyphase	T ₁	T ₂	T ₃	—	Ground
	Single Phase	T ₁	T ₄	T _A	—	Ground
Control Cable	All	P ₁	P ₂	W ₁	W ₂	Ground

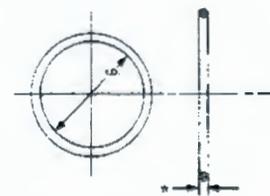
STANDARD REPLACEMENT SEAL CROSS REFERENCE



PURCHASING SPECIFICATIONS													
Part No. 64262-	a	Crane Type Seal	Type Seat	Spring Code No.	b	c	d	e	f	g	h	k	m
12-A	1.250	T-21	Cup Ceramic	BP1C1	1-15/16	1.875	47/64	1-1/16	1-1/2	1/16	3/8	1-7/16	2-3/16
12-B	1.500	T-21	Cup Ceramic	BP1C1	2-3/16	2.125	47/64	1-1/8	1-9/16	1/16	3/8	1-11/16	2-3/16
12-C	1.750	T-21	Cup Ceramic	BP1C1	2-5/8	2.500	49/64	1-3/8	1-7/8	1/16	7/16	1-15/16	2-7/8
12-D	2.000	T-21	Cup Ceramic	BP1C1	2-7/8	2.750	49/64	1-1/2	2	1/16	7/16	2-3/16	3-3/16
12-E	2.250	T-21	Cup Ceramic	BP1C1	3-1/8	3.125	49/64	1-11/16	2-1/4	1/16	1/2	3-7/16	3-7/16
12-G	3.00	T-21	Cup Ceramic	BP1C1	4.00	4.125	2.687	2.062	2.687	0.06	0.56	3.19	4.50
18-F	2.75	T-21	Cup Ceramic	BP1C1	3.75	3.500	0.796	1.125	1.75	0.03	0.595	2.94	4.12
18-G	3.00	T-21	Cup Ceramic	BP1C1	4.00	3.875	0.796	1.125	1.75	0.06	0.56	3.19	4.50
18-N	2.75	T-21	Cup Ceramic	BP1C1	3.75	3.50	0.796	1.125	1.75	0.06	0.56	2.94	4.12
B-J	3.25	T-21	Cup Ceramic	BP1C1	4.84	4.125	2.187	2.187	2.968	0.06	0.69	3.44	4.88

STANDARD REPLACEMENT "O" RING CROSS REFERENCE

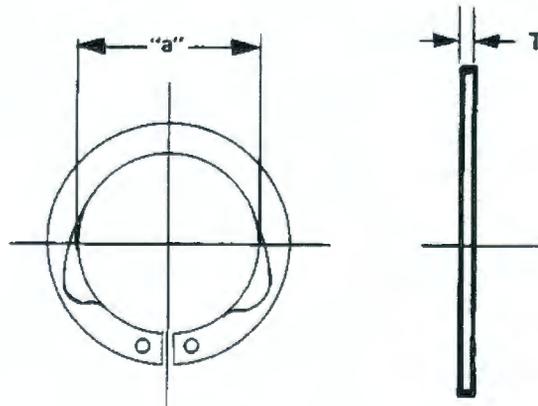
Part No. 421900	I.D.	Nominal W.	UL Listed Material	Approved Suppliers and Compound Number
60-FU	3.750	0.139	BUNA N	National Seal No. B-46A
72-FU	4.500	0.125	BUNA N	Parker Seal N-219-7
94-FU	5.875	0.125	BUNA N	Precision Rubber No. 1197
100-FU	6.250	0.125	BUNA N	Crane Packing No. 2561
124-FU	7.750	0.125	BUNA N	
144-FU	9.000	0.125	BUNA N	
168-FU	10.500	0.125	BUNA N	
192-FU	12.000	0.125	BUNA N	
208-FU	13.000	0.140	BUNA N	
240-FU	15.000	0.140	BUNA N	



TO BE USED AT 9-1/2 I.D.
@ 3/32 NOM. THICKNESS

STANDARD REPLACEMENT SNAP RING CROSS REFERENCE

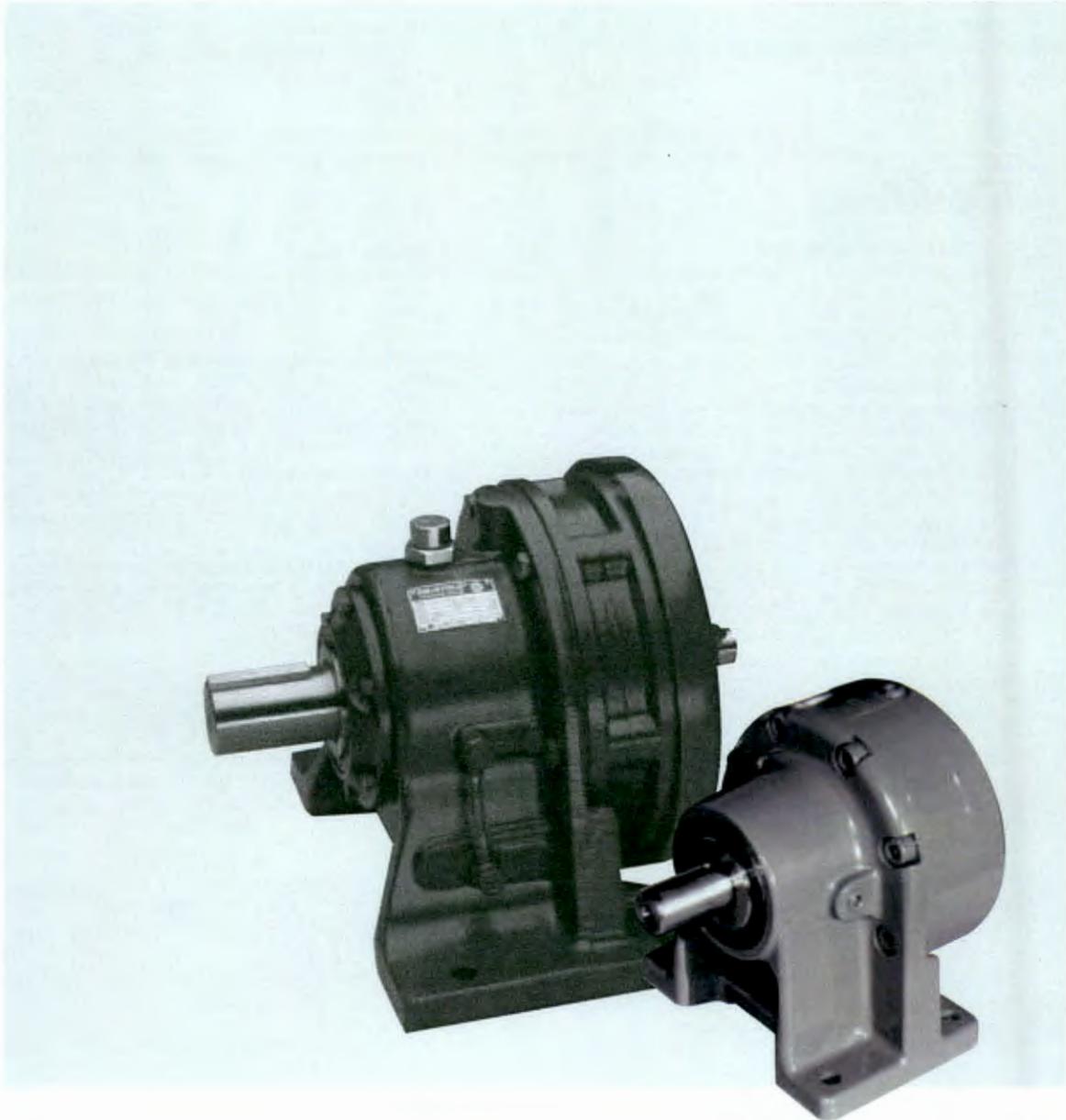
Part No. 47174-5-	a	T	Shaft Size	Waldes Catalog Number	Remarks
A	1.156 + .010 - .015	.050 ± .002	1-1/4	5108-125-H	#420 Stainless
B	1.387 + .010 - .015	.050 ± .002	1-1/2	5108-150-H	#420 Stainless
C	1.637 + .013 - .020	.062 ± .003	1-3/4	5108-177-H	#420 Stainless
D	1.850 + .013 - .020	.062 ± .003	2	5108-200-H	#420 Stainless
E	2.081 + .015 - .025	.078 ± .003	2-1/4	5108-225-H	#420 Stainless
H	2.543 + .015 - .025	.093 ± .003	2-3/4	5100-275-H	#420 Stainless
F	2.775 + .020 - .030	.093 ± .003	3	5100-300-H	#420 Stainless
G	3.006 + .020 - .030	.093 ± .003	3-1/4	5100-325-H	#420 Stainless



NOTE: *Outer shaft seal must be in liquid when motor is operated, whether motor is submerged or in air.*

Seals cannot be run in a dry environment without a significant reduction in seal life.

SM-CYCLO[®] SPEED REDUCERS



SECTION A CONTENTS

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Mounting

1. Mounting on Exact Planes

The Horizontal Type oil-lubricated units must be mounted on horizontal surfaces. Where they are mounted on inclined surfaces, some modifications may be necessary. Specify mounting plane inclination at time of ordering.

2. Accurate Alignment

Where the reducer is connected to the motor and the driven machine through couplings, align the shafts accurately. Where the reducer is connected through V pulleys or sprockets, insure that the belts or chains are neither too tight nor too slack.

3. Overhung Load Positions

Overhung loads should be located as close to the bearing as possible. (See the SM-CYCLO® 6000 Series Catalog page E-8.)

4. Foundations

Foundations must be rugged enough to withstand shock and stress applied from the load side through the reducer.

5. Secure Housing

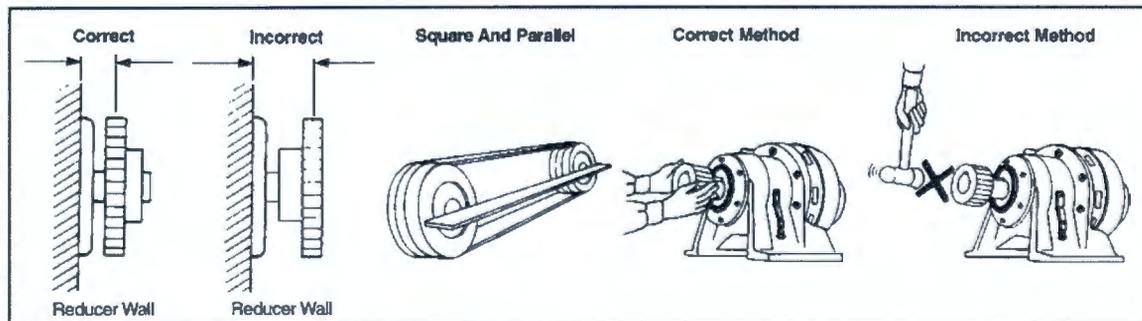
Where the reduction units are operated under conditions of vibration and/or frequent starts and stops, it is recommended to secure them on their mounting surfaces by inserting dowel pins into the knock-holes provided on the foot of the casing. This will insure that bending or shearing forces are reduced on the mounting bolts. Pins must be securely inserted, particularly when the units are to be operated under conditions of severe recurrent peak loads.

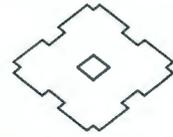
6. Mounting Accessibility

The reduction units must be mounted in locations with easy accessibility for lubrication maintenance purposes.

7. Ventilation

When the SM-CYCLO® Speed Reducer is mounted in a separate enclosure, be sure that adequate ventilation is provided.





GENERAL CONSTRUCTION

Fig. A-1 Speed Reducer – Horizontal Foot Mount, Single Reduction

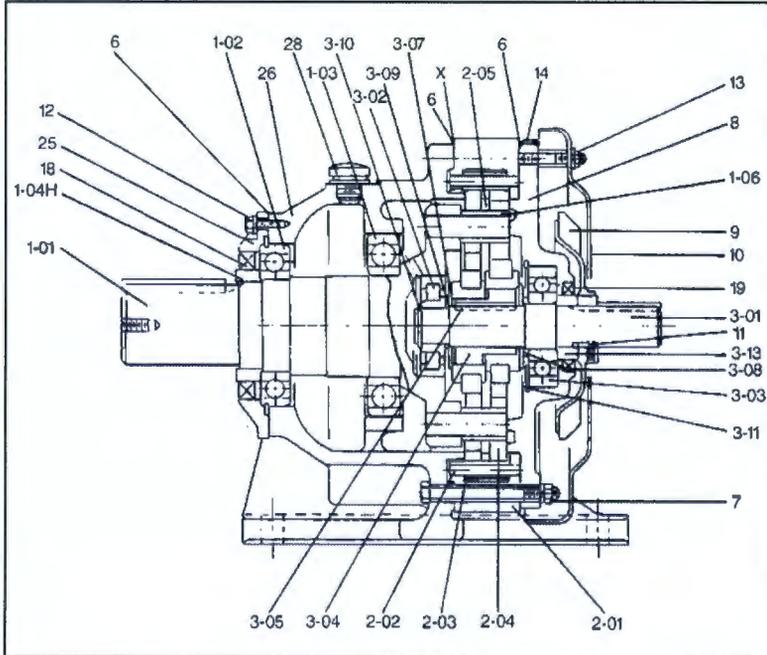
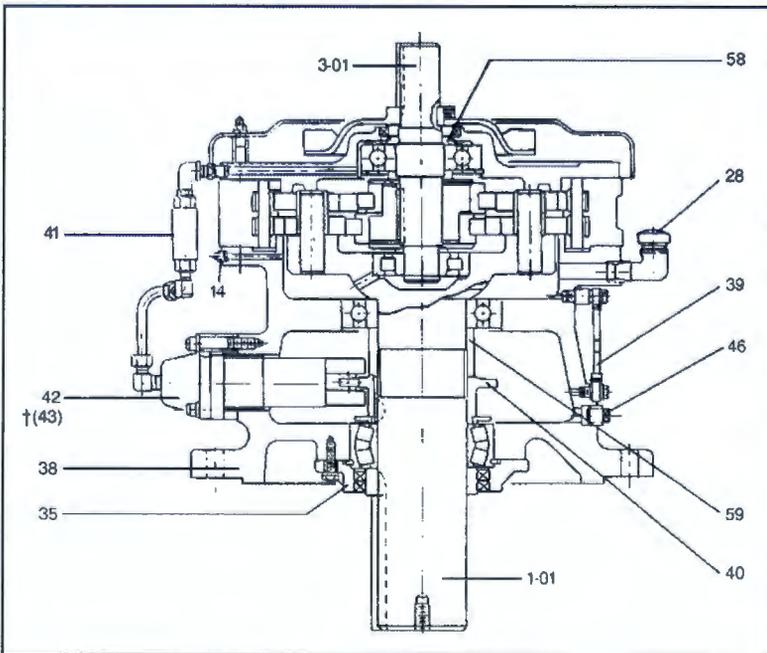


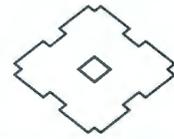
Fig. A-2 Speed Reducer – Vertical Base Mount, Single Reduction



Note: For details of oil seals, bearings or gaskets, refer to A-11 – 13.
 †Refer to Table A-16 on Pg. A-9 for units which require a positive displacement pump.
 *Pt. No. 58 — frame sizes 6195-6275 only; Pt. No. 59 — frame sizes 6205-6275 only.
 **See Fig. A-3, Page A-4; † See Fig. A-4, Page A-4.

Table A-1. Speed Reducer Main Parts

Part No.	Part Name
1-01	Slow Speed Shaft w/pins
1-02	Bearing A
1-03	Bearing B
1-04H	Oil Seal Collar—Horizontal
1-06	Slow Speed Shaft Rollers
2-01	Ring Gear Housing
2-02	Ring Gear Pins
2-03	Ring Gear Rollers
2-04	Cyclo Disc
2-05	Spacer Ring
3-01	High Speed Shaft
3-02	Bearing C
3-03	Bearing D
3-04	Eccentric Bearing Assembly
3-05	Eccentric Key
**3-06	Balance Weight
3-07	Spacer
3-08	Spacer
3-09	Spacer
3-10	Retaining Ring
3-11	Retaining Ring
3-13	Collar
† 5-01	Intermediate Shaft w/Pins
† 5-02	Bearing F
† 5-03	Bearing G
† 5-04	Eccentric Bearing Assembly
6	Gasket Set
7	Casing Nuts & Bolts
8	High Speed End Shield
9	Cooling Fan & Set Screw
10	Fan Cover
11	Fan Key
12	Bolts For SS Oil Seal Housing
13	Bolts, Spacers For Fan Cover
14	Plug
† 15	Grease Nipple
18	Slow Speed Output Oil Seal
19	High Speed Input Oil Seal
25	Horizontal Oil Seal Housing
26	Horizontal Case
28	Oil Fill Plug
29	Oil Gauge—Horizontal Unit
35	Vertical Oil Seal Housing
38	Vertical Case (Integral V Type)
39	Oil Gauge—Vertical Unit
40	Cam
41	Piping Set & Oil Signal
42	Plunger Pump
43	Positive Displacement Pump
46	Drain Plug
† 55	Intermediate Cover
† 57	Eye Bolt
*58	Oil Slinger
*59	Spacer



Lubricants

Grease Lubricated Models

Those models listed in Tables A-3 ~ A-6 as grease lubricated are filled with grease before shipment to the customer and are ready for use.

Table A-7. Standard Greases^[1]

Ambient Temperature ^[2]		SM-Cyclo [®] Speed Reducer
°F	°C	Shell Oil
14 to 122	-10 to 50	Shell Alvania [®] Grease 2 (NLGI Grade #2)

Table A-8. Grease Replenishment and Change Interval

Model	Condition	Interval ^[3]	
Single and Double Reduction Maintenance Free Type	Replenishment	NOT REQUIRED	
	Overhaul ^[4]	Every 20,000 Hours or Every 4 ~ 5 Years	
Double Reduction	Replenishment	Less Than 10 Hours Per Day Operation	Every 3 ~ 6 Months
		10 ~ 24 Hours Per Day Operation	Every 500 ~ 1000
	Change	Speed Reducer Mechanism, High Speed Shaft Bearings (Speed Reducer Type)	Every 2 ~ 3 Years
		Slow Speed Shaft Bearings	Every 3 ~ 5 Years

Replenishment and Change Guidelines

Replenish grease to the reduction mechanism 1/3 to 1/2 of the quantity listed in Table A-9 or A-10 for the first reduction stage at the interval recommended in Table A-8.

When the unit is disassembled for overhauling, refill with the grease quantities indicated in Table A-9 or A-10. Or alternatively, 80% of the space around the reduction mechanism and slow speed shaft bearings of single reduction units, and 50% around the reduction mechanism of both the first and second stage of double reduction units.

Slightly larger quantities may be supplied to lower reduction ratio units, and somewhat smaller quantities for high reduction ratio units.

Apply grease liberally to the central part (i.e., around the eccentric bearings) of the mechanism. Apply grease to both the slow speed and high speed shaft bearings as you would to ordinary bearings at the time of re-assembly.

If excessive grease is added, agitation heating of the grease will raise the operating temperature of the unit. Avoid excessive greasing, but do not supply an insufficient amount of grease. When the grease is insufficient, it will raise the unit's operating temperature due to breakdown of the lubrication films on the eccentric bearing. In this case, if the operating temperature rises, supply grease immediately.

Table A-9. Single Reduction Grease Quantities – oz. (g.)

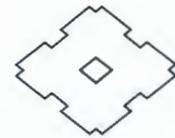
Frame Size	6060 6065	6070 6075	6080 6085	6090 6095	6100 6105 610H	6110 6115	6120 6125 612H
Speed Reduction Mechanism	0.9 (25)		2.3 (65)	3.2 (90)	4.9 (140)	7.1 (200)	11.6 (330)
Slow Speed Shaft Bearing	1.2 (35)		2.5 (70)	3.5 (100)		3.2 (90)	4.2 (120)

Notes: [1] Avoid the use of grease other than shown in Table A-7.

[2] Consult the factory when the drives are used under widely fluctuating temperatures, ambient temperatures other than those listed in Table A-7, or any other special conditions.

[3] Single reduction frame sizes 6060 ~ 612H and double reduction frame sizes 6060DA ~ 6125DB are maintenance free units. Grease replenishment is not necessary. Where longer life of the drive is expected or if re-lubricating is preferred before the recommended interval, refer to Tables A-7, A-8, A-9 and A-10.

[4] Overhauling consists of disassembling the unit, replacing the seals and gaskets, cleaning the internal parts and then repacking the unit with designated grease.



BEARINGS, OIL SEALS, GASKETS

Fig. A-9

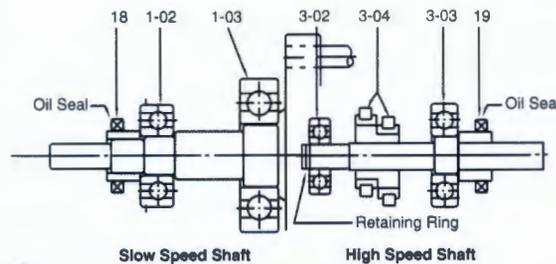


Table A-20. Slow Speed Shaft Bearing

Single Reduction	Frame Size	Double Reduction	Slow Speed Shaft	
			Bearing A Part #1-02	Bearing B Part #1-03
6060, 6065		6060DA, 6065DA	6204Z	6909
6070, 6075		6070DA, 6075DA	6204Z	6909
6080, 6085		-	6305Z	6009
6090, 6095		6090DA, 6095DA	6306Z	16011
6100, 6105, 610H		6100DA, 6105DA	6306Z	16011
6110, 6115		-	6307Z	6011
6120, 6125, 612H		6120DA, 6125DA, 6120DB, 6125DB	6308Z	6013
6130, 6135	6130DA, 6135DA, 6130DB, 6135DB, 6130DC, 6135DC		6211NR	6213
6140, 6145, 614H	6140DA, 6145DA, 6140DB, 6145DB, 6140DC, 6145DC		22211EXNR	6213
6160, 6165	6160DA, 6165DA, 6160DB, 6165DB, 6160DC, 6165DC		3TM-6213NR ^[1]	6215 ^[1]
6170, 6175	6170DA, 6175DA, 6170DB, 6175DB, 6170DC, 6175DC		6216NR ^[1]	6218 ^[1]
6180, 6185	6180DA, 6185DA, 6180DB, 6185DB		6218NR ^[1]	6220 ^[1]
6190, 6195	6190DA, 6195DA, 6190DB, 6195DB		6221NR ^[1]	6026 ^[1]
6205		6205DA, 6205DB	22220BNRC2	6222C2
6215		6215DA, 6215DB	23022BNRC2	6224C2
6225		6225DA, 6225DB	23024BNRC2	6226C2
6235		6235DA, 6235DB	23026BNRC2	NUP228C2
6245		6245DA, 6245DB	23028BNRC2	NUP230C2
6255		6255DA, 6255DB	23032BNRC2	NUP234C2
6265		6265DA	23034BNRC2	NUP236C2
6275		6275DA	23136BNXR	6340

Table A-21. High Speed Shaft Bearing

Single Reduction	Frame Size	Double Reduction	High Speed Shaft			Qty.
			Bearing C Part #3-02	Bearing D Part #3-03	Eccentric Part #3-04	
6060, 6065		6060DA, 6065DA, 6070DA, 6075DA	6301	6301Z	607YXX	1
6070, 6075		6090DA, 6095DA, 6100DA, 6105DA, 6120DA, 6125DA, 6130DA, 6135DA, 6140DA, 6145DA	6301	6301Z	607YXX	1
6080, 6085		-	6301SH	6302Z	6004RSH2ZZC3	1
6090, 6095		6120DB, 6125DB, 6130DB, 6135DB, 6140DB, 6145DB, 6160DA, 6165DA, 6170DA, 6175DA	6302RSH2	6302Z	Refer to Table A-22	1
6100, 6105, 610H		6130DC, 6135DC, 6140DC, 6145DC, 6160DB, 6165DB, 6170DB, 6175DB, 6180DA, 6185DA	6302RSH2	6302Z		
6110, 6115		-	6302RSH2	6302Z	611YSS, 611GSS	2
6120, 6125, 612H		6160DC, 6165DC, 6170DC, 6175DC, 6190DA, 6195DA, 6205DA	6304	6305Z		
6130, 6135		6180DB, 6185DB, 6190DB, 6195DB, 6205DB, 6215DA, 6225DA	6305	6306	Refer to Table A-22	1
6140, 6145, 614H		-	6305R	6306		
6160, 6165, 616H		6215DB, 6235DA, 6245DA	6307R	6308		
6170, 6175		6255DA, 6255DB	6406	6407	617YSX	2
6180, 6185		6235DB, 6245DB	6407	6409	618YSX	2
6190, 6195		6255DB, 6265DA, 6275DA	6408	6411	619YSX	2
6205		-	NJ310EV7	21311V1	620GXX	2
6215		-	NJ311EV16	21311V1	621GXX	2
6225		-	NJ312EV11	21312V1	622GXX	2
6235		-	NJ313EV11	21314V1	623GXX	2
6245		-	NJ314EV7	21315V1	624GXX	2
6255		-	NJ316EV1	21318V1	625GXX	2
6265		-	NJ317EV1	21318V1	626GXX	2
6275		-	NJ417	22222BL1	627GXX	2

Note: [1] For grease lubricated models, a sealed bearing should be used, which changes the following letters in the part number to those shown in bold: NR (Std.) - ZNR; NXR - ZNXR; None - add Z.

BEARINGS, OIL SEALS, GASKETS

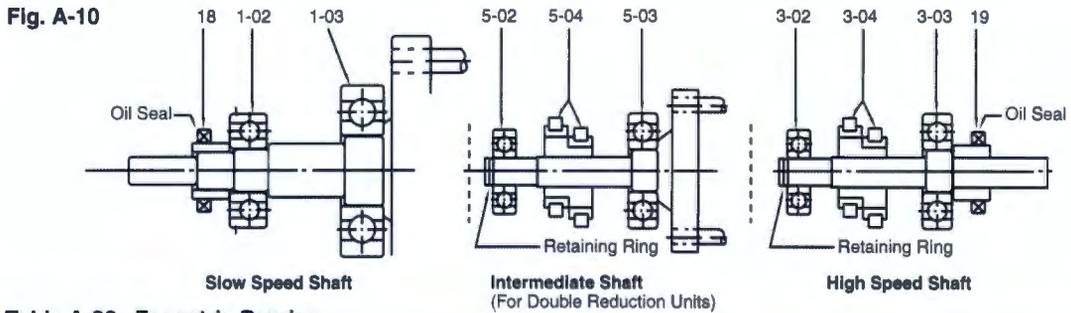
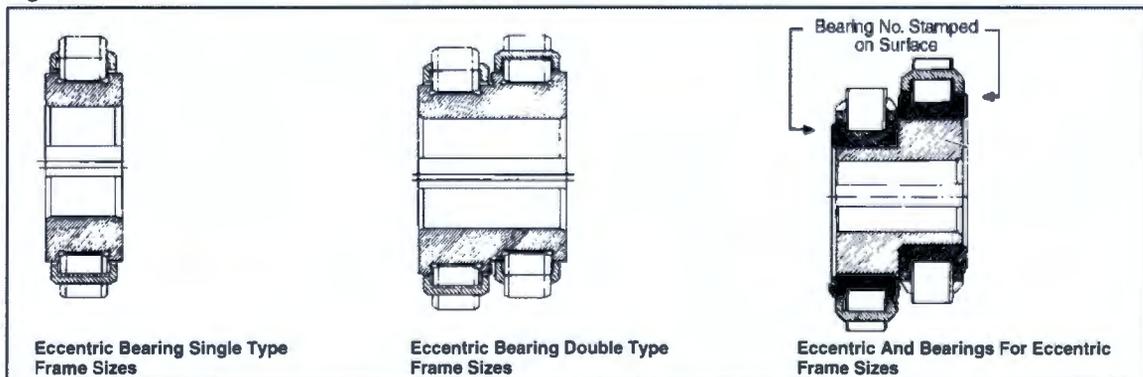


Table A-22. Eccentric Bearing

		Frame Size					
High Speed Shaft, Motor Shaft Part #3-04	6090, 6095	6100, 6105	6120, 6125	6130, 6135	6140, 6145	6160, 6165	
Intermediate Shaft Part #5-04	6090DA 6095DA	6100DA 6105DA	6120DA, 6125DA 6120DB, 6125DB	6130DA, 6135DA 6130DB, 6135DB 6130DC, 6135DC	6140DA, 6145DA 6140DB, 6145DB 6140DC, 6145DC	6160DA, 6165DA 6160DB, 6165DB 6160DC, 6165DC	
Reduction Ratio							
6	60906YRX	6100608YRX	6120608YRX	61406-11YSX	61406-11YSX	6160608YRX2	
8	60908-15YSX	6100608YRX	6120608YRX	61406-11YSX	61406-11YSX	6160608YRX2	
11	60908-15YSX	61011-15YRX	6121115YSX	61406-11YSX	61406-11YSX	61611-15YSX	
13	60908-15YSX	61011-15YRX	6121317YSX	61413-17YSX	61413-17YSX	61611-15YSX	
15	60908-15YSX	61011-15YRX	6121115YSX	61413-17YSX	61413-17YSX	61611-15YSX	
17	60917YSX	61017YSX	6121317YSX	61413-17YSX	61413-17YSX	61617-25YSX	
21	60921YSX	61021YRX	61221YRX	6142125YSX	6142125YSX	61617-25YSX	
25	6092529YSX	6102529YRX	6122529YSX	6142125YSX	6142125YSX	61617-25YSX	
29	6092529YSX	6102529YRX	6122529YSX	6142935YSX	6142935YSX	6162935YSX	
35	60935YSX	61035YRX	61235YRX	6142935YSX	6142935YSX	6162935YSX	
43	60943YSX	61043YSX	61243YSX	61443-59YSX	61443-59YSX	6164351YSX	
51	60951YRX	61051YRX	6125159YSX	61443-59YSX	61443-59YSX	6164351YSX	
59	60959YSX	61059YRX	6125159YSX	61443-59YSX	61443-59YSX	61659YSX	
71	60971YRX	61071YRX	6127187YSX	6147187YSX	6147187YSX	61671YRX2	
87	60987YSX	61087YRX	6127187YSX	6147187YSX	6147187YSX	61687YSX	
119	609119YSX	610119YSX	-	-	-	-	

Fig. A-11



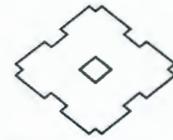


Table A-23. Intermediate Shaft Bearing

Frame Size	Intermediate Shaft				Qty.	Frame Size	Intermediate Shaft				
	Bearing F Part #5-02	Bearing G Part #5-03	Eccentric Bearing Part #5-04				Bearing F Part #5-02	Bearing G Part #5-03	Eccentric Bearing Part #5-04	Qty.	
6060DA, 6065DA	6301	6909	607YXX		1	6180DA, 6185DA	6407	6208	618YSX	2	
6070DA, 6075DA	6301	6909	607YXX		1	6180DB, 6185DB	6407	6213	618YSX	2	
6090DA, 6095DA	6302RSH2	6007	Refer to Table A-22	1		6190DA, 6195DA	6408	6210	619YSX	2	
6100DA, 6105DA	6302RSH2	6007					6190DB, 6195DB	6408	6213	619YSX	2
6120DA, 6125DA	6304	6007					6205DA	NJ310EV7	6210	620GXX	2
6120DB, 6125DB	6304	6205					6205DB	NJ310EV7	6310	620GXX	2
6130DA, 6135DA	6305	6007					6215DA, 6215DB	NJ311EV16	6311	621GXX	2
6130DB, 6135DB	6305	6206					6225DA, 6225DB	NJ312EV11	6313	622GXX	2
6130DC, 6135DC	6305	6206					6235DA, 6235DB	NJ313EV11	6314	623GXX	2
6140DA, 6145DA	6305	6007					6245DA	NJ314EV7	6315	624GXX	2
6140DB, 6145DB	6305	6206					6245DB	NJ314EV7	6316	624GXX	2
6140DC, 6145DC	6305	6206					6255DA, 6255DB	NJ316EV1	6318	625GXX	2
6160DA, 6165DA	6307R	6207					6265DA	NJ317EV1	6320	626GXX	2
6160DB, 6165DB							6275DA	NJ417	22220RH	627GXX	2
6160DC, 6165DC	6307R	6208									
6170DA, 6175DA	6406	6207			617YSX	2					
6170DB, 6175DB											
6170DC, 6175DC	6406	6208	617YSX	2							

Table A-24. Oil Seals

Frame Size	Type ^[1]	Slow Speed Shaft Part #18			High Speed Shaft Part #19		
		Dimension (mm) (I.D. x O.D. x W)	Quantity		Type ^[1]	Dimension (mm) (I.D. x O.D. x W)	Quantity
			Horizontal Shaft	Vertical Shaft			
6060, 6065	D	30 x 47 x 8	1	1	S	17 x 30 x 6	1
6070, 6075	D	30 x 47 x 8	1	1	S	17 x 30 x 6	1
6080, 6085	D	45 x 62 x 9	1	1	S	17 x 30 x 6	1
6090, 6095	D	50 x 72 x 12	1	1	S	20 x 35 x 7	1
6100, 6105	D	50 x 72 x 12	1	1	S	20 x 35 x 7	1
6110, 6115	D	55 x 80 x 12	1	1	S	20 x 35 x 7	1
6120, 6125	D	65 x 90 x 13	1	1	D	32 x 52 x 8	1
6130, 6135	D	68 x 88 x 12	1	2	D	38 x 58 x 11	1
6140, 6145	D	65 x 88 x 12	1	2	D	38 x 58 x 11	1
6160, 6165	D	85 x 110 x 13	1	2	D	55 x 78 x 12	1
6170, 6175	D	95 x 130 x 15	1	2	D	60 x 82 x 12	1
6180, 6185	D	110 x 145 x 15	1	2	D	65 x 88 x 12	1
6190, 6195	D	120 x 155 x 16	1	2	S	70 x 88 x 10	1
6205	D	120 x 155 x 16	1	2	S	70 x 88 x 10	1
6215	D	130 x 160 x 14	1	2	S	75 x 100 x 13	1
6225	D	145 x 175 x 14	1	2	S	75 x 100 x 13	1
6235	D	160 x 190 x 16	1	2	S	85 x 110 x 13	1
6245	D	170 x 200 x 16	1	2	S	95 x 120 x 13	1
6255	D	190 x 225 x 16	1	2	S	110 x 140 x 14	1
6265	D	200 x 240 x 20	1	2	S	110 x 140 x 14	1
6275	D	230 x 270 x 20	1	2	S	120 x 150 x 14	1

Note: [1] D indicates lip (dust proof and seal lip) type.

DISASSEMBLY/ASSEMBLY

Disassembly

SM-CYCLO® Reducers are designed to provide maximum ease when disassembling and reassembling; they require no special maintenance skills.

1. Remove the complete SM-CYCLO® Reducer with adaptor (motorized type) from the driven machine.
2. Remove the plug at the bottom of the oil gauge to drain all oil from the unit.
3. Remove the cooling fan cover and fan from those Speed Reducers (not motorized) equipped with a cooling fan, and stand the unit on a solid base with its high speed shaft side down. Remove the through bolts for the high speed end shield, ring gear housing, and lift the slow speed side, thus separating the unit into two parts so that the inner mechanism can be removed (Figs. A-12 ~ A17).

Note: If the reducer is motorized (C-adaptor and coupling) remove the motor and coupling before following the procedure outlined above. As a final step, remove the adaptor and cooling fan.

4. If the unit will not separate easily, gently drive a wedge at the line X shown in Fig. A-1 on page A-3 (if this produces a burr, be sure to remove it before reassembly).
5. To lift the slow speed side, attach an eyebolt to the tapped hole on the end of the slow speed shaft and use a hoist or chain block (Fig. A-12).
6. Take out the slow speed shaft rollers, item 1-06, page A-3 (Fig. A-13). Check the slow speed shaft pins (1-01) to see whether any rollers have adhered to them.
7. Using both hands, lift out the top cycloid disc (2-04) on the slow speed side (Fig. A-14).

8. Remove the spacer ring (2-05).

9. The eccentric (3-04) can be removed from the input shaft (3-01) after taking out the retaining ring (3-10) and the inner bearing raceway (Figs. A-15, A-16).

Note: In certain sizes, the eccentric bearings are roller bearings without a retainer. Remove bearings of the top disc before proceeding with the next step.

10. Take out the second disc located on the motor side. (Also remove second disc bearings and eccentric with inner bearing raceway if required.)
 11. Remove the ring gear housing (2-01).
 12. Follow these steps to remove the slow speed shaft (1-01) with its bearings from the casing (26): (a) Remove the horizontal oil seal housing (25). (b) With a wooden or hard rubber mallet, rap the inner end of the slow speed shaft to expose the retaining ring* from the outer raceway of the bearing. (c) Remove the retaining ring. (d) Rap the outer end of the slow speed shaft with a wooden or hard rubber mallet, and remove it from the casing.
 13. The high speed shaft (3-01) with bearings is removed from the high speed shaft end shield (8) by tapping the shaft end after first taking off the retaining ring (3-11).
 14. The cycloid disc is made from heat-treated bearing steel and the spacer ring is cast iron. Take care not to strike them together while handling. The above instructions cover complete disassembly. In ordinary cases, however, only the removal of the cycloid discs and the eccentric, and removal of the slow speed shaft from the slow speed end cap is necessary.
- ***Note:** Retaining ring is part of bearing A (Part No. 1-02).

Assembly

SM-CYCLO® Reducers are reassembled by reversing the disassembly procedure. Care must be taken to exclude dust or foreign matter from the moving parts, and to see that gaskets are properly placed to make the assembly oil-tight.

Following are some helpful points to remember when assembling SM-CYCLO® Reducers.

1. Set the ring gear housing and insert the ring gear pins and rollers; then test-rotate the pins and rollers by hand. (Apply grease liberally to the ring gear pins and rollers before they are inserted in grease lubricated SM-CYCLO® Reducers.)
2. Cycloid discs are a matched pair. Each carries the same number stamped on one side of the disc.
3. Set the cycloid disc with the stamped number face up as shown in Fig. A-17.

4. Insert the spacer (3-07) and then insert the eccentric with bearings by rapping with a wooden or hard rubber mallet (Fig. A-16).

5. Insert the other spacer and the inner bearing raceway. Secure them with the retaining ring (Fig. A-15).

6. Set the spacer ring in place.

7. **Insert top disc in such a way that the mark is 180° opposed to the mark on the bottom disc (Fig. A-13).**

8. Insert slow speed shaft rollers (Fig. A-13).

9. Put the slow speed shaft pins into the rollers (Fig. A-12). The above instructions are for **eccentric bearings with retainer**. Following are the instructions suggested for **roller bearings without retainer**.

- a. First insert the eccentric with inner raceways of bearings by rapping with a wooden or hard rubber mallet.

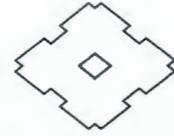


Fig. A-12



Fig. A-13



Fig. A-14

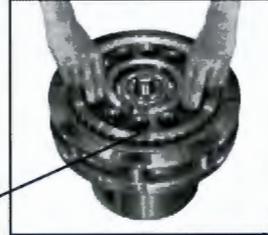


Fig. A-15



Fig. A-16

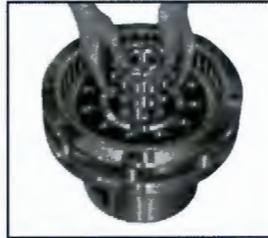
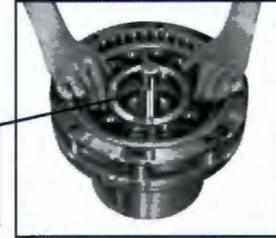


Fig. A-17



Note: Insert second disc with number facing slow speed side, exactly 180° opposed to number on first disc.
Note: Set disc with number facing slow speed side.

b. Apply grease to the raceway of the eccentric on the disc. Fix the rollers and set disc in place.

c. Insert the spacer ring and set second disc in such a way that mark is 180° opposed to mark on the bottom disc.

Eccentric Bearing Replacement Precautions

The eccentric bearings are specially designed for installation on SM-CYCLO® Reducers. They are special roller bearings without outer raceways (refer to the list of bearings on pages A-12 ~ A-13).

It is necessary to insert replacement bearings with numbered surfaces of the inner raceways facing outward. Note that incorrect insertion of the bearings (i.e., insertion of bearings with numbered surfaces inside) causes trouble.

Disassembly and Assembly of Sizes 6060-6095 SM-CYCLO® Reducers

Small sizes 6060-6095 have a single disc system, so they differ in construction from larger sizes in the following ways:

1. A balance weight is provided in lieu of the two-disc system. Refer to figure A-18.
2. The balance weight must be positioned exactly 180° as opposed to that of the eccentric.
3. There are no end plates on either side of the eccentric. In all other respects, 6060-6095 have exactly the same construction as the larger sizes. Follow the instructions given under "Disassembly and Assembly".

Disassembly Of Output Side (6060-612H)

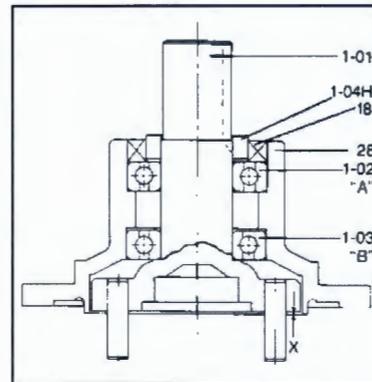
1. With casing supported, tap output shaft until it is disengaged from casing.
2. Remove bearing "A" by using pulling tool.
3. Replace all bearings, gaskets and seals when reassembling. (Pages A-11 ~ A-13).

Assembly Of Output Side (6060-612H)

1. Assemble the "B" bearing (Part No. 1-03) on the slow speed shaft (Part No. 1-01). Heating of "B" bearing is recommended for easier assembly.
Note: Do not exceed temperature of 200°F.
2. Assemble the casing (Part No. 26) over the slow speed shaft (Part No. 1-01), being sure to maintain "X" (Fig. A-18).
3. Carefully tap bearing "A" (Part No. 1-02) onto the slow speed shaft (Part No. 1-01) until the bearing is flush with the shoulder of the casing.
4. Place the collar (Part No. 1-04H) onto the slow speed shaft (Part No. 1-01). Heating the collar is recommended for easier assembly.
5. Insert the oil seal (Part No. 18), lip in, into the casing (Part No. 26).

Note: Measure for dimension "X" preferably in 3 places to insure proper spacing.

Fig. A-18



X" Dimension (Inches)

Frame Size	Dimension
6060/65	0.046 ± 0.007
6070/75 6080/85	0.042 ± 0.007
6090/95	0.046 ± 0.007
6100/05 610H	0.046 ± 0.007
6110/15/20/ 25, 612H	0.042 ± 0.007

DAILY INSPECTION

1. Visually check the oil level gauge on the vertical unit, forced-lubricated type. Check lubrication flow by viewing piping set and oil signal (Part No. 41). Faulty operation is caused by a lack of lubrication oil, damage to the plunger pump (Part No. 42) or the positive displacement pump (Part No. 43) or the clogging of pipes, etc. In case of faulty operation, stop and inspect the unit immediately.

2. A temperature rise of approximately 105°F (40.6°C) above ambient on the surface of the ring gear housing (Part No. 2-01) is allowable if the temperature

fluctuation is small. If temperature rises rapidly from a stable condition, add the recommended oil or grease (Tables A-7 and A-11). A rapid temperature rise may be caused from a lack of lubrication.

If after lubricating unit, the problem persists, stop operation and consult factory.

3. When an abnormal sound is heard from inside the unit, stop operation and inspect the unit.

4. If the lubrication oil leaks, replace the damaged or worn part with a new one. (Refer to Part No. 1-04H, Page A-3.)

Ordering Correct Replacement Units Or Parts

The SM-CYCLO® is fully standardized to offer maximum part interchangeability among models of the same frame size. However, there are many frame sizes, models and types in the production range of SM-CYCLO®. Therefore to get correct replacement units or parts, proper information to identify the speed reducer in question is essential. The name plate, which is secured to the body of the drive, provides this identifying data.

Please give the full description shown on the name plate to your distributor. Be sure to include the *SERIAL NUMBER* and *MODEL NUMBER*. This information, along with our production records, will enable us to provide you with the correct replacement unit or parts.

Name Plate on SM-CYCLO®

SM-CYCLO® CHESAPEAKE, VIRGINIA			
MODEL			
RATIO	SERVICE FACTOR		
INPUT	HP	RPM	
OUTPUT TORQUE		IN-LB	
SERIAL NO.			
 SUMITOMO			<small>MACHINERY CORP. OF AMERICA</small>

Storage And Operation After Storage

Storage 6 Months–1 Year

Oil-Lubricated

1. Completely fill unit(s) with a rust-preventive oil (NP20 or equivalent) or a circulating oil (Shell VSI No. 100 or equivalent).

2. At approximately 3 month intervals, rotate the input shaft a sufficient number of times to insure all internal components remain coated. (The higher the ratio, the greater the amount of rotations needed for proper lubrication.)

Grease-Lubricated

Grease-lubricated models do not require any special attention during storage. (Inspect unit before operation.)

Note: For both the *Oil-Lubricated* and *Grease-Lubricated* models, if units are to be stored for a period exceeding 1 year, consult factory.

Operation After Storage 6 Months–1 Year

Oil-Lubricated

1. Completely drain the rust preventive, or circulating oil from unit.

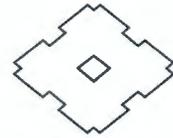
2. Flush unit with the recommended operating oil as shown in Table A-11.

3. After flushing, fill the unit to the proper oil level with the recommended lubricating oil.

Grease-Lubricated

Add ½ of the recommended quantity of new grease as shown in Table A-10.

Note: Consult the factory before operating units stored for periods greater than 1 year.



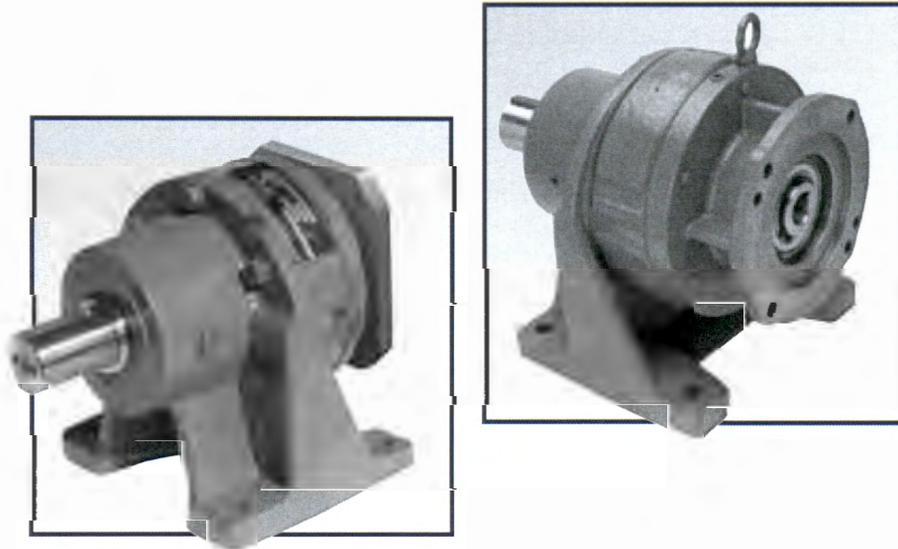
TROUBLESHOOTING AND REPAIR

This troubleshooting guide is to help you identify and overcome common problems of reducers. If you have a problem not listed below, please consult factory.

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer.	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load.
	Improper Lubrication	Insufficient lubrication.	Check lubricant level and adjust up to recommended levels.
		Excessive lubrication.	Check lubricant level and adjust down to recommended level.
		Wrong lubricant.	Flush out and refill with correct lubricant as recommended.
Runs Noisy	Loose Foundation Bolts	Weak mounting structure.	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting and structure.
		Loose hold down bolts.	Tighten bolts.
	Worn Disc	Overloading unit may result in damage to disc.	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant.	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload.	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory-recommended level.
Damaged Pins & Rollers	Overloading of reducer.	Disassemble and replace ring gear pins and rollers. Check load on reducer.	
Output Shaft Does Not Turn	Input Shaft Broken	Overloading of reducer can cause damage.	Replace broken shaft. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
	Eccentric Bearing Broken	Lack of lubricant.	Replace eccentric bearing. Flush and refill with recommended lubricant.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Breather filter may be clogged. Replace or clean filter.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Vent clogged.	Clean or replace element, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Mount horizontally or rework reducer to wall or ceiling mount.

CIRCULUTE³⁰⁰⁰ REDUCER

Service, Parts and Instruction Manual



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Warranty

With the exception of shaft seals, which are a normal wear item, Seller warrants Circulute 3000 Reducers (Products) manufactured by Seller to be free from defects in materials and workmanship under normal use and proper maintenance for two (2) years from date of shipment. If within such period any product shall be proved to Seller's reasonable satisfaction to be defective, such product shall be repaired or replaced at the Seller's option. Seller's obligation and Buyer's exclusive remedy will be limited to such repair or replacement and shall be conditioned upon Seller receiving written notice of any alleged defect no later than ten (10) days after its discovery within the warranty period. Shipping terms for any repaired or replaced product will be FOB shipping point. If necessary, we reserve the right to inspect the product claimed to be defective at Buyer's location or place of installation. Travel time and expenses for any Seller service personnel provided to Buyer's premises to effect such repair or replacement will be at Buyer's expense. Seller reserves the right to satisfy our warranty obligation in full by reimbursing the Buyer for all payments made to Seller and Buyer shall thereupon return the product to Seller. **THE FOREGOING WARRANTIES ARE THE ONLY WARRANTIES MADE BY SELLER WITH REGARD TO THE PRODUCTS, AND SELLER HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS, STATUTORY AND IMPLIED, APPLICABLE TO THE PRODUCTS, INCLUDING, BUT NOT LIMITED TO, ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND ALL EXPRESS, STATUTORY AND IMPLIED WARRANTIES APPLICABLE TO THE PARTS WHICH ARE NOT MANUFACTURED BY SELLER.** These warranties shall not be effective if the product has been subject to overload, misuse, negligence, or accident, or if the product has been repaired or altered outside of Seller's factory or authorized control in any respect which, in our judgment, adversely affects its condition or operation. Buyer shall establish, to our satisfaction, that the product has at all times, been properly assembled, installed, serviced, maintained, tested, operated and used in accordance with the current maintenance and operating instructions of Seller and has not been altered or modified in any manner without our prior written consent.

Model Number Chart for Induction Motor Reducers

B 0 7	- - 1 7	C - 5 6	B H	- - -
Frame Size <small>(from the selection tables)</small>	Reduction Ratio <small>(from the selection tables use dashes if all four places are not used)</small>	Input Type	Mounting Type Position	Modifications <small>(use dashes for any place not used - list modifications in alphabetical order using position one first)</small>

INPUT TYPE

Input Shaft SHFT

Standard Quill Style NEMA C-Face Input

Motor Size	Ordering Code
56C	C-56
143/145TC	C140
182/184TC	C180
213/215TC	C210
254/256TC	C250
284/286TC	C280
324/326TC	C320

For coupling style C-Face adapters, please change "C" to "A" in the ordering code

Shovel Base Input

Motor Size	Ordering Code
56	S-56
143/145T	S140
182/184T	S180
213/215T	S210
254/256T	S250
284/286T	S280
324/326T	S320

For top mount adapters, please change "S" to "T" in the ordering code

MOUNTING TYPE		MOUNTING POSITION		Position L	Position R
Mounting Type	Ordering Code	Mounting Position	Ordering Code	(Viewed from output shaft)	(Viewed from output shaft)
Base (foot)	B	Horizontal	H		
Flange	F	Vertical Output Shaft Down	D		
Ring	R	Vertical Output Shaft Up	U		
		Ceiling (base mount)	C		
		Wall Feet Left (base mount)	L		
		Wall Feet Right (base mount)	R		

Modifications

Expansion chamber breather (oil filled units)	E
USDA approved food grade lubricant	F
Oil level gauge	G
High temperature lubricant and acrylic oil seals (104°F to 140°F ambient temperatures)	H
Oil lubrication in place of standard grease lubrication	J
Grease lubrication in place of standard oil lubrication	K
Low temperature lubricant (-4°F to 32°F ambient temperatures)	L
Synthetic lubricant	S
Taper pins (for extreme reversing load applications)	T
Washdown breather (oil filled units)	U
Washdown modifications (a stainless steel sleeve under the output shaft seal, a V-ring deflector on the output shaft, a sealed motor shaft bearing for vertical output shaft down units, and a washdown breather for oil filled units. This modification reduces the usable shaft length)	W
White epoxy paint	X
Washdown modifications with white epoxy paint	Y
Steel-It® paint	B
Washdown modifications with Steel-It® paint	C
Precision backlash	P

Model Number Chart for Servo Motor Reducers

B 0 7	- - 1 7	S 0	0 9 0	1 6	A	B H	- -	
Frame Size <small>(from the selection tables)</small>	Reduction Ratio <small>(from the selection tables use dashes if all four places are not used)</small>	Servo Motor Input	Backlash	Servo Motor Bolt Circle Diameter in mm <small>(See Dimensional Table)</small>	Quill Shaft Diameter	Quill Shaft Tolerance <small>(Specified by Shimpo)</small>	Mounting Type Position	Modifications <small>(use dashes for any place not used - list modifications in alphabetical order using position one first)</small>

Backlash

Standard Backlash: Approximately 60 arc-min 0
Precision Backlash: Less than 6 arc-min P

SHIMPO CIRCULUTE 3000

Safety Precautions



WARNING: The keyways on all shafts are extremely sharp. Care should be exercised when working with all shafts.



CAUTION: Do not mount an oil-lubricated reducer in other than its intended position. Doing this can cause damage to the reducer. Contact Shimpo Drives Customer Service for information on mounting in a position other than the one indicated on the nameplate.



CAUTION: The reducer should be worked on only by a person who is familiar with mechanical assembly and disassembly techniques, including the proper handling of bearings. The reducer can be damaged by improper disassembly and assembly techniques.



CAUTION: Do not mount an oil-lubricated reducer in other than its intended position. Doing this can cause damage to the reducer. Contact Shimpo Drives Customer Service for information on mounting in a position other than the one indicated on the nameplate.

- The reducer should be bolted down to a rigid, vibration-free base, such as a concrete foundation, sturdy cast iron beam, or steel frame work.
- Gears, pulleys, or sprockets that are mounted to the input or output shafts should slide on easily. Pounding these components into place on the shafts can damage bearings and other reducer components, and should be avoided (Figure 1).
- Mount any gears, pulleys, or sprockets as close to the housing of the reducer as is practical. Overhung loads must be checked prior to operating the unit. Contact Shimpo Drives Customer Service for assistance (Figure 2).
- Secure the gear, pulley or sprocket to the shaft. If a key and set screw are used, the top of the key should have .004" to .008" (0.1 mm to 0.2 mm) of clearance.
- Make sure that the overhung load on the shaft does not exceed the overhung load capacity of the unit.
- All connected devices should be checked carefully for angular and parallel alignment.
- For oil lubricated units, check to ensure that the oil is filled to the bottom of the oil level plug.
- For oil lubricated reducers, if a separate breather was supplied, install it. If the breather was provided with a plug or cover, remove it. Be sure that the breather is not obstructed.

Inspection

Unpack the reducer and check to see that it is identical to what is specified in the purchase order. Check the model number using the chart on page 3 of this manual. Inspect for shipping damage. Notify the shipping agent immediately if any damage is discovered.

Identification

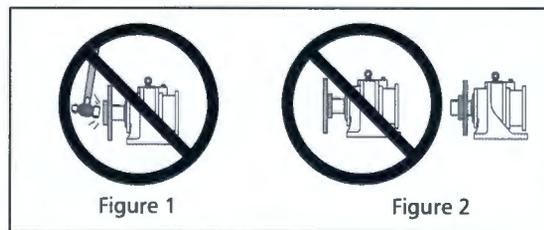
Circulate 3000® Reducers can be provided in single, double or triple reduction configurations.

For single reduction, the first character of the model number indicates the reducer's size.

For double reduction, the first character of the model number indicates the size of the input stage. The second character indicates the size of the output stage.

Installation

- Install the unit in a clean, dry location with plenty of ventilation. A site in which rain or water is splashed around the unit should be avoided unless the reducer has been specifically modified for these conditions.
- Proper ambient temperature is 32°F - 104°F. (0°C - 40°C). If the unit must operate outside of this temperature range, contact Shimpo Drives Customer Service.
- Grease lubricated reducers have no restriction on their mounting position. Oil lubricated reducers must be mounted in the position that is specified in the model number of the reducer. The nameplate of the reducer indicates the type of lubrication used. The lubrication section of this manual also describes the standard type of lubricant that is used in each reducer.



Direction of Shaft Rotation

Circulate 3000® Reducers can be operated in either direction of input rotation. The input and output shafts of single and triple reduction units will rotate in opposite directions. The input and output shafts of double reduction units will rotate in the same direction.

Maintenance



WARNING: The keyways on all shafts are extremely sharp. Care should be exercised when working with all shafts.

In addition to changing the lubricant periodically, the following checks should be performed on a regular basis.

Depending on the application, it may be desirable to make such checks on a weekly or monthly basis.

1. Check the case temperature of the reducer. A temperature of up to 90°F (50°C) above ambient is acceptable.
2. Check to see if the unit is being overloaded. This can often be done by measuring the drive motor's current.
3. Be sure that the reducer is not making an abnormal or irregular noise.
4. Check the reducer for abnormal vibration.
5. Look for lubricant leaks around the reducer.
6. Check all power transmitting components for misalignment and excessive wear.
7. Check for loose bolts. This includes the reducer body bolts and mounting bolts.

Repair Instructions

The following notes, in combination with the exploded view assembly drawings (pages 10-21), are provided to assist in the inspection and repair of the reducer.



CAUTION: The reducer should be worked on only by a person who is familiar with mechanical assembly and disassembly techniques, including the proper handling of bearings. The reducer can be damaged by improper disassembly and assembly techniques.

Disassembly Instructions

1. Disassembly always starts from the output side of the reducer.
2. Jack screw holes are provided between many sections to assist in the disassembly.
3. The output shaft bearings on reducers with case sizes A through C are held in place using two cone point set screws; these must be backed out in order to remove the output shaft assembly.
4. Reducer case sizes D and larger have a snap ring around the outside of the output shaft bearing. This snap ring must be removed in order to separate the output housing from the pin body.

Inspection Guidelines

1. Inspect all oil seals for damage. Also inspect the shaft surfaces on which they contact.

2. Inspect the oil or grease for signs of metal flakes.
3. Check all bearings to ensure that they rotate freely and do not have excessive free play.
4. Inspect the housing and all torque transmitting components for cracks and excessive wear.

Assembly Guidelines

1. Assembly always starts at the input side of the reducer.
2. An aerobic gasket compound or gaskets should be used between all mating housing parts.
3. Removable thread locking compound should be used on all bolts and nuts.
4. When reassembling a reducer (case sizes B and larger), ensure that the two eccentric roller bearings are installed in opposite directions. For reducer case size A, be sure that the cam on the balance weight is pointing in the opposite direction of the large lobe on the eccentric roller bearing. Failure to do this will result in excessive vibration when the reducer is returned to operation.
5. On case sizes B and larger, the two wheels must be installed exactly 180° opposite to each other. Match marks are provided on the wheels for this purpose. Failure to do this will result in a reducer that will not turn.
6. It is generally easier to install the wheel first and then the eccentric bearing. In this way, the rollers do not interfere with the hole in the wheel that forms the bearing's outer race.
7. On case sizes A through C, it is important to ensure that the bushings remain seated in the wheel as the output shaft assembly is installed. It is often useful to use some grease to hold the bushings in position on the wheels.
8. When case sizes A through C are reassembled, the cone point set screws should be alternately tightened to pull the output shaft in place. Each should be loosened a quarter of a turn after the output shaft is completely seated in the output housing.



Lubrication Specifications

Circulate 3000® Reducers are internally lubricated using either grease or oil. The following tables describe the type of lubricant that is normally used with these reducers.

Because different lubricants may be used for extreme environmental conditions, check the nameplate of the reducer to determine the type of lubricant that is being used. Lubrication quantities listed are approximate.

Follow the instructions below when adding lubricant to the reducer.

Grease lubricated reducers should be disassembled, cleaned and filled with new grease every 5 years or 20,000 hours operation, whichever comes first. Under extreme environmental conditions, the grease may need to be replaced more frequently. The grease should be packed into the reducer in a similar manner to the way that an anti-friction bearing is re-greased. Approximately 50% air space should remain.

Oil lubricated units should receive an oil change after the first 500 hours of operation. After this initial oil change, the oil should be changed after every 5,000 hours of operation or annually, whichever comes first. Under extreme environmental conditions, the oil may need to be replaced more frequently. To drain the oil, remove the oil breather plug and the oil drain plug. To refill the reducer, install the drain plug and remove the level plug. Add oil through the oil fill opening until the oil overflows from the level plug opening. Replace the level plug and the breather.

Single Reduction, Standard Backlash

Frame Size	All Mounting Positions	
	Input Speed	
	Less than 2000 rpm	2000 rpm & Over
A03 - A07	NLGI # 0 Grease	ISO VG 100 Oil
B01 - B07		
C01 - C07		
D01 - D07		
E01 - E07		
F03 - F07	N/A	

Double Reduction, Standard Backlash, Input Less than 2000 rpm

Frame Size	Horizontal	Vertical Down Output Shaft	Vertical Up Output Shaft
AB3, AB7	NLGI # 0 Grease	NLGI # 0 Grease	NLGI # 0 Grease
AC3, AC7			NLGI # 0 Grease
AD3, AD7	ISO VG 220 Oil		ISO VG 220 Oil
BD7			
BE3, BE7			
CE7			
CF3, CF7			
DF7	ISO VG 220 Oil		

Double Reduction, Standard Backlash, Input 2000 rpm & Over

Frame Size	Horizontal	Vertical Down Output Shaft	Vertical Up Output Shaft
AB3, AB7	ISO VG 100 Oil	ISO VG 100 Oil	ISO VG 100 Oil
AC3, AC7			
AD3, AD7			
BD7			
BE3, BE7			
CE7			
CF3, CF7			
DF7	ISO VG 220 Oil	ISO VG 220 Oil	ISO VG 220 Oil

Double Reduction, Precision Backlash

Frame Size	Horizontal	Vertical Down Output Shaft	Vertical Up Output Shaft
AB3, AB7	ISO VG 100 Oil	ISO VG 100 Oil	ISO VG 100 Oil
AC3, AC7			
AD3, AD7			
BD7			
BE3, BE7			
CE7			
CF3, CF7	ISO VG 220 Oil	ISO VG 220 Oil	ISO VG 220 Oil
DF7			

Lubrication Specifications

Lubricant Type	Generic Specification	Brand Reference		
		Shell	Mobil	Exxon
Grease	NLGI # 0 Grease	Darina EP No. 0	-	-
Oil	ISO VG 100 Gear Oil (AGMA 3EP)	Omala Oil 100	Mobilgear 627	Spartan EP 100
Oil	ISO VG 220 Gear Oil (AGMA 5EP)	Omala Oil 220	Mobilgear 630	Spartan EP 220
Oil *	ISO VG 320 Gear Oil (AGMA 6EP)	Omala Oil 320	Mobilgear 632	Spartan EP 320

The lubricants listed are for normal industrial service, and other oils may be specified for severe operating conditions. Refer to the nameplate of the reducer for specific lubrication type.

**For high temperature applications, ISO VG 320 (AGMA 6 EP) is available upon request.*

Approximate Lubricant Quantities

Single Reduction

Frame Size	Mounting Position	
	Horizontal	Vertical
A03 - A07	5 oz	
B01 - B07	7 oz	
C01 - C07	14 oz	
D01 - D07	0.25 gal	0.40 gal
E01 - E07	0.50 gal	0.65 gal
F03 - F07	0.85 gal	1.15 gal

Double Reduction

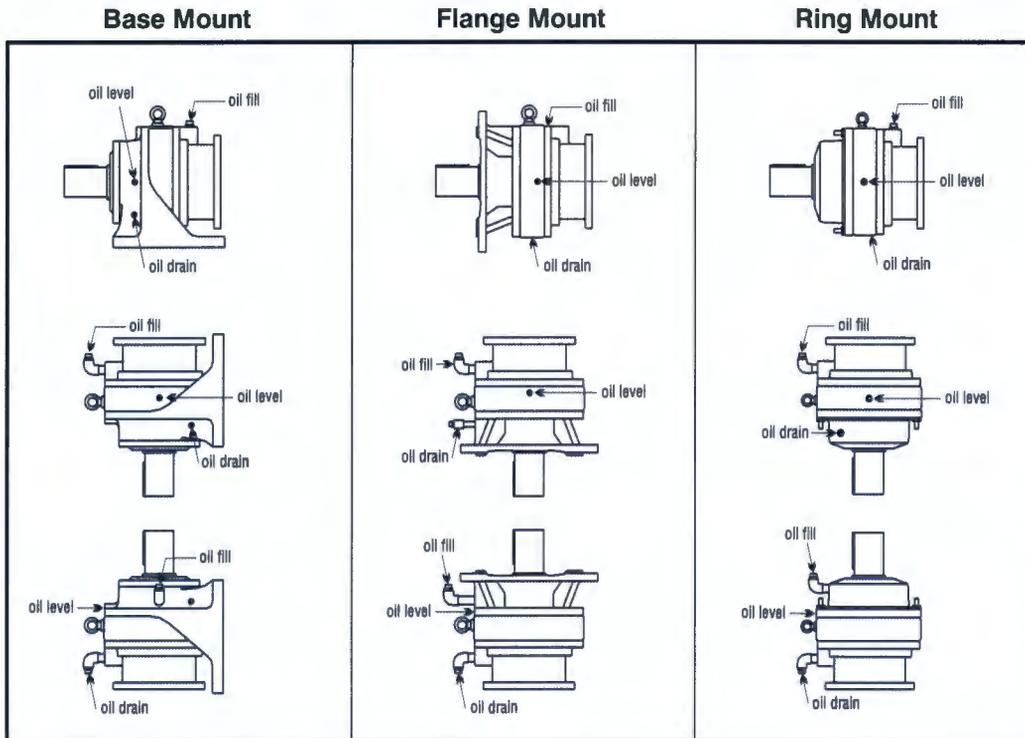
Frame Size	Mounting Position		
	Horizontal	Vertical Output Shaft Down	Vertical Output Shaft Up
AB3, AB7	10 oz		
AC3, AC7	15 oz		
AD3, AD7	0.31 gal	29 oz	0.45 gal
BD7	0.32 gal	31 oz	0.51 gal
BE3, BE7	0.58 gal	42 oz	0.90 gal
CE7	0.63 gal	49 oz	0.98 gal
CF3, CF7	1.00 gal	72 oz	1.53 gal
DF7	1.08 gal	2.06 gal	2.06 gal

Grease quantities are given in oz. Oil quantities are given in gal.

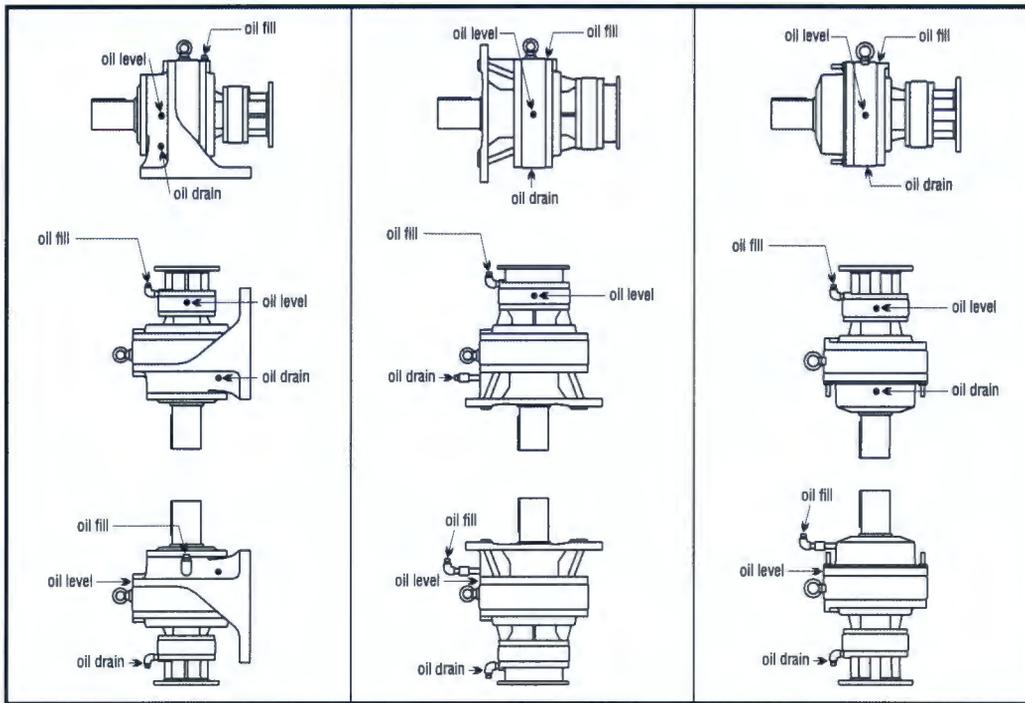


Oil Fill, Level and Drain Locations

Single Reduction



Double Reduction



Exploded View Drawings & Parts Lists

Single Reduction Case Sizes

Frame Size	Case Size
A03 - A07	A
B01 - B07	B
C01 - C07	C
D01 - D07	D
E01 - E07	E
F03 - F07	F

The following pages (10-21) provide exploded view drawings and parts lists for Circulute 3000® Reducers.

These are grouped by case size. Single reduction reducers use one case size. Double reduction reducers are built from two case sizes.

A coupler and a counter shaft, along with other support parts, are used to connect the two case sizes together.

Double Reduction Case Sizes

Frame Size	Input Case Size	Output Case Size
AB3, AB7	A	B
AC3, AC7	A	C
AD3, AD7	A	D
BD7	B	D
BE3, BE7	B	E
CE7	C	E
CF3, CF7	C	F
DF7	D	F

The connection parts are shown with the smaller, input case size reducer. The charts relate the model number of the complete reducer to the case sizes used.

Generic parts, such as oil seals, snap rings, keys and many bearings, are described in enough detail to allow you to purchase them locally.

Examples of the numbering system for snap rings and oil seals are given in the table below. Other parts are self-explanatory.

When ordering parts, please provide the following information:

- Complete model number of the reducer
- Serial number of the reducer, if available
- Item number of the part
- Description of the part

With the above information, we will be able to ensure that you are ordering the correct parts for your reducer. If you find that it is necessary to return a part, contact Shimpo Drives Customer Service for complete shipping instructions and a return materials authorization number.

NOTE: We will not accept returned parts or units without a return materials authorization number.

Generic Part Number Examples

S-50	External snap ring, 50mm in diameter
R-47	Internal snap ring, 47mm in diameter
D456008	Double lip oil seal, for a 45mm shaft and 60 mm outside diameter, 8 mm thick
S254008	Single lip oil seal, for a 25 mm shaft and 40 mm outside diameter, 8 mm thick



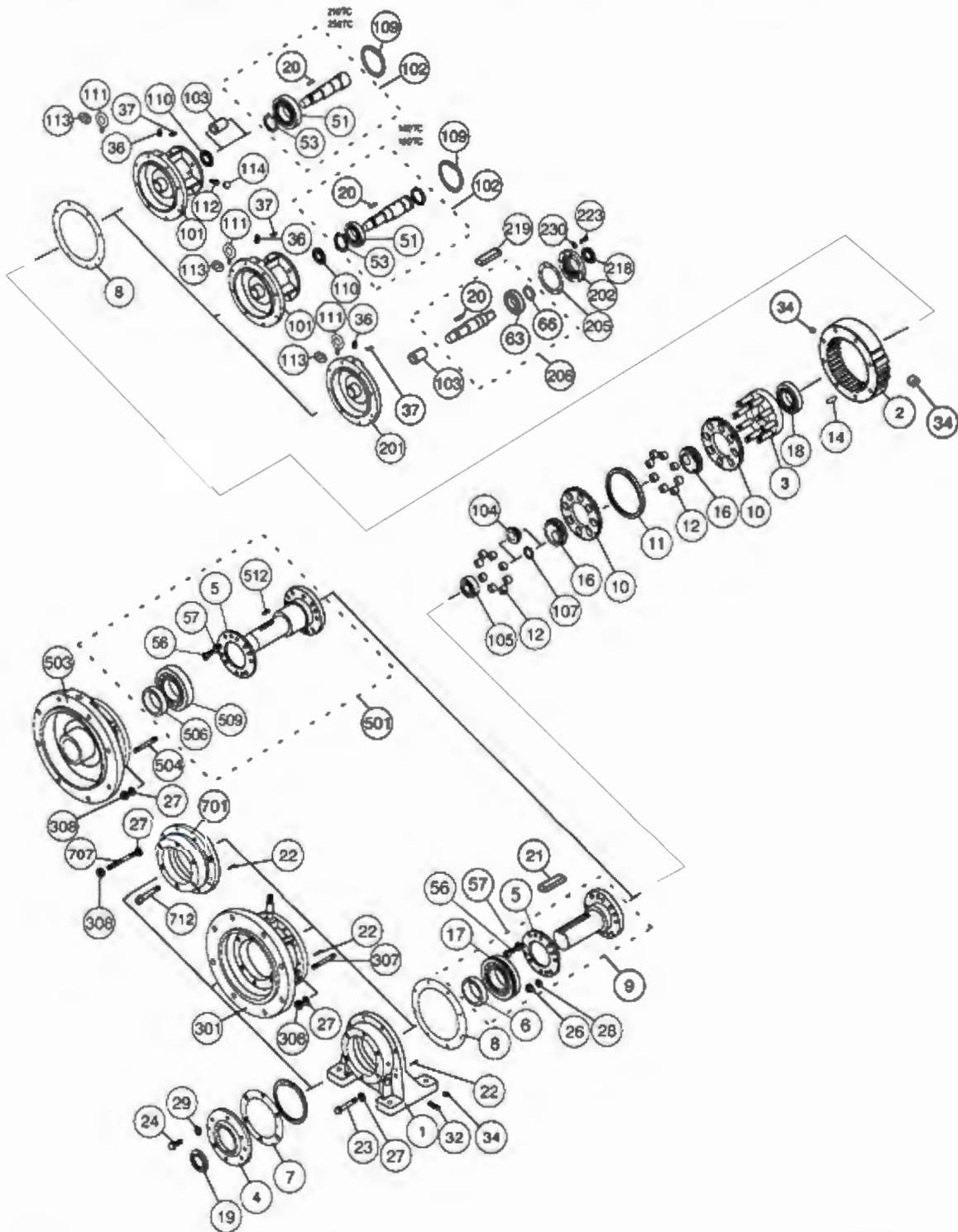
Parts List - Frame Sizes D01 - D07 (Double Reduction Case Size D)

Item	Qty	Part Number	Description	Comments
1	1	BERG1400010	Base ND1	
2	1	BNZY1400920	Pin Housing ND1	11,17,35,71:1
2	1	BNZY3400920	Pin Housing ND2	29,59:1
2	1	BNZY5400920	Pin Housing ND3	47:1
2	1	AERA1421022	Pin Housing D41 Precision Backlash	11,17,35,71:1
2	1	AERA4421021	Pin Housing D42 Precision Backlash	29,59:1
2	1	AERA5421022	Pin Housing D43 Precision Backlash	47:1
3	1	AERB1400030	Holder with Pins ND1	11:1
3	1	AERB2400030	Holder with Pins ND2	17:1
3	1	AERB4400030	Holder with Pins ND3	29,35,47,59,71:1
4	1	BERB1400051	Bearing Cover A ND1	
5	1	BERB1400480	Locating Spacer ND1	11:1
5	1	BERB2400480	Locating Spacer ND2	17:1
5	1	BERB4400480	Locating Spacer ND3	29,35,47,59,71:1
6	1	BERB1400470	Output Bushing ND1	
7	1	BERB1400540	Gasket at Bearing Cover A ND1	
8	2	BERB1400560	Gasket at Pin Housing, ND1	
9	1	KNZY1437040	Output Shaft Assy ND1	11:1
9	1	KNZY2437040	Output Shaft Assy ND2	17:1
9	1	KNZY3422041	Output Shaft Assy ND3	29,35,47,59,71:1
10	2*	BERB1400220	Wheel ND1	11:1
10	2*	BERB2400220	Wheel ND2	17:1
10	2*	BERB4400220	Wheel ND3	29:1
10	2*	BERB3400220	Wheel ND4	35:1
10	2*	BERB5400220	Wheel ND5	47:1
10	2*	BERB6400220	Wheel ND6	59:1
10	2*	BERB7400220	Wheel ND7	71:1
10	2*	BERA1400222	Wheel D1	11:1, Precision Backlash
10	2*	BERA2400222	Wheel D2	17:1, Precision Backlash
10	2*	BERA4400223	Wheel D3	29:1, Precision Backlash
10	2*	BERA3400223	Wheel D4	35:1, Precision Backlash
10	2*	BERA5400223	Wheel D5	47:1, Precision Backlash
10	2*	BERA6400222	Wheel D6	59:1, Precision Backlash
10	2*	BERA7400223	Wheel D7	71:1, Precision Backlash
11	1	BERB1400230	Wheel Spacer ND1	11:1
11	1	BERB2400230	Wheel Spacer ND2	17:1
11	1	BERB3400231	Wheel Spacer ND3	29,35,47,59,71:1
11	1	BERA1400230	Wheel Spacer D1	11:1, Precision Backlash
11	1	BERA2400230	Wheel Spacer D2	17:1, Precision Backlash
11	1	BERA3400231	Wheel Spacer D3	29,35,47,59,71:1, Precision Backlash
12	16*	BERB1400361	Bushing ND1	
12	16*	BERA1400360	Bushing D1	Precision Backlash
14	**	BERA1400381	Internal Pin D1	
14	**	BERA1421380	Internal Pin D41	Precision Backlash
16	2*	BERA1400400	Eccentric Bearing D1	11:1
16	2*	BERA2400400	Eccentric Bearing D2	17:1
16	2*	BERA4400400	Eccentric Bearing D3	29:1
16	2*	BERA3400400	Eccentric Bearing D4	35:1
16	2*	BERA5400400	Eccentric Bearing D5	47:1
16	2*	BERA6400400	Eccentric Bearing D6	59:1
16	2*	BERA7400400	Eccentric Bearing D7	71:1
17	1	RBBGA006213	Ball Bearing 6213NR	
17	1	RBBKA006213	Ball Bearing 6213NRDD	Vertical Up
18	1	RBBCA006010	Ball Bearing 6010ZZ	11:1
18	1	RBBCA006210	Ball Bearing 6210ZZ	except 11:1
19	1	ROSPA750013	Oil Seal D750013	
20	1	RLKAA007040	Key 7x7x40	11:1
20	1	RLKAA010038	Key 10x8x38	except 11:1
21	1	56000321	Key 5/8x5/8x2.95 (75mm)	
22	1	RLPAA010035	Spring Pin 10x35	
23	8	RSRAC010090	Hex. Head Screw M10x90, 11T	
24	6	RSRAA010035	Hex. Head Bolt M10x35	
26	8	RSNBA000012	Nut, Hex. M12 Type 3	
27	8	RWLBA000010	Spring Washer Disk, PS, M10	

Item	Qty	Part Number	Description	Comments
28	8	RWLBA000012	Spring Washer Disk, PS, M12	
29	7	RWSAA000010	Lock Washer M10	
32	2	RSPAA000104	Square Head Plug PT1/4 PG2	
34	4	RSPBB000104	Hex. Headless Plug PT1/4	
36	1	RSQBA000308	Breather Plug PT3/8 BC3	
37	1	ROTA0000004	Plug Red 4mmOD Rubber	
51	1	RBBCA006209	Ball Bearing 6209ZZ	140TC/180TC
51	1	RBBCA006310	Ball Bearing 6310ZZ	210TC
51	1	RBBCA006212	Ball Bearing 6212ZZ	250TC
53	2	RLSSA000045	Snap Ring S-40 External	140TC/180TC
53	1	RLSSA000050	Snap Ring S-50 External	210TC
53	1	RLSSA000060	Snap Ring S-60 External	250TC
56	4	RSSAA008020	Socket Screw M8x20	11:1
56	4	RSSAA010020	Socket Screw M10x20	except 11:1
57	4	RWADB000008	Lock Washer M8	11:1
57	4	RWADB000010	Lock Washer M10	except 11:1
63	1	RBBCA006307	Ball Bearing 6307ZZ	
66	1	RLSAA000035	Snap Ring S-35 External	
101	1	BXKG0415021	Motor Flange D7 56C/140TC	
101	1	BXKG0437021	Motor Flange D4 180TC	
101	1	BXKG0455021	Motor Flange D5 210TC	
101	1	BXKG0491021	Motor Flange D6 250TC	
101	1	C/F	Motor Flange Servo Input	
102	1	KNZY7407050	Motor Shaft D6 w/Brg	56C except 11:1
102	1	KNZY5415050	Motor Shaft D5 w/Brg	140TC except 11:1
102	1	KNZY1437050	Motor Shaft D1 w/Brg	11:1 180TC
102	1	KNZY2437050	Motor Shaft D3 w/Brg	180TC except 11:1
102	1	KNZY1455030	Motor Shaft D2 w/Brg	11:1 210TC
102	1	KNZY2455030	Motor Shaft D4 w/Brg	210TC except 11:1
102	1	KNZY1491030	Motor Shaft D7 w/Brg	11:1 250TC
102	1	KNZY2491030	Motor Shaft D8 w/Brg	250TC except 11:1
102	1	C/F	Motor Shaft Servo Input w/Brg	
103	1	BERB0103040	Counter Shaft Bushing ND1	11:1 Shaft In & 250TC
103	1	BERB0203040	Counter Shaft Bushing ND2	Shaft In & 250TC except 11:1
104	1	BERB0103030	Distance Collar ND1	11:1 Shaft In & 250TC
104	1	BERB0203030	Distance Collar ND2	Shaft In & 250TC except 11:1
105	1	RBRCA002204	Roller Bearing NF2204	11:1
105	1	RBRCA002305	Roller Bearing NF2305	except 11:1
107	1	RLSAA000024	Snap Ring S-24 External	11:1 210TC
107	1	RLSAA000028	Snap Ring S-28 External	140TC-210TC except
109	1	RLSRA000085	Snap Ring R-85 Internal	140TC/180TC
109	1	RLSRA000100	Snap Ring R-100 Internal	210TC/250TC
110	1	ROSAA355008	Oil Seal S355008	
111	1	RSIAA000010	Eye Bolt M10	
112	1	RSSAA006014	Socket Screw M6x14	210TC
112	1	RSSAA008014	Socket Screw M8x14	250TC
114	1	SOBAA000015	Rubber Plug 15mm Dia. LP2	210TC/250TC
201	1	BXEA1400110	Input Bracket D1	
202	1	BERA1400120	Bearing Cover B D1	
205	1	BERA1400550	Gasket at Bearing Cover B D1	
206	1	KNZY1437060	Input Shaft D1 w/Brg	11:1
206	1	KNZY2437060	Input Shaft D2 w/Brg	except 11:1
218	1	ROSPA355008	Oil Seal D355008	
219	1	56000309	Key 1/4x1/4x1.37(35mm)	
223	4	RSRAA006025	Hex. Head Bolt M6x25	
230	4	RWSAA000006	Spring Washer M6	
301	1	BERG1431160	Output Flange ND1	
308	8	RSNAA000010	Nut M10 Type 1	
501	1	KERB0004610	Counter Shaft Assy. NDF1	11x11,17
501	1	KERB0004620	Counter Shaft Assy. NDF2	11x29-71
501	1	KERB0004630	Counter Shaft Assy. NDF3	17x17
503	1	BEXB0947010	Coupler NDF1	DF
504	8	BERA1331181	Stud Bolt M10x100	
506	1	BERB0111040	Counter Shaft Bushing NF1	For Counter Shaft Assy. NDF1 & 3
506	1	BERB4511040	Counter Shaft Bushing NF2	For Counter Shaft Assy. NDF2
509	1	RBBAA006213	Ball Bearing 6213	
512	1	RLKAA012058	Key 12x8x58 KM10	For Counter Shaft Assy. NDF1 & 3
512	1	RLKAA015058	Key 15x10x58 KM12	For Counter Shaft Assy. NDF2
701	1	BERG1400040	Ring Output Housing ND1	
707	6	BERA1300080	Stud Bolt M10X118	
712	2	RSRBA010075	Socket Screw, M10x75	

C/F - Contact SHIMPO Drives Customer Service.
* indicates that these parts must be purchased in sets of this size.
** indicates that the number of items per reducer varies.

Exploded View - Frame Sizes D01 - D07 (Double Reduction Case Size D)





Troubleshooting

CONDITION	PROBLEM	POSSIBLE CAUSE	SOLUTION
Load does not rotate	Drive motor not operating	Overload tripped	Reset the overload. If condition continues, check the motor and reducer sizing.
		Defective drive motor	Remove the motor from the reducer and apply power. Replace if it does not operate properly.
	Input jammed	Improper input drive train alignment or assembly	Check all portions of the input drive assembly for proper alignment and smooth operation.
	Reducer input shaft not driven	Broken or missing key	Inspect the keys on all input drive shafts.
		Defective input drive train	Inspect all input drive components for proper assembly and operation. Check the tension and condition of any input drive belts.
	Output mechanical problems	Broken or missing key	Inspect the keys on all output drive shafts.
		Defective output drive train	Check all portions of the output drive assembly for proper alignment and smooth operation.
		Worn load components	Disconnect the reducer from the driven load. Operate it using the drive motor. Check for smooth, quiet operation. Disassemble and repair the reducer if required.
	Overload	Load too large for the motor/reducer combination	Compare the see of the drive train with the see of the load. If necessary, replace with a larger motor/reducer combination. For an existing application, consider any changes that might have increased the load.
		Worn load components	Inspect all load components for damage or wear. Replace or repair as needed.
Damaged reducer	Damaged reducer components	Disconnect the reducer from the driven load. Operate it using the drive motor. Check for smooth, quiet operation. Disassemble and repair the reducer, if required.	
Load does not reach full speed	Drive motor turning too slowly	Motor overloaded	Check motor current to see if it is overloaded. Repair the cause of the overload or replace with a larger motor/drive combination.
		Motor connected to wrong power source	Compare the voltage and frequency of the power source to the motor's nameplate.
		Adjustable speed drive is too slow	If the motor is driven by an adjustable speed drive, ensure that it is operating properly.
	Incorrect reducer selected	Incorrect motor	Check the motor's nameplate for proper speed rating.
Unusual noise	Damaged components	Reducer ratio too high	Replace the reducer with one having a smaller ratio. It may be necessary to change the sizes of the motor, the reducer, or both.
		Damaged motor	Disconnect the motor and drive it separately. Replace if necessary.
	Vibration	Damaged or misaligned drive train components	Check all drive train components for proper alignment and operation. Replace as necessary.
		Damaged reducer	Disconnect the reducer from the load and operate it. If necessary, disassemble and repair. Look for external causes of the damage.
Excessive temperature	Excessive load	Loose mounting	Check all mounting bolts and all reducer body bolts for tightness.
		Improper reducer lubrication type or quantity	Lubricate the reducer according to factory specifications.
	Improper cooling	Overload	Check the motor current to determine if the drive is overloaded. Reduce the load or crease the motor/reducer size.
		Input/output misalignment or excessive overhung/thrust load	Check all input and output connections for proper alignment.
	Improper ambient temperature	Restricted air flow	Inspect motor and reducer fans for proper air flow. Clean as required. Be sure that the reducer is in an area where air can flow freely around it.
	Improper lubrication	Ambient temperature is not in the range from 32°F to 104 °F	Contact Shimpo Drives.
Mechanical damage	Improper reducer lubrication type or quantity	Lubricate the reducer according to factory specifications.	
Lubricant leaks	Excessive internal pressure	Reducer damaged	Disassemble and repair the reducer as required.
		Plugged oil breather	Be sure that the oil breather is installed and functioning properly.
	Damaged or loose components	Damaged oil seals	Inspect all oil seals. Replace if necessary.
		Loose reducer body joints	Inspect all body joints for leaks. Tighten all body bolts. If necessary, disassemble the reducer and replace the gaskets.
Vibration	Excessive input speed	Cracked reducer body	Inspect the reducer for cracked body parts. Disassemble and replace as needed.
		Reducer input shaft is being driven at more than 1750 rpm	Reduce the input speed. Contact Shimpo Drives if an input speed greater than 1750 rpm is required.
	Improper assembly	The eccentrics are aligned in the same direction	Disassemble the reducer and ensure that the eccentrics are mounted opposite to each other.
		Loose mounting bolts or structure or improper alignment of connected equipment	Ensure that the reducer is firmly mounted to a rigid base. Check the alignment of devices connected to the reducer's input and output.
Improper mounting	Internal damage to the reducer	Disassemble and inspect all reducer parts, particularly bearings.	

The Complete Line of Shimpo Drives Products



Adjustable Speed Drive



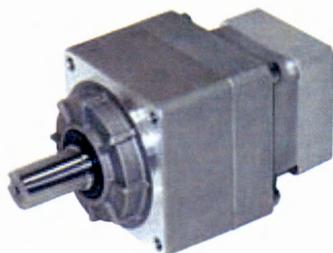
Speed Reducer



Servo Cycloidal Speed Reducer



Overhead Conveyor Speed Reducer



Servo Planetary Gearhead



Top Mount Adaptor Reducer

DISTRIBUTED BY:

CIRC3000.002.1105



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Attachment G-2

Seepex I-110

Additional information vendor information can be found in Hanford Site
Integrated Document Management System (IDMS)

seepex.



Operating and Maintenance Instructions Macerator

Range

MAC 110 I

Non binding Operating and Maintenance Instructions

seepex operating and maintenance instructions are individually compiled for each pump. These operating instructions are non binding and give only an overview. Binding operating instructions can be requested using the email address om@seepex.com. For this purpose, please also indicate the relevant pump comm. number.

This operating and maintenance instruction includes important safety information and instructions for installation, commissioning, operating and maintenance of the **seepex** machinery. It is essential therefore, that the responsible specialist refers to it before starting any work on the machinery as well as prior to commissioning. Furthermore, this instruction must always be available on site.

seepex.



Operating and Maintenance Instructions Macerator

index

item	document	denomination
1.0.0	OM.GEN.01e	General
2.0.0	OM.SAF.01e	Safety
3.0.0	OM.TRA.01e	Transport and Intermediate Storage
4.0.0	OM.DES.02e	Description of the seepex pump and Accessories
5.0.0	OM.INS.02e	Assembly and Installation
6.0.0	OM.COM.02e	Commissioning/De-commissioning
7.0.0		Service and Maintenance
	OM.MAI.11e	110 l with flushing connection
	OM.MAI.11e	110 l without flushing connection
7.1.0		Disassembly / Re-assembly
	OM.CHD.04e	110 l with flushing connection
	OM.CHD.02e	110 l without flushing connection
9.0.0	OM.ACC.01e	Auxiliary seepex documentation
		Sectional drawing and parts list
9.3.0	075-006A1	Sectional drawing with flushing connection
9.4.0	SL.075.006	Part list
9.3.0	075-001A1	Sectional drawing without flushing connection
9.4.0	SL.075.001	Part list
9.5.0		Shaft Sealing
	OM.SEA.09e	Shaft sealing with flushing connection
	075-007A2	Sectional drawing shaft sealing with flushing connection
	SL.075.007	Parts list shaft sealing with flushing connection
	OM.SEA.05e	Shaft sealing without flushing connection
	075-002A2	Sectional drawing shaft sealing without flushing connection
	SL.075.002	Parts list shaft sealing without flushing connection
9.6.0		Wearing Parts and Gaskets
	OM.WPS.10e	110 l with flushing connection
	OM.WPS.10e	110 l without flushing connection
	OM.SPT.02e	Tools
10.0.0	OM.MDS.01e	Manufacturer's documents from sub-supplier
99.0.0	OM.ADR.01e	seepex Subsidiaries

seepex.

**Operating Instructions
seepex Machine
General**



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1. General

1.1 Application

These operating instructions contain basic information on the installation, commissioning and maintenance of **seepex** machines. Compliance with the work steps described in the individual sections is essential.

1.2 Details of the seepex machines

1.2.1 Operating Instructions

The Commission Number (comm. no) assigns the operating instructions to a particular **seepex** machine. The operating instructions are produced in relation to a specific job/commission and are valid only for the machine whose comm. no. is identical with that indicated on the cover sheet and possessing the associated data sheet, Point 9.

1.2.2 Manufacturer

The machines were manufactured by **seepex**.

1.2.3 Range, Size, Version

of the machines are stated in the appended data sheet, Point 9.

1.2.4 Machine Comm. No. and Year of Construction

are stated on the type plate at the machine.

1.2.5 Release Date of the Operating Instructions

is stated on the cover sheet of the operating instructions.

1.2.6 Modifications, Notes of Modification

If modifications to the machines are carried out in agreement with **seepex**, a new set of operating instructions will be provided, or the existing operating instructions will be supplemented by an additional sheet together with a new cover sheet. The date of modification and modification index will be noted on the new cover sheet.

1.2.7 EEC Machine Directive

1.2.7.1 Manufacturer's Declaration

seepex Manufacturer's Declaration as required by the EEC Machine Directive 89/392/EEC, Appendix II B:

The **seepex** machines delivered in accordance with our design are intended to be fitted in one machine or assembled together with other machines to form one machine/plant. The commissioning of the machine is forbidden until such a time as has been established that the entire machine/plant satisfies the requirements of the EEC Directive for Machines as amended 91/368/EEC and 93/44/EEC.

Particular attention must be paid to the safety requirements specified in EN809 (s and Equipment for Fluids) as well as the information in these operating instructions.

1.2.7.2 Declaration of Conformity

seepex machines possessing no safety accessories do not fulfill the requirements of the EEC Machine Directive 89/392/EEC as amended 91/368/EEC and 93/44/EEC.

For this reason, no Declaration of Conformity as required by the EEC Machine Directive 89/392/EEC, Appendix IIA can be issued before appropriate safety devices have been installed/mounted on the machine and/or plant with due regard to the information given in these operating instructions.

The following harmonized standards are particularly applicable:
EN 809, EN292T1, EN292T2
Applicable national standards and specifications must be taken into consideration.

Following assessment of the conformity of the machine/plant with the EEC Machine Directive, customers may on their own initiative place on the full machine/plant the EEC symbol 'CE' as defined in Identification Directive 93/68/EEC.

CAUTION

This documentation must be kept available for at least 10 years.

seepex.

**Operating Instructions
seepex Machine
General**



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1.2.8

Copyright and Industrial Property Rights

These operating instructions are copyrighted. The reproduction, in particular by photocopying, of these instructions is not permitted (§§ 54, 54 UrhG) and constitutes a criminal offence (§ 106 UrhG). Proceedings will be instituted if the copyright is violated.

1.2.9

Specifications Required for Inquiries and Orders

The following information must be included when inquiring about replacement parts or placing orders:

- comm. no.
- / machine type

This information is given on the type plate mounted the machine.

1.2.10

Technical Data Sheet

see Point 9.

1.2.11

Performance Data, Load Index, Power Consumption

are indicated in the associated data sheet, Point 9.

1.2.12

Sound Pressure Level

The sound pressure level and/or noise characteristics of the **seepex** machines are ascertained in accordance with DIN 45635. The measuring guidelines are largely identical with the international standards ISO 3740-1980 and ISO 3744-1981.

1.2.13

Operating Range

Employment of the machine is not permissible for purposes other than those stated in the data sheet, see Point 9. **seepex** cannot accept liability for damage arising through failure to comply with this operating range.

1.3

Supplementary Information

1.3.1

Accessories, Optional Extras

Please refer to the data sheet, Point 9.

1.3.2

Company Address, Service Addresses

see Point 11

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**Operating Instructions
seepex Machine
Safety**



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2. Safety

These operating instructions contain basic requirements to be observed during the installation, operation and maintenance of the machine. Therefore, the instructions must be read by the mechanical fitter and by the technical personnel/operator responsible for the machine prior to assembly and commissioning, and kept available at the operating site of the machine/plant at all times.

Compliance is required not only with the general safety instructions given in this section but also with the detailed instructions, e.g. for private usage, given under the other main headings in these operating instructions.

2.1 Labeling of Advice in the Operating Instructions

In these operating instructions safety advice whose non-observance could lead to danger for life or limb is labeled with the following general hazard symbol:



safety symbol acc. to ISO 3864 - B.3.1

Warnings regarding electric power are labeled with:



safety symbol acc. to ISO 3864 - B.3.6

Safety instructions whose non-observance could jeopardize the machine and its functions are labeled by the word

CAUTION

Always comply with instructions mounted directly on the machine, e.g.

- rotational direction arrow
- fluid connection indicators

and ensure that the information remains legible.

2.2 Personnel Qualifications and Training

Personnel charged with operation, maintenance, inspection and assembly must be in possession of the appropriate qualifications for the tasks. The company operating the machine must define exact areas of responsibility, accountabilities and personnel supervision schemes. Personnel lacking the required skills and knowledge must receive training and instruction. If necessary, the operating company may commission the manufacturer/ supplier to conduct these training courses. Furthermore, the operating company must ensure that the personnel fully understand the contents of the operating instructions.

2.3 Dangers Resulting from Failure to Observe Safety Instructions

Failure to comply with the safety instructions may lead to hazards to life and limb as well as dangers for the environment and the machine. Non-observance of safety instructions can invalidate the right of claim to damages.

The following are just some **examples** of possible dangers resulting from failure to comply with the safety instructions:

- Failure of important machine/plant functions
- Failure of prescribed methods of service and maintenance
- Danger to life and limb due to electrical, mechanical and chemical influences
- Danger to the environment due to the leakage of hazardous substances

2.4 Safety-conscious Working

Always comply with the safety instructions listed in this document, the existing national accident prevention regulations and any company-internal work, operating and safety rules.

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**Operating Instructions
seepex Machine
Safety**



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2.5

Safety Instructions for the Operating Company/Machine Operator

- Any potentially hazardous hot or cold machine parts must be provided with protection against accidental contact at the customer's premises.
- Protective guards for moving parts (e.g. coupling) must never be removed while the machine is in operation.
- Leakages (e.g. in the shaft seal) of hazardous conveying liquids (e.g. explosive, toxic, hot) must be drained in such a way that no danger arises for persons or for the environment. Always observe the relevant statutory requirements.
- The risk of exposure to electrical power must be eliminated (for details, see the VDE regulations, for example, or those of the local power supply company).

2.6

Safety Instructions for Maintenance, Inspection and Assembly Work

The operator must ensure that all maintenance, inspection and assembly tasks are carried out by authorized and qualified personnel who have studied the operating instructions closely and become sufficiently familiar with the machine.

As a basic rule, the machine must be brought to a standstill before work is carried out. Always comply with the de-commissioning procedure described in this document.

Any machiness or assemblies conveying media that are detrimental to health must be decontaminated.

Immediately following completion of work, all safety and protective devices must be replaced in position and, where applicable, re-activated.

Before re-starting the machine, observe the points listed under the heading "Initia Startup".

2.7

Unauthorized Modification and Manufacture of Replacement Parts

Conversions or modifications of the machine are permissible only in consultation with the manufacturers. Original manufacturer replacement parts and manufacturer-approved accessories enhance the operational safety of the machine. The usage of unauthorized parts may lead to the nullification of the manufacturer's liability for any resultant damages.

2.8

Impermissible Modes of Operation

The operational safety of the machines supplied is warranted only for employment in accordance with the intended use as defined in Section 1 - General - of these operating instructions. Never allow the threshold values specified in the data sheet to be exceeded.

seepex.

**Operating Instructions
seepex Machine
Transport and Intermediate Storage**



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3. Transport and Intermediate Storage

3.1 Safety Precautions

Employ appropriate transport means, hoists and tools when transporting and storing the machine, always observing the safety instructions.

3.2 Transport

Depending on its weight, the **seepex** machine must be transported manually or with appropriate transport means. Comply with the transport instructions on the packing.

3.3 Unpacking

The design of the packing is such that the equipment can be removed manually or, if demanded by the weight, by means of appropriate hoists.

Any screw fittings between the machine and the packing must be undone. Comply with the attached information notices and symbols.

3.4 Intermediate Storage/Preservation

Unless otherwise indicated in the data sheet, **seepex** machines are provided with preservation only for the duration of transport. If a long period of intermediate storage is foreseen before the machine is commissioned, it is necessary to provide supplementary preservation. If necessary, the appropriate measures should be drawn up in consultation with **seepex**.

Intermediate storage in extreme climatic conditions is permissible only for machine whose design is appropriate to the circumstances. If necessary, **seepex** must be consulted.

CAUTION

Pumps of the range MAP
If the period from supply and subsequent storage until the commissioning is more than 4 weeks, the hoses should be dismantled, refer to Point 7.

3.5 Protection against Environmental Influences

To afford protection against environmental influences, the intermediate storage location must be dry, enclosed and free from frost.

seepex.

**Operating Instructions
Macerator
Description of the seepex Macerator
and Accessories**



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**4.
Description of the seepex Macerator and
Accessories**

**4.1
General Description, Design and Mode of Operation**

The main components of a **seepex** macerator are a complete (replaceable) headstock assembly with shearplate, rotating cutterhead with fixed knives, macerator casing and drive.

The openings in the shearplate are either circular or oblong. The shape, size and number of openings is dependent on the conveying capacity and the required size of the macerated product.

if necessary the complete headstock assembly can be easily replaced by a new or reconditioned unit, it is not necessary to dismantle the pipe work.

The **seepex** macerator has a cutting action and does not tear the solids or textiles which have to be macerated. A lower driving power can be used in comparison to other systems. By selecting low output speeds a higher torque is developed and the driving power can be further reduced. An optimal cutting effect is achieved by having a low clearance between shearplate and the knives/cutterhead.

**4.2
Mechanical Design**

Please consult the sectional drawing, Point 9, for the mechanical design of the macerator. The data sheet, Point 9, gives information on the design of the macerator housing, cutterhead, shearplate and the rotating parts.

Refer to document OM. SEA. ____, Point 9 for information on the design of the shaft seal.

The data sheet, Point 9, specifies details of the design of the drive. Further details are given in the appended manufacturer's documents, Point 10.

**4.3
Accessories**

Consult the data sheet, Point 9, for information.

**4.4
Dimensions, Weight**

Consult the appended dimensional drawing, Point 9.

**4.5
Design Variants**

Refer to the data sheet, Point 9, for the design of the **seepex** macerator. Other design variants are possible, whereby **seepex** must first check whether a particular macerator is suitable for the intended purpose.

**4.6
Operating Site Specifications**

Operating site specifications are listed in the data sheet, Point 9. Details of the space required for installation, operation and maintenance are given in Point 5.2.1.

seepex.

**Operating Instructions
Macerator
Assembly and Installation**



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5. Assembly and Installation

5.1 Mounting Tools / Hoists

No special tools are required for the assembly and installation of the pump.

The customer must check the dimensions and weight of the **seepex** progressive cavity pump to ascertain whether the available hoisting apparatus is sufficient for the assembly and fitting of the pump.

5.2 Initial Assembly

5.2.1 Inspection Prior to Commencement of Assembly

5.2.1.1 Location

The place of installation for the macerator must conform with the site stated in the data sheet in Point 9. Any change of location must be checked and approved by **seepex**.

5.2.1.2 Space Requirements

Customers are responsible for determining the space requirements; the following factors must be taken into consideration:

- dimensions and weight of the machine
- required transport and hoisting equipment
- possible piping layout with allowance for the space allowing disassembly of the rotor as defined in 5.2.1.3
- freedom of movement to:
 - operate the drive / speed regulation
 - read speed and pressure indicators
 - adjust a stator retensioning device, if fitted
 - operate a buffer fluid supply unit, if fitted
- space required for lubrication / renewal of lubricants
- disassembly of mechanical protective devices, e.g. V-belt or coupling protection
- space required for handling the mounting tools, e.g. sufficient wall clearance

5.2.1.3 Heavy Solid Collecting Separator

Heavy solids which cannot be macerated (metal, stones etc) have to be separated before they are drawn into the cutterhead to prevent damage to the cutting elements and other associated equipment.

If these solids cannot be removed by alternative means before reaching the macerator a **seepex** heavy solid collecting separator can be installed.

Solids which have been separated can be removed by way of cleanout ports.

5.2.2 Installation of the Fully Assembled Macerator

- Installation in conformity with data sheet
Installation of the macerator is permissible only in accordance with the data sheet specifications and the associated basic drawing, see Point 9. Any change in the position must be checked and approved by **seepex**.
- Tension-free mounting of macerator
This rule applies to macerators with and without drives, to versions with and without baseplate, for mounting on the foundation or other bearing elements. The entire area of all bearing surfaces of the machine must rest on the ground. Any unevenness must be corrected by appropriate supports.
- Correct seating of drives
All drives have been aligned ready for operation and mounted by **seepex**. However, displacements may occur during transport or installation. For this reason, check that the alignment and fastening of the drive and coupling are correct.
- Protective devices
On completion of the assembly and installation work, immediately mount all safety and protective devices in their proper locations and set them in operation.



5.2.3 Protective and Controlling Equipment

Information on equipment of this nature, where fitted, is provided in the data sheet, Point 9. Consult the attached manufacturer's specifications, Point 10, for instructions on assembly and installation.

seepex.

**Operating Instructions
Macerator
Assembly and Installation**



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**5.2.4
Electric Connection of Electric Motor
and Frequency Converter**

The electric connections must be established in accordance with the manufacturer's specifications, Point 10, as well as the safety specifications applying at the installation site. The mains voltage and frequency must match the ratings indicated on the type and rating plates.



**5.2.5
Piping**

**5.2.5.1
Inlet and Outlet Connection**

CAUTION

The position, nominal width and standard of the inlet and outlet connection of the macerator are specified in the dimension drawing, Point 9, and in the data sheet Point 9.

Always observe the flow direction of the liquid.

**5.2.5.2
Piping Dimensioning**

CAUTION

The pipe diameters on the inlet and outlet sides must be dimensioned in accordance with the customer's pressure-loss calculation in such a way that the pressures specified in the data sheet, Point 9, are not exceeded. The nominal width of the pipework should at least match that of the macerator inlet and outlet connection.

**5.2.5.3
Residue-free Piping**

CAUTION

Prior to starting up the macerator, ensure that all pipeworks are free from foreign bodies. Installation residues (such as weld spatter, screws, steel chips etc.) will lead to damage of the **seepex** macerator for which guarantee claims will not be accepted.

**5.2.5.4
Tension-free Mounting**

CAUTION

Pipeworks and other components requiring to be connected with the macerator must be mounted without stresses.

**5.2.5.5
Fluid Connections**

- flushing connections for shaft sealing

CAUTION

If the macerator is designed with flushing connection according to data sheet, Point 9, the flushing connection must be fitted.

For flushing the shaft seal with flushing liquid/buffer fluid a lantern ring supply unit without/with flow meter has to be installed.

- fluid connections for optional extras

Consult the data sheets, Point 9, for information regarding the available optional extras, if any. The technical description is given under Point 9.

seepex.

**Operating Instructions
Macerator
Commissioning/De-commissioning**



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**6.
Commissioning/De-commissioning**

**6.1
Engineering Data**

Details regarding all technical specifications and operating conditions are given in these operating instructions together with the data sheet, Point 9.

To guarantee the correct assignment of documentation to macerator, the commission number on the

- cover sheet
- and data sheet of these operating instructions must match the commission number stated on
- the nameplate of the macerator.

**6.1.1
See Point 7.2.2 for Lubricant Chart**

**6.2
Preparation for Operation**

**6.2.1
Bearing**

**6.2.1.1
See Point 7.2.1.4 for macerator bearing.**

**6.2.1.2
See manufacturer's documents, Point 10, for drive bearings.**

**6.2.2
Shaft Sealing**

See document OM.SEA.____, Point 9.

**6.2.3
Filling Up of Cutter Casing to Avoid Dry Running at Startup**

CAUTION

Before starting the macerator, fill the inlet-sided macerator casing with fluid to ensure the lubrication of the cutting elements.

**6.2.4
Electric/Hydraulic Connections**

The connections are listed in the appended manufacturer's documents, Point 10.



The risk of exposure to electrical hazards must be ruled out. Always observe the safety regulations valid at the site of installation.



**6.2.5
Control of rotating direction**

The rotating direction of macerator drive shaft is clockwise seen from the drive.



Pay attention to the direction sign on the macerator casing.

CAUTION

Due to a wrong direction of rotation a serious damage of the cutting unit will arise.

**6.2.6
Only deaerate ring casing of macerator size 15 incl. impeller**

Deaerate the ring casing so that the impeller achieves the requested efficiency.

**6.3
Control and Monitoring Equipment**

Where applicable, please refer to the associated documents, Point 10, for information on commissioning.

**6.3.1
Performance Check**

Any optional extras must be subjected to a performance check in conformity with the specifications by **seepex** or other manufacturers, see manufacturer's documents, Point 10.

**6.3.2
Setting**

Unless already performed in the factory, setting must be carried out in accordance with the appended manufacturer's specifications, Point 10. Pay attention to the operating specifications in the data sheet (Point 9).

seepex.

**Operating Instructions
Macerator
Commissioning/De-commissioning**



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**6.4
Equipment for Protection of Persons**

Machines must be fitted with mechanical protective devices complying with DIN EN 809.

- Moving or working parts must be protected against accidental contact.
- However, safety considerations demand it be possible at all times to check without hindrance whether the shaft seal is fully functional. A protective guard is necessary in this area only if components are mounted on the rotating, smooth shaft.



- Country-specific protective regulations must be observed at the site of installation. Prior to activation of the macerator, check the proper function of all protective equipment.

**6.5
Commissioning**

**6.5.1
Initial Startup/Re-starting**

CAUTION

Every **seepex** macerator is designed for the specific operating conditions documented in the data sheet. Commissioning is permissible only if the operating conditions conform with those indicated in the data sheet. Although the potential usages of the **seepex** macerator are not confined to the specified operating conditions, any change in the original conditions must be checked and approved by **seepex**.

The right to make claims under the warranty agreement will be annulled if operating conditions are changed without prior approval by **seepex**.

- **seepex** heavy solid collecting separator for non destructable ingredients

CAUTION

Heavy solids which cannot be macerated (metal, stones, etc.) have to be separated before they are drawn into the cutterhead to prevent damage to the cutting elements.

If these solids cannot be removed by alternative means before reaching the macerator a **seepex** heavy solid collecting separator can be installed.

Solids which have been separated can be removed by way of cleanout ports.

- Commissioning of the macerator

CAUTION

The macerator has to be started before feeding of the conveying liquid to remove possibly existing residues from the knives.

- Commissioning of the combination **seepex** macerator - **seepex** pump

CAUTION

Never start the pump without prior starting of macerator. Doing this, heavy solids could get stuck in the holes of the shearplate, causing obstructions and thus blocking the macerator.

**6.5.2
Avoid Dry Running of Macerator**

CAUTION

- shaft sealing
Normally, the shaft sealing is charged with flushing liquid. Doing this, the flushing liquid will be directly transported to the shaft sealing through the flushing connection thus avoiding dry running.

The supply of flushing liquid and the flushing connection can be dropped by using special designs of headstock assembly. Refer to the data sheet, Point 9, and document OM.SEA_, Point 9, regarding this design.

- knives / shear plate
Dry running can lead to destruction of both cutting elements. Please ensure that the cutter casing is filled with water during commissioning.

**6.5.3
Pressure in the Macerator**

The admissible pressure in the macerator can be taken from data sheet, Point 9.

**6.5.4
Drive Engine**

Consult the attached manufacturer's operating instructions, Point 10, for information on commissioning the drive.



seepex.

**Operating Instructions
Macerator
Commissioning/De-commissioning**



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6.6 De-commissioning

6.6.1 De-activation

The electric connections must be switched off and protected against accidental re-activation. Observe the safety regulations applying to the plants.



6.6.2 Stationary Macerator

The macerator and all optional equipment must be provided with the following protection modes while at a standstill:

- Frost protection
- Protection against solid particle deposits
- Protection against sedimentation of the medium
- Corrosion protection for parts in contact with the medium

We recommend that the pipeline and macerator be emptied for the duration of the plant standstill. Following evacuation, the macerator should be preserved.

6.6.3 Evacuation of the Macerator

The pipeline must be evacuated or shut-off directly behind the macerator connections. Drain any residual liquid in the macerator. Conveying medium residues always remain in the macerator and may run out during transport or disassembly. If conveying aggressive or hazardous media, therefore, wear appropriate protective gear during all installation work.



6.6.4 Disassembly of the Macerator

see document OM.MAI.____, Point 7.3

6.6.5 Preservation/Storage

The macerator must be preserved prior to storage. Appropriate preservation measures must be agreed with **seepex**. Always state the macerator commission number when making inquiries.

seepex.

**Operating Instructions
Macerator
Service and Maintenance**



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These operating instructions are valid for
range I
size 110

**7.
Service and Maintenance**

Contents

7.1 General Instructions

7.2 Service and Inspection

7.3 Disassembly and Re-assembly

The sectional drawing and parts list can be taken
from Point 9.

**7.1
General Instructions**

A requirement for the reliable operation of any
macerator is service and maintenance in compliance
with instructions. Maintenance personnel must
therefore have access to these operating instructions
and adhere to them meticulously. **seepex** will accept
no liability for damage arising through non-
observance of these operating instructions.

CAUTION

Heavy, non-maceratorable solids contained in the
conveying product (metals, stones) lead to damages
of the cutting tools. Therefore, they have to be
separated before entering the macerator. See
document OM.INS.02, point 5.2.1.3

**7.2
Maintenance and Inspection**

**7.2.1
Lubrication**

**7.2.1.1
Knives and Shearplate**

The knives and the shearplate are lubricated by the
conveying medium.

**7.2.1.2
Shaft sealing**

Consult document OM.SEA.____ Point 9 for information
on lubricating and flushing the shaft sealing.

**7.2.1.3
Bearing of Macerator / Headstock Assembly**

The bearing of the headstock assembly is filled
with grease and can be regreased by the lubrication
nipple (128), if necessary.

lubricant: grease
filling quantity: ca. 200 cm³
quality: Esso Beacon EP2 / DIN KP2N-25
Shell Alvonía EP2 / DIN KP2K-20
Aral Lub HLP2 / DIN KP2K-30

Equal greases can be used.

**7.2.1.4
Drive Engine**

For lubrication acc. to instruction of the manufacturer,
see attached documents, Point 10.

**7.2.2
Lubricant / Filling Quantity / Quality**

see item 7.2.1.3

**7.2.3
Drives and Optional Extras**

For maintenance and inspection
specifications, see the appended
manufacturer's documents, Point 10.



**7.2.4
Supervising during Operation**

**7.2.4.1
Shaft Sealing**

see document OM.SEA.____, Point 9.

**7.2.4.2
Optional Extras**

These must be monitored in accordance with the
separate documents, Point 9 / Point 10.

**7.2.4.3
Drives**

These must be monitored in accordance with the
separate manufacturer's documents, Point 10.

**7.2.5
Preventive Measures**

To avoid the expenses incurred by lengthy stop
periods of the macerator, **seepex** recommends the
acquisition of a new or entirely overhauled and
completely mounted replacement cutting unit having
been operational tested.

seepex.

Operating Instructions
Macerator
Service and Maintenance



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7.3 seepex Macerator - Disassembly / Assembly

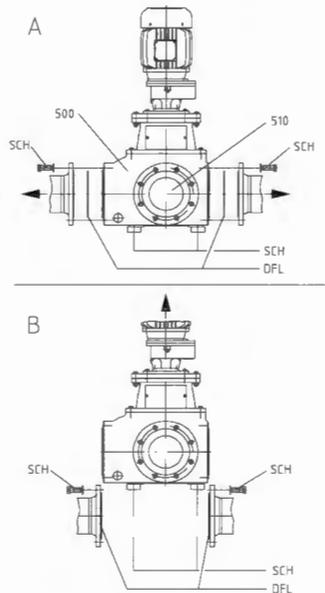
7.3.1 Evacuation of the Macerator

The pipeline must be evacuated on inlet and outlet side or must directly be turned off behind the macerator connections. Remove the cleanout (510) and drain off the liquid from the cutter casing. Conveying medium residues always remain in the macerator and may run out during transport or disassembly. If conveying aggressive or hazardous media, therefore, wear appropriate protective gear during all installation work.



7.3.2 Macerator - Disassembly / Assembly

as illustrated in "A" or alternative "B". Assembly of the pipework by disassembly / assembly of the flange screws (SCH), flange seal (DFL) and screws (SCH) from/on the macerator support.

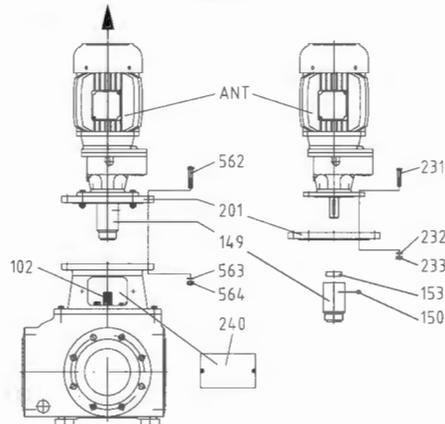


7.3.3 Drive (ANT)/Headstock Assembly (SDE) - Disassembly / Re-assembly

On this occasion, a disassembly of the complete macerator acc. to Point 7.3.2 is not necessary.

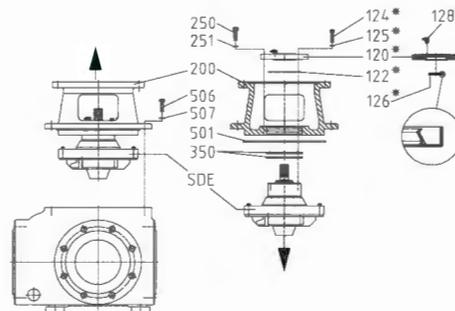
7.3.3.1 Drive (ANT)

- Disassembly/re-assembly of the cover plate (240).
- Pull off the drive (ANT) vertically from the macerator drive shaft (102).
Before re-assembly moisten the multi key profile on the drive shaft (102) with antiseize graphite petroleum.
- Pay attention to the correct position of the drive (ANT)/motor clamping box.



7.3.3.2 Headstock Assembly (SDE)

- Disassembly/assembly of the drive casing (200) together with the headstock assembly (SDE).
 - Disassembly of the headstock assembly (SDE) after removing from SDE-cover plate / APL (120). Cover plate / APL (120), observe before re-assembly:
Check lip seal (126) for damage and if necessary replace it and fill it with grease ¹⁾.
Check flat packing (122) for damage and replace it if necessary.
Installing position of lubrication nipples (128) in direction of holes at lantern side (200).
 - headstock assembly (SDE) disassembly / re-assembly see document OM.CHD.____e
- * SDE-components see parts list SL.075.002



¹⁾ quality of grease see Point 7.2.1.3

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Operating Instructions Macerator-Headstock Assembly 110 with flushing connection Disassembly / Re-assembly

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Table of contents:

1. Disassembly
2. Reassembly
3. Lubrication

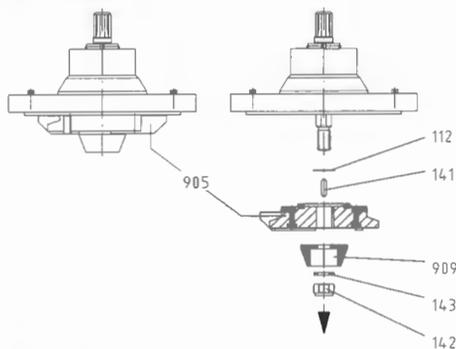
The sectional drawing "Headstock Assembly" and parts list can be taken from Point 9.

Mounting tools

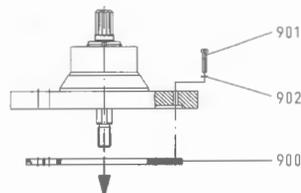
Some mounting tools are required for the disassembly and reassembly. Refer to the document OM.SPT.__e regarding these tools.

1. Headstock Assembly - Disassembly

1.1 Headstock (905)



1.2 Shear Plate (900)

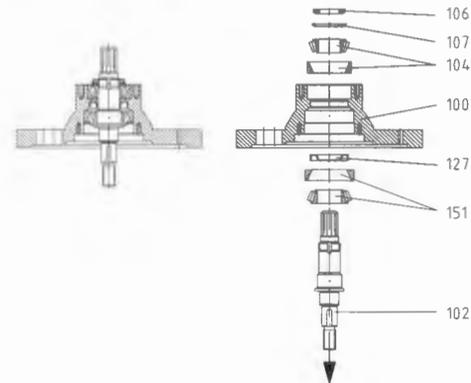


1.3 Shaft Sealing (SEA)

Disassembly of the shaft sealing see document OM.SEA.__e, Point 9.

1.4 Drive Shaft (102)

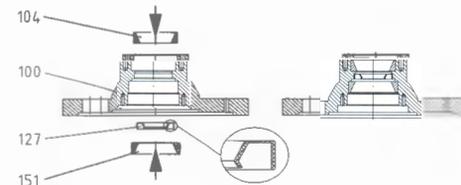
After disassembly of the lock nut (106) and locking plate (107) the drive shaft (102) will be pressed out of the bearing housing (100).



2. Headstock Assembly - Re-assembly

2.1 Bearing Housing (100)

Check lip seal (127) for damage / replace it if necessary, press it in and fill it with grease ¹⁾. Press in the external bearing rings (151 and 104).



2.2 Drive Shaft (102)

Press the internal bearing ring onto the drive shaft (102) and fill it with grease ¹⁾. Cover the thread (G) on the drive shaft (102) with a bonding sheet to protect it against damage during the further assembly. Before re-assembly fill the internal bearing ring (104) with grease ¹⁾.

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**Operating Instructions
Macerator-Headstock Assembly 110
with flushing connection
Disassembly / Re-assembly**

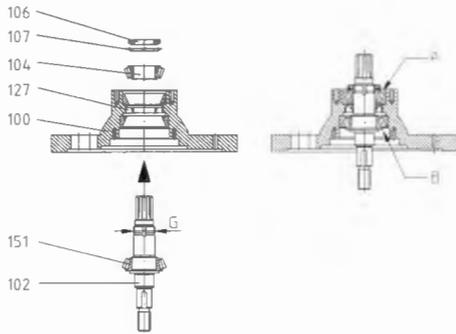
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Adjust the bearing with lock nut (106) without clearance / pre-clamping and lock it with a new locking plate (107). Fill the external bearing area A and B with grease ¹⁾.



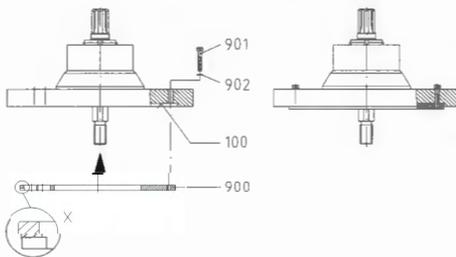
**2.3
Shaft Sealing (SEA)**

Assembly of the shaft seal (SEA) as described in document OM.SEA.____e, Point 7.

**2.4
Shear Plate (900)**

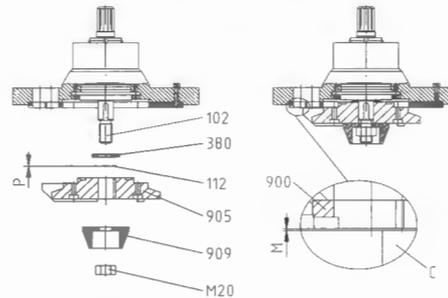
Burr and clean the seat-engaging surface in the bearing housing (100).

Installation position of the shear plate (900) with grooves as illustrated (detail X).



**2.5
Headstock (905)**

**2.5.1
Adjustment of the distance between knives**



A - Slip ring (380), fitting discs (112) with a total thickness of 3 mm (dimension "P"), headstock (905), conical unit (909) must be slipped on the drive shaft (102).

Screw down with hexagon nut (M20 / not self-locking and no component of the headstock assembly). Do not use the self-locking hexagon nut (142), because this hexagon nut can only be used once for the re-assembly acc. to Point 2.5.3.

B - Measure the distance between the knife "C" in the headstock (905) and the shear plate (900) using a thickness gauge.

C - Dismantle the headstock (905) again.

D - Reduce the fitting disc (112) in such a way that the distance between the knife "C" in the headstock (905) and the shear plate (900) is 0,05 mm up to max. 0,2 mm (dimension "M").

E - Repeat the assembly "A" with reduced fitting discs (112) as ascertained in "D" and check the distance between knife and shear plate as follows:

E1-

CAUTION

The knives in the headstock (905) must not touch the shear plate (900), because of danger to destroy knives and shear plate.

F - Dismantle headstock (905) again. Continue assembly acc. to Point 2.5.2.

**2.5.2
Headstock (906), split ring (903) - Re-assembly**

Continue assembly as illustrated and observe particularly:
Fill the shaft sealing (SEA) at area "L" with grease ¹⁾.

¹⁾ quality of grease see document OM.MAI____, Point 7.2.1.3.

Split ring (903):

The outer diameter of the mounted split ring (903) must not contact the inner diameter of the shear

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**Operating Instructions
Macerator-Headstock Assembly 110
with flushing connection
Disassembly / Re-assembly**

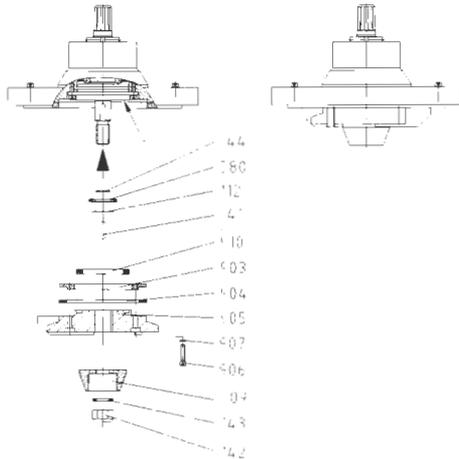
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plate (900) because there is the danger of the split ring (903) to be destroyed. Perhaps loosen and newly adjust shear plate (900). Additionally, safeguard screws (906) by means of a screw locking device / an adhesive of medium strength.

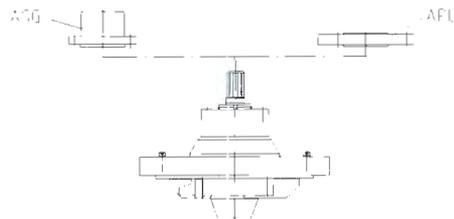
In addition, safeguard the self-locking hexagon nut (142) by a screw locking device / an adhesive of medium strength.

Rechecking acc. to Point 2.5.1, item E1.



**2.5.3
Closing Casing (ASG) / Cover Plate (APL)**

Re-assembly see document OM.MAI.__e.



**3.
Lubrication of Headstock Assembly**

The lubrication of the bearing depends on design, range and size. See document OM.MAI.__e, Point 7.2.1.3.

seepex.

**Operating Instructions
Macerator-Headstock Assembly
Disassembly / Re-assembly**



Dokument
document **OM.CHD.02e**
Blatt
sheet 1 (3)
Datum
date 04.09.95

Table of contents:

1. Disassembly
2. Reassembly
3. Lubrication

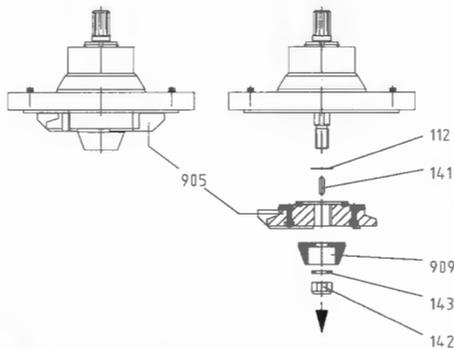
The sectional drawing "Headstock Assembly" and parts list can be taken from Point 9.

Mounting tools

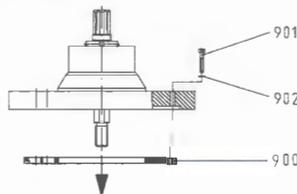
Some mounting tools are required for the disassembly and reassembly. Refer to the document OM.SPT. __ regarding these tools.

1. Headstock Assembly - Disassembly

1.1 Headstock (905)



1.2 Shear Plate (900)

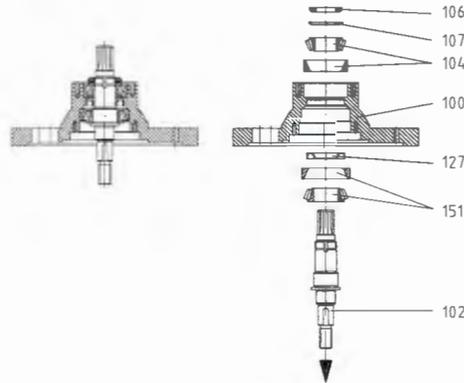


1.3 Shaft Sealing (SEA)

Disassembly of the shaft sealing see document OM.SEA. __e, Point 9.

1.4 Drive Shaft (102)

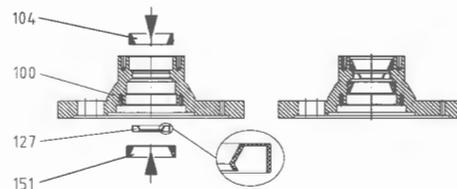
After disassembly of the lock nut (106) and locking plate (107) the drive shaft (102) will be pressed out of the bearing housing (100).



2. Headstock Assembly - Re-assembly

2.1 Bearing Housing (100)

Check lip seal (127) for damage / replace it if necessary, press it in and fill it with grease ¹⁾. Press in the external bearing rings (151 and 104).



2.2 Drive Shaft (102)

Press the internal bearing ring onto the drive shaft (102) and fill it with grease ¹⁾. Cover the thread (G) on the drive shaft (102) with a bonding sheet to protect it against damage during the further assembly. Before re-assembly fill the internal bearing ring (104) with grease ¹⁾.

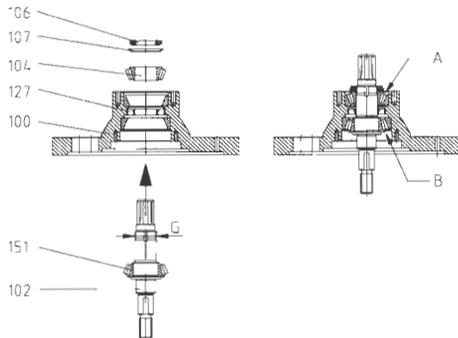
seepex

**Operating Instructions
Macerator-Headstock Assembly
Disassembly / Re-assembly**



Dokument
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Adjust the bearing with lock nut (106) without clearance / pre-clamping and lock it with a new locking plate (107). Fill the external bearing area A and B with grease ¹⁾.



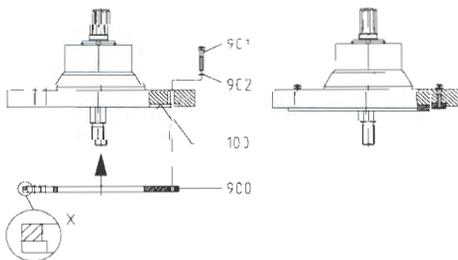
**2.3
Shaft Sealing (SEA)**

Assembly of the shaft seal (SEA) as described in document OM.SEA.___d, Point 7.

**2.4
Shear Plate (900)**

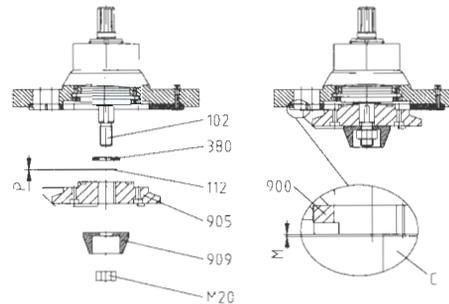
Burr and clean the seat-engaging surface in the bearing housing (100).

Installation position of the shear plate (900) with grooves as illustrated (detail X).



**2.5
Headstock (905)**

**2.5.1
Adjustment of the distance between knives**



- A - Slip ring (380), fitting discs (112) with a total thickness of 3 mm (dimension "P"), headstock (905), conical unit (909) must be slipped on the drive shaft (102).
Screw down with hexagon nut (M20 / not self-locking and no component of the headstock assembly). Do not use the self-locking hexagon nut (142), because this hexagon nut can only be used once for the re-assembly acc. to Point 2.5.3.
- B - Measure the distance between the knife "C" in the headstock (905) and the shear plate (900) using a thickness gauge.
- C - Dismantle the headstock (905) again.
- D - Reduce the fitting disc (112) in such a way that the distance between the knife "C" in the headstock (905) and the shear plate (900) is 0,05 mm up to max. 0,2 mm (dimension "M").
- E - Repeat the assembly "A" with reduced fitting discs (112) as ascertained in "D" and check the distance between knife and shear plate as follows:
- E1- **CAUTION**
The knives in the headstock (905) must not touch the shear plate (900), because of danger to destroy knives and shear plate.
- F - Dismantle headstock (905) again. Continue assembly acc. to Point 2.5.2.

**2.5.2
Headstock (906) - Re-assembly**

Continue assembly as illustrated and observe particularly:

Fill the shaft sealing (SEA) at area "L" with grease ¹⁾.
Impregnate the felt rings (910 and 904) completely with oil ²⁾ in the oil quenching bath.

¹⁾ quality of grease see document OM.MAI __, Point 7.2.1.3.
²⁾ quality of oil - standard mineral oil AN DIN 51501

seepex.

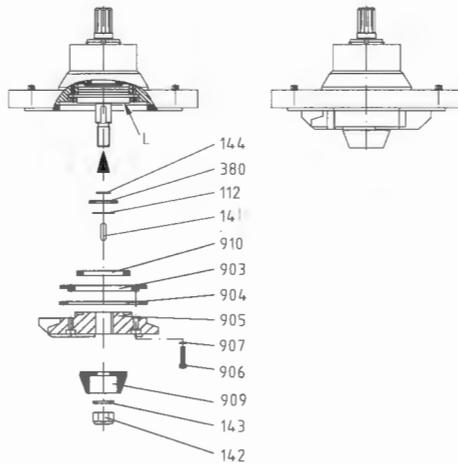
**Operating Instructions
Macerator-Headstock Assembly
Disassembly / Re-assembly**



Dokument
document
Blatt
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date

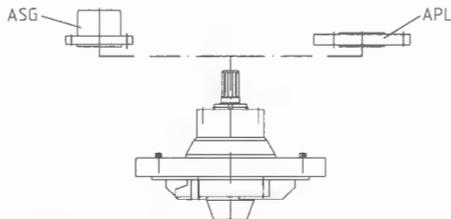
OM.CHD.02e
3 (3)
04.09.95

In addition, the screws (906) have to be medium strength fastened with screw retention / adhesive.
Lock additionally the hexagon nut being self-locking (142) with Loctite 242. Recheck acc.to Point 2.5.1 - item E1.



**2.5.3
Closing Casing (ASG) / Cover Plate (APL)**

Re-assembly see document OM.MAI.____.



**3.
Lubrication of Headstock Assembly**

The lubrication of the bearing depends on design, range and size. See document OM.MAI.____e, Point 7.2.1.3.

seepex.

**Operating Instructions
seepex Machine
Auxiliary documentation**



Dokument
document **OM.ACC.01e**
Ausgabe
issue A / 13.01.95
Blatt
sheet 1 (1)

9. Auxiliary seepex documentation

seepex.

**Operating Instructions
Single-Acting Mechanical Seal
Headstock Assembly size 110
with flushing connection**



Dokument
document **OM.SEA.09e**
Blatt
sheet 1 (2)
Datum
date 26.07.99

**1.
General**

- Please take the appertaining drawing "Headstock Assembly" and parts list from respective macerator data sheet.
- The mechanical seal is suitable for the operating conditions indicated in the macerator data sheet. Modifications are only admissible after the customer has consulted with **seepex**. Additionally, attention must be paid to the manufacturer's operating manual.

**2.
Safety**

Any mode of operation impairing the operating safety of the mechanical seal has to be avoided.

The operator is advised to consider the possible effects on the environment which could be caused by a defective mechanical seal and what additional measures must be taken to protect the environment and the public.

The macerator must be mounted and operated in such a way that operation with a defective mechanical seal will not result in injury or harm to the public and that any leakage can be safely and properly dealt with.

Mechanical seals are often used to seal hazardous material (chemicals, drugs, etc.). It is essential that rules pertaining to the handling of hazardous materials are adhered to.

Modifications effected by the customer himself and changes influencing the safety of the mechanical seal are not allowed.

**3.
dropped**

**4.
dropped**

**5.
Commissioning**

Regardless of the macerator's operating status, the conveying medium to be sealed must always be in liquid form at the mechanical seal. This particularly applies to the macerator's commissioning and its placing out of service.

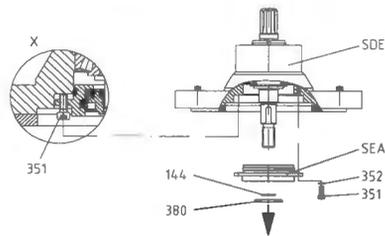
**6.
Maintenance**

When operating the macerator according to the instructions, no maintenance is required.

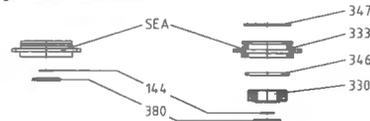
**7.
Disassembly / Re-assembly**

**7.1
Shaft Sealing (SEA) - Disassembly**

Use the screws (351) as forcing screws, detail "X". Additionally, two threaded drillings were effected at the casing (333). Squeeze the shaft sealing (SEA) out of the casing of the headstock assembly (SDE) by using forcing screws.



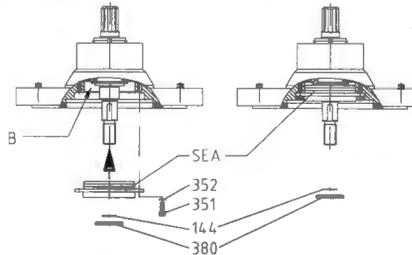
**7.2
Mechanical Seal (330) - Disassembly / Re-assembly, as illustrated.**



**7.3
Shaft Sealing (SEA) - Re-assembly**

Before mounting of the shaft sealing (SEA), fill the area "B" up to the upper edge of the bearing with grease ¹⁾.

Re-assembly of o-ring (144) and slip ring (380) see document OM.CHD.___e, Point 2.5.3.



¹⁾ quality of grease see document OM.MAI.___e, Point 7.2.1.3

seepex.

**Operating Instructions
Single-Acting Mechanical Seal
Headstock Assembly size 110
with flushing connection**



Dokument
document
Blatt
sheet
Datum
date

OM.SEA.09e

2 (2)

26.07.99

8. Flushing connection for shaft sealing

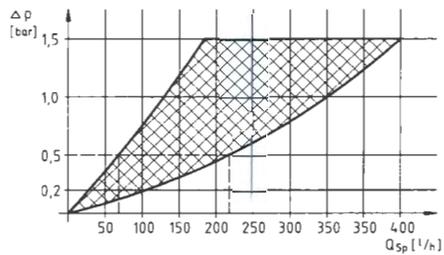
CAUTION

Annex the flushing connection before commissioning.

Flushing medium: water

Flushing pressure (Δp): 0,5 bar higher than the
pressure which has to
be sealed.

Flushing quantity (Q_{Sp}):



Supply mountings:

To supply the shaft sealing with flushing/buffer liquid a
seal cage supply unit with/or without current meter has
to be installed. See also document OM.INS.02e,
item 5.2.5.5.

seepex.

**Operating Instructions
Single-Acting Mechanical Seal
Headstock Assembly size 110
without flushing connection**



Dokument
document **OM.SEA.05e**
Blatt
sheet **1 (1)**
Datum
date **27.07.95**

**1.
General**

- Please take the appertaining drawing "Headstock Assembly" and parts list from respective macerator data sheet.
- The mechanical seal is suitable for the operating conditions indicated in the macerator data sheet. Modifications are only admissible after the customer has consulted with **seepex**. Additionally, attention must be paid to the manufacturer's operating manual.

**2.
Safety**

Any mode of operation impairing the operating safety of the mechanical seal has to be avoided.

The operator is advised to consider the possible effects on the environment which could be caused by a defective mechanical seal and what additional measures must be taken to protect the environment and the public.

The macerator must be mounted and operated in such a way that operation with a defective mechanical seal will not result in injury or harm to the public and that any leakage can be safely and properly dealt with.

Mechanical seals are often used to seal hazardous material (chemicals, drugs, etc.). It is essential that rules pertaining to the handling of hazardous materials are adhered to.

Modifications effected by the customer himself and changes influencing the safety of the mechanical seal are not allowed.

**3.
dropped**

**4.
Flushing or circulation of single-acting mechanical seals**

Single-acting mechanical seals contacting the conveying liquid require no additional flushing or a circulation pipe because sufficient flushing and heat exchange occurs around the seal due to the conveying liquid.

**5.
Commissioning**

Regardless of the macerator's operating status, the conveying medium to be sealed must always be in liquid form at the mechanical seal. This particularly applies to the macerator's commissioning and its placing out of service.

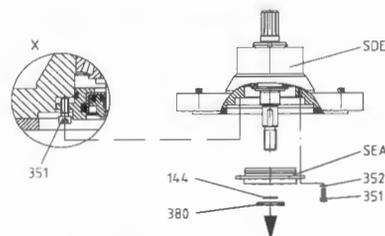
**6.
Maintenance**

When operating the macerator according to the instructions, no maintenance is required.

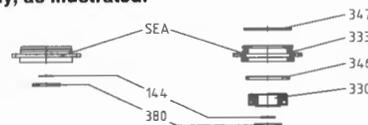
**7.
Disassembly / Re-assembly**

**7.1
Shaft Sealing (SEA) - Disassembly**

Use the screws (351) as forcing screws, detail "X". Additionally, two threaded drillings were affected at the casing (333). Squeeze the shaft sealing (SEA) out of the casing of the headstock assembly (SDE) by using forcing screws.



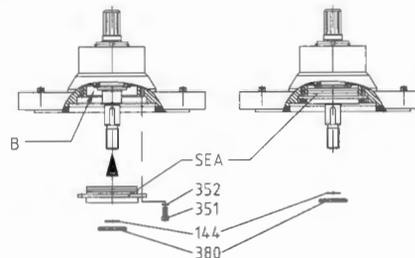
**7.2
Mechanical Seal (330) - Disassembly / Re-assembly, as illustrated.**



**7.3
Shaft Sealing (SEA) - Re-assembly**

Before mounting of the shaft sealing (SEA), fill the area 'B' up to the upper edge of the bearing with grease ¹⁾.

Re-assembly of o-ring (144) and slip ring (380) see document OM.CHD.02e, Point 2.5.3.



¹⁾ quality of grease see document OM.MAI...e, Point 7.2.1.3

seepex.

**Operating Instructions
Macerators
Wearing Parts and Gaskets**



Dokument
document

OM.WPS.10e

Blatt
sheet

1 (1)

Ausgabe
issue

A / 20.03.96

Wearing parts and gaskets for

Sizes: 25 and 110
Range: I and U

Please consider in case of spare part orders for necessary repairs:

The repair in your own works calls for highly qualified staff as well as a test device in order to check the function of the headstock.

For the reasons mentioned above it would be more economically to purchase a completely mounted and function-checked spare headstock assembly, whereas the function is guaranteed. Therefore, please return the headstock assembly which has to be repaired for renewal purposes. Additionally, call for a renewed or a new one.

Parts designation	Set of wearig parts	Set of gaskets	Item number acc. to sectional drawing of macerator and parts list
	Number		
o-ring / gasket		1	122
Lip seal		1	126
Lip seal		1	127
o-ring		1	144
o-ring		1	346
o-ring		1	347
Shear plate 1)	1		900
Split ring	1		903
Felt ring		1	904
Headstock 2)	1		905
Felt ring		1	910
o-ring		2	350
o-ring		1	501
Drive shaft	1		102
Bearing	1		104
Bearing	1		151
Mechanical seal / stationary seat unit	1		330
Slip ring	1		380
Shaft securing sleeve	1		140
Locking plate	1		107
Set of fitting discs	1		112
Coupling	1		149
Tool			Essention for assembly, see item 9. dcument OM.SPT. ...

1)
Shear plate (900)

In case the cutting surfaces show furrows or are worn, the cutting plate should be regrinded. It has to be considered that every whole has a cutting edge after the regrinding. It is compulsory to achieve a grinding surface having a minimal surface roughness of Ra 1,6. The cutting plate can be regrinded up to a minimum thickness of 8 mm.

2)
Headstock (905)

Headstock with welded knives. In case the heavy metal of the knives is damaged/tweaked or the knives are worn, the relevant knife or all knives have to be renewed. A welding as well as a later grinding of the knives can only be carried out with special devices. Therefore, this kind of repair should be carried out at **seepex** works, only



Macerator - Werkzeuge
Macerator - Tools



Dokument
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issue

OM.SPT.02de

1 (1)

C / 13.08.96.

Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeug bedingt ersetzbar. Recommended seepex tools Due to the design recommended for certain repairs, these tools partially replace the standardized tools.									
Werkzeug Nr. tool No.	W8	W50	W51	W52	W53	W54	W55	W57	W58
zur Montage von: tool for mounting of:	Schmiernippel lubrication nipple	Schneideinheit cutterhead assembly	Lager bearing	Lager bearing	Lager bearing	Antriebswelle drive shaft	Wellenabdichtung shaft sealing	Lager bearing	Wellenabdichtung Schonhülse shaft sealing protective sleeve
Benennung: denomination	Einschlaghülse drive-in sleeve	Montagesockel mounting socket	Hülse slave	Bolzen pin	Bolzen pin	Profilschlüssel profile key	Hülse slave	Hülse slave	Hülse slave
Baugröße size									
25	ESH N0 000 0000 0 XXX	MSO B2 075 0250 W50	HUL B3 075 1100 W51					HUL B3 075 0250 W57	HUL B4 075 0250 W58
110		MSO B2 075 1100 W50	HUL B3 075 1100 W51	BOL B4 075 1100 W52	BOL B4 075 1100 W53	SPO B3 075 1100 W54	HUL B3 075 1100 W55		

Die Preise sind dem Preisblatt AL.SPTde zu entnehmen / prices are listed on price sheet AL.SPTde
1) Gilt nur für Pumpen in Edelstahl Ausführung / only valid for pumps in special steel design

seepex.

Operating Instructions
seepex Machine
Manufacturer's documents



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document
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sheet

OM.MDS.01e

A / 22.02.95

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10. Manufacturer's documents from sub-supplier

seepex.

We deliver your success



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document **OM.ADR.01e**

Ausgabe
issue **27.09.04**

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sheet **1 (1)**

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Your seepex agent

APPENDIX H
Aerators



Environmental Equipment Engineering
P.O. Box 389
Mechanicsville VA 23111
804/730-1280

Operation and Maintenance Manual

For Proper
Receiving
Installation
Start-Up and
Maintenance of **EEE Floating Aerators**

Warning

Safety Precautions

High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Publication MG2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators*, the National Electrical Code, and sound local practices is recommended.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- avoid contact with energized circuits or rotating parts.
- avoid by-passing or rendering inoperative any safeguards or protective devices.
- avoid extended exposure in close proximity to machinery with high noise levels, and
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment.

Safe maintenance practices with qualified personnel are imperative. Before initiating maintenance procedures, be sure that *all* power sources are disconnected from the machine and accessories to avoid electric shock. High potential insulation test for this equipment is not recommended; however, should it be required, procedures and precautions outlined in NEMA Standards MG-1 should be followed.

Failure to properly ground the frame of this machine may cause serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound local practice.

Installation, Operation And Maintenance EEE Floating Aerators

Introduction

The aerators covered by these instructions when properly installed and when given reasonable care and maintenance, will give long reliable service. To insure proper installation and maintenance, read and follow these instructions carefully.

General Application

EEE aerators are the surface type aerators, specifically floating aerators, that are designed to entrain and disperse atmospheric oxygen into the liquid contents of a basin or lagoon by pumping the liquid from well below the aerator intake and discharging it radially. The aerator utilizes an anti-fouling two-blade propeller that will pass large spheres and is both dynamically and hydraulically balanced.

Checking For Transit Damage

Upon receipt of the aerator, a quick visual check should be made to determine if any damage has occurred in transit or handling. If any damage has been incurred, **PROMPTLY** notify your nearest EEE Representative **AND** the transit company that delivered the aerator.

Receiving

Connect a chain of adequate size to each eyebolt so as to distribute the weight of the unit evenly. Secure the chain to the lifting equipment so that when initial lifting begins, the unit will not swing into nearby fixtures or the lifting equipment.

WARNING: AERATOR MUST BE LIFTED BY FLOAT EYEBOLTS. DO NOT ATTEMPT TO LIFT BY MOTOR LUGS. THEY ARE FOR LIFTING MOTOR WEIGHT ONLY.

Preservation

In the event that the aerator will not be installed immediately, fill the motor bearings completely with a suitable lubricant. (See heading "Lubrication") Although the grease-lubricated bearing housings are packed with the proper amount of grease at the factory, this is a good practice if motors are to remain out of service for an extended period of time.

Installation

The EEE Floating Aerator is shipped assembled and will arrive at its destination ready to be installed in the basin or lagoon. Before placing the unit in the basin or lagoon, it is best to make the necessary water-tight electrical connection at the motor junction box (if this was not already done at the factory). Be sure that the ground wire is attached properly. A wiring diagram is located inside of each junction box or on a nameplate on the motor near the box. A fitting is required for the power cable at the motor junction box suitable for the junction box and the diameter of the power cable used.

NOTE: Be sure to cut off enough cable to reach the control box. Spliced cable is not permitted. Care must be exercised to insure that the cable does not contain sufficient slack to allow it to be drawn into the unit.

Once the aerator has the proper power cable connection, take the unit to the edge of the basin or lagoon and place the unit in water deep enough to allow the unit to float on its own, or so it will rest on the bottom of the basin or lagoon and stand vertically without the chance of rolling over or being knocked over by the lifting equipment.

NOTE: AT NO TIME SHOULD THE MOTOR BE SUBMERGED. IF MOTOR IS SUBMERGED, DO NOT PROCEED. INSTEAD, CONTACT YOUR LOCAL REPRESENTATIVE OR EEE HEADQUARTERS.

Attach the mooring lines to the mooring eyes on the float of the unit. Guide the unit to its desired location in the lagoon and attach the mooring lines to the anchors on the shoreline. The mooring technique may vary from one installation to another but be sure the mooring cables are as tight as possible. Two (2) wire clips and one (1) thimble are required at each mooring connection on the unit and at the shore. Special care should be exercised when mooring units that have an extreme liquid level variation. However, some vertical movement is desirable.

Make the required electrical connection at the control box on the shore. Refer to the wiring diagram for the control for the proper connection, and be sure to make a good ground wire connection.

Start-Up

Before start-up check all electrical connections. If everything checks out, start the unit. A large volume of liquid should begin to flow and should be noticeable from the shoreline. If not, stop the unit, and take the following steps:

- A. Check electrical connections again.
- B. Check power source to the control box.
- C. Check wiring for proper voltage.
- D. Reverse the rotation of the unit's propeller by interchanging any two line leads.

When all four of the above are followed in this order, restart the unit. If the volume of the liquid has not improved, stop the unit again and contact your EEE Representative or EEE Headquarters.

Once successful in locating the problem, operate the motor under load conditions and check the current. Be sure that the amperes steady value does not exceed the nameplate rating of the motor for the respective voltage. Check this figure to the heater rating in the control box.

If at any time you have questions regarding installation of an EEE Floating Aerator, or if something arises that is not covered above, please contact your nearest EEE Representative.

Maintenance

WARNING: BEFORE INITIATING MAINTENANCE PROCEDURES, DISCONNECT ALL POWER SOURCES TO THE MOTOR AND SPACE HEATERS (WHEN APPLICABLE) AND COMPLETELY DISCHARGE ALL PARTS WHICH MAY RETAIN ELECTRIC CHARGE. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

MAINTENANCE

The fundamental principle of electrical maintenance is keep the motor clean and dry. This requires periodic inspection of the motor, the frequency depending upon the type of motor and the service.

The following should be checked at regular intervals:

1. Windings should be dry and free of dust. Windings may be cleaned by suction cleaners or by wiping. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using mineral spirits. Do not use gasoline or other inflammable solvents.
2. Terminal connections, assembly screws, bolts and nuts should be tight. They may loosen if motor is not securely mounted and tend to vibrate.
3. Long storage or unusual operating conditions may cause motor insulation to absorb moisture. Therefore, a megger should be used to check insulation resistance of the motor to ground. Periodic megger readings should be taken at approximately the same temperature and humidity conditions to determine possible deterioration of the insulation. Standards of the IEEE recommend that the insulation of stator windings of clean dry machines at room temperature (approximately 77°F or 25°C) should not be less than:

$$\text{Insulation Resistance} = \frac{\text{Motor rated voltage} \times 1000}{1000} \text{ (meg-ohms)}$$

If the resistance is below this value follow corrective procedure outlined in the installation section.

4. Totally-enclosed, fan-cooled motors require very little attention. Be sure that the external air chamber of this motor does not become clogged with foreign material which will restrict the passage of air.
5. Squirrel Cage rotors are rugged and, in general, give little trouble. The first symptom of a defective rotor is lack of torque. This may cause a slowing down in speed accompanied by a growing noise or perhaps failure to start the load.

This is caused by an open or high resistance joint in the rotor bar circuit. Such a condition can generally be detected by looking for evidence of localized heating.

Repairing end rings should be done only by a competent person. It is recommended that a factory representative be consulted before attempting to do this work.

DISASSEMBLY

If it becomes necessary to disassemble this motor care should be taken not to damage the stator windings as the insulation may be injured by improper or rough handling. Precautions to keep bearings clean should be exercised.

Remove bearing cartridge screws before removing end shield screws. Marking end shields relative to position on frame will make reassembly easier.

Bearings should not be removed unless they are to be replaced. When removal is necessary it is recommended that an authorized Reliance Electric Repair Facility be utilized.

The thrust bearing systems used in Reliance® Duty Master motors may be one of several types depending on the application requirements. Your Reliance Electric Authorized Repair Facility is best equipped to service these bearing systems.

LUBRICATION

This motor has been properly lubricated at the time of manufacture and it is not necessary to lubricate at time of installation. If motor has been in storage for a period of six months or more lubricate before starting.

Lubrication of anti-friction bearings should be done as a part of a planned maintenance schedule. The Recommended Lubrication Interval should be used as a guide to establish this schedule.

Cleanliness is important in lubrication. Any grease used to lubricate anti-friction bearings should be fresh and free from contamination. Similarly, care should be taken to properly clean the grease inlet area of the motor to prevent grease contamination.

RECOMMENDED LUBRICANT

For motors operating in ambient temperatures shown below, use the following lubricants or their equal:

Operating Temperature - 25°C (-15°F) to 50°C (120°F)

*CHEVRON OIL SRI No. 2
SHELL OIL CO. DOLIUM R

Minimum Starting Temperature -75°C (-100°F)

SHELL OIL CO. AEROSHELL #7

*Reliance Standard Lubricant

CAUTION: Mixing lubricants is not recommended due to possible incompatibility. If it is desired to change lubricant without motor disassembly, follow instructions for lubrication and repeat lubrication a second time after 100 hours of service. Care must be taken to look for signs of lubricant incompatibility, such as extreme souppiness visible from the grease relief area.

SPECIAL APPLICATIONS: Silicone grease may be required in special high temperature applications. Consult your local Reliance Electric Representative.

LUBRICATION FREQUENCY

Standard Conditions	Eight hours per day normal or light loading, clean, @ 40°C (100°F) maximum ambient
Severe Conditions	Twenty-four hour per day operation or shock loading, vibration, or in dirt or dust @ 40-50°C (100-120°F) ambient
Extreme Conditions	Heavy shock or vibration, or dust

RECOMMENDED VOLUME

Frame Size	1800 RPM & Slower	3600 RPM
182 thru 215	5 Cu. In.	5 Cu. In.
254 thru 286	1.0 Cu. In.	1.0 Cu. In.
324 thru 365	1.5 Cu. In.	1.5 Cu. In.
404 thru 449	2.5 Cu. In.	1.0 Cu. In.

BALL BEARINGS

Horsepower	Standard Conditions	Severe Conditions	Extreme Conditions
1 thru 7½ 1800 RPM and slower	2 Years	6 Months	1 Month
10 thru 75 1800 RPM and slower	1 Year	3 Months	1 Month
100 and greater 1800 RPM and slower	1 Year	3 Months	1 Month
All over 1800 RPM	6 Months	2 Months	1 Month

LUBRICATION PROCEDURE

Reliance anti-friction bearings may be lubricated with the motor running or stationary, however, stationary with the motor warm is preferred.

1. Locate the grease inlet, clean the area and replace the pipe plug with a grease fitting, if the motor is not equipped with grease fittings.
2. Add the Recommended Volume of the Recommended Lubricant using a hand operated grease gun.
3. Run the motor for two hours.
4. Replace the pipe plug in grease inlet.

ROLLER BEARINGS

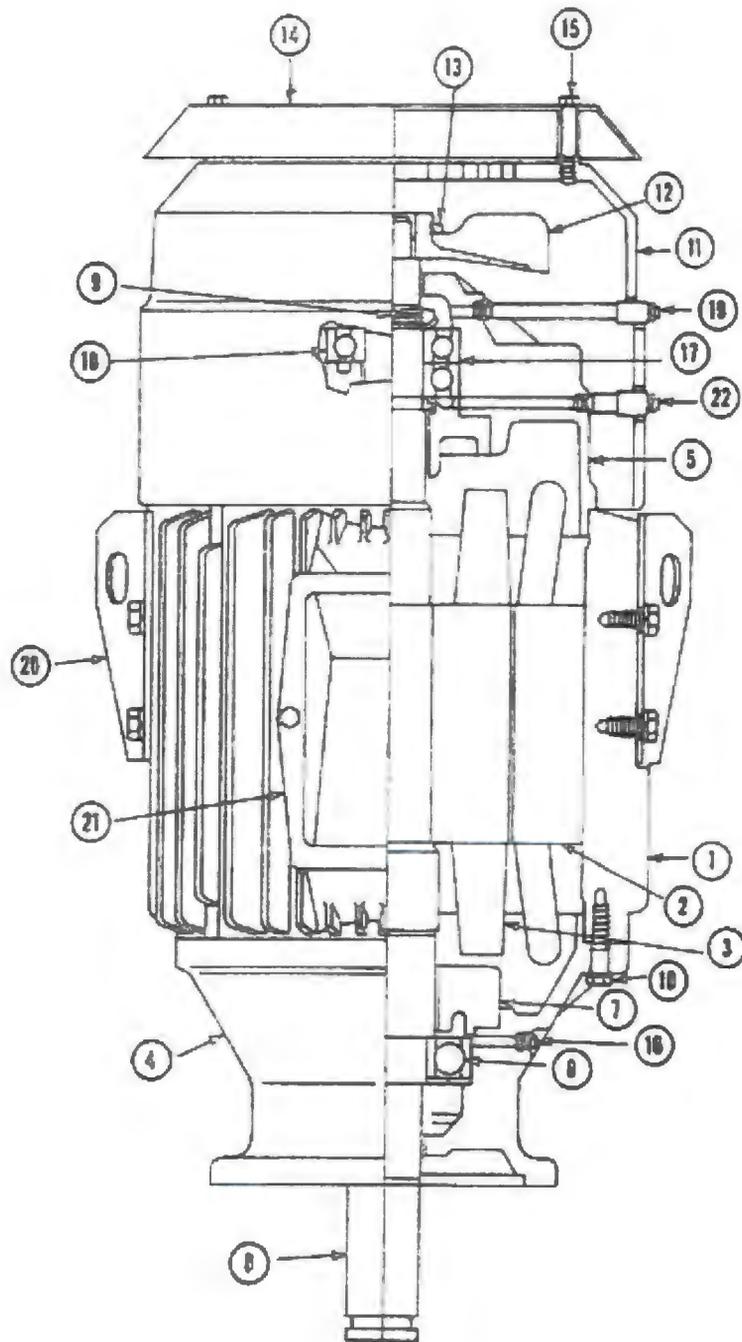
For Roller Bearings divide the above times by 2.

PARTS LIST

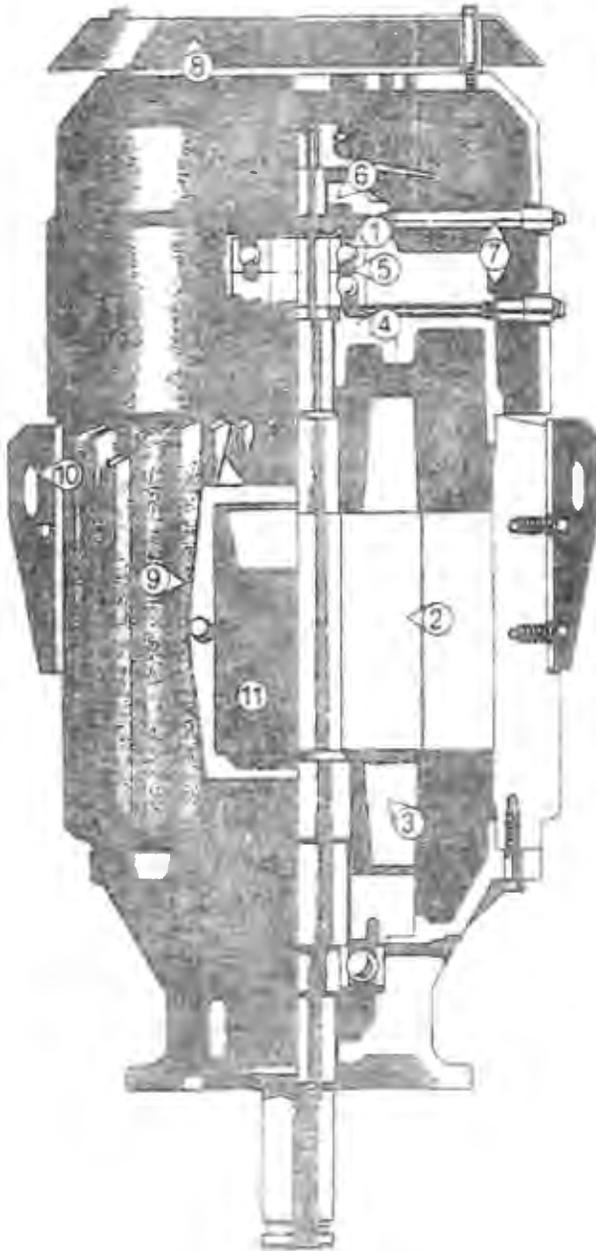
FIND NO.	PART DESCRIPTION
1	FRAME
2	STATOR
3	ROTOR
4	BACK END BRACKET
5	FRONT END BRACKET
6	SHAFT
7	BACK END INNER CAP
8	BACK END BALL BEARING
9	BEARING LOCKNUT & LOCKWASHER
10	BACK END BRACKET BOLTS
11	FAN COVER

FIND NO.	PART DESCRIPTION
12	OUTER FAN
13	FAN CLAMP
14	DRIP COVER
15	DRIP COVER BOLTS
16	GREASE ENTRY BACK END
17	FRONT END BALL BEARINGS, IN-LINE
18	FRONT END BALL BEARING, NORMAL THRUST
19	GREASE INLET FRONT END
20	LIFTING PLATES
21	CONDUIT BOX
22	GREASE DRAIN

PARTS IDENTIFICATION DRAWING



Typical NEMA Frame Construction

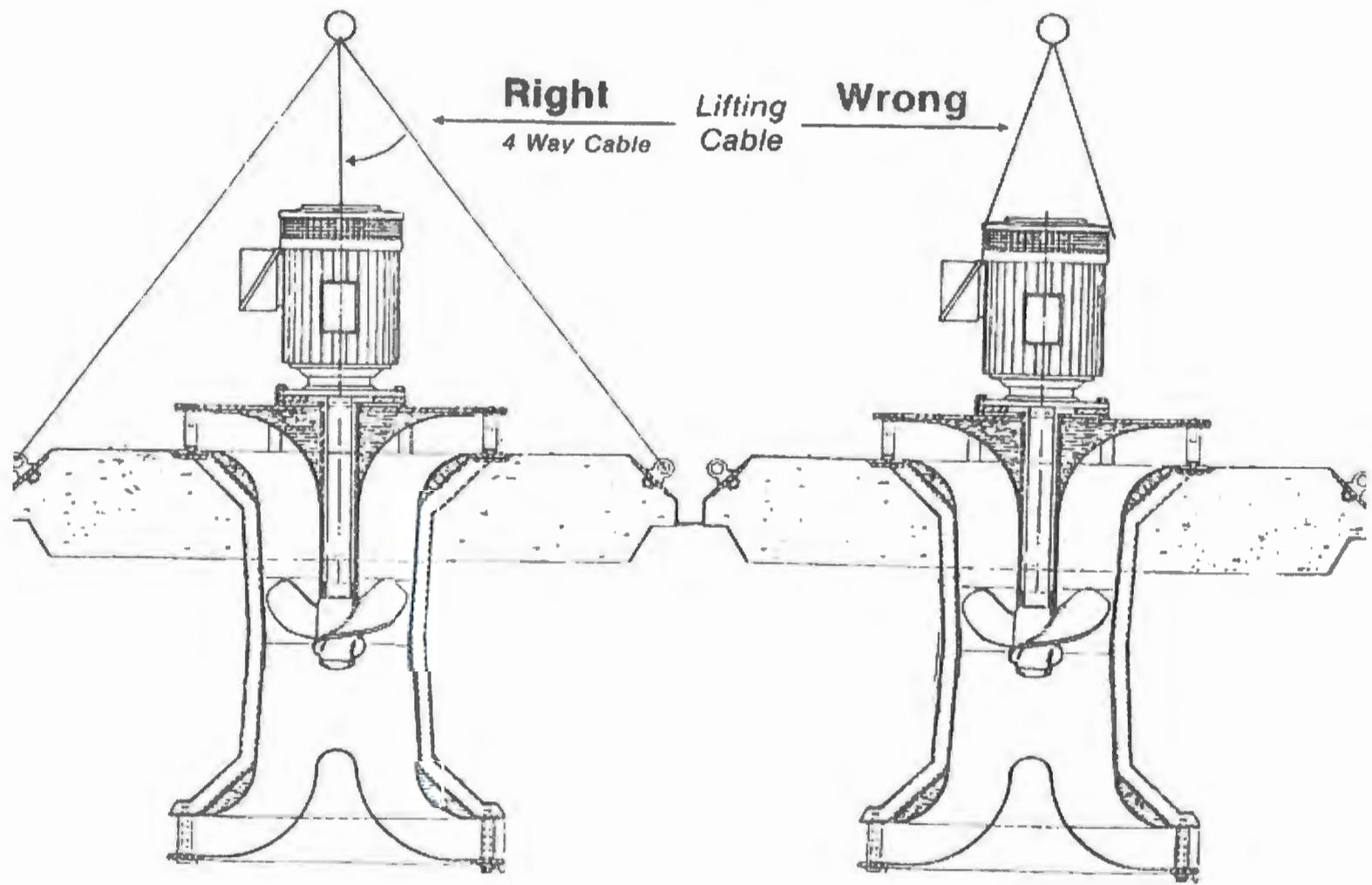


- 1** Top mounted bearing in NEMA LP designs meets the requirements of A.P.I. Spec. #610.
- 2** High-grade steel laminations of rotor and stator reduce current densities and losses for greater electrical efficiency.
- 3** Integrally cast rotor fins provide rapid heat dissipation to assure cool operation for longer life.
- 4** Bearing cap clamps bearing system in slurry bracket to help eliminate end play and extend life of both motor and driven equipment.
- 5** Thrust bearing is designed to withstand upward and downward thrust to minimize shaft movement.
- 6** Large grease reservoir is located above bearing to assure proper lubrication for maximum motor life.
- 7** Grease relief occurs by purging through bearing for positive lubrication.
- 8** Drip cover extends motor life by preventing rain, snow or falling objects from entering motor.
- 9** Standard conduit box is diagonally split for fast installation and easy servicing; can be rotated for connection from top, bottom, or either side.
- 10** Steel lifting plates bolted on the frame of totally enclosed fan-cooled enclosures simplify motor lifting per NEMA requirements.
- 11** Provision for grounding in the conduit box is standard in all frame sizes; assures a positive ground for all electrical connections.

Failure	Possible Problem	What Action To Take
Motor won't start	Faulty wiring	Check all wiring, motor connections, control connections, fuses, overload trips.
	Defective motor	Contact EEE Representative or factory.
Motor runs but small discharge	Motor operating in wrong rotation	Interchange power leads. Restart.
	Debris clogging propeller or throat	Stop unit for 30 seconds and restart. If no improvement, inspect unit and remove debris.
	Wrong wire connections	Check connections at motor junction box.
Overloads trip repeatedly	Faulty wiring	Check all wiring and connections.
	Incorrect size fuses or circuit breakers	Check overload ratings of fuses or breakers against motor nameplate rating.
	Debris clogging unit and overloading motor	Stop for 30 seconds and restart. If problem persists, inspect unit and clear debris.
	Overloads affected by outside temperature	Shield and/or ventilate controls to reduce temperatures. Use ambient compensating heaters.
Motor overloaded but overloads don't trip	Debris affecting operation	Stop unit, clear of debris, replace overloads with proper rated ones. Operation of motor under overload conditions will void warranty.

Warning

Motor Lugs For Motor Weight Only



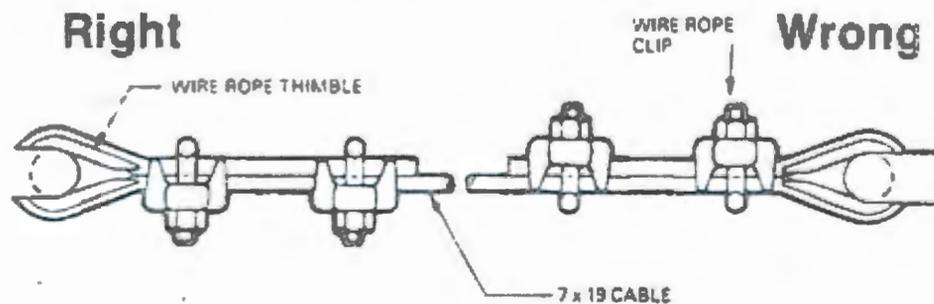
Mooring Hardware

Certain wire rope fittings are required to secure the mooring cable to an aerator and to the anchor on the shore. There are many techniques that may be employed to adequately make these connections.

EEE recommends that wire rope clips and a thimble be utilized at all mooring connections, and that an anchor shackle be used at the mooring connection on the aerator. The shackle is optional. On cable sizes 1/8", 3/16", 1/4", and 3/8", two (2) clips are required at each connection. The spacing between all sizes of clips should be 3½ to 4 inches.

The shackle is used only for quick removal of the cable from the aerator. This method offers flexibility and is quite efficient. All wire rope fittings furnished by EEE are corrosion resistant stainless steel.

U-Bolt Always On The Short End Of The Cable



NOTE ALL COMPONENTS ARE STAINLESS STEEL

APPENDIX I
Mixers & Agitators

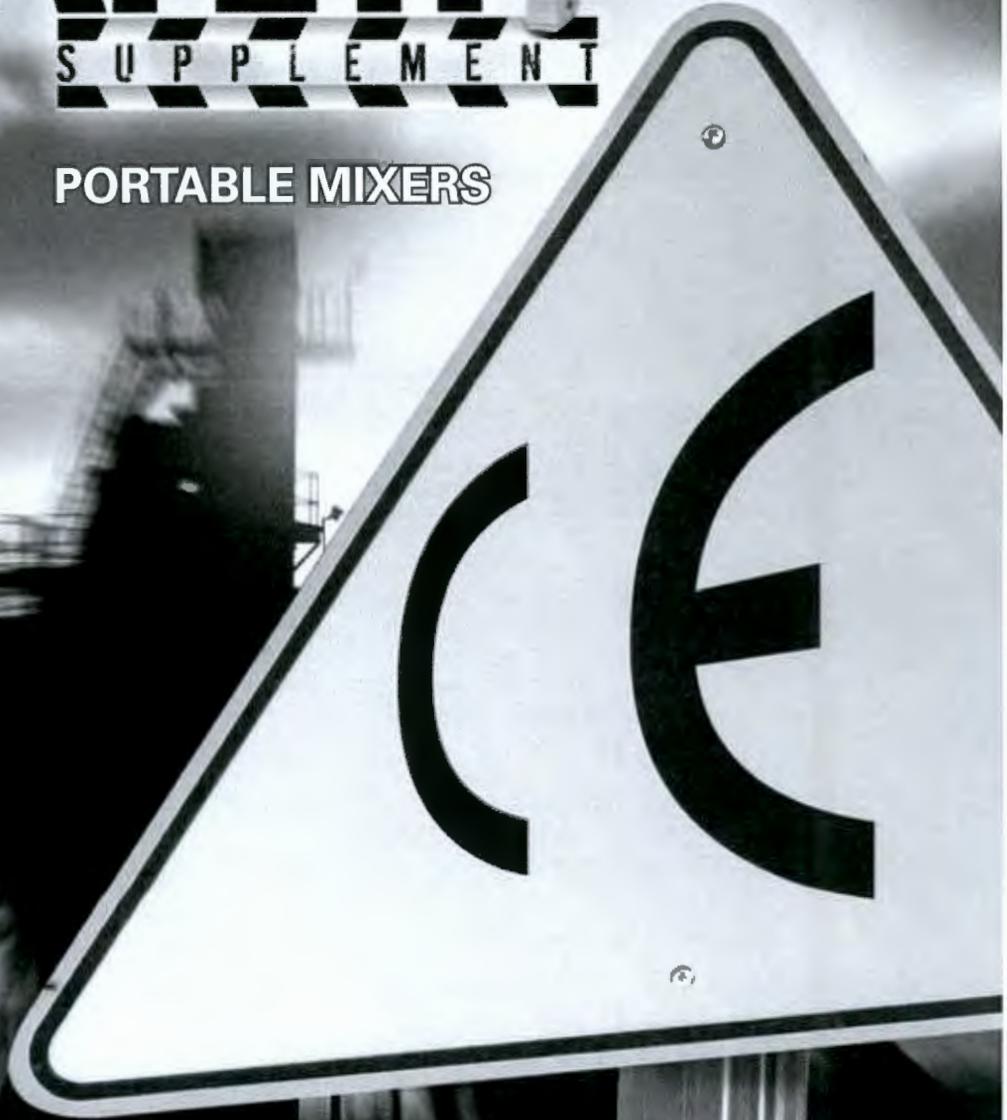
Additional information vendor information can be found in Hanford Site
Integrated Document Management System (IDMS)

SAFETY



S U P P L E M E N T

PORTABLE MIXERS



NPT-10001-E-01

NEPTUNE PORTABLE MIXER SAFETY MANUAL



ENGLISH



This safety manual applies to portable mixers and provides instructions for safe installation, operation, inspection, and maintenance of the products. Failure to follow these instructions could result in severe personal injury, including death, and/or substantial product and/or property damage. This document is a supplement to the Engineering, Operation and Maintenance manuals. It is important to refer to the Engineering, Operation, and Maintenance manuals for additional information about specific products

GENERAL SAFETY CONSIDERATIONS

- Verify that the model received matches the purchase order and/or specification sheet.
- Ensure all operators are properly trained and employ safe operating and maintenance practices as outlined in this Safety Manual, and the Engineering, Operation and Instruction manual for the specific product.
- Wear appropriate safety equipment during installation, operation, inspection and maintenance. Use caution to avoid contact with process fluids, cleaning fluids, and other chemicals. Gloves, coveralls, face shields and other equipment may be required to adequately protect personnel. All personnel must review the Material Safety Data Sheet (MSDS) for all process and cleaning fluids and follow all handling instructions.
- Wear safety glasses and additional safety equipment during operation.
- Always use proper hearing protection. Sound level of the mixer in operation may exceed 85 dBA.
- Equipment operating sound level and hearing protection may impair the operator's ability to hear acoustic signals. Verify that all acoustic signals can be heard during the operation of this product and/or provide alternate signals such as lights.
- Splashes from mixing may occur. Take necessary precautions to protect eyes and skin from being injured.
- Mist or vapor from mixing may occur. Take necessary precautions to protect against inhalation of hazardous fumes.

PRODUCT INSTALLATION

- Always refer to the detailed installation instructions supplied in the Engineering, Operation, and Instruction manual.
- Clean products thoroughly before installation to reduce the possibility of process fluid contamination or chemical reaction.
- Remove all the tools which may have been used during assembly/installation from the area before starting the mixer.
- All Neptune Mixers should be properly secured while in use. All drums and totes must be on flat surface. All Neptune Portable Mixing Systems should be stable and secure during the use. All Hand held mixers are properly held before starting and during operation. Failure to properly secure the system will allow the system to fall over or get disoriented and potentially harm those present in the area.
- Mixers operated by an air motor must have an air shut off valve (user supplied). It should be installed to stop the mixer in an emergency situation. The air shut off valve should be located so that it can be reached safely in an emergency situation.
- In the event of a power failure,
 1. In the case of an electric motor driven mixer, the power switch should be turned off if restarting of the system is not desirable once power is regained.
 2. In the case of an air motor driven mixer, the air shut off valve should be closed if restarting of the system is not desirable once power is regained.
- To prevent electrical spark caused by static charge build-up, ground the mixer prior to operation.
- Do not use combustible gases to drive the air motor.

NEPTUNE PORTABLE MIXER SAFETY MANUAL

PRODUCT OPERATION

- Read the motor specification and make sure that it conforms to the power requirement of the specific mixer before turning the mixer on.
- The air motor on the mixing system is designed for use with a maximum of 7.0 bar (100 psig). Exceeding this maximum rating could result in failure of the motor and/or harm to anyone in the area.
- Always perform an inspection of the entire mixing system before each use. Insure that all parts are in good working condition, all the clamping screws are tight and do not show signs of wear. Use of damaged components can result in failure of the equipment which may cause physical harm.
- Do not run the mixer with shaft and impeller attached unless the impeller is submerged in the process fluid. Running the system dry could result in vibration that may damage the unit, or cause harm to anyone in the area.
- A rotating impeller could result in injury and/or entanglement. Never operate the mixer if a person's body or clothing is near the impeller.
- Stop operation immediately if the mixing system appears to be unbalanced. Vibration could lead to failure of the mixing system and result in bodily injury. Verify that the impeller, shaft and the motor are not damaged and that the process fluid does not contain large solids.
- Neptune Portable mixers are designed for use with fluids that contain only small particulate and not large solids. Use of a Neptune Portable mixing systems with immiscible solid laden process media could result in severe vibration, mixer damage and/or cause harm to anyone in the area.
- Large chunks of solids may trap the mixing blades and cause severe damage to the mixer.
- The lid of the Neptune Portable Drum and tote System should be installed using two hands. This is to prevent the operator from being harmed by the pinch point between the mixer lid and the upper drum edge. Use proper caution while lowering the lid onto the drum. Actions otherwise could result in bodily injury.
- For Neptune Portable Mixing Systems, always shut off the electric power (for electric motor driven mixers) or air supply (for air motor driven mixers) prior to removing the mixer from the tank. Failure to do so may expose equipment operators to the hazard of a rotating impeller and result in bodily injury due to cutting, severing, friction, abrasion, and/or entanglement.
- It is always recommended that two (2) people lift and move any Neptune Portable Mixer. It is never recommended to lift heavy or awkward objects over your head. A ceiling hoist or other assisting mechanism is recommended for preventing injury if this type of lifting is required.
- Spills or drips may cause a hazardous floor surface which can lead to a slip or fall. Be aware of any spills or drips and take the appropriate actions to maintain a safe working environment.
- When beginning operation of a mixer fitted with an air motor, always slowly increase the impeller speed in order to reduce both the possibility of a spill and stress on the equipment.
- All hand held mixers are to be held securely by two hands during operation.

PRODUCT MAINTENANCE

- Follow all maintenance instructions in the Engineering, Operation and Instruction manual.
- Always wear hand and eye protection to prevent injury during installation and maintenance.
- Always lock-out the electric power of an electric motor prior to performing service or repairs. Failure to do so could result in unexpected rotation of mixer impeller and shaft, which could result in harm to anyone in the area.
- Always lock-out power supply or disconnect the air supply to the air motor, prior to performing service or repairs. Failure to do so could result in unexpected rotation of mixer impeller and shaft, which could result in harm to anyone in the area.
- Periodically check and tighten the set screws and/or set pins that attach the mixer shaft to the mixer body. If the set screws and/or set pins become loose or fall out, the shaft and impeller will become uncoupled from the mixer body, resulting in damage to the unit and possible harm to anyone in the area.
- Never attempt to use or repair a damaged impeller or shaft. Replace any damaged parts immediately with genuine Neptune Portable mixer parts.
- Never attempt to modify the mixer shaft, shaft extensions or impeller. Modification will change the dynamics of the mixing system and could result in vibration that could damage the unit or cause harm to anyone in the area.
- When securing the shaft to the motor spindle, align the hex head screws with the key way. Periodically check and tighten these screws to prevent them from becoming loose or falling out. This will eliminate the possibility of a hazard generated by the motor spindle slipping or becoming decoupled during operation.
- DO NOT tamper with, disable, or remove any safety systems.
- Do not use kerosene or other combustible solvents to flush the air motor.

NEPTUNE PORTABLE MIXER SAFETY MANUAL

REGULATORY COMPLIANCE

- Always ensure that product installation, operation, inspection and maintenance conforms to all applicable laws, regulations and codes.
- Not all products are compliant to all regulatory standards. Consult your local distributor for models that meet your regulatory requirements.

FIRE AND EXPLOSION PREVENTION - USE OF PRODUCTS IN EXPLOSION ZONES

- There is a risk of fire and/or explosion if certain conditions exist. These conditions include, but are not limited to, the following:
 1. Mixing flammable fluids (in some cases an additional risk may be created by vapors or gases.)
 2. Product used in flammable atmospheres (flammable atmospheres can be caused by the presence of gases, dusts, or vapors)
 3. Placement of flammable materials near product.
- Be aware of the hazards associated with the specific application and the application environment. Conform to all applicable laws, regulations and codes. Do not use the product if there is any doubt about the safety of the application. Mechanical operation and flowing fluids can generate static electricity. Grounding of all products are required for all potentially flammable or explosive applications to prevent static spark. Periodic inspection of the ground connection should be performed to ensure the equipment is properly grounded.
- The surface temperature of the equipment must be kept below the ignition temperature of any potential explosive atmosphere. The surface temperature is affected by the temperature of the fluid being mixed and the kinetic energy added by the mixer and application. The end user must ensure process media and equipment maximum temperature is acceptable for the environment.

CHEMICAL COMPATIBILITY

- Check the chemical compatibility of all wetted components with all process and cleaning fluids to minimize the risk of dangerous chemical reactions. Refer to Neptune Chemical compatibility chart.
- All wetted components of the Neptune Portable mixers are made from 316 stainless steel.

TEMPERATURE LIMITS

- Normal conditions: Operate at temperatures up to 121°C (250°F) .
- Hazardous conditions: Operate at temperatures up to 40°C (104°F)

OPERATING & INSTRUCTION MANUAL

**Series JG Gear Drive and
Series JD Direct Drive Clamp Mount Mixer**
PLUS: JGR and JDR Angle Riser Mount
Series JGF and JDF Flange Mount




Neptune
A DOVER COMPANY

295 Dekalb Pike,
North Wales, PA 19454



Tel.: 215-699-8700 • FAX: 215-699-0370

ZL106636

WARNING

**LOCKOUTS ARE REQUIRED BEFORE
SERVICING THIS EQUIPMENT.**

SAFETY INSTRUCTIONS:

Shut off/Lockout Mixer Power before Servicing.

**DO NOT OPERATE MIXER UNLESS PROPERLY INSTALLED, AVOID
ROTATING SHAFT AND BLADES, TURN OFF POWER AND
LOCKOUT EQUIPMENT BEFORE ADJUSTING OR SERVICING, ETC.**

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LIMITED WARRANTY

All Neptune Mixers are tested at the factory prior to shipment. Each part used in their construction has been carefully checked for workmanship.

If the Mixer is installed properly, Neptune Chemical Pump Company warrants to the purchaser of this product for a period of one year from the date of shipment, whichever occurs first, this product shall be free of defects in material and/or workmanship, as follows:

1. Neptune Chemical Pump Company will replace, at no charge, any part that fails due to a defect in material and/or workmanship during the warranty period, FOB our factory, North Wales, Pennsylvania. To obtain warranty service, you must get an RMA number to return the defective parts to the factory for examination, freight pre-paid.
2. This warranty period does not cover any product or product part, which has been subject to accident, misuse, abuse or negligence. Neptune Chemical Pump Company shall only be liable under this warranty if the product is used in the manner intended by the manufacturer as specified in the written instructions furnished with this product.

Any express warranty not provided in this warranty document, and any remedy for breach of contract that, but for this provision, might arise by implication or operation of law, is hereby excluded and disclaimed. Under no circumstances shall Neptune Chemical Pump Company be liable to purchaser or any other person for any charge for labor, repairs, or parts, performed or furnished by others, nor for any incidental consequential damages, whether arising out of breach of warranty, express or implied, a breach of contract or otherwise. Except to the extent prohibited by applicable law, any implied warranty of merchantability and fitness for a particular purpose are expressly limited in duration to the duration of this limited warranty.

Some states do not allow the exclusion or limitation of incidental or consequential damages, or allow limitations on how long any implied warranty lasts, so the above limitations may not apply to you. This warranty gives you specific legal rights, and you may have other rights, which may vary from state to state.

IMPORTANT

SHOULD IT BE NECESSARY TO SEND THE PUMP TO THE FACTORY FOR REPAIR OR MAINTENANCE REBUILDING; DRAIN ALL OIL AND CHEMICAL FROM PUMP BEFORE SHIPPING. FAILURE TO DO SO CAN CAUSE EXTENSIVE DAMAGE TO THE MOTOR.

¹SEE IMPORTANT NOTICE -RETURN GOODS AUTHORIZATION

IMPORTANT NOTICE RETURN GOODS AUTHORIZATION

- (1) All equipment returned to Neptune Chemical Pump Company requires proper Returned Goods Authorization Number (RGA) and tags.
- (2) All equipment returned to the factory for repair or service must first be thoroughly flushed and have all chemical contact areas neutralized.
- (3) All equipment which has been in contact with chemicals must be accompanied by a copy of the Chemical Product Material Safety Data Sheet (MSDS).
- (4) Failure to comply with the above instructions will result in equipment being returned to sender, freight collect, without service.

PARTS ORDERING INSTRUCTIONS

The complete model number and serial number of the pump must be furnished to insure prompt and accurate parts service. These numbers are found on the name plate (sample below) located on the side of the mixer. Refer to Pages 6, 7, 9, 11 and 13 for complete parts lists.

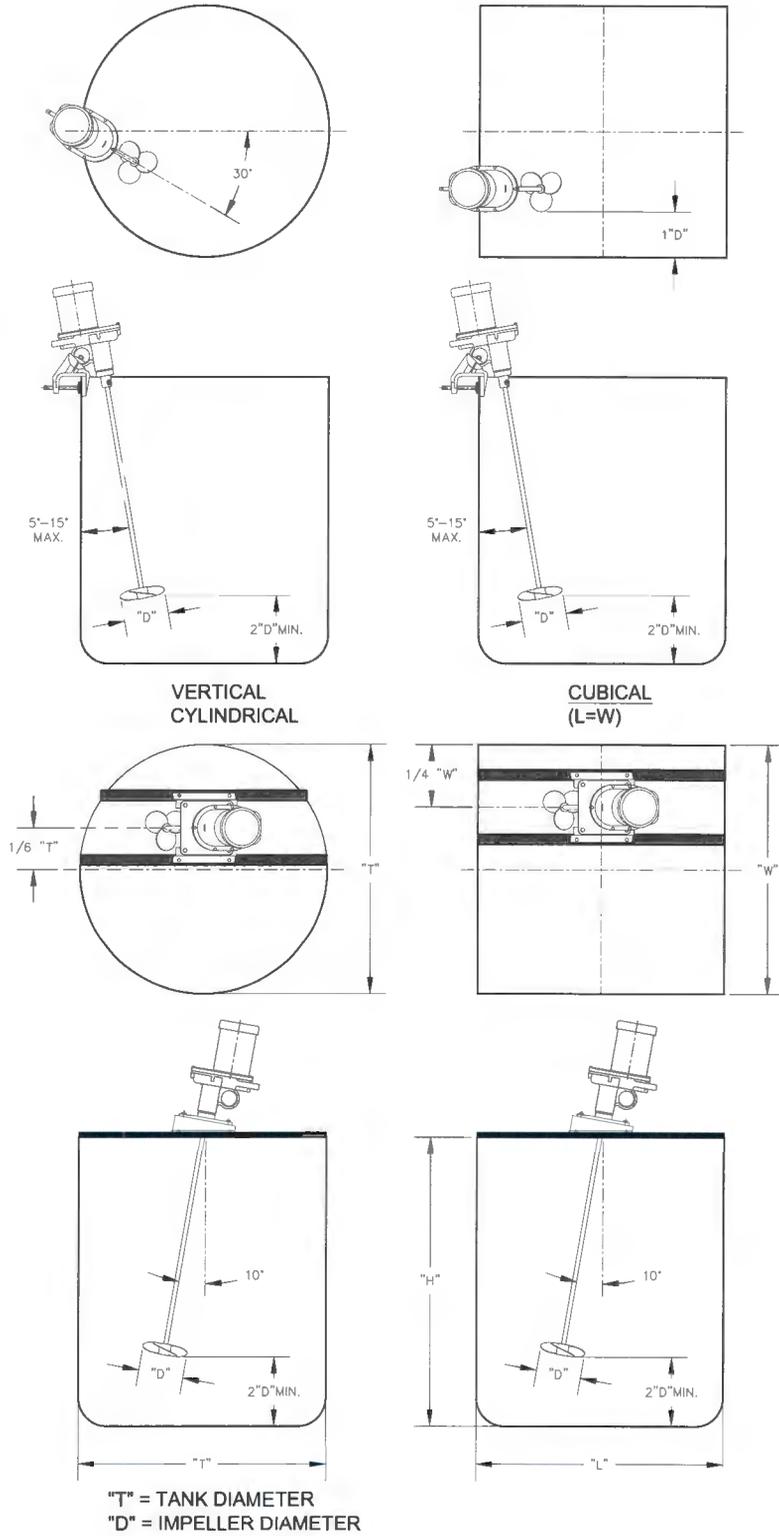


Send all orders or inquiries for parts to:

Parts Department
Neptune Chemical Pump Company
295 DeKalb Pike
North Wales, PA 19454
Tel.: 215-699-8700
1 -888-3NEPTUNE (888-363-7886)
FAX: 215-699-0370
Web: www.neptune1.com
Email: pump@neptune1.com

NOTE: PLEASE SUPPLY BOTH MODEL AND SERIAL NUMBERS.

MIXER POSITIONING



INTRODUCTION

The Neptune Mixer is a carefully designed piece of precision equipment which will give you years of satisfactory service under normal operating conditions.

A. INSPECTION

All Neptune Mixers are shipped in a specially designed carton to insure against damage in shipment. Each shaft is shipped in an individual box. Upon receipt, examine the mixer for damage; report any damage to Neptune and the delivering carrier at once.

B. LUBRICATION/MAINTENANCE

The outboard ball bearing [30] and upper ball bearing [27] are sealed and pre-greased for bearing life. The gear box is lubricated at the factory. Neptune recommends changing grease annually. To change grease or to change the motor: Remove motor midplate (fig. 21) by taking out the six bolts & washers (fig. 14/15). Remove motor and midplate (they will be attached) from gearbox. Remove four motor bolts (fig. 12/13) underneath midplate. Clean gear box and gears with solvent. Repack with the following grease.

Mixers use LUBRIPLATE® 1200-2 Grease. Order P/N 114444

C. MOUNTING THE MIXER

Remove the mixer from the carton and attach clamp. Rotate the clamp to an initial position such that the motor will be upright when the unit is clamped to the tank.

Place the clamp on the desired location on the tank, being certain that both the horizontal and vertical surfaces of the clamp are in contact with the top and side of the tank. Rotate the nut clockwise to tighten; counter clockwise to loosen.

D. MOUNTING MIXER SHAFT

Neptune supplies standard square pitch propellers which may be put on the mixer shaft either face up or face down. Place the propellers on the end of the shaft WITHOUT THE NOTCHES. If two propellers are used, they should be spaced at least two propeller diameters apart. Be certain to securely tighten the propeller set screws. Place the end of shaft with the notches into the shaft collar until it bottoms. Screw in the setscrews [32]. Certain Mixer Models require a Shaft Adapter Reducer [33] to be inserted beforehand into the shaft collar and temporarily held in position with the setscrews [32] until the propeller shaft is inserted. Rotate the shaft to line up the shaft notches with setscrews [32] and tighten the setscrews. (See Shaft Installation Diagram on pg. 5.)

E. ELECTRICAL CONNECTIONS

Your Neptune mixer is designed to rotate clockwise when looking down on the end of the motor. This is so indicated by arrows cast on the motor midplate.

Follow the wiring directions as indicated on the motor to obtain proper rotation.

F. MIXER POSITIONING

To utilize energy supplied by the mixer, atop to bottom turnover of the liquid should be created. The mixer shaft should be angled 5° to 15° off vertical wall of tank pointed 20° to 30° right of the center line.

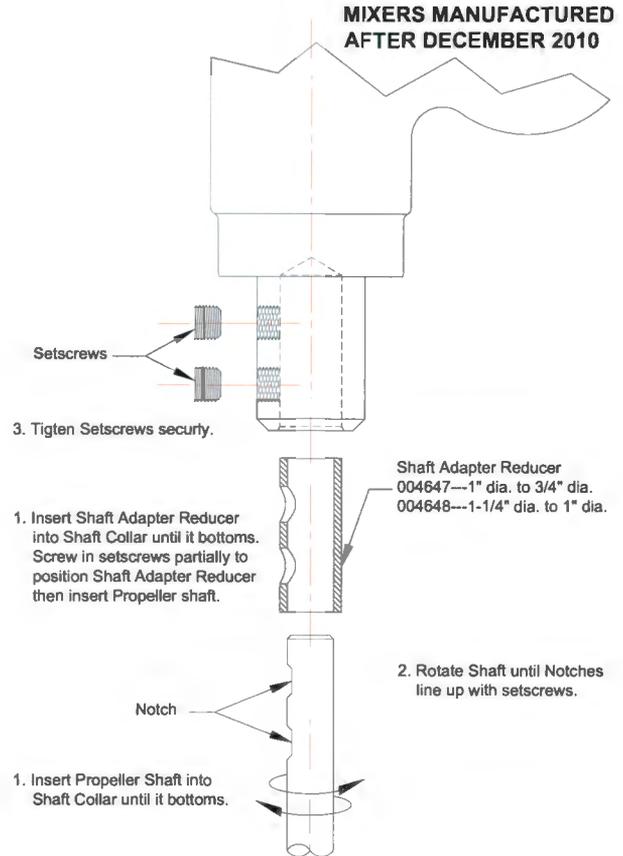
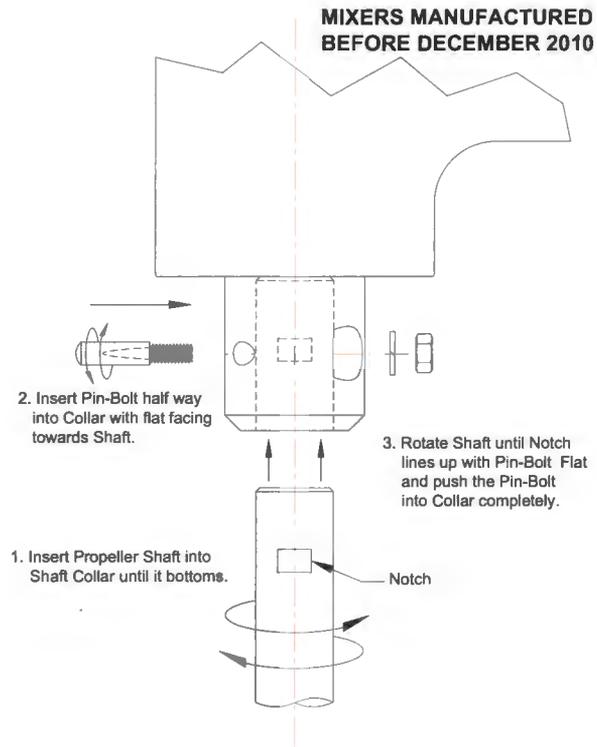
Moving the shaft to the left of the position described will increase swirl of vortex. This helps to submerge light powders or to aerate the mix but decreases mixing efficiency.

G. MIXER OPERATION

Neptune mixers are designed for continuous operation under normal conditions. It is not good practice to operate continuously when extreme vortexing occurs. Mixer Propellers must be submerged in the Liquid during mixing operation, damage could occur.

After mixer has been turned on and the mixing pattern developed, adjust mixer position if necessary.

After ten days of operation, check the Motor Midplate screws, and shaft collar Hex Nut for tightness. At the end of a mixing period, it is a good practice to turn off the mixer before the tank is drained. Turn mixer off when liquid level is one propeller diameter above lower propeller.



SHAFT INSTALLATION DIAGRAM
(Refer to Section D.)

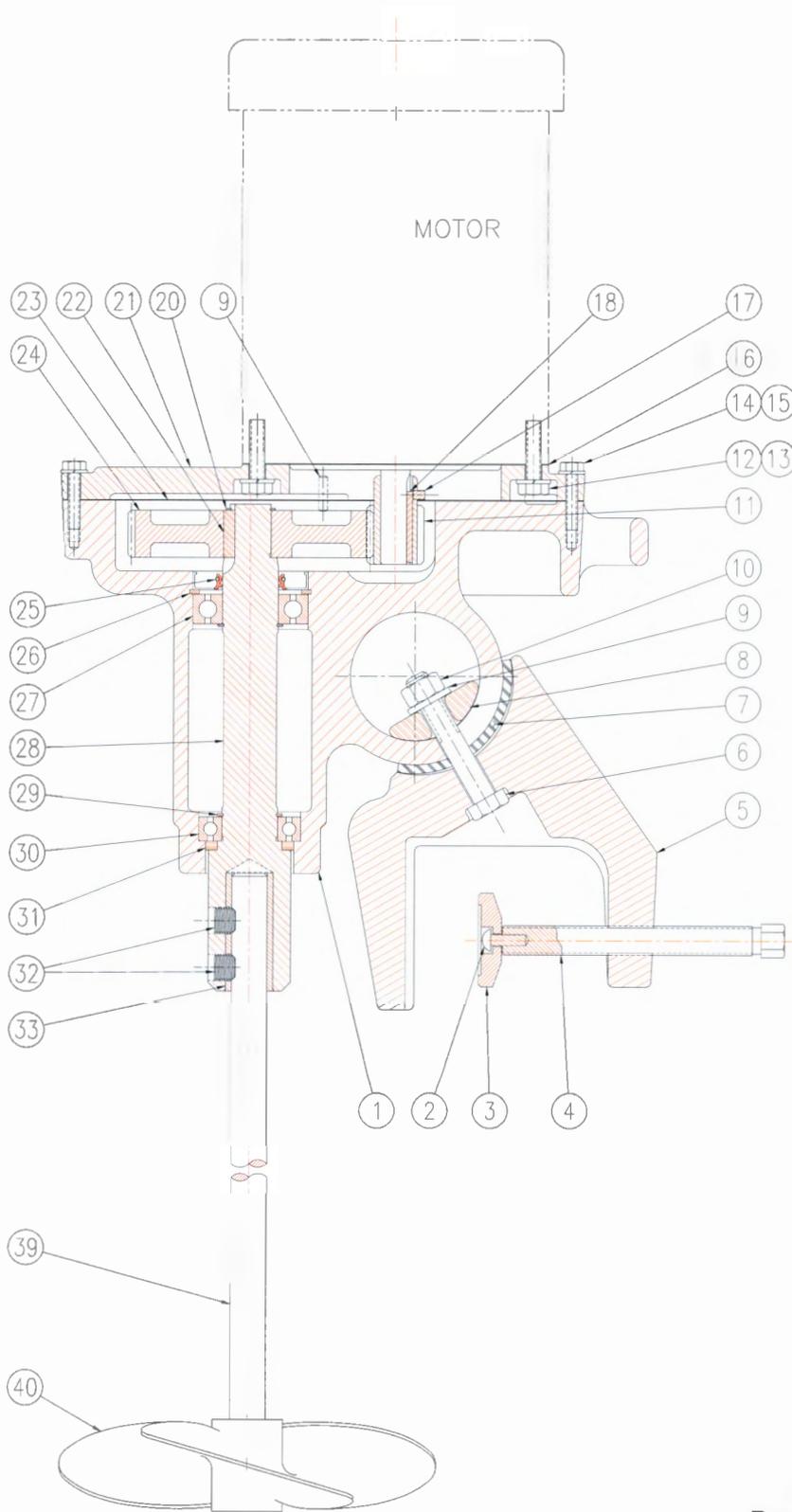
SHAFT AND PROPELLER PARTS LIST
For Series JG, JD Clamp Mount Model Mixers
And Series JGR and JDR Angle Riser Mount Model Mixers
(Refer to Drawing on Page 8)

ITEM NUMBER	ITEM DESCRIPTION	QTY.	MODEL JG2.0- JG6.1	MODEL JG7.1 - JG8.1	MODEL JG9.1
39	Shaft 3/4" dia. x 30" lg.	1	004396		
	Shaft 3/4" dia. x 40" lg.	1	004397		
	Shaft 3/4" dia. x 36" lg.	1	003084		
	Shaft 3/4" dia. x 48" lg.	1	003075		
	Shaft 3/4" dia. x 60" lg.	1	003076		
	Shaft 1" dia. x 48" lg.	1	004398		
	Shaft 1" dia. x 60" lg.	1	003071		
	Shaft 1" dia. x 72" lg.	1	003072		
	Shaft 1-1/4" dia. x 60" lg.	1		003073	003073
	Shaft 1-1/4" dia. x 72" lg.	1		003074	003074
40	Prop 5 x 5, 3/4" Bore, P/N 100383	A/R	As Required Per Application	As Required Per Application	As Required Per Application
	Prop 4 x 4, 3/4" Bore, P/N 100384				
	Prop 14 x 14, 1-1/4" Bore, P/N 100385				
	Prop 12 x 12, 1" Bore, P/N 100389				
	Prop 11 x 11, 1" Bore, P/N 100390				
	Prop 6 x 6, 1" Bore, P/N 100392				
	Prop 5 x 5, 1" Bore, P/N 100393				
	Prop 7 x 7, 3/4" Bore, P/N 100394				
	Prop 6 x 6, 3/4" Bore, P/N 100395				
	Prop 5 x 5, 3/4" Bore, P/N 106046				
	Prop 6 x 6, 3/4" Bore, P/N 106043				
	Prop 8 x 8, 3/4" Bore, P/N 106218				
	Prop 10 x 10, 3/4" Bore, P/N 106219				
	Prop 12 x 12, 3/4" Bore, P/N 106220				
	Prop 13 x 13, 3/4" Bore, P/N 106221				
	Prop 13 x 13, 1" Bore, P/N 1 06222				
	Prop 16 x 16, 1-1/4" Bore, P/N 106225				
Prop 11 x 11, 3/4" Bore, P/N 106229					
Prop 7 x 7, 1" Bore, P/N 106232					
Prop 15 x 15, 1-1/4" Bore, P/N 106344					

PARTS LIST
For Series JG Clamp Mount Model Mixers
(Refer to Drawing on Page 8)

ITEM NUMBER	ITEM DESCRIPTION	QTY.	MODEL JG2.0 - JG6.1	MODEL JG7.1 - JG8.4	MODEL JG9.1
1	Mixer Gearbox - Body	1	003161	003053	003053
2	Drive Screw	1	100370	N/A	N/A
3	Clamp Button	1	000476	N/A	N/A
4	Stud	1	002683	N/A	N/A
5	Mounting Clamp	1	003146	N/A	N/A
6	Hex Head Cap Screw or Stud	1	100397	N/A	N/A
7*	Flat Washer	1	100369	N/A	N/A
8	Pivot Washer	1	100509	N/A	N/A
9	Flat Washer	1	106833	N/A	N/A
10	Hex Nut	1	WA170583	N/A	N/A
11	Helical Pinion	1	003143	003141	003054
12	Hex Head Cap Screw	4	100216	100216	100216
13	Lock Washer	4	100217	100217	100217
14	Hex Head Cap Screw	6	106748	106748	106748
15	Lock Washer	6	100075	100075	100075
16	Motor Gasket	1	106097	106097	106097
17	Set Screw	1	105159	105159	105159
18	Key	1	003060	106589	003060
19	Dowel Pin	2	100351	100579	100579
20	Retaining Ring	1	106594	106496	106496
21	Motor Midplate	1	003148	003147	003057
22	Key	1	100110	100110	100110
23	Midplate Gasket	1	106507	106494	106494
24	Helical Gear	1	003144	003142	003055
25	Seal	1	106586	106542	106542
26	Retaining Ring	1	106592	106562	106562
27*	Ball Bearing	1	106180	106495	106495
28	Shaft Adapter, 3/4" dia.	1	003407	N/A	N/A
	Shaft Adapter, 1" dia.	1	003407	N/A	N/A
	Shaft Adapter, 1-1/4" dia.	1	N/A	003058	003058
29	Retaining Ring	2	106593	106497	106497
30*	Ball Bearing	1	106588	106564	106564
31	Felt Wiper Seal	1	106502	106488	106488
32	Setscrew	2	104618	104618	104618
33	Shaft Adapter Reducer, 1" to 3/4"	1	004647	N/A	N/A
	Shaft Adapter Reducer, 1-1/4" to 1"	1	N/A	004648	N/A

*Recommended Spare Parts

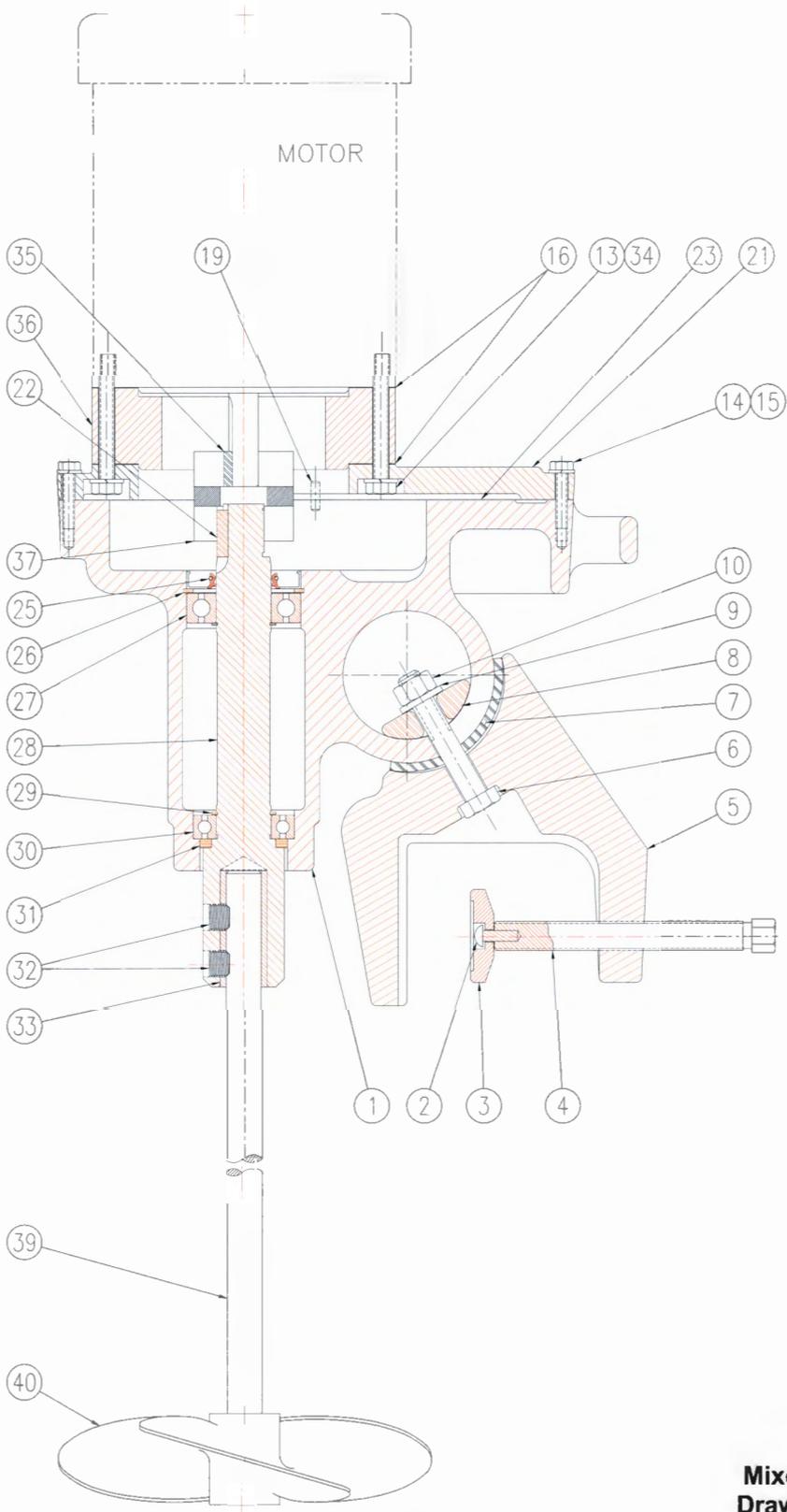


Mixer Model JG
Drawing No. S00070

PARTS LIST
For Series JD Clamp Mount Model Mixers
(Refer to Drawing on Page 10)

ITEM NUMBER	ITEM DESCRIPTION	QTY.	MODEL	MODEL
			JD2.0 - JG6.1	JD7.1 - JD7.4
1	Mixer Gearbox - Body	1	003161	003053
2	Drive Screw	1	100370	100370
3	Clamp Button	1	000476	000476
4	Stud	1	002683	002683
5	Mounting Clamp	1	003146	002682
6	Hex Head Cap Screw or Stud	1	100397	106387
7*	Flat Washer	1	100369	100369
8	Pivot Washer	1	100509	106074
9	Flat Washer	1	106833	100051
10	Hex Nut	1	WA170583	108518
13	Lock Washer	4	100217	100217
14	Hex Head Cap Screw	6	106748	106748
15	Lock Washer	6	100075	100075
16	Motor Gasket	1	106097	106097
19	Dowel Pin	2	100351	100579
21	Motor Midplate	1	003148	003057
22	Key	1	100110	100110
23	Midplate Gasket	1	106507	106494
25	Seal	1	106586	106542
26	Retaining Ring	1	106592	106562
27*	Ball Bearing	1	106180	106495
28	Shaft Adapter, 3/4" dia.	1	003407	N/A
	Shaft Adapter, 1" dia.	1	003407	003058
	Shaft Adapter, 1-1/4" dia.	1	N/A	N/A
29	Retaining Ring	2	106593	106497
30*	Ball Bearing	1	106588	106564
31	Felt Wiper Seal	1	106502	106488
32	Setscrew	2	104618	104618
33	Shaft Adapter Reducer, 1" to 3/4"	1	004647	N/A
	Shaft Adapter Reducer, 1-1/4" to 1"	1	N/A	004648
34	Hex Head Cap Screw	4	108338	108338
35	Key	1	100218	100218
36	Motor Extension	1	003197	003197
37	Coupling	1	106664	106640

*Recommended Spare Parts



10

**Mixer Model JD
Drawing No. S00072**

PARTS LIST

For Series JGR and JDR Angle Riser Mount Model Mixers

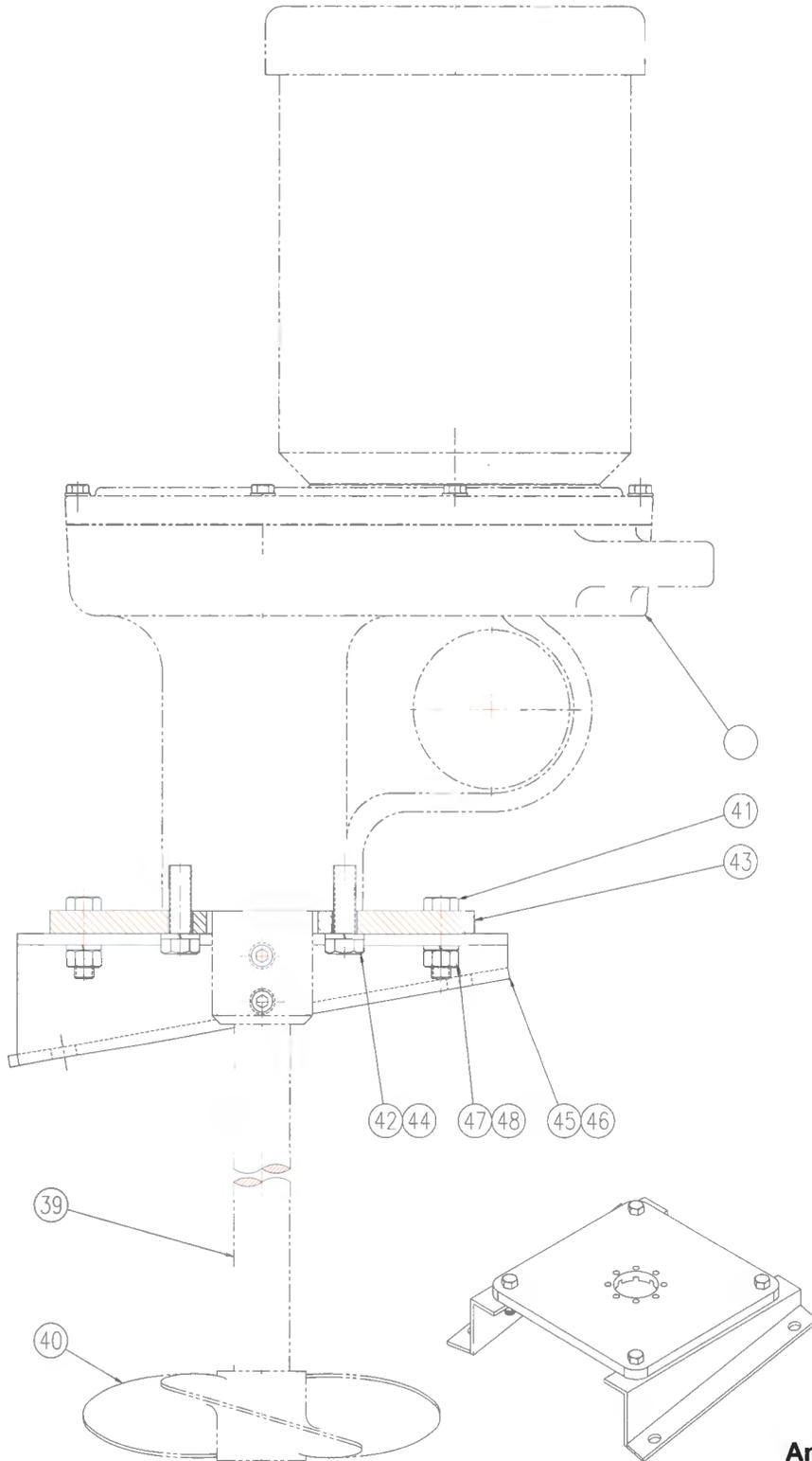
NOTE: All parts in JGR and JDR Mixers are the same as JG or JD Mixers except mounting clamps. JGR and JDR Mixers do not use items 2 to 10 including items on parts list (Refer to pages 7 and 9). JGR and JDR do use parts listed below for Angle Riser Mount.

ITEM NUMBER	PART NUMBER	ITEM DESCRIPTION	QTY. PER ASSEMBLY	
			JGR QTY.	JDR QTY.
1 **	003161	Mixer Gearbox - Body	1	1
41	106268	Hex Head Cap Screw	4	4
42 **	106704	Hex Head Cap Screw	4	4
	106996	Socket Head Cap Screw	8	8
43 **	106281	Angle Riser Midplate	1	1
	106809	Angle Riser Midplate	1	1
44 **	100457	Lock Washer	4	4
	108592	Internal Tooth Lock Washer	8	8
45	002794	Angle Riser (Right Side)	1	1
46	002795	Angle Riser (Left Side)	1	1
47	100105	Lock Washer	4	4
48	106267	Hex Nut	4	4

**These Parts are for JGR/JDR-2.0-JGR/JDR 6.1 Only.

INSTALLATION:

1. Remove the Mixer and Angle Riser Unit (A.R.U.) from their shipping cartons.
2. Install assembled A.R.U. onto tank, see page 3, for mounting instruction, and secure in place.
3. Place Mixer onto A.R.U. and secure with hardware provided (42, 44).
4. Insert Shaft into Mixer Shaft Collar and secure as described on page 5 in Section "0" of the Operating and Instruction Manual of Series JG and JD Mixers.



**Angle Riser Mount
Drawing No. S00051**

FLANGE MOUNTING MIXER ADDENDUM TO OPERATING AND INSTRUCTION MANUAL FOR SERIES JG AND JD MIXERS

PARTS LIST For Series JGF and JDF Stuffing-Box Model Mixers

NOTE: All parts in JGF and JDF Mixers are the same as JG or JD Mixers except mounting clamps. JGF and JDF Mixers do not use items 2 to 10 including items on parts list (Refer to pages 7 and 9). JGF and JDF do use Parts listed below for Flange Mount.

ITEM NO.	PART NO.	ITEM DESCRIPTION	QTY.
1 **	003161	Mixer Gearbox - Body	1
42	106704	Hex Head Cap Screw 1/2-20 x 1-1/2" lg.	4
**	106996	Socket Head Cap Screw 1/4-20 x 3/4" lg.	8
44	100457	1/2" Lock Washer	4
**	108592	1/4" Internal Tooth Lock Washer	8
47	100105	7/16" Lock Washer	16
48	106267	7/16-14 Hex Nut	8
49	106619	Hex Head Cap Screw 7/16-14 x 1-3/4" lg.	8
50 **	003270	Mixer Spacer Adapter	1
	003271	Mixer Spacer Adapter	1
51	003260	Stuffing-Box Spacer	1
52	108180	3/8-16 Hex Nut with Nylock	4
53 **	003265	1" dia. Shaft, Sealing Bushing	1
	003266	1-1/4" dia. Shaft, Sealing Bushing	1
**	003274	3/4" dia. Shaft, Sealing Bushing	1
54	106620	3/8-16 x 3-1/2" lg. Stud	4
55	100036	Grease Filling	1
56	100104	Hex Head Cap Screw 7/16-14 x 1-1/4" lg.	8
*57 **	003261	1" dia. Shaft, Lantern Ring	1
	003262	1-1/4" dia. Shaft, Lantern Ring	1
**	003273	3/4" dia. Shaft, Lantern Ring	1

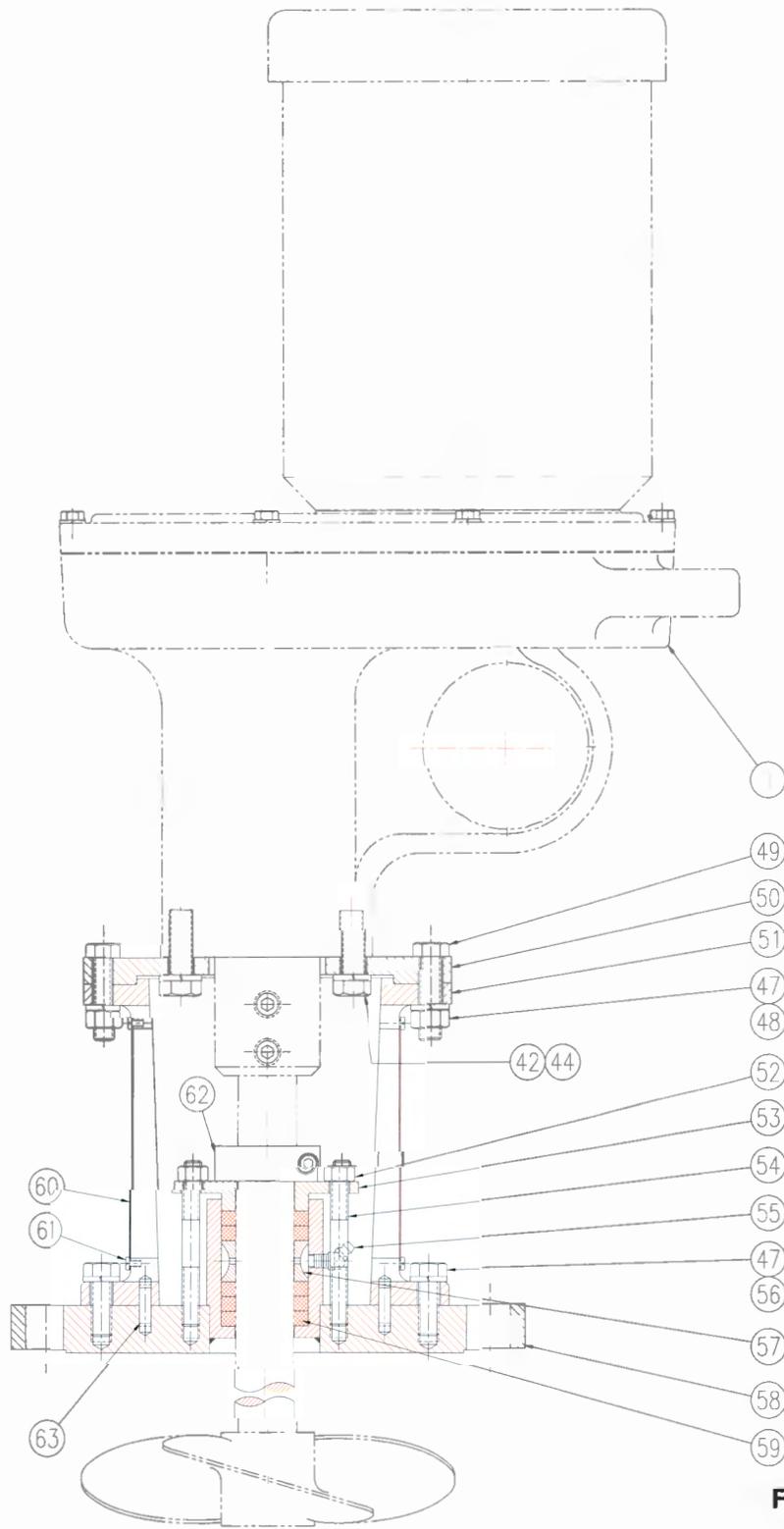
*Recommended Spare Parts.

**These Parts are for Models JGF JDF-2.0 through JGF/JDF-6.1 Only.
Item 58 available in 316SS & Carbon Steel.

ITEM NO.	PART NO.	ITEM DESCRIPTION	QTY.
58 **		1" dia. Shaft, 6" Flange Assembly	1
**		1" dia. Shaft, 8" Flange Assembly	1
**		1" dia. Shaft, 10" Flange Assembly	1
**		1" dia. Shaft, 12" Flange Assembly	1
**		1" dia. Shaft, 14" Flange Assembly	1
		1-1/4" dia. Shaft, 6" Flange Assembly	1
		1-1/4" dia. Shaft, 8" Flange Assembly	1
		1-1/4" dia. Shaft, 10" Flange Assembly	1
		1-1/4" dia. Shaft, 12" Flange Assembly	1
		1-1/4" dia. Shaft, 14" Flange Assembly	1
**		3/4" dia. Shaft, 6" Flange Assembly	1
**		3/4" dia. Shaft, 8" Flange Assembly	1
**		3/4" dia. Shaft, 10" Flange Assembly	1
**		3/4" dia. Shaft, 12" Flange Assembly	1
**		3/4" dia. Shaft, 14" Flange Assembly	1
59 **	003267	1" dia. Shaft, Packing	5
	003268	1-1/4" dia. Shaft, Packing	5
**	003269	3/4" dia. Shaft, Packing	5
60	003272	Mixer Window Screen	2
61	106621	#8-32 x 3/8 lg. Pan Head Screw	8
62 **	106614	1" dia. Shaft Collar	1
	106615	1-1/4" dia. Shaft Collar	1
**	106811	3/4" dia. Shaft Collar	1
63	101208	1/4" x 3/4" lg. Dowel Pin	2

INSTALLATION:

1. Remove the Mixer and Flange Mounting Unit (F.M.U.) from their shipping cartons.
2. Remove the (2) Window Screens [60] by unscrewing (8) Screws [61].
3. Remove Mixer Spacer Adapter [50] from the F.M.U.
4. Place the Propellers on the end of the shaft WITHOUT THE NOTCH and then insert into the empty tank.
5. Lubricate the end of the Shaft WITH THE NOTCH and insert through the Orifice of the F.M.U. to protrude approximately 2-1/2", taking care as not to mar the surface of the propeller shaft.
6. To prevent the Shaft from falling into the tank, place the Shaft Collar [62] on the Shaft and secure with a Socket Head Screw and Hex Wrench provided.
7. Install assembled F.M.U. onto Tank and secure in place, make sure that there is free access to the Stuffing Chamber through the windows.
8. Fasten Mixer Spacer [50] with Screws [42] and Lock Washers [44] onto Mixer.
9. Place Mixer assembled with Mixer Spacer Adapter [50] onto F.M.U. and secure with Hardware provided [47, 48, 49].
10. Insert Shaft into Mixer Shaft Collar and secure as described on pg. 5 in Section D, of the Operating and Instruction Manual of Series JG & JD Mixers.
11. Pack Stuffing Chamber with Grease through Grease Fitting [55].
12. Adjust the Packing Pressure with Sealing Bushing [53] by applying approximately 10 in. lbs. to the (4) 3/8-16 Hex Nuts (tightened uniformly).
13. Replace Window Screens [60] before operating Mixer.



Flange Mounting Unit
Drawing No. S00073

MATERIAL SAFETY DATA SHEET

SECTION 1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

LUBRIPLATE® Lubricants Co.
129 Lockwood St.
Newark, NJ 07105

Emergency Telephone Number:
1-800-255-3924-CHEM-TEL (24 hour)
Telephone Number for information:
1-973-589-9150

SUBSTANCE: LUBRIPLATE 1200-2

MSDS No. 0892150102001

TRADE NAMES/SYNONYMS:

PRODUCT USE: Petroleum lubricating grease

CREATION DATE: 06/14/2007

REVISION DATE: 01/21/2010

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT: Residual oils (petroleum), solvent dewaxed
CAS NUMBER: 64742-62-7
EC NUMBER (EINECS): 265-166-0
PERCENTAGE: 40-45

COMPONENT: Heavy hydrotreated naphthenic distillates (petroleum)
CAS NUMBER: 64742-52-5
EC NUMBER (EINECS): 265-155-0
PERCENTAGE: 35-40

COMPONENT: Zinc oxide
CAS NUMBER: 1314-13-2
EC NUMBER (EINECS): 215-222-5
PERCENTAGE: 5-10

COMPONENT: 12 hydroxy stearic acid
CAS NUMBER: 106-14-9
EC NUMBER (EINECS): 203-366-1
PERCENTAGE: 5-10

COMPONENT: Antimony 0,0-dipropylphosphorodithionate
CAS NUMBER: 15874-48-3
EC NUMBER (EINECS): 240-001-5
PERCENTAGE: 0-2

COMPONENT: Inedible animal grease
CAS NUMBER: 68153-81-1

EC NUMBER (EINECS): 268-896-8
PERCENTAGE: 0-2

COMPONENT: Lithium hydroxide monohydrate
CAS NUMBER: 1310-66-3
EC NUMBER (EINECS): Not assigned
PERCENTAGE: 0-2

COMPONENT: Butyl zimate
CAS NUMBER: 136-23-2
EC NUMBER (EINECS): 205-232-8
PERCENTAGE: 0-1

COMPONENT: Hydroxyalkyl carboxylic acid
CAS NUMBER: NA
EC NUMBER (EINECS): NA
PERCENTAGE: 0-1

COMPONENT: Methacrylate copolymer
CAS NUMBER: NA
EC NUMBER (EINECS): NA
PERCENTAGE: 0-1

NOTE: The IP 346 value of the mineral oil is less than 3%

SECTION 3 HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS:

INHALATION: SHORT TERM EXPOSURE: Irritation

LONG TERM EXPOSURE: Lung damage

SKIN CONTACT:

SHORT TERM EXPOSURE: Irritation

LONG TERM EXPOSURE: Irritation, skin disorders

EYE CONTACT:

SHORT TERM EXPOSURE: Irritation

LONG TERM EXPOSURE: No information available

INGESTION:

SHORT TERM EXPOSURE: Diarrhea, difficulty breathing

LONG TERM EXPOSURE: no information on significant adverse effects

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM (HMIS):

Health - 1

Flammability - 1

Reactivity - 0

Not a Controlled Product under (WHMIS) - Canada

Special Protection: See Section 8

SECTION 4 FIRST AID MEASURES

INHALATION: Vapor pressure is very low and inhalation at room temperature is not a problem. If overcome by vapor from hot product, immediately remove from exposure and call a physician.

SKIN CONTACT: Remove any contaminated clothing and wash with soap and warm water. If injected by high pressure under skin, regardless of the appearance or its size, contact a physician IMMEDIATELY. Delay may cause loss of affected part of the body.

EYE CONTACT: Flush with clear water for 15 minutes or until irritation subsides. If irritation persists, consult a physician.

INGESTION: If ingested, call a physician immediately. Do not induce vomiting.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Slight fire hazard

EXTINGUISHING MEDIA: Foam, Dry Chemical, Carbon Dioxide or Water Spray (Fog)

SPECIAL FIRE FIGHTING PROCEDURES: Cool exposed containers with water. Use air-supplied breathing equipment for enclosed or confined spaces.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Do not store or mix with strong oxidants. Empty containers retain residue. Do not cut, drill, grind, or weld, as they may explode.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE: Scrape up grease, wash remainder with suitable petroleum solvent or add absorbent. Keep petroleum products out of sewers and water courses. Advise authorities if product has entered or may enter sewers and water courses.

SECTION 7 HANDLING AND STORAGE

STORAGE: Keep containers closed when not in use. Do not handle or store near heat, sparks, flame, or strong oxidants.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:

OIL MIST IN AIR (Not Encountered in Normal Usage):

5 mg/m³ UK OES TWA

10mg/m³ UK OES STEL

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant (nitrile) gloves.

RESPIRATOR: Consider the need for appropriate protective equipment, such as self-contained breathing apparatus, adequate masks and filters.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: semi-solid
APPEARANCE: smooth
COLOUR: beige
PHYSICAL FORM: grease
ODOR: mineral oil odor
BOILING POINT: >288°C
FREEZING POINT: Not available
FLASH POINT: 218°C (COC)
LOWER FLAMMABLE LIMIT: 0.9% by volume
UPPER FLAMMABLE LIMIT: 7.0% by volume
AUTO IGNITION: not available
VAPOUR PRESSURE: not available
VAPOR DENSITY (air=1): not available
SPECIFIC GRAVITY (water=1): 0.941
DENSITY: not available
WATER SOLUBILITY: negligible
pH: not available
VOLATILITY: not available
ODOR THRESHOLD: not available
EVAPORATION RATE (Butyl acetate = 1): <0.01
VISCOSITY: not available
COEFFICIENT OF WATER/OIL DISTRIBUTION: not available

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressures

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Avoid contact with incompatible materials.

INCOMPATIBLES: Oxidising materials, chlorine

HAZARDOUS DECOMPOSITION:

Thermal decomposition products or combustion: oxides of carbon, oxides of sulphur

POLYMERISATION: Will not polymerise.

SECTION 11 TOXICOLOGICAL INFORMATION

Residual oils (petroleum), solvent dewaxed:

TOXICITY DATA:

No data available

Heavy hydrotreated naphthenic distillates (petroleum):

TOXICITY DATA:

No data available

Zinc oxide:

TOXICITY DATA:

No data available

12 hydroxy stearic acid:

TOXICITY DATA:

Greater than 5 g/kg oral-rat LD50

Antimony 0,0-dipropylphosphorodithionate

TOXICITY DATA:

4,695 mg/kg oral-rat LD50

Inedible animal grease:

TOXICITY DATA:

No data available

Lithium hydroxide monohydrate:

TOXICITY DATA:

210 g/kg oral-rat LD50

Butyl zimate:

TOXICITY DATA:

Greater than 16,000 g/kg oral-rat LD50

Hydroxyalkyl carboxylic ester:

TOXICITY DATA:

Between 2,000 and 5,000 g/kg oral-rat LD50

Alkyl thiadiazole mixture:

TOXICITY DATA:

Greater than 10,000 g/kg oral-rat LD50

SECTION 12 ECOLOGICAL INFORMATION

Not available

SECTION 13 DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations

SECTION 14 TRANSPORT INFORMATION

LAND TRANSPORT ADR: No classification assigned.

LAND TRANSPORT RID: No classification assigned.

AIR TRANSPORT IATA: No classification assigned.

AIR TRANSPORT ICAO: No classification assigned.

MARITIME TRANSPORT IMDG: No classification assigned.

SECTION 15 REGULATORY INFORMATION

EUROPEAN REGULATIONS:

EC CLASSIFICATION (CALCULATED): N

Risk Phrases: R51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

SARA/TITLE III, Section 313 Status – Zinc Compounds <6%, Antimony Compounds <3%

SECTION 16 OTHER INFORMATION

The above information is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of LUBRIPLATE Lubricants Company. The data on these sheets relates only to the specific material designated herein. LUBRIPLATE Lubricants Company assumes no legal responsibility for use or reliance upon this data.

APPENDIX J
Air Compressors

Submittal #69, Section 15251

Atlas Copco

KT Series Air Compressor Manual



For questions concerning this air compressor,
please contact your distributor.

Rev. 0807

Printed in USA

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2	When Installing or Moving the Compressor Before Each Use
3	Follow Safety Precautions for Electrical Connection Plan Ahead to Protect Your Eyes, Hands, Face & Ears When Operating
4	Spraying Precautions Perform These Maintenance Operations
5	Typical Compressor Installation Glossary
6	Wiring Starting the Compressor (Electric Compressors)
7	Starting the Compressor (Gasoline)
8	Troubleshooting Guide
9	Troubleshooting (Cont.)
10	Warranty Statement

SAFETY GUIDELINES - DEFINITIONS

Safety is a combination of common sense, staying alert and knowing how your compressor works. Read this manual to understand this compressor.



DANGER

means if safety information is not followed someone will be seriously injured or killed



WARNING

means if safety information is not followed someone could be seriously injured or killed



CAUTION

means if safety information is not followed someone may be seriously injured or killed

IMPORTANT SAFETY INSTRUCTIONS

Save these instructions

Improper operation or maintenance of this product could result in serious injury and property damage. Read and understand all warnings and operation instructions before using this compressor.

Before using the air compressor

Things you should know

Air compressors are utilized in a variety of air system applications. Because air compressors and other components (hoses, connectors, air tools, spray guns, etc.) make up a high pressure pumping system, the following safety precautions should be observed at all times.

Only persons familiar with these rules of safe operation should use the air compressor.

1. Read the instruction manual carefully before attempting to assemble, disassemble or operate your system. Be thoroughly familiar with the controls and the proper use of the equipment.
2. Review and understand all safety instructions and operating procedures in this manual.
3. Review the maintenance methods for this compressor (See "Maintaining Your Compressor" section).

Inspect your work area

1. Keep work area clean.
2. Cluttered areas and benches invite accidents. Floors must not be slippery from wax or dust.

Inspect your compressor

1. To reduce the risk of injury from accidental starting, turn switch off and disconnect the power before checking it.
2. If any part is missing, bent or broken in any way, or any electrical part does not work properly, keep the compressor off and disconnected.
3. Check hoses for weak or worn condition before each use, making certain all connections are secure. Do Not use if defect is found.



WARNING

Do not operate compressor if damaged during shipping, handling or use. Damage may result in bursting and cause injury or property damage.



DANGER

This compressor is Not designed for and should not be used in breathing air applications.

When installing or moving the compressor



WARNING

This compressor is extremely top heavy. The compressor must be bolted to the floor with vibration pads before operating to prevent equipment damage, injury or death. **Do Not** tighten bolts completely as this may cause stress to the tank welds.

To reduce the risk of a dangerous environment

1. Keep work area well lit.
2. Operate compressor in a well-ventilated area free from flammable liquids and vapors.
3. Operate compressor in a ventilated area so that compressor may be properly cooled and the surrounding air temperature will not be more than 103°F.
4. Never use a compressor in a wet environment.
5. Protect material lines and air lines from damage or puncture. Keep hose and wires away from sharp objects, chemical spills, oil, solvents and wet floors.



WARNING

Do Not secure compressor with toggle bolts into drywall. Drywall, sheetrock or plaster will not support the weight of the compressor.

Note: Tank Outlet Size: ~~1/2" NPT for KT52-V60~~

3/4" NPT for All 80 Gallon and Simplex 120 Gallon Units

1" NPT for All Duplex Compressors

6. A minimum clearance of 18 inches between the compressor and a wall is required because objects could obstruct airflow.
7. The compressor should be located where it can be directly wired to a circuit breaker. The compressor should be wired by a qualified electrician.
8. Never store flammable liquids or gases in the vicinity of an operating compressor.
9. **Do Not** locate the compressor air inlet near steam, paint spray, sandblasting areas or any other source of contamination. The debris could damage the motor and pump.



WARNING

Never use plastic (PVC) pipe for compressed air. Serious injury or death could result.



CAUTION

Never use the shipping skid for mounting the compressor.



NOTICE

This compressor is not intended for outdoor installation.



WARNING

Never install a shut off valve between the compressor pump and tank. Personal injury and/or equipment damage could occur.

Before each use

Inspect your work area

1. Keep work area clean. Cluttered areas and benches invite accidents.
2. The floor must not be slippery from wax or dust.

Inspect your compressor

1. To reduce the risk of injury from accidental starting, turn the switch off and disconnect power.
2. If any part is missing, bent or broken in any way, or any electrical part does not work properly, keep the compressor off and disconnect power. **Do Not** use if defect is found.
3. Check hoses for weak or worn condition before each use, making certain all connections are secure. **Do Not** use if a defect is found.

Follow the safety precautions for electrical connections

1. Follow all local electrical and safety codes, as well as the National Electric Code (NEC) and the Occupational Safety and Health Act (OSHA).
2. Wiring and fuses should follow electrical codes, current capacity and be properly grounded.
3. Protect wires from contact with sharp objects.



CAUTION

All electrical connections should be made by a qualified electrician.

Plan ahead to protect your eyes, hands, face and ears

Dress for safety

1. Wear safety glasses (meeting ANSI Z87.1 or in Canada CSA Z94.3-99) and use hearing protection when operating the unit. Everyday glasses are not safety glasses.
2. Wear shoes to prevent shock hazards.
3. Tie back long hair.



WARNING

Be careful when touching the exterior of compressor, pump, motor and air lines, they may become hot enough to cause injury.



WARNING

Never operate the compressor without a beltguard. The compressor can start automatically without warning. Personal injury or property damage could occur from contact with moving parts.

Pay attention to your hands



WARNING

Keep fingers away from running compressor. Fast moving and hot parts may cause injury and/or burns.



CAUTION

The compressor may be hot even if the unit is stopped.



WARNING

Use of a mask or respirator per chemical manufacturers' instructions may be necessary if there is a chance of inhaling toxic fumes. Read mask and respirator instructions carefully. Consult a safety expert if you are not sure about the use of certain masks or respirators.

When operating

1. Do not exceed the pressure rating of any component of the system.
2. Release pressure within the system slowly to prevent flying dust and debris.
3. If the equipment starts to abnormally vibrate, STOP the compressor immediately and check for the cause.



WARNING

Never change the safety valve or pressure switch settings. Keep safety valve free from paint and other accumulations. See compressor specification decal for maximum operating pressure. Do not operate with the pressure switch set higher than the maximum operating pressure.

Spraying precautions



WARNING

Never point a spray gun at yourself or any other person or animal. Accidental discharge may result in serious injury.

Reduce the risk of dangerous environment



WARNING

Extreme caution should be taken when spraying flammable liquids as the spark from a motor or pressure switch may cause a fire or explosion. Ample ventilation must be provided.



WARNING

Spray in a well ventilated area to keep fumes from collecting and causing serious injury and fire hazards.

1. **Do Not** spray in the vicinity of open flames or other places where a spark can cause ignition. **Do Not** smoke when spraying paint, insecticides, or other flammable substances.

Be informed about the materials you use

1. When spraying with solvents or toxic chemicals, follow the instructions provided by the chemical manufacturer. Consult a safety expert if unsure about the use of masks or respirators.
2. If the material you intend to spray contains trichloroethane and methylene chloride, do not use accessories that contain aluminum or galvanized materials, as these chemicals can react with galvanized components causing corrosion and weakening equipment. Use stainless steel accessories.

Perform these maintenance operations

1. Do regular maintenance; keep all nuts, bolts, and screws tight, to be sure equipment is in safe working condition.
2. Inspect tank yearly for rust, pin holes or any other imperfections that could cause it to become unsafe.



WARNING

NEVER attempt to repair or modify a tank! Welding, drilling or any other modification will weaken the tank resulting in damage from rupture or explosion. Always replace worn, cracked or damaged tanks.

3. Clean electrical equipment with an approved cleaning agent, such as a dry, non-flammable cleaning solvent.

4. Drain tanks of moisture after each day's use. If unit will not be used for awhile, it is best to leave the drain cock open until such time as it is to be used. This will allow moisture to completely drain out and help prevent corrosion of inside of tank.

5. Always disconnect from power source before working on or near a motor, or its connected load. If power disconnect point is out-of-sight, secure it in the "OFF" position and tag it to prevent unexpected application of power.



WARNING

Disconnect power and depressurize system before servicing air compressor. Slightly open drain cock after shutting off compressor.

Daily

Check oil level at sight glass. Oil level should be 1/2 to slightly higher in the oil sight glass.

Drain moisture from tank.

Verify the pressure switch unloader is working by listening for a brief hissing sound when the compressor shuts off.

Visually check the compressor for loose parts, excessive noise or vibration. Tighten any necessary part.

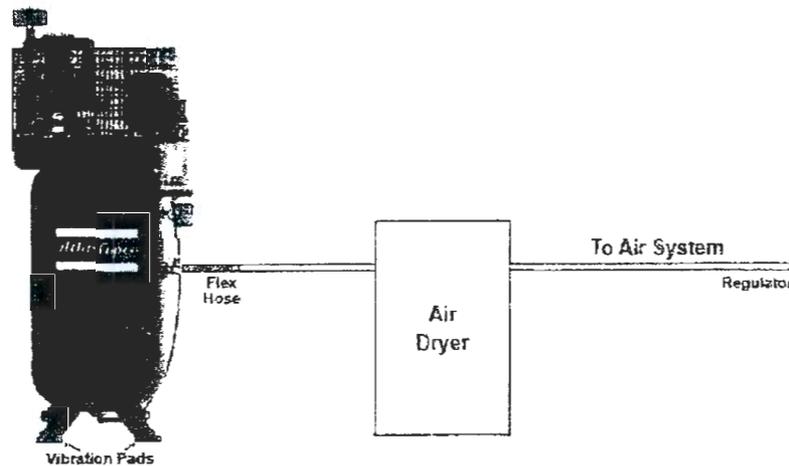
Monthly

(Make sure the main power is off.) Check the belts for tension. Belts should not move up and down when the compressor runs and when stopped, should not have more than 1/2 in of play when depressed. Be careful not to over tighten belts during adjustment.

Remove and check air filter, replace if necessary.

Change oil every 3 months or 300 hours. A compressor grade 30 wt non-detergent oil should be used.

TYPICAL COMPRESSOR INSTALLATION



GLOSSARY OF TERMS

Air Filter

Porous element contained within a metal or plastic housing attached to the compressor cylinder head which removes impurity from the intake air of the compressor.

Air Tank

Cylindrical component which contains the compressed air.

Check Valve

Device which prevents compressed air from flowing back from the air tank to the compressor pump.

Electric Motor

Device which provides the rotational force necessary to operate the compressor pump.

Pressure Gauge

Device which shows the tank or regulated pressure of the compressed air.

Pressure Switch

Device which automatically controls the on/off cycling of the compressor. It stops the compressor when the cut-off pressure in the tank is reached and starts the compressor when the air pressure drops below the cut-in pressure.

PSI (Pounds per Square Inch)

Measurement of the pressure exerted by the force of air. The actual psi is measured by a pressure gauge on the compressor.

Pump

Device which produces the compressed air with a reciprocating piston contained within a cylinder.

Safety Valve

Device which prevents air pressure in the air tank from rising over a predetermined limit.

Thermal Overload Switch

Device, integrated into the electric motor winding, which automatically "shuts off" the compressor if the temperature of the electric motor exceeds a predetermined limit.

WIRING



WARNING

ALL ELECTRICAL WIRING SHOULD BE DONE BY A QUALIFIED ELECTRICIAN

General Information

Adequate wiring and motor protection should be provided for all stationary compressors. Wiring used for other machinery should not be used. A qualified electrician familiar with local electrical codes in your area should be used. Size supply wiring per NEC (National Electric Code) requirements.



WARNING

To reduce the risk of electrical hazards, fire hazards or damage to the compressor, use proper circuit protection. Your compressor is wired at the factory for operation using the voltage shown. Connect the compressor to a power source with the correct breaker size.



WARNING

Electrical connections must be properly grounded. Ground connections should be connected at the grounding screw.



CAUTION

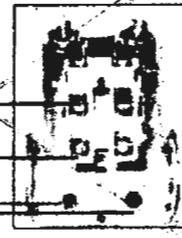
Overheating, short circuiting and fire damage will result from inadequate wiring.

For Models Without Magnetic Starter

Incoming power should be connected to the posts marked (line)

Do Not Make Connections On Prewired Posts (Motor)

Grounding Screw



For Models With Magnetic Starter

Incoming power should be connected to L1 and L2 at the Top of the Magnetic Starter *

*3 Phase units should be connected to L1, L2 and L3.

Ground

DO NOT MAKE CONNECTIONS AT THE PRESSURE SWITCH



STARTING THE COMPRESSOR

Prior to actually running the compressor, check the following items:

Crankcase oil - Make sure the sight glass shows 1/2 full or slightly above.

Make sure all rags, tools, oil, etc. are away from the unit.

Open the air system to free it of any pressure.

Switch the compressor on for a few revolutions to make sure the rotation is correct. Correct rotation is clockwise when facing the sight glass on the pump.

Operate the compressor for a few minutes unloaded (air system open) then allow the compressor to pump up. Make sure the electrical pressure switch properly switches off the compressor according to the setting desired. (165 for KT52eV60, and 175 psi for all other Two Stage.)



CAUTION

Make sure the pressure in the tank does not exceed its rating. Model KT52eV60 should operate at a maximum of 165 psi, other Two Stage units at a maximum of 175 psi. If the pressure gauge indicates a pressure that is higher than these maximum pressures, shut off compressor immediately and call your distributor.

TROUBLESHOOTING GUIDE		
Low discharge pressure	<ol style="list-style-type: none"> 1. Compressor too small for application 2. Air leaks 3. Restricted intake air 4. Blown gasket(s) 5. Broken or misaligned valves 	<ol style="list-style-type: none"> 1. Reduce air demand or use a compressor with more air capacity. 2. Listen for air leaks. Apply a soap solution to all fittings and connections. Bubbles will form at points of leakage. Tighten or replace fittings or connections. 3. Clean or replace air filter. 4. Replace necessary gaskets. 5. Remove head and inspect for broken or misaligned valves. Replace valves, if necessary. <p>CAUTION Install a new head gasket each time head is removed</p>
Excessive noise "knocking"	<ol style="list-style-type: none"> 1. Loose drive pulley or flywheel 2. Low on oil 3. Worn connecting rod or connecting rod bearing 4. Noisy check valve 	<ol style="list-style-type: none"> 1. Tighten drive pulley or flywheel bolt. 2. Check for proper oil level. Low or dirty oil may cause bearing damage 3. Replace connecting rod and/or connecting rod bearings. 4. Replace check valve. <p>DANGER Do not remove check valve with air pressure in tank</p>
Excessive oil carryover	<ol style="list-style-type: none"> 1. Worn piston rings 2. Restricted intake air 3. Too much oil in compressor 4. Incorrect oil viscosity 	<ol style="list-style-type: none"> 1. Replace with new piston rings 2. Clean or replace air filter 3. Drain oil to proper oil level 4. Use a quality non-detergent 30 or 40wt oil specified for each model (Page 4).
Water in tank and/or discharge line	<ol style="list-style-type: none"> 1. Normal Amount of water will increase as humidity in the air increases. 	<ol style="list-style-type: none"> 1. Drain tank at least once per day. 2. Add an inline filter to reduce moisture in the air line
Will not run or motor hums	<ol style="list-style-type: none"> 1. Low voltage 2. Malfunctioning pressure switch 3. Malfunctioning check valve 	<ol style="list-style-type: none"> 1. Check voltage with volt meter across both legs of incoming power. Check reset button on motor. 2. Repair or replace pressure switch. 3. Replace check valve or pressure switch. <p>DANGER Do not remove check valve with air pressure in tank</p>
Breaker or reset repeatedly trips	<ol style="list-style-type: none"> 1. Incorrect breaker size 2. Low voltage 3. Malfunctioning motor 4. Loose electrical connections 5. Malfunctioning pressure switch 6. Malfunctioning check valve 	<ol style="list-style-type: none"> 1. Make sure the breaker is sized properly. See page 6 in this manual 2. Check voltage with volt meter across both legs of incoming power. 3. Replace motor. 4. Check all electrical connections. 5. Adjust or replace pressure switch. 6. Replace check valve. <p>DANGER Do not remove check valve with air pressure in tank</p>
Tank does not hold pressure when not running and shut off valve is closed	<ol style="list-style-type: none"> 1. Malfunctioning check valve 2. Loose fittings or connections 3. Crack or pin hole in tank 	<ol style="list-style-type: none"> 1. Replace check valve <p>DANGER Do not remove check valve with air pressure in tank</p> <ol style="list-style-type: none"> 2. Tighten or replace fittings or connections 3. Replace tank. Do not attempt to repair tank.

TROUBLESHOOTING GUIDE (Continued)		
Pressure switch un-loader constantly leaking air	1. Malfunctioning check valve	1. Replace check valve if unloader bleeds constantly. DANGER Do not remove check valve with air pressure in tank
Pressure switch not unloading	1. Malfunctioning pressure switch	1. Replace pressure switch if it does not release air pressure briefly when unit shuts off. DANGER Do not remove pressure switch with air pressure in tank
Excessive vibration	1. Improper installation 2. Loose belts 3. Misaligned flywheel or drive pulley	1. Make sure unit is mounted on a level surface with vibration pads 2. Replace belts. Align and tighten properly 3. Align flywheel and drive pulley.
Overheating	1. Compressor too small for application 2. Cooling surfaces dirty 3. Improper cooling	1. Reduce air demand or use a compressor with more air capacity. 2. Clean all cooling surfaces of dirt and dust. 3. Install compressor in an area with adequate cool dry air

Warranty Statement

The Company warrants that the Equipment manufactured by it and delivered hereunder shall be free from defects in material and workmanship for a period of twelve (12) months from the date of initial start-up, or eighteen (18) months from the date of shipment from the manufacturer, whichever occurs first. The foregoing warranty period shall apply to all Equipment, except for the following: (A) a two-stage reciprocating stationary models are warranted for the earlier of twenty-four (24) months from the date of initial operation or thirty (30) months from date of shipment from the manufacturer. (B) Replacement parts will be warranted for three (3) months from the date of shipment from the manufacturer. Should the failure to conform to this warranty be reported in writing to the Company within said period, the Company shall, at its option, correct such non-conformity by suitable repair to such Equipment or furnish a replacement part F.O.B. point of shipment, provided that the Purchaser has installed, maintained and operated such Equipment in accordance with good industry practices and has complied with specific recommendations of the Company. Accessories and equipment furnished by the Company, but manufactured by others, shall carry whatever warranty the manufacturer conveyed to the Company and which can be passed on to the Purchaser. The Company shall not be liable for any repairs, replacements, or adjustments to the Equipment, or any costs of labor performed by the Purchaser without the Company's prior written approval.

The Company makes no performance warranty unless specifically stated within its proposal, and the effects of corrosion, erosion, and normal wear and tear are specifically excluded from the Company's warranty. In the event performance warranties are expressly included, the Company's obligation shall be to correct in the manner and for the period of time provided above.

THE COMPANY MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. THIS WARRANTY SUPERSEDES ALL PREVIOUS WARRANTY STATEMENTS.

Correction by the Company of non-conformities, whether patent or latent, in the manner and for the period of time provided above, shall constitute fulfillment of all liabilities of the Company and its distributors for such non-conformities with respect to, or arising out of such Equipment.

LIMITATION OF LIABILITY

THE REMEDIES OF THE PURCHASER SET FORTH HEREIN ARE EXCLUSIVE, AND THE TOTAL LIABILITY OF THE COMPANY, ITS DISTRIBUTORS AND SUPPLIERS WITH RESPECT TO CONTRACT OR THE EQUIPMENT AND SERVICES FURNISHED IN CONNECTION WITH THE PERFORMANCE OR BREACH THEREOF, OR FROM THE MANUFACTURE, SALE, DELIVERY, INSTALLATION, REPAIR OR TECHNICAL DIRECTION COVERED OR FURNISHED UNDER CONTRACT, WHETHER BASED ON CONTRACT, WARRANTY, NEGLIGENCE, INDEMNITY, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE OF THE EQUIPMENT UPON WHICH SUCH LIABILITY IS BASED.

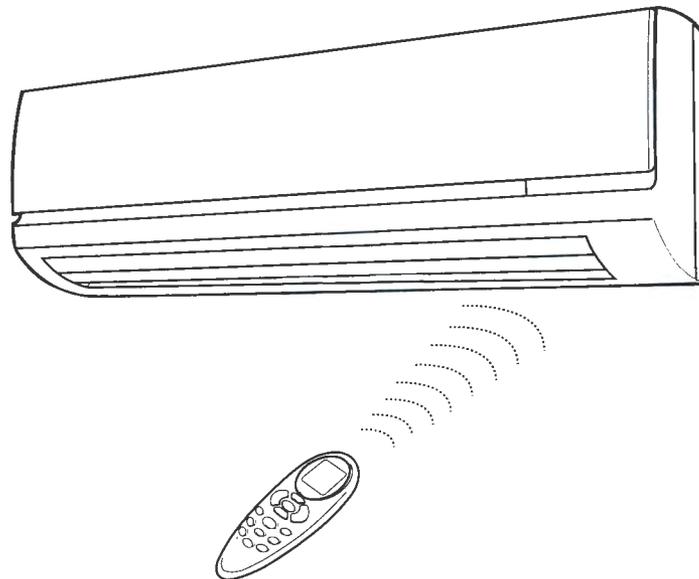
THE COMPANY, ITS DISTRIBUTORS AND ITS SUPPLIERS SHALL IN NO EVENT BE LIABLE TO THE PURCHASER, ANY SUCCESSORS IN INTEREST, OR ANY BENEFICIARY OR ASSIGNEE OF THE CONTRACT FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR PUNITIVE DAMAGES ARISING OUT OF THIS CONTRACT OR ANY BREACH THEREOF, OR ANY DEFECT IN, OR FAILURE OF OR MALFUNCTION OF THE EQUIPMENT WHETHER OR NOT BASED ON LOSS OF USE, LOSS OF PROFITS OR REVENUE, INTEREST, LOST GOODWILL, WORK STOPPAGE, IMPAIRMENT OF OTHER GOODS, LOSS BY REASON OF SHUTDOWN OR NON-OPERATION, COST OF PURCHASE OF REPLACEMENT POWER, OR CLAIMS OF PURCHASER OR CUSTOMERS OF PURCHASER FOR SERVICE INTERRUPTION, WHETHER OR NOT SUCH LOSS OR DAMAGE IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, INDEMNITY, STRICT LIABILITY OR OTHERWISE.

APPENDIX K
HVAC Equipment

Attachment K-1
Carrier Indoor AC Unit

OWNER'S MANUAL

High-Wall Fan Coil Unit



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Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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Pg 1

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Replaces: OM38/40-6

GENERAL

The high wall fan coil unit provides quiet, maximum comfort. In addition to cooling and/or heating, the high wall fan coil unit matched with an outdoor condensing unit will filter and dehumidify the air in the room to provide maximum comfort. See Fig. 1.

IMPORTANT: The high wall fan coil unit should be installed by authorized personnel only, using approved tubing and accessories. If technical assistance, service or repair is needed, contact the installer or call 1-800-227-7437.

The high wall fan coil unit can be set up and operated from the remote control (provided). See Fig. 2. If the remote is misplaced, the system can be operated from the "Auto" setting on the unit.

Operating Modes — The high wall fan coil unit has 5 operating modes:

- Fan only
- Auto (heat pump models only)
- Heating (heat pump models only)
- Cooling
- Dehumidification

FAN ONLY — In Fan Only mode, the system filters and circulates room air without changing room air temperature.

AUTO — In Auto mode, the system will automatically cool or heat the room according to the user selected set point.

If the room temperature is 2° F lower than the set point, the system will operate in Heating mode. If the room temperature is 2° F higher than the set point, the system will operate in Cooling mode.

HEATING — In Heating mode, the system heats and filters room air.

COOLING — In Cooling mode, the system cools, dries and filters room air.

DEHUMIDIFICATION — In Dehumidification mode, the system dries, filters and slightly cools room air temperature. This mode *does not* take the place of a dehumidifier.

NOTE: Two settings are available for use with selected modes. The Turbo setting provides maximum capacity. The Economical setting provides quiet, energy saving operation. Cooling and Heating modes can be operated in either the Turbo or the Economical setting. The Dehumidification mode can be operated in the Turbo setting, and the Auto mode can be operated in the Economical setting. See the Using the Turbo Setting or Using the Economical Setting sections for more information.

Remote Control (Fig. 2-6) — The remote control transmits commands to set up and operate the system. The controller has a window display panel that shows the current system status. The controller can be secured to a surface when used with the mounting rack provided. See Fig. 2.

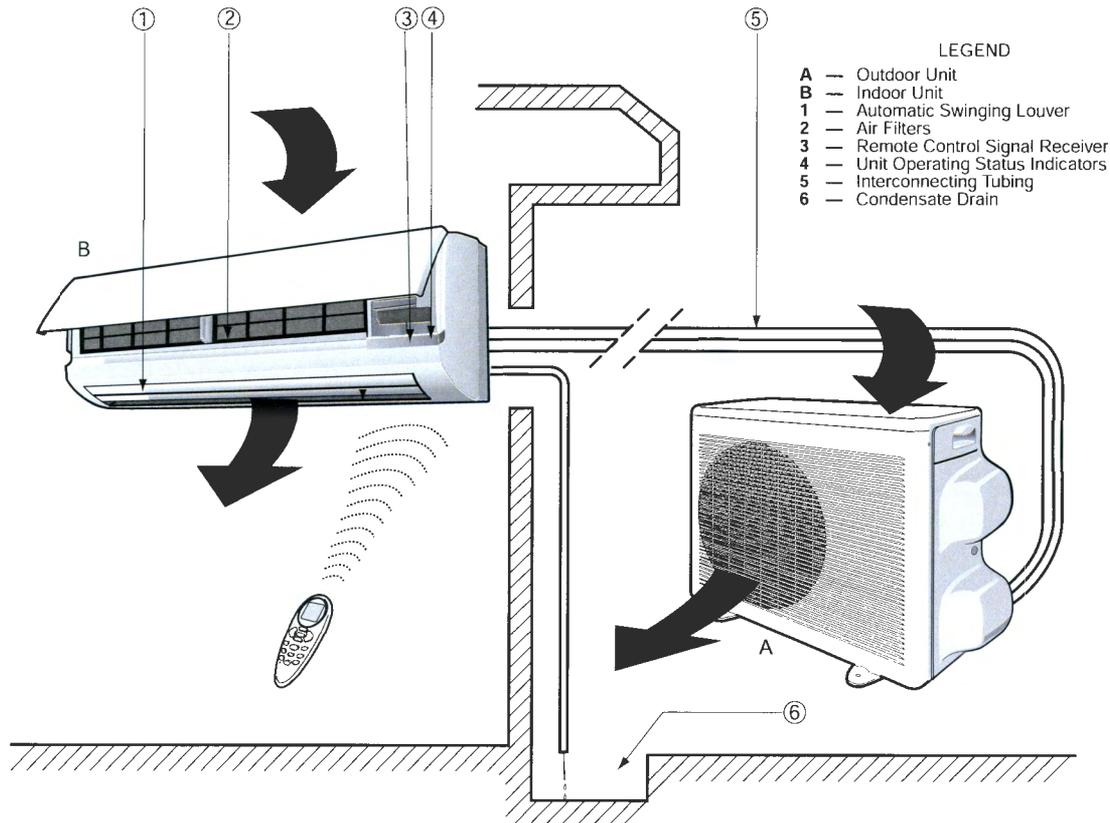


Fig. 1 — Indoor and Outdoor Unit Components

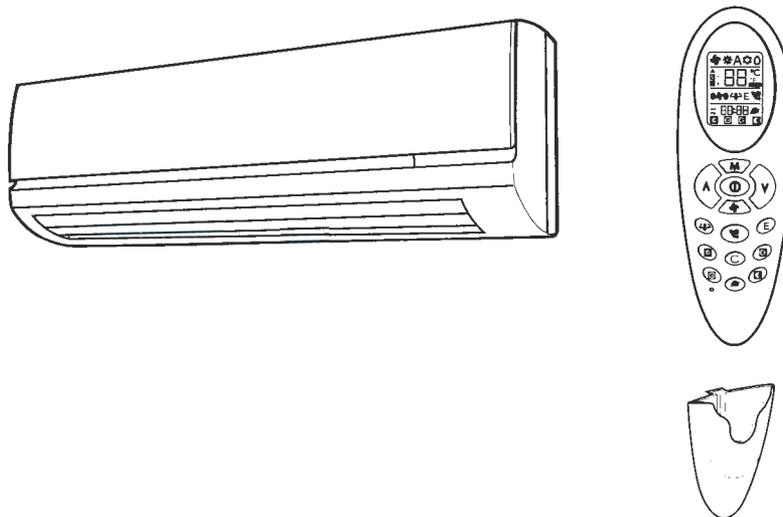


Fig. 2 — High Wall Fan Coil Unit and Remote Control

⚠ CAUTION

Handle the controller with care and avoid getting the controller wet. Damage to the device may result.

IMPORTANT: The remote control can operate the unit from a distance of up to 16 ft as long as there are not any obstructions.

The remote control can perform the following functions:

- Turn the system ON and OFF
- Select operating mode
- Adjust room air temperature set point and fan speed
- Set time periods for automatic system operation

BATTERY INSTALLATION — Two AAA 1.5-v alkaline batteries (included) are required for operation of the remote control. See Fig. 3 for battery location.

After new batteries have been inserted, press the reset button with a paper clip or the tip of a pen. Do not use old batteries or batteries of different types, as this may cause the

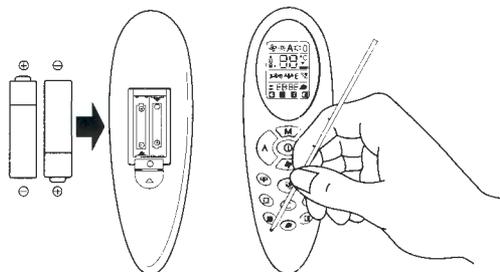


Fig. 3 — Location of Batteries on Remote Control

unit to malfunction. Batteries should only be changed after turning the unit off. The average battery life during normal use is approximately one year. If the air conditioner does not operate normally after replacing the batteries, refit the batteries and press the reset button again after 5 seconds.

To install batteries:

1. Remove battery compartment cover by pushing the tab up and removing it from the remote.
2. Insert batteries being sure to follow polarity markings inside battery compartment.
3. Replace battery compartment cover.

NOTE: Replace batteries whenever “Low battery” indicator appears on remote control display panel. See Fig. 4.

DISPLAY SCREEN — There are five operating mode indicators that appear on the remote control display screen. See Fig. 4.

OPERATION

Remote Control Operation — The remote control has 3 buttons (see Fig. 5) used for operating and controlling the system:

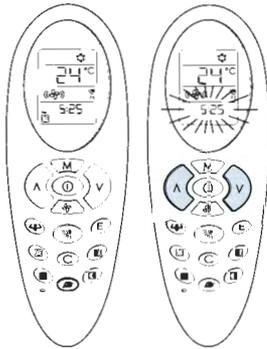
- **M** — changes operating mode
- **^ V** — adjust temperature
- **⓪** — turns the system on or off.

NOTE: When transmitting a command from the remote control to the unit, be sure to point the controller toward the right side of the unit. See Fig. 6. The unit will confirm receipt of a command by sounding an audible beep.

IMPORTANT: If no changes are made within 10 seconds, the remote control will return to its previous setting.

SETTING THE TIME ON THE REMOTE CONTROL (Current Time Adjusting C and Reset Buttons) — Press current time adjusting button **C** to adjust the current time. Press the reset button with the tip of a pen or a paperclip if the remote control is not operating properly or after replacing the batteries.

1. With the remote control ON or OFF, press **C** for at least 5 seconds.
2. The current hour flashes. Press either **▲** or **▼** to set the current hour. Press **C** again to move to set the minutes.
3. Once the current time is set, press **C** to confirm it.



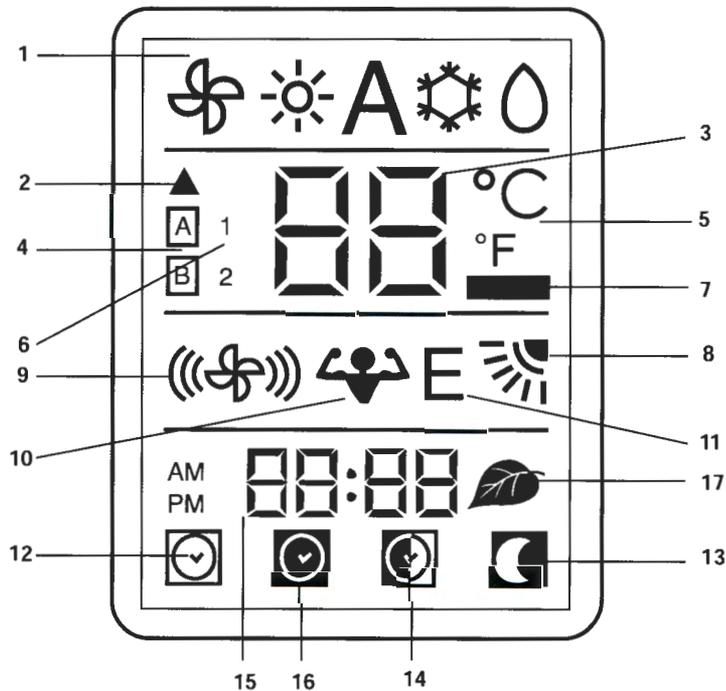
FAN SPEED — To select the Fan mode and change the Fan Speed, follow the steps below:

1. Press the Mode button to select the Fan mode.
2. Press the Fan Speed button to select desired fan speed.

NOTE: If unit is operating in Dehumidification mode the fan will only operate in low speed and cannot be changed.

TEMPERATURE SETTINGS — The temperature set point can be easily changed by pointing the controller toward the unit and pressing the increase/decrease temperature set point buttons until the desired temperature appears on screen.

AIRFLOW DIRECTION — The louvers can be manually operated by pressing the Louver button to change airflow direction. Refer to Table 1 for louver positions.



- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Operating mode (from left to right) <ul style="list-style-type: none"> • Fan only • Heating (heat pump models only) • Automatic (heat pump models only) • Cooling • Dehumidification 2. Signal transmission symbol 3. Temperature set point selected 4. Address selected 5. Temperature unit of measurement (°C or °F) 6. Unit configuration | <ol style="list-style-type: none"> 7. Low Battery indicator 8. Louver position 9. Fan speed 10. Turbo setting 11. Economical setting 12. ON timer selected 13. Night timer active 14. DAILY timer active (Everyday) 15. ON timer and OFF timer or current time 16. OFF timer selected 17. Ionizer active |
|--|---|

Fig. 4 — Remote Control Display Icons

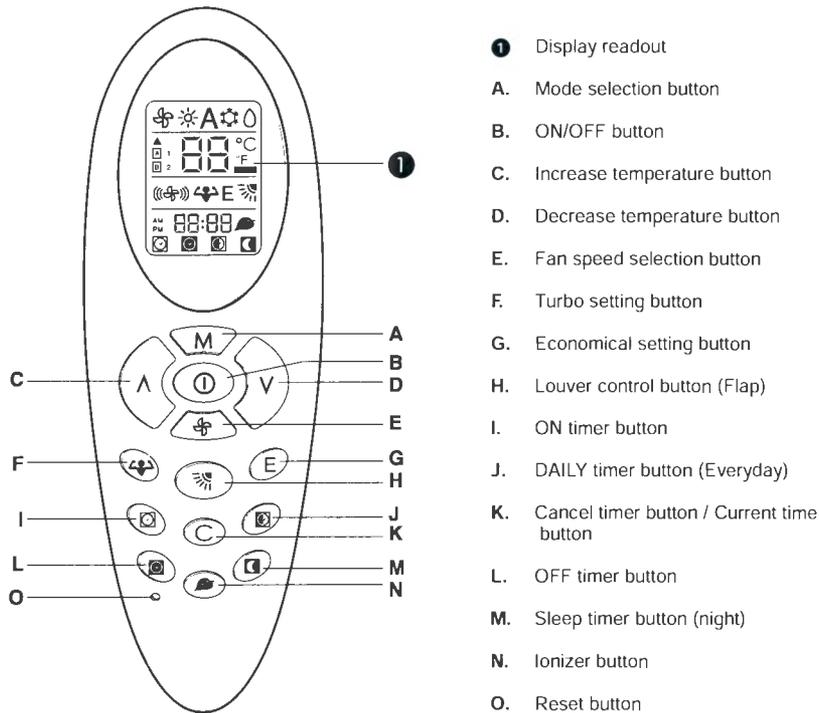


Fig. 5 — Operating Mode Indicators on Remote Control

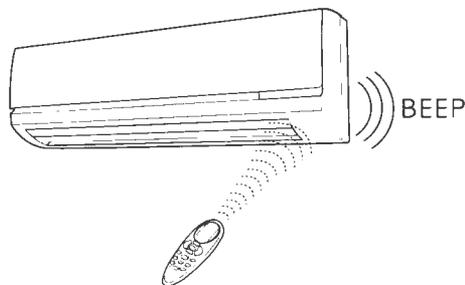


Fig. 6 — Proper Positioning of Remote Control

Table 1 — Louver Positions

SYMBOL ON REMOTE CONTROL	DESCRIPTION
	Louver position will be set automatically. Louver will be set to the preset position according to the operation mode.
	The louver can be set to one of six different airflow directions.
	The louver will continuously swing up and down. The "swing" setting will provide optimal, even air distribution in the room.

Indoor Unit Display (Fig. 7) — The indoor unit display has three LED indicators at the lower right hand portion of the unit. The Blue light is illuminated when the ionizer is

active. The Orange light is illuminated during timer mode. The Green light is illuminated during operation.

Emergency Operation — When the remote control is lost or damaged or the batteries are exhausted, the EMER. button can be used to run the unit.

Press the EMER. button once briefly when the system is off.

To stop emergency operation, push the EMER. button again or operate the remote control.

The set conditions of emergency operation are as follows:

- Preset set point: 77 F
- Fan speed: AUTO
- Timer mode: Disabled
- Discharge air direction: Pre-set position based on operation in "Cool" or "Heat" mode.



Pressing the On/Off Button — When the air conditioner is not in operation, the remote control readout will display the time of day only.

Press the On/Off button to start the unit.

The unit will start in the last operating mode.

Press button On/Off to stop the unit.

All indicator lights on the unit will go out, and the remote control will display only the current time.

If the unit does not stop, turn the control on (by pressing the On/Off button) and repeat the operation.

NOTE: If the On/Off button is pressed too soon after a stop, the compressor will not start for 3 to 5 minutes due to the inherent protection against frequent compressor cycling. The unit will only emit an audible beep when the signals are received correctly.

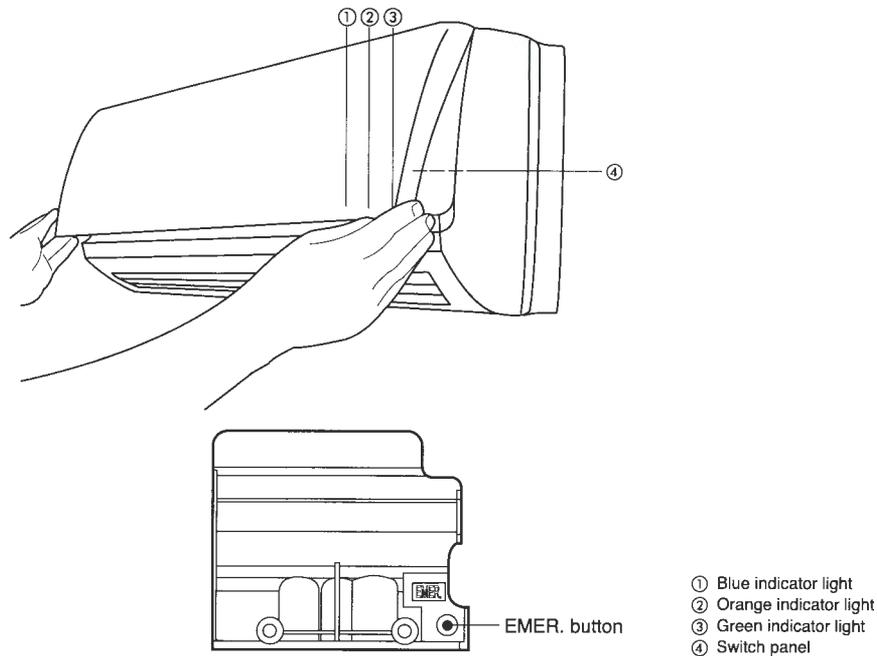


Fig. 7 — Unit Display and Switch Panel

M **Selecting an Operating Mode** — Use the **M** button to select the unit operating mode.

Repeatedly press the Operating Mode button to select available modes.

The chosen mode is shown as follows, while the unit will acknowledge signal receipt with a beep.

Indicated symbol:

Fan Only

Heating

Automatic

Cooling

Dehumidification

Setting the Room Temperature Set Point — Pressing the increase temperature set point and decrease buttons will raise or lower the temperature.

The unit will confirm signal receipt with a beep, and the value of the set temperature on the display will change accordingly.

The temperature can be set between 63 F and 90 F at 1 degree intervals.

NOTE: In Cooling mode, if the temperature selected is higher than the room temperature the unit will not start; the same applies for the Heating mode, if the selected temperature is lower than the room temperature.

The remote control can be set to display the temperature in degrees Fahrenheit or degrees Celsius. To change the temperature setting, complete the following steps while the unit is off:

1. Press the decrease set point button and the louver button simultaneously for 5 seconds.

2. The display will show the channel setting (CH).
3. Press the mode **M** button once to go to the Temperature (tu) screen.
4. Use the increase or decrease set point arrows to change the temperature display setting.
5. Press the louver button to transmit the temperature display setting to configure the remote.

Selecting the Direction of Louver Position — The airflow direction can be adjusted to optimize air distribution.

Press the louver button repeatedly to choose one of the louver positions. See Table 1.

In the Cooling, Dehumidification and Fan Only mode, the louver will swing in the cooling range. In the Heating mode, the louver will swing in the heating range. See Fig. 8.

NOTE: Always use the remote control to adjust the louver position, otherwise abnormal operation may occur. If the louver is manually adjusted out of its range, turn the unit off and then on again.

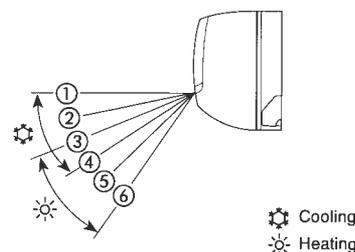


Fig. 8 — Cooling and Heating Louver Position

LEFT AND RIGHT CONTROL — To adjust the direction of the discharge air to the left or right, adjust the vertical guide vane with the handle after opening the louver. See Fig. 9.

NOTE:

- Do not set the louver to position  for long periods of time, because this position minimizes air circulation resulting in uneven room temperature.
- Do not adjust the louver manually during SWING operation because it may damage the air swing mechanism.
- For maximum cooling or heating capacity, please louver to position .

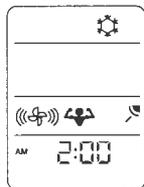


Selecting the Fan Speed — The fan speed can be selected by pressing the fan speed button .

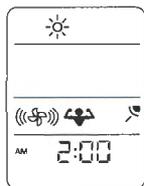
SYMBOL	DESCRIPTION
	Low speed.
	Medium speed.
	High speed.
	Automatic (fan will automatically switch to the appropriate speed for optimum comfort).



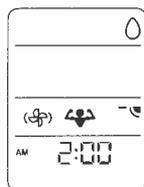
Using the Turbo Setting — For maximum capacity while in Cooling, Dehumidification and Heating modes, press the Turbo Setting button . On the display, the Turbo Setting icon  will appear.



1. Turbo Cooling mode performs the turbo cooling operation until room temperature reaches 63 F or 20 minutes after pressing the Turbo Setting button. While in Turbo Cooling mode, indoor fan speed is high and compressor speed is over-rating speed to obtain maximum cooling capacity.



2. Turbo Heating mode performs the turbo heating operation until room temperature reaches 90 F or 20 minutes after pressing the turbo setting button. While in Turbo Heating mode, the indoor fan and compressor operates in high speed in order to obtain maximum heating capacity.



3. Turbo Dehumidification mode performs the dehumidification operation until room temperature is under 63 F or 3 hours after pressing the turbo setting button. While in Turbo Dehumidification mode, indoor fan speed operates in low speed in order to remove humidity more effectively.

During the turbo setting, room temperature and fan speed cannot be changed using the remote controller.

Press **M**,  or **E** to cancel turbo setting mode.

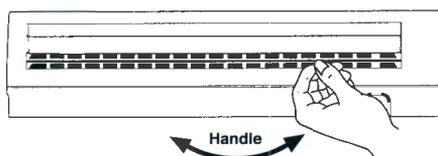


Fig. 9 — Using the Vertical Guide Vane

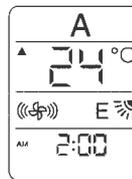
E Using the Economical Setting — For quiet, energy saving operation in Cooling, Heating and Auto modes, press the Economical Setting button **E**. On the display, the Economical Setting icon **E** will appear.



1. Economical Cooling mode:
The indoor fan and compressor operate at a minimum speed for maximum energy savings.



2. Economical Heating mode:
The indoor fan and compressor operate at a minimum speed for maximum energy savings.



3. Economical Auto mode:
Unit operates in Economical Cooling mode or Economical Heating mode depending on the room temperature and set point.

During the Economical setting, the room temperature and louver position can be set by using the remote control. Fan speed cannot be changed while in the Economical setting.

Press **M**,  or **E** to cancel the economical setting.



Setting the ON Timer



1. ON TIMER button 
Press the , even if the unit is off.
The relevant icon and time figure will start to flash.
If 10 seconds have elapsed and no button is pressed, the remote control returns to the previous setting without making any changes.

2. Setting the ON time with **^** **v**.

When the unit is ON, the only possible selection is the start-up time. The Operating mode and set point remain the same as the current operation.

To select the start-up time when the unit is off, use **^** **v**.

First select the hours and confirm by pressing . Then select the minutes using either **^** or **v**.

To finish setting the time, press  again.

3. Choose the unit Operating mode.

To select the operating mode, use the **M** button. Once the operating mode has been selected, press .

The icon of the selected mode will stop flashing.

4. Select the desired set point temperature.

To select the desired temperature, use either **^** or **v**. Push  to confirm the selection. The set point numbers will stop flashing.

5. Fan speed:

Choose the fan speed, using . When the selection has been completed, press button for confirmation. The fan speed icon will stop flashing.

6. Louver positioning:

Use to select desired louver position. Press for confirmation. Now all icons are fixed on display. To cancel selections made up to this point, push **C**; to cancel all of the selected options once the timer has been set, push and then **C**. The ON Timer settings are now complete.



Setting the Off Timer — Set the Off Timer to select a time for the system to turn off.



1. Press the Off Timer button.

The Off timer icon and numbers for a time selection flash.

NOTE: This function can be set even if the remote control is OFF.

2. Setting the Off time (buttons \wedge and \vee).

To set the Off time, press either button \wedge or \vee .

To move from hour to minute, press .

Press again to confirm Off time setting.



Setting the DAILY Timer — Push the button when the ON or OFF timer is active. The icon will appear on display.

In this way the ON and OFF timer settings will be repeated every day.

To deactivate the daily function, press again.

EXAMPLE 1: Combining the ON, OFF and DAILY timer features.

To start the unit at 5:30 P.M. and stop at 10:30 P.M. for one day only, complete the following steps:

1. Set the ON timer for 5:30 P.M.
2. Set the OFF timer for 10:30 P.M.
3. Select desired operating mode (M).



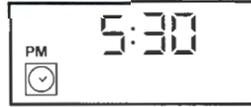
EXAMPLE 2: To stop operation at 10:30 P.M. and start again at 7:30 A.M. with the same operating mode, complete the following steps:

1. Set the OFF timer for 10:30 P.M. while the system is operating.
2. Set the ON timer for 7:30 A.M.



For everyday operation to start at 5:30 P.M. and stop at 10:30 P.M. complete the following steps:

1. Set the ON timer for 5:30 P.M.
2. Set the OFF timer for 10:30 P.M.
3. Press the DAILY timer button .

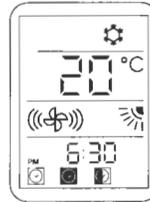


CANCELLING THE ON, OFF AND DAILY TIMER SETTINGS — To cancel the ON or OFF timer setting, press the following buttons in order:

1. Button or .
2. Button **C**.

To deactivate the Daily timer function, press .

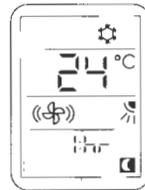
NOTE: Everyday operation will remain active until one of the two timers (ON or OFF) is active.



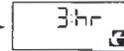
Setting the Sleep Timer — Press this button to set the SLEEP timer with the system on. The icon will appear on the display.

This procedure permits setting the remaining unit operating time until the Sleep mode is entered.

1. "1:hr" will be displayed together with the icon.



2. Press \wedge . The display will show the following settings in sequence: 1:hr, 2:hr, 3:hr, 4:hr, 5:hr, 6:hr, 7:hr, 8:hr and 9:hr.



3. Once the remaining operating hours have been selected with either button \wedge or \vee , press the button to confirm.
4. When the SLEEP timer is set, the unit will control the set temperature to avoid overcooling or overheating during operation. The set temperature will change as in Fig. 10.

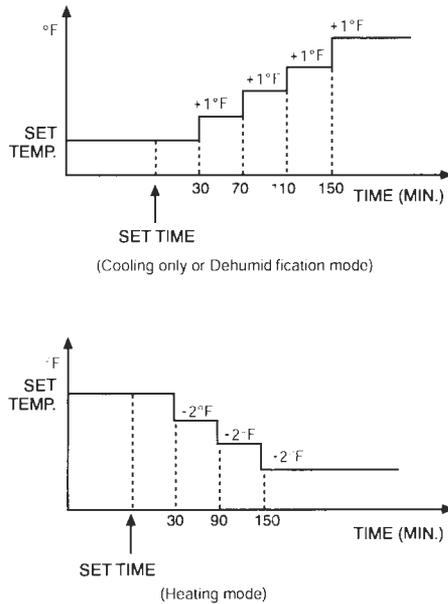


Fig. 10 — Set Temperature Levels



Using the Ionizer Function — The ionizer helps to eliminate odors in the conditioned space.



1. Press to activate the Ionizer function.
2. Press again to turn off Ionizer function.

Remote Control Address Selection — If two indoor units are in the same room, one remote control can be linked to one indoor unit, and the other remote control to the other indoor unit, or both indoor units can be controlled with a single remote control.

For more information, refer to the installation instructions.

Resetting the Remote Control — If the remote control is not functioning properly it can be reset by pressing the reset button with a paper clip or tip of a pen.

Operating Conditions — Temperature ranges suitable for unit operation are as follows.

MODE	INDOOR (°F)	OUTDOOR (°F)
Cool	59-90	14-115
Heat	Max. 81	14- 75
Dehumidification	59-90	14-115

If the unit operates above 59 to 90 F maximum temperature conditions for a long period of time, system diagnostics may modify the system operation to prevent damage to the system.

Time Delay — If unit operation is started after the power is turned off, there will be a 3-minute time delay until the compressor turns on.

When heating operation starts, hot air delivery may be delayed due to a warm-up period.

Minimum Operation Time — In normal operation, there is a minimum operation time of 5 to 7 minutes between the compressor turning on and turning back off.

Heating Features — If the unit starts in Heating mode, there may be a preheating period before the unit is ready to deliver warm air.

Defrost Operation — In heating mode, if the outdoor coil is frosted, the indoor fan and outdoor fan will turn off while system removes the frost on the outdoor coil.

The system will automatically revert to normal operation when frost is removed from the outdoor unit.

Auto Recovery — If the power fails while the unit is operating, the unit memorizes the operating condition, and it will start operation automatically when the power is restored.

Indoor Unit Frost Prevention in Cooling and Dehumidification Mode — If the unit operates at a low ambient temperature, frost may appear on the indoor coil. If the indoor coil temperature is near 32 F, the compressor's speed is reduced or stopped to protect the unit from frost.

CLEANING, MAINTENANCE AND TROUBLESHOOTING

CAUTION

To avoid the possibility of electric shock, always turn off power to the system before performing any cleaning or maintenance to the system. Turn off the outdoor disconnect switch located near outdoor unit. Be sure to disconnect indoor unit if on a separate switch.

CAUTION

Operating the system with dirty air filters may damage the indoor unit and could cause reduced cooling performance, intermittent system operation, frost build-up on indoor coil or blown fuses.

Periodic Maintenance — Periodic maintenance is recommended to ensure proper operation of the unit. Recommended maintenance intervals may vary depending on the installation environment, e.g., dusty zones, etc. Refer to Table 2.

CAUTION

The coil fins are very sharp. Use caution when cleaning the coil fins to prevent unit damage and to avoid personal injury.

Cleaning the Coil — Clean the coil at the beginning of each cooling season, or when necessary. Use a vacuum cleaner or a long-bristle brush to avoid damage to the coil fins.

Air Filters — Remove and clean the air filters once a month.

NOTE: If air filters show signs of excessive wear or are torn, they must be replaced. Contact your local dealer for replacement filters.

1. Open front panel on unit.
2. Pull filters down to remove.
3. Vacuum filters.
4. Clean with warm water.
5. Shake filter to remove excess water and dry thoroughly.
6. Replace filter by sliding filter behind front grille until filter snaps in place.

⚠ CAUTION

When cleaning the front panel, *do not* use water hotter than 105 F and do not pour water onto the fan coil.

Do not use abrasive or petroleum based cleaners as they may damage the front panel.

Ionizer — Clean the ionizer with a brush every four months.

⚠ CAUTION

Disconnect the unit from the main power supply prior to cleaning or performing maintenance on the ionizer. Serious personal injury could result.

1. Unscrew and lift the ionizer cover.
2. Brush the needles on the base of the ionizer.
3. Close the cover and tighten the screw.

Indoor Unit Front Panel — To clean the front panel on the indoor unit, wipe the outside with a soft, dry cloth. If necessary, a mild liquid detergent can be applied and wiped off with a dry cloth.

Preparing for a Long Shutdown Period — Clean the filters and reposition them in the unit. Operate the unit in Fan only mode for 12 hours to dry all internal parts.

Turn main power supply off and remove batteries from the remote control.

System Operation Check List — The items outlined in the following list will help to assure proper system operation:

- Be sure unit is connected directly to electrical supply.
- Replace both remote control batteries at the same time when the Low Battery indicator appears.
- Point the remote control toward the unit display panel when transmitting a command.
- Keep doors and windows closed while unit is operating.
- Close air vents in unoccupied rooms to save electricity.
- Contact an authorized service representative if a problem arises that cannot be easily resolved.
- Do not perform cleaning or maintenance activities while unit is on.
- Keep display panel on unit away from direct sunlight and heat as this may interfere with remote control transmissions.
- Do not block air intakes and outlets on the indoor or outdoor units.

Energy Saving Recommendations — The following recommendations will add greater efficiency to the duct-free system:

- Select a comfortable thermostat setting and leave it at chosen setting. Avoid continually raising and lowering the setting.
- Keep unit filter clean. Frequent cleaning may be necessary depending on indoor air quality.
- Use drapes, curtains or shades to keep direct sunlight from heating room on very hot days.
- Do not obstruct front grille air intake on front panel.
- Turn on air conditioning before indoor air becomes too uncomfortable.

Troubleshooting — Refer to Tables 3 and 4 before contacting your local dealer.

Table 2 — Periodic Maintenance

INDOOR UNIT	EVERY MONTH	EVERY 4 MONTHS	EVERY YEAR
Clean Air Filter*	●		
Clean Drain Pipe		●	
Change Remote Control Batteries			●
Clean Ionizer		●	
OUTDOOR UNIT	EVERY MONTH	EVERY 4 MONTHS	EVERY YEAR
Clean Outdoor Coil from Outside		●	
Clean Outdoor Coil from Inside†			●
Blow Air Over Electric Parts†			●
Check Electric Connection Tightening†			●
Clean Fan Wheel†			●
Check Fan Tightening†			●
Clean Drain Pans†			●

*Increase frequency in dusty zones.

†Maintenance to be carried out by qualified service personnel. Refer to the Installation Manual.

Table 3 — Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Unit/System Does Not Work	<ul style="list-style-type: none"> • The circuit breaker has tripped or a fuse has blown. • Power failure. • Green or Orange LED is flashing on and off, which could indicate an indoor or outdoor unit fault. • Voltage is too low. 	<ul style="list-style-type: none"> • Reset the circuit breaker or replace the fuse with the specified replacement fuse. • Restart operation when the power is restored. • Call your service representative.
Cooling is Not Working Properly	<ul style="list-style-type: none"> • The filter is blocked with dust. • Temperature is not set properly. • A window or door is open. • The outdoor unit is obstructed. • The fan speed is too low. • The operation mode is in Fan or Auto instead of Cool. 	<ul style="list-style-type: none"> • Clean the air filter. • Check the temperature and reset if necessary. • Close the window or door. • Remove the obstruction. • Change the fan speed selection. • Change the operating mode to Cool or reset the unit.
Heating is Not Working Properly	<ul style="list-style-type: none"> • The filter is blocked with dust. • Temperature is set too low. • A window or door is open. • The outdoor unit is obstructed. 	<ul style="list-style-type: none"> • Clean the air filter. • Check the temperature and reset if necessary. • Close the window or door. • Remove the obstruction.
Unit Stops During Operation	<ul style="list-style-type: none"> • The Off timer is not operating correctly. • Green or Orange LED is flashing on and off, which could indicate an indoor or outdoor unit fault. 	<ul style="list-style-type: none"> • Restart the operating mode. • Call your service representative.

LEGEND

LED — Light Emitting Diode

Table 4 — Unit Protection Devices

TYPE OF PROTECTION	EFFECT OF PROTECTION	OPERATING MODE
Indoor Coil High Temperature Protection	Compressor speed slow down or off	Heating and Auto mode at high outdoor temperatures
Indoor Coil Freeze Up Protection	Compressor speed slow down or off	Cooling, Dehumidification and Auto mode at low outdoor temperatures
Discharge Gas High Temperature Protection	Compressor speed slow down or off	Cooling, Heating, Dehumidification and Auto mode outdoor temperatures
Frequent Compressor Cycling	Compressor time delay	All

⚠ CAUTION

During heating operation the unit may defrost to remove ice that might collect on the outdoor unit. During defrost, the indoor fan will automatically stop, the louver will be fixed at a horizontal position and can not be changed until the defrost cycle is completed. Forcing the louver to change its position during defrost could result in equipment damage.

Fill out the following to save time on any future service calls.

Dealer's Name _____

Address _____

Telephone _____ Purchase Date _____

Indoor Model # _____ Outdoor Model # _____

Indoor Serial # _____ Outdoor Serial # _____

Attachment K-2
Carrier Outdoor AC Unit



38HDF018-036
Duct Free Condensing Units
38HDR018-060
Ducted Condensing Units

Installation, Start-Up and Service Instructions

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SAFETY CONSIDERATIONS

Installing and servicing air conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install or service air conditioning equipment.

Untrained personnel can perform basic maintenance, such as cleaning and replacing filters. All other operations should be performed by trained service personnel. When working on air conditioning equipment, observe safety precautions in literature, tags, and labels attached to unit.

Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions *thoroughly*. Consult local building codes and the National Electrical Code (NEC) for special installation requirements.

▲ WARNING

Before installing or servicing system, always turn off main power to system. There may be more than one disconnect switch. Turn off accessory heater power if applicable. Electrical shock can cause serious personal injury.

▲ CAUTION

Puron® (R-410A) refrigerant systems operate at higher pressures than standard R-22 systems. Do not use R-22 service equipment or components on Puron refrigerant equipment. If service equipment is not rated for Puron refrigerant, equipment damage or personal injury may result.

INSTALLATION

Step 1 — Complete Pre-Installation Checks

UNPACK UNIT (See Fig. 1) — Move the unit to final location. Remove unit from carton, being careful not to damage service valves and grilles.

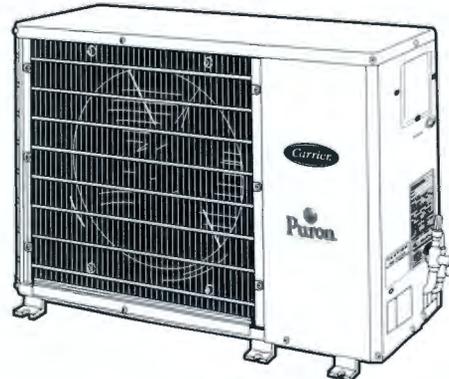


Fig. 1 — 38HDF,HDR Unit

INSPECT SHIPMENT — File a claim with the shipping company if shipment is damaged or incomplete. Check unit nameplate to ensure unit matches job requirements.

CONSIDER SYSTEM REQUIREMENTS — Consult local building codes and NEC for special installation requirements.

Allow sufficient space for airflow clearance, wiring, refrigerant piping, and servicing unit. See Fig. 2.

Locate unit so that condenser airflow is unrestricted on both sides. Refer to Fig. 2.

Unit may be mounted on a level pad directly on base legs or mounted on raised pads at support points. See Fig. 2 for center of gravity.

MATCHING THE CONDENSING UNIT TO AN INDOOR UNIT — The 38HDF,HDR units can be matched to a corresponding indoor unit. The 38HDF018-036 units can be matched with an in-ceiling cassette or high wall indoor unit. The 38HDR unit can be matched with under-ceiling and residential fan coils. Refer to separate indoor unit literature for more information.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

Book 1 | 4 Catalog No. 02-38HD0001-SI Printed in U.S.A. Form 38HD-4SI Pg 1 1-06 Replaces: 38HDC-3SI
Tab | 3e | 2f

UNIT MODELS		CHASSIS SIZE (Reference)	A	B	C	D	E	F	G	H	J	K	L	N	P
38HDF Unit Size	38HDR Unit Size														
018	018	0	2'-11 ¹ / ₁₆ " (638.2)	3'-0 ¹ / ₁₆ " (938.2)	1'-2 ⁹ / ₁₆ " (369.9)	1'-4" (406.4)	1'-11 ⁷ / ₁₆ " (595.3)	1'-5 ¹ / ₁₆ " (436.6)	1'-5 ¹ / ₁₆ " (435)	1'-10" (559.1)	1'-1" (330.2)	0'-6 ⁵ / ₁₆ " (168.3)	0'-11 ¹ / ₄ " (285.8)	0'-2 ¹ / ₁₆ " (75)	0'-6" (152.4)
024,030	024	0.6	2'-7 ¹ / ₁₆ " (790.6)	3'-0 ¹ / ₁₆ " (938.2)	1'-2 ¹ / ₁₆ " (369.9)	1'-4" (406.4)	1'-11 ¹ / ₁₆ " (595.3)	1'-5 ¹ / ₁₆ " (436.6)	1'-11 ¹ / ₁₆ " (587.4)	2'-4" (711.5)	1'-2" (355.6)	0'-6 ³ / ₄ " (171.5)	0'-11 ¹ / ₄ " (295.3)	0'-2 ¹ / ₁₆ " (75)	0'-6" (152.4)
036	030,036	1.0	3'-1 ¹ / ₁₆ " (944.6)	3'-8 ¹ / ₁₆ " (1131.9)	1'-5 ¹ / ₁₆ " (433.4)	1'-6 ¹ / ₁₆ " (468.3)	2'-6 ¹ / ₁₆ " (774.7)	1'-7 ¹ / ₁₆ " (498.5)	2'-5 ¹ / ₁₆ " (741)	2'-10 ¹ / ₁₆ " (865.5)	1'-1 ¹ / ₁₆ " (347.7)	0'-8 ¹ / ₁₆ " (206.4)	1'-3 ¹ / ₁₆ " (403.2)	0'-3 ⁷ / ₁₆ " (88)	0'-6 ¹ / ₂ " (165.4)
—	048,060	1.6	3'-7 ¹ / ₁₆ " (1097)	3'-8 ¹ / ₁₆ " (1131.9)	1'-5 ¹ / ₁₆ " (433.4)	1'-6 ¹ / ₁₆ " (468.3)	2'-6 ¹ / ₁₆ " (774.7)	1'-7 ¹ / ₁₆ " (498.5)	2'-1 ¹ / ₁₆ " (893.4)	3'-4 ¹ / ₁₆ " (1017.9)	1'-2 ¹ / ₂ " (354.2)	0'-8 ¹ / ₂ " (215.9)	1'-6 ¹ / ₁₆ " (479.4)	0'-3 ⁷ / ₁₆ " (88)	0'-6 ¹ / ₂ " (165.4)

NOTE: Dimensions shown in feet-inches. Dimensions in () are millimeters.

UNIT SIZE	M		OPERATING WT		
	in.	mm	lb	kg	
38HDF	018	1/2	15.88	166	75.3
	024	3/8	15.88	176	79.8
	030	3/4	19.05	187	84.8
	036	1/2	19.05	250	113.4
38HDR	018	1/2	15.88	166	75.8
	024	3/8	15.88	176	79.8
	030	3/4	19.05	187	84.8
	036	1/2	19.05	250	113.4
	048	1/2	22.22	278	126.1
060	1/2	22.22	306	138.8	

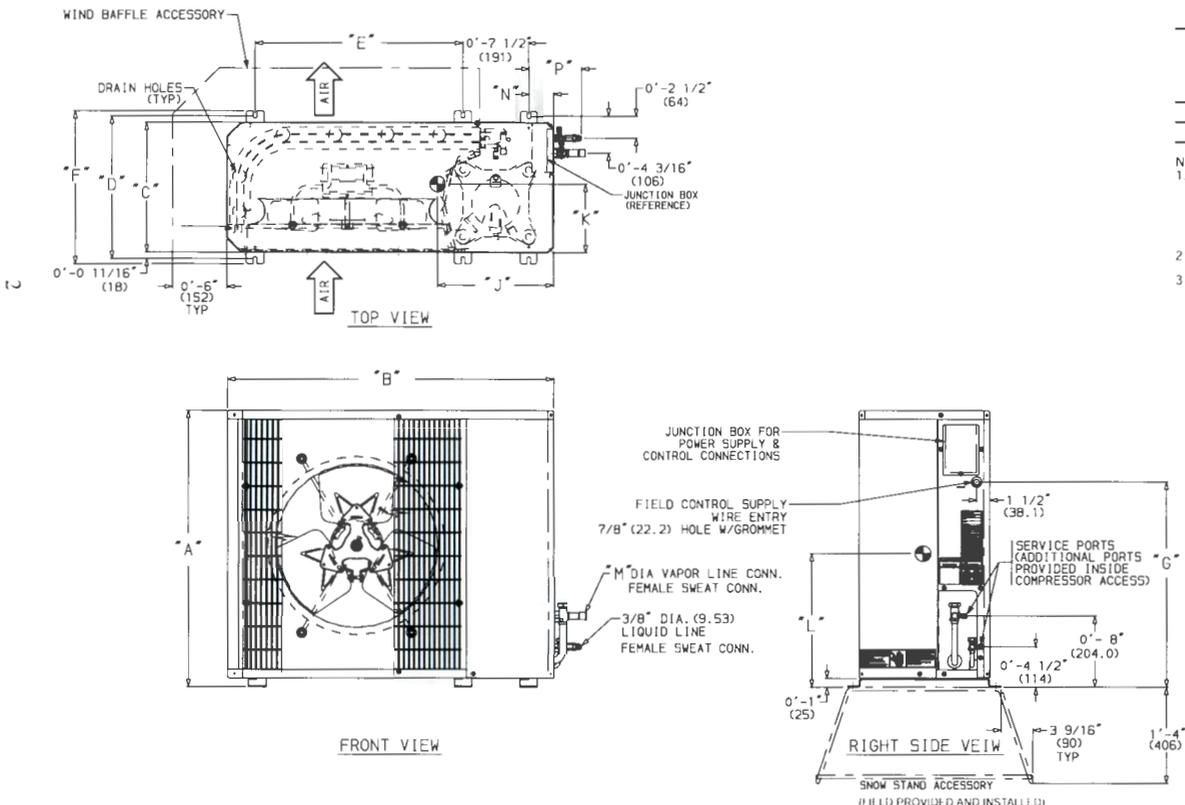


Fig. 2 — 38HDF,HDR Unit Dimensions

UNIT SIZE	MINIMUM MOUNTING PAD DIMENSIONS	
	Support Feet	
	ft-in.	mm
CHASSIS SIZES 0 & .6	1'-11" x 3'-6"	584.2 x 1066.8
CHASSIS SIZES 1 & 1.6	2'-0" x 4'-2"	609.6 x 1270

- NOTES:
- Required clearances: with coil facing wall, allow 6 in. minimum clearance on coil side and coil end, and 3 feet minimum clearance on compressor end and fan side. With fan facing wall, allow 8 in. minimum clearance on fan side and coil end, and 3 feet minimum clearance on compressor end and coil side. With multi-unit application, arrange units so discharge of one does not enter inlet of another.
 - Dimensions in parenthesis are in millimeters.
 - Center of Gravity

Appendix 532

Step 2 — Rig and Mount Unit

MOUNTING ON GROUND — Mount unit on a solid, level concrete pad. Position unit so water or ice from roof does not fall directly onto unit. Accessory stacking kits can be used when units are to be stacked. See installation instructions provided with the accessory kit. Use field-provided snow stand or ice rack where prolonged subfreezing temperatures or heavy snow occurs.

If conditions or local codes require unit be fastened to a pad, 6 field-supplied tiedown bolts should be used and fastened through slots provided in unit mounting feet.

MOUNTING ON ROOF — Mount unit on a level platform or frame at least 6 in. above roof surface. Isolate unit and tubing from structure.

RIGGING

▲ CAUTION

Be sure unit panels are securely in place prior to rigging. Loose unit panels could result in equipment damage or personal injury.

Keep the unit upright and lift unit using a sling. Use cardboard or padding under the sling, and spreader bars to prevent sling damage to the unit. See Fig. 3. See Fig. 2 for center of gravity reference. Install the unit so that the coil does not face into prevailing winds. If this is not possible and constant winds above 25 mph are expected, use accessory wind baffle. See installation instructions provided with the accessory kit.

NOTE: Accessory wind baffles should be used on all units with accessory low ambient temperature control.

Field-fabricated snow or ice stands may be used to raise unit when operation will be required during winter months. Units may also be wall mounted using the accessory wall-mounting kit.

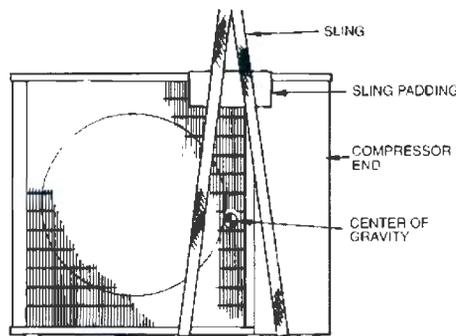


Fig. 3 — Lifting Unit with Sling

Step 3 — Complete Refrigerant Piping Connections

Outdoor units may be connected to indoor units using field-supplied tubing of refrigerant grade and condition. See Tables 1A and 1B for correct line sizes. Do not use less than 10 ft of interconnecting tubing.

▲ CAUTION

DO NOT BURY MORE THAN 36 IN. OF REFRIGERANT PIPE IN THE GROUND. If any section of pipe is buried, there must be a 6-in. vertical rise to the valve connections on the outdoor unit. If more than the recommended length is buried refrigerant may migrate to cooler, buried section during extended periods of system shutdown. This causes refrigerant slugging and could possibly damage the compressor at start-up.

When more than 50 ft of interconnecting tubing and more than 30 ft of vertical lift is used, consult the residential long line application instruction guide. For long-line applications, interconnecting lines over 100 ft must be installed with a liquid line solenoid. A liquid line solenoid may also be installed on some units to improve part-load efficiency. Refer to the ARI (Air Conditioning & Refrigeration Institute) Directory.

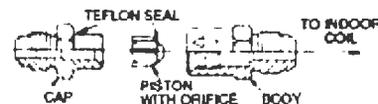
If either refrigerant tubing or indoor coil is exposed to the atmosphere, the system must be evacuated following good refrigeration practices.

Run refrigerant tubes as directly as possible, avoiding unnecessary turns and bends. Suspend refrigerant tubes so they do not damage insulation on vapor tube and do not transmit vibration to structure. Also, when passing refrigerant tubes through a wall, seal the opening so that vibration is not transmitted to structure. Leave some slack in refrigerant tubes between structure and outdoor unit to absorb vibration. Refer to separate indoor unit installation instructions for additional information.

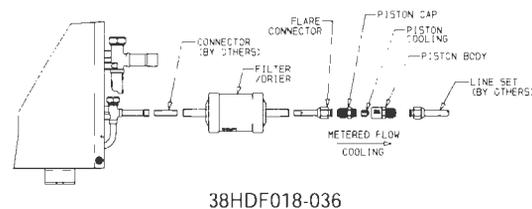
CHECK ACCURATER CONTROL — The correct AccuRater (bypass type) refrigerant control is required for system capacity optimization. An AccuRater device with field-replaceable piston (see Fig. 4) is supplied with the outdoor unit. Refer to the AccuRater metering device table in separate indoor unit installation instructions to determine the correct AccuRater piston size required for the condenser/evaporator system being installed.

Piston style as shown in Fig. 4 is shipped with the unit. Do not interchange components between the AccuRater device types. Matching of outdoor unit with indoor unit may require field replacement of piston. Replace piston, if required, before connecting refrigerant lines. See Fig. 4. Piston replacement instructions are included in the indoor unit installation instructions. After system installation is complete, see the Refrigerant Charging section on page 12 to check and/or adjust refrigerant charge.

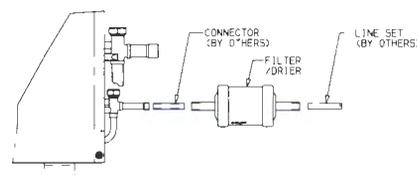
FILTER DRIER — The filter drier must be replaced whenever the refrigeration system is exposed to the atmosphere. See Fig. 4 for filter drier installation.



NOTE: Arrow on AccuRater body points in free flow direction, away from the indoor coil.



38HDF018-036



38HDR018-060

Fig. 4 — AccuRater (Bypass Type) Metering Device Components

Only use factory specified liquid-line filter driers with rated working pressures less than 600 psig.

NOTE: Do not install a suction-line filter drier in liquid line.

MAKE PIPING SWEAT CONNECTIONS — Remove plastic caps from liquid and suction service valves. Use refrigerant grade tubing. Service valves are closed from the factory and are ready for brazing. After wrapping the service valve with a wet cloth, the tubing set can be brazed to the service valve using either silver bearing or non-silver bearing brazing material. Consult local code requirements. Refrigerant tubing and the indoor coil are now ready for leak testing.

NOTE: Unit is shipped with R-410A factory charge indicated on nameplate.

Pass nitrogen or other inert gas through piping while brazing to prevent formation of copper oxide.

CAUTION
To avoid damage while brazing, service valves should be wrapped with a heat-sinking material such as a wet cloth.

CAUTION
When brazing tubing sets to the service valves, a brazing shield MUST be used to prevent damage to the painted unit surface.

PROVIDE SAFETY RELIEF — A fusible plug is located in unit suction line; do not cap this plug. If local code requires additional safety devices, install as directed.

Table 1A — 38HDF018-036 Physical Data

UNIT 38HDF	018	024	030	036
NOMINAL CAPACITY (Tons)	1.5	2.0	2.50	3.0
OPERATING WEIGHT (lb)	166	176	187	250
REFRIGERANT TYPE	R-410A			
METERING DEVICE	AccuRater (Located at Fan Coil)			
CHARGE (lb)*	4.8	5.3	5.0	7.1
OUTDOOR FAN				
Rpm/Cfm	840/1720	840/1720	840/1720	850/1720
Diameter (in.)	18	18	18	24
No. Blades	3	3	3	3
Motor (hp)	1/8	1/8	1/8	1/4
OUTDOOR COIL				
Face Area (sq ft)	5.82	7.27	7.27	12.1
No. Rows	2	3	3	2
FPI	20	20	20	20
HIGH PRESSURE SWITCH				
Cut-In (psig)	420 ± 25	420 ± 25	420 ± 25	420 ± 25
Cutout (psig)	650 ± 10	650 ± 10	650 ± 10	650 ± 10
LOW PRESSURE SWITCH				
Cut-In (psig)	45 ± 25	45 ± 25	45 ± 25	45 ± 25
Cutout (psig)	20 ± 5	20 ± 5	20 ± 5	20 ± 5
REFRIGERANT LINES				
Connection Type			Sweat	
Liquid Line (in.) OD	3/8	3/8	3/8	3/8
Vapor Line (in.) OD	5/8	5/8	3/4	3/4
Max Length (ft)	200	200	200	200
Max Lift (ft)	65	65	65	65
Max Drop (ft)	150	150	150	150
COMPRESSOR				
Type			Scroll	
Model	ZP16K5E-PFV	ZP21K5E-PFV	ZP25K5E-PFV	ZP34K5P-PFV
Oil Charge (POE - oz)	25.0	25.0	25.0	42.0
Accumulator			Yes	
CONTROLS				
Fusible Plug (F)			210	
Control Voltage†			24 vac	
System Voltage	208/230 v	208/230 v	208/230 v	208/230 v, Single and 3 Phase, 460 v, 3 Phase
FINISH	Gray			

LEGEND
FPI — Fins Per Inch
POE — Polyol Ester

*Unit shipped with full factory charge. See ARI (Air Conditioning and Refrigeration Institute) capacity table for proper charge and piston for each fan coil type.
†24 v and a minimum of 40 va is provided in the fan coil unit.

Table 1B — 38HDR018-060 Physical Data

UNIT 38HDR	018	024	030	036	048	060
NOMINAL CAPACITY (Tons)	1.5	2.0	2.50	3.0	4.0	5.0
OPERATING WEIGHT (lb)	166	176	250	250	278	306
REFRIGERANT TYPE	R-410A					
METERING DEVICE	AccuRater (Located at Fan Coil)					
CHARGE (lb)*	6.3	6.5	10.0	8.9	12.0	12.2
OUTDOOR FAN						
Rpm/Cfm	840/1720	840/1720	850/3900	850/3900	850/3900	850/3900
Diameter (in.)	18	18	24	18	24	24
No. Blades	3	3	3	3	3	3
Motor (hp)	1/8	1/8	1/4	1/4	1/4	1/4
OUTDOOR COIL						
Face Area (sq ft)	5.8	7.3	12.1	12.1	14.1	14.1
No. Rows	2	3	2	2	3	3
FPI	20	20	20	20	20	20
HIGH PRESSURE SWITCH						
Cut-In (psig)	420 ± 25	420 ± 25	420 ± 25	420 ± 25	420 ± 25	420 ± 25
Cutout (psig)	650 ± 10	650 ± 10	650 ± 10	650 ± 10	650 ± 10	650 ± 10
LOW PRESSURE SWITCH						
Cut-In (psig)	45 ± 25	45 ± 25	45 ± 25	45 ± 25	45 ± 25	45 ± 25
Cutout (psig)	20 ± 5	20 ± 5	20 ± 5	20 ± 5	20 ± 5	20 ± 5
REFRIGERANT LINES						
Connection Type	Sweat					
Liquid Line (in.) OD	3/8	3/8	3/8	3/8	3/8	3/8
Vapor Line (in.) OD	5/8	5/8	3/4	3/4	7/8	7/8
Max Length (ft)	200	200	200	200	200	200
Max Lift (ft)	65	65	65	65	65	65
Max Drop (ft)	150	150	150	150	150	150
COMPRESSOR						
Type	Scroll					
Model	ZP16K5E-PFV	ZP21K5E-PFV	ZP25K5E-PFV	ZP29K5E-PFV	ZP42K5E-PFV	ZP51K5E-PFV
Oil Charge (POE - oz)	25.0	25.0	25.0	25.0	42.0	42.0
Crankcase Heater (watts)	—	—	40	40	40	40
Accumulator	Yes					
CONTROLS						
Fusible Plug (F)	210					
Control Voltage**	24 vac					
System Voltage	208/230 v	208/230 v	208/230 v	208/230 v, Single and 3 Phase, 460 v, 3 Phase		
FINISH	Gray					

LEGEND
FPI — Fins Per Inch
POE — Polyol Ester

*Unit shipped with full factory charge. See ARI (Air Conditioning and Refrigeration Institute) capacity table for proper charge and piston for each fan coil type.

†Valve connection size is 7/8 inch. Recommended line size is 1 1/8 inches.

**24 v and a minimum of 40 va is provided in the fan coil unit.

Step 4 — Make Electrical Connections

⚠ WARNING

Unit cabinet must have an uninterrupted, unbroken electrical ground to minimize the possibility of personal injury if an electrical fault should occur. This ground may consist of electrical wire connected to unit ground lug in control compartment, or conduit approved for electrical ground when installed in accordance with NEC, and local electrical codes. Failure to follow this warning could result in the installer being liable for the personal injury of others.

⚠ CAUTION

Unit failure as a result of operation on improper line voltage or excessive phase imbalance constitutes abuse and may cause damage to electrical components. Such operation would invalidate any applicable Carrier warranty.

⚠ WARNING

Before performing service or maintenance, be sure indoor unit main power switch is turned OFF and indoor blower has stopped. Failure to do so may result in electrical shock or injury from rotating fan blades.

CONTROL CIRCUIT WIRING — Control voltage is 24 v (40 va minimum). See Fig. 5 and unit label diagram for field-supplied wiring details. Route control wire through opening in unit side panel to connection in unit control box.

NOTE: For wire runs up to 50 ft, use no. 18 AWG (American Wire Gage) insulated wire. For 50 to 75 ft, use no. 16 AWG insulated wire. For over 75 ft, use 14 AWG insulated wire.

NOTE: All wiring must conform to NEC and local codes.

NOTE: Operating unit on improper line voltage constitutes abuse and could affect Carrier warranty. See Tables 2 and 3. *Do not* install unit in a system where voltage may fluctuate above or below permissible limits.

See Tables 2 and 3 for recommended fuse sizes. When making electrical connections, provide clearance at the unit for refrigerant piping connections.

NOTE: The 38HDF units are supplied with a 24-v control transformer. The 38HDR units use the control transformer supplied with the matched indoor unit.

POWER WIRING — Unit is factory wired for voltage shown on nameplate. Provide adequate, fused disconnect switch within sight from unit, readily accessible, but out of reach of children. Provision for locking the switch open (off) is advisable to prevent power from being turned on while unit is being serviced. Disconnect switch, fuses, and field wiring must comply with the NEC and local code requirements. Use copper wire only between the disconnect switch and unit. Use minimum 60 C wire for the field power connection.

Route power wires through the opening in unit side panel and connect in the unit control box as shown on the unit label diagram and Fig. 6 and 7. Unit must be grounded.

CONNECTIONS TO DUCT-FREE FAN COIL UNITS — The 38HDR units are designed for easy match-up to 40QA duct free fan coils. This unit provides 24 v power for the outdoor unit from the fan coil. Connect the Y and C terminals of the indoor unit to the Y and C terminals.



NOTE: For more information see schematic inside unit.

Fig. 5 — Typical Control Circuit Connections

Table 2 — 38HDF Electrical Data

38HDF UNIT SIZE	V-PH-Hz	VOLTAGE RANGE*		COMPRESSOR		OUTDOOR FAN MOTOR			MIN CKT AMPS	FUSE/HACR BKR AMPS
		Min	Max	RLA	LRA	FLA	NEC Hp	kW Out		
018	208/230-1-60	187	253	10.0	48.0	0.80	0.125	0.09	13.3	20
024	208/230-1-60	187	253	14.3	58.3	0.80	0.125	0.09	18.7	30
030	208/230-1-60	187	253	15.7	73.0	0.80	0.125	0.09	20.4	35
036	208/230-1-60	187	253	20.0	112.0	1.45	0.25	0.19	26.5	45
	208/230-3-60	187	253	14.7	88.0	1.45	0.25	0.19	19.8	30
	460-3-60	414	506	6.6	44.0	0.80	0.25	0.19	9.1	15

LEGEND

- FLA — Full Load Amps
- HACR — Heating, Air Conditioning, Refrigeration
- LRA — Locked Rotor Amps
- NEC — National Electrical Code
- RLA — Rated Load Amps (Compressor)

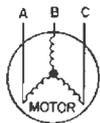
*Permissible limits of the voltage range at which unit will operate satisfactorily.

NOTES:

1. Control circuit is 24 v on all units and requires an external power source.
2. All motors and compressors contain internal overload protection.
3. In compliance with NEC (U.S.A. Standard) requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker.
4. Motor RLA values are established in accordance with UL (Underwriters' Laboratories) Standard 465 (U.S.A. Standard).
5. 38HDF.HDR018-030 units are only available in single-phase voltage.
6. **Unbalanced 3-Phase Supply Voltage**
Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance:

$$= 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

EXAMPLE: Supply voltage is 460-3-60.



AB = 452 v
BC = 464 v
AC = 455 v

$$\begin{aligned} \text{Average Voltage} &= \frac{452 + 464 + 455}{3} \\ &= \frac{1371}{3} \\ &= 457 \end{aligned}$$

Determine maximum deviation from average voltage:

(AB) 457 - 452 = 5 v
(BC) 464 - 457 = 7 v
(AC) 457 - 455 = 2 v

Maximum deviation is 7 v.

Determine percentage of voltage imbalance:

$$\begin{aligned} \% \text{ Voltage Imbalance} &= 100 \times \frac{7}{457} \\ &= 1.53\% \end{aligned}$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable of 2%.

IMPORTANT: Contact your local electric utility company immediately if the supply voltage phase imbalance is more than 2%.



Table 3 — 38HDR Electrical Data

38HDR UNIT SIZE	V-PH-Hz	VOLTAGE RANGE*		COMPRESSOR		OUTDOOR FAN MOTOR			MIN CKT AMPS	FUSE/HACR BKR AMPS
		Min	Max	RLA	LRA	FLA	NEC Hp	kW Out		
018	208/230-1-60	187	253	10.0	48.0	0.80	0.125	0.09	13.3	20
024	208/230-1-60	187	253	14.3	53.3	0.80	0.125	0.09	18.7	30
030	208/230-1-60	187	253	15.7	64.0	1.45	0.25	0.19	21.1	35
036	208/230-1-60	187	253	15.7	77.0	1.45	0.25	0.19	21.1	35
	208/230-3-60	187	253	10.4	88.0	1.45	0.25	0.19	14.5	20
	460-3-60	414	506	6.3	38.0	0.80	0.25	0.19	8.7	15
048	208/230-1-60	187	253	24.3	117.0	1.45	0.25	0.19	31.8	55
	208/230-3-60	187	253	15.6	83.1	1.45	0.25	0.19	21.0	35
	460-3-60	414	506	6.9	41.0	0.80	0.25	0.19	9.4	15
060	208/230-1-60	187	253	29.4	134.0	1.45	0.25	0.19	38.2	65
	208/230-3-60	187	253	17.8	110.0	1.45	0.25	0.19	23.7	40
	460-3-60	414	506	8.6	52.0	0.80	0.25	0.19	11.6	20

LEGEND

- FLA — Full Load Amps
- HACR — Heating, Air Conditioning, Refrigeration
- LRA — Locked Rotor Amps
- NEC — National Electrical Code
- RLA — Rated Load Amps (Compressor)

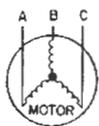
*Permissible limits of the voltage range at which unit will operate satisfactorily.

NOTES:

1. Control circuit is 24 v on all units and requires an external power source.
2. All motors and compressors contain internal overload protection.
3. In compliance with NEC (U.S.A. Standard) requirements for multi-motor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker.
4. Motor RLA values are established in accordance with UL (Underwriters' Laboratories) Standard 465 (U.S.A. Standard).
5. 38HDF, HDR018-030 units are only available in single-phase voltage.
6. **Unbalanced 3-Phase Supply Voltage**
Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance:

$$= 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

EXAMPLE: Supply voltage is 460-3-60.



AB = 452 v
BC = 464 v
AC = 455 v

$$\begin{aligned} \text{Average Voltage} &= \frac{452 + 464 + 455}{3} \\ &= \frac{1371}{3} \\ &= 457 \end{aligned}$$

Determine maximum deviation from average voltage:

- (AB) 457 - 452 = 5 v
- (BC) 464 - 457 = 7 v
- (AC) 457 - 455 = 2 v

Maximum deviation is 7 v.

Determine percentage of voltage imbalance:

$$\begin{aligned} \% \text{ Voltage Imbalance} &= 100 \times \frac{7}{457} \\ &= 1.53\% \end{aligned}$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable of 2%

IMPORTANT: Contact your local electric utility company immediately if the supply voltage phase imbalance is more than 2%.



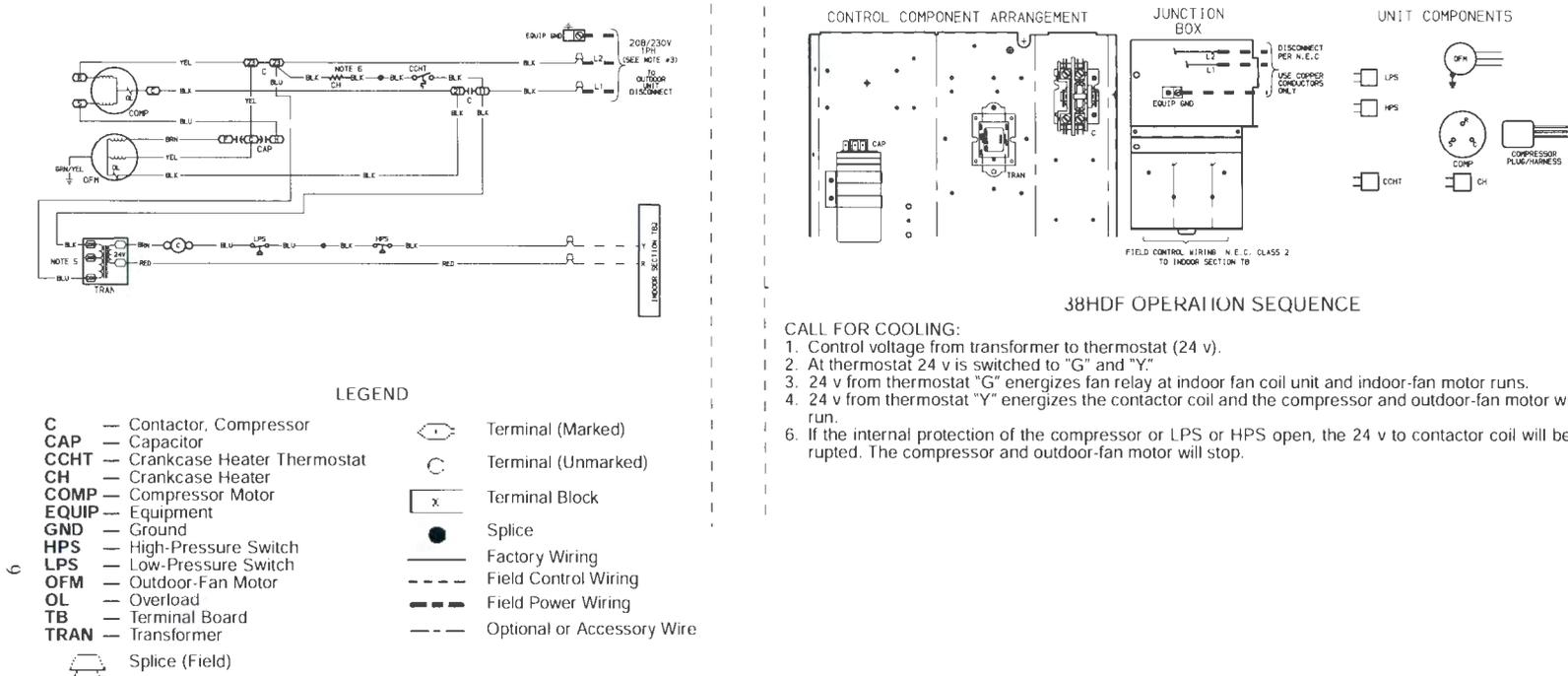
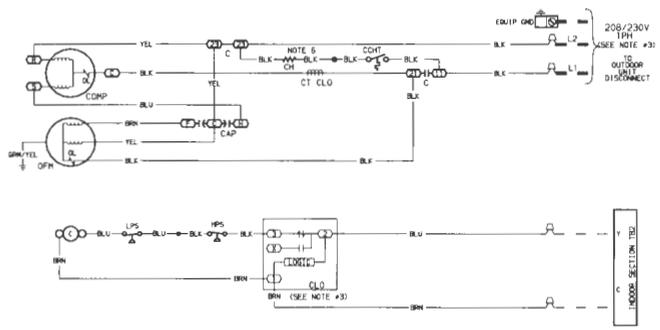


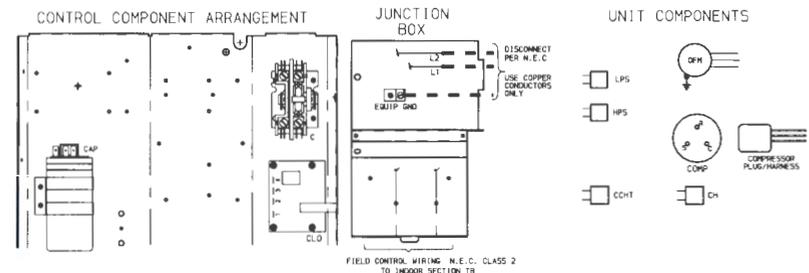
Fig. 6 — 38HDF018-036 Typical Wiring Schematic



LEGEND

C — Contactor, Compressor	Splice (Field)
CAP — Capacitor	Terminal (Marked)
CCHT — Crankcase Heater Thermostat	Terminal (Unmarked)
CH — Crankcase Heater	Terminal Block
CLO — Compressor Lockout	Splice
COMP — Compressor Motor	Factory Wiring
CT — Current Transformer	Field Control Wiring
EQUIP — Equipment	Field Power Wiring
GND — Ground	
HPS — High-Pressure Switch	
LPS — Low-Pressure Switch	
OFM — Outdoor-Fan Motor	
OL — Overload	
TB — Terminal Board	

- NOTES:**
1. Compressor and fan motors are thermally protected.
 2. Wire in accordance with National Electrical Code (NEC) and local codes. Replace any original wires with 90° C wire or its equivalent.
 3. The CLO locks out the COMP to prevent short cycling on COMP overloads and safety devices. Before replacing CLO check these devices.
 4. If indoor section has a transformer with a grounded secondary, connect the grounded side to "C" on the low voltage board.
 5. Use minimum 60° C wire for field power wiring.
 6. Crankcase heater and thermostat used on selected models only.



38HDR OPERATION SEQUENCE

- CALL FOR COOLING:**
1. Control voltage from transformer to thermostat (24 v).
 2. At thermostat 24 v is switched to "G" and "Y".
 3. 24 v from thermostat "G" energizes fan relay at indoor fan coil and indoor-fan motor runs.
 4. 24 v from thermostat "Y" energizes the logic in the CLO, and the contactor coil, both at the outdoor unit. Compressor and outdoor-fan motor run.
 6. If the internal protector of the compressor, HPS, or LPS open, the 24 v to the contactor coil will be interrupted, the compressor and outdoor-fan motor will stop, and the CLO will keep the circuit open until reset by stopping and restarting the 24 v power at the thermostat.

Fig. 7 — 38HDR018-060 Typical Wiring Schematic

START-UP

Preliminary Checks

1. Check that all internal wiring connections are tight and that all barriers, covers, and panels are in place.
2. Field electrical power source must agree with unit name-plate rating.
3. All service valves must be open.
4. Belly-band crankcase heater must be tight on compressor crankcase for those units with belly-band heaters.

Leak Test — Field piping and fan coil must be leak tested by pressure method. Use R-410A at approximately 25 psig backed up with an inert gas to a total pressure not to exceed 245 psig.

Leak detectors should be designed to detect HFC (hydro-fluorocarbon) refrigerant.

Evacuate and Dehydrate — Field piping and fan coil must be evacuated and dehydrated.

Charge System — Release charge into system by opening (backseating) liquid and suction line service valves. Refer to separate indoor unit installation instructions for the required total system charge when connected to 25 ft of tubing.

To Start Unit — Be sure that the field disconnect is closed. Set room thermostat below ambient temperature. Operate unit for 15 minutes, then check system refrigerant charge. See Refrigerant Charging section on page 12.

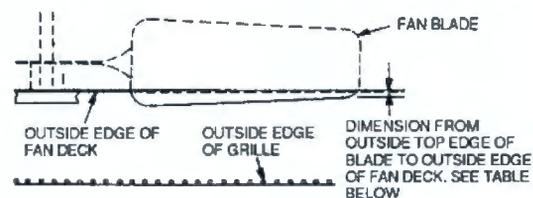
NOTE: When using in conjunction with 40QA or 40QK fan coils, refer to start-up instructions included with fan coil for correct start-up procedures.

SERVICE

⚠ WARNING

Before performing recommended maintenance, be sure unit main power switch is turned off. Failure to do so may result in electrical shock or injury from rotating fan blade.

Outdoor Fan — A reinforced wire mount holds the outdoor fan assembly in position. See Fig. 8 for proper mounting position.



38HDF UNIT SIZE, in.	
018,030	036
0.433	0

38HDR UNIT SIZE, in.		
018,024	030,036	048,060
0.433	0	0

Fig. 8 — Condenser-Fan Mounting Positions

High-Pressure Relief Valve — The high-pressure relief valve is located in the compressor. The relief valve opens at a pressure differential of approximately 550 to 625 ± 50 psid between suction (low side) and discharge (high side) to allow pressure equalization.

Internal Current and Temperature Sensitive Overload

— The control resets automatically when internal compressor motor temperature drops to a safe level (overloads may require up to 45 minutes to reset). When an internal overload is suspected of being open, check by using an ohmmeter or continuity tester.

Pumpdown Procedure — The system may be pumped down in order to make repairs on the low side without losing complete refrigerant charge.

⚠ CAUTION

Never open system to atmosphere while it is under a vacuum. Equipment damage may result.

When system must be opened for service, recover refrigerant, break vacuum with dry nitrogen before opening system.

1. Attach pressure gage to suction service valve gage port.
2. Frontseat the liquid/mixed phase line valve.

⚠ CAUTION

The 38HDC unit coils hold only the factory-designated amount of refrigerant. Additional refrigerant may cause units to relieve pressure through the compressor internal pressure relief valve (indicated by a sudden rise of suction pressure) before suction pressure reaches 5 psig. If this occurs, shut off unit immediately then frontseat the suction valve and remove and recover excess refrigerant following accepted practices. Equipment damage may result.

3. Start unit and run until suction pressure reaches 20 psig.
4. Shut unit off and frontseat suction valve.
5. Depressurize low side of unit and recover refrigerant following accepted practices.

High-Pressure Switch — The high-pressure switch, located on discharge line, protects against high discharge pressures caused by such events as overcharge, condenser-fan motor failure, system restriction, etc. It opens on pressure rise at about 650 ± 10 psig. If system pressures go above this setting during abnormal conditions, the switch opens.

⚠ WARNING

DO NOT attempt to simulate these system abnormalities — high pressures pose a serious safety hazard.

The high-pressure switch is checked with an ohmmeter. If system pressure is below 625 psig switch shows continuity.

Crankcase Heater — The crankcase heater prevents refrigerant migration and compressor oil dilution during shutdown when compressor is not operating. If the crankcase heater is deenergized for more than 6 hours, both compressor service valves must be closed.

NOTE: Crankcase heaters are only available on 38HDR030-060 units.

The crankcase heater is powered by the high-voltage power of the unit. It is connected across the line side of the contactor and is thermostatically controlled.

⚠ CAUTION

Use extreme caution when troubleshooting this device, as line voltage is continually present. Serious personal injury could result.

To troubleshoot:

1. Apply voltmeter across crankcase heater leads to see if heater voltage is on. *Do not touch heater*: Carefully feel area around crankcase heater; if warm, crankcase heater is functioning.
2. With power off and heater leads disconnected, check across leads with ohmmeter. Do not look for a specific resistance reading. Check for resistance or an open circuit, and change heater if an open circuit is detected.

Service Valves — The service valves in the outdoor unit come from the factory frontseated. This means the refrigerant charge is isolated from the line-set connection ports. To prevent damage to the valve, use a wet cloth or other accepted heat sink material on the valve before brazing.

The service valve cannot be field repaired, therefore, only a complete valve or valve stem seal and service port caps are available for replacement.

Refrigerant Charging

⚠ WARNING

To prevent personal injury, wear safety glasses and gloves when handling refrigerant. Do not overcharge system — this can cause compressor flooding.

⚠ WARNING

Service valves must be fully backseated to close service port. There is no Schrader valve at the service port, and failure to backseat the valve could result in loss of system charge or personal injury.

NOTE: Do not vent or depressurize unit refrigerant to atmosphere. Remove and recover refrigerant following accepted practices.

All units are shipped with the refrigerant charge listed on the nameplate. See indoor unit Installation Instructions for additional charge requirements.

NOTE: For 38HDF units only, charge to nameplate. See the indoor unit owner's manual for any additional charge requirements.

Refer to Table 4 and consider the following when working with Puron® refrigerant:

- Puron refrigerant cylinders are rose colored.
- Recovery cylinder service pressure rating must be 400 psig, DOT (Department of Transportation) 4BA400 or DOT BW400.
- Puron systems should be charged with liquid refrigerant. Use a commercial type metering device in the manifold hose when charging into suction line with compressor operating.
- Manifold sets should be 700 psig high side and 180 psig low side with 550 psig low-side retard.
- Use hoses with 700 psig service pressure rating.
- Puron refrigerant, as with other HFCs, is only compatible with POE oils.
- Vacuum pumps will not remove moisture from oil.
- Polyol Ester oils absorb moisture rapidly. Do not expose oil to atmosphere.
- Polyol Ester oils may cause damage to certain plastics and roofing materials.
- Wrap all filter driers and service valves with wet cloth when brazing.
- A factory approved, liquid-line filter drier is required on every unit.
- Do not use a TXV (thermostatic expansion valve) designed for use with R-22 refrigerant. Refer to separate indoor unit installation instructions for more details.
- If using a suction line drier, do not leave in place for more than 72 hours.

Table 4 — Pressure vs. Temperature Chart — Puron® Refrigerant (R-410A)

PRESSURE PSIG	TEMPERATURE °F	PRESSURE PSIG	TEMPERATURE °F	PRESSURE PSIG	TEMPERATURE °F	PRESSURE PSIG	TEMPERATURE °F	PRESSURE PSIG	TEMPERATURE °F	PRESSURE PSIG	TEMPERATURE °F
12	-37.7	114	37.8	216	74.3	318	100.2	420	120.7	522	137.6
14	-34.7	116	38.7	218	74.9	320	100.7	422	121.0	524	137.9
16	-32.0	118	39.5	220	75.5	322	101.1	424	121.4	526	138.3
18	-29.4	120	40.5	222	76.1	324	101.6	426	121.7	528	138.6
20	-26.9	122	41.3	224	76.7	326	102.0	428	122.1	530	138.9
22	-24.5	124	42.2	226	77.2	328	102.4	430	122.5	532	139.2
24	-22.2	126	43.0	228	77.8	330	102.9	432	122.8	534	139.5
26	-20.0	128	43.8	230	78.4	332	103.3	434	123.2	536	139.8
28	-17.9	130	44.7	232	78.9	334	103.7	436	123.5	538	140.1
30	-15.8	132	45.5	234	79.5	336	104.2	438	123.9	540	140.4
32	-13.8	134	46.3	236	80.0	338	104.6	440	124.2	544	141.0
34	-11.9	136	47.1	238	80.6	340	105.1	442	124.6	548	141.6
36	-10.1	138	47.9	240	81.1	342	105.4	444	124.9	552	142.1
38	-8.3	140	48.7	242	81.6	344	105.8	446	125.3	556	142.7
40	-6.5	142	49.5	244	82.2	346	106.3	448	125.6	560	143.3
42	-4.5	144	50.3	246	82.7	348	106.6	450	126.0	564	143.9
44	-3.2	146	51.1	248	83.3	350	107.1	452	126.3	568	144.5
46	-1.6	148	51.8	250	83.8	352	107.5	454	126.6	572	145.0
48	0.0	150	52.5	252	84.3	354	107.9	456	127.0	576	145.6
50	1.5	152	53.3	254	84.8	356	108.3	458	127.3	580	146.2
52	3.0	154	54.0	256	85.4	358	108.8	460	127.7	584	146.7
54	4.5	156	54.8	258	85.9	360	109.2	462	128.0	588	147.3
56	5.9	158	55.5	260	86.4	362	109.6	464	128.3	592	147.9
58	7.3	160	56.2	262	86.9	364	110.0	466	128.7	596	148.4
60	8.6	162	57.0	264	87.4	366	110.4	468	129.0	600	149.0
62	10.0	164	57.7	266	87.9	368	110.8	470	129.3	604	149.5
64	11.3	166	58.4	268	88.4	370	111.2	472	129.7	608	150.1
66	12.6	168	59.0	270	88.9	372	111.6	474	130.0	612	150.6
68	13.8	170	59.8	272	89.4	374	112.0	476	130.3	616	151.2
70	15.1	172	60.5	274	89.9	376	112.4	478	130.7	620	151.7
72	16.3	174	61.1	276	90.4	378	112.6	480	131.0	624	152.3
74	17.5	176	61.8	278	90.9	380	113.1	482	131.3	628	152.8
76	18.7	178	62.5	280	91.4	382	113.5	484	131.6	632	153.4
78	19.8	180	63.1	282	91.9	384	113.9	486	132.0	636	153.9
80	21.0	182	63.8	284	92.4	386	114.3	488	132.3	640	154.5
82	22.1	184	64.5	286	92.8	388	114.7	490	132.6	644	155.0
84	23.2	186	65.1	288	93.3	390	115.0	492	132.9	648	155.5
86	24.3	188	65.8	290	93.8	392	115.5	494	133.3	652	156.1
88	25.4	190	66.4	292	94.3	394	115.8	496	133.6	656	156.6
90	26.4	192	67.0	294	94.8	396	116.2	498	133.9	660	157.1
92	27.4	194	67.7	296	95.2	398	116.6	500	134.0	664	157.7
94	28.5	196	68.3	298	95.7	400	117.0	502	134.5	668	158.2
96	29.5	198	68.9	300	96.2	402	117.3	504	134.8	672	158.7
98	30.5	200	69.5	302	96.6	404	117.7	506	135.2	676	159.2
100	31.2	202	70.1	304	97.1	406	118.1	508	135.5	680	159.8
102	32.2	204	70.7	306	97.5	408	118.5	510	135.8	684	160.3
104	33.2	206	71.4	308	98.0	410	118.8	512	136.1	688	160.8
106	34.1	208	72.0	310	98.4	412	119.2	514	136.4	692	161.3
108	35.1	210	72.6	312	98.9	414	119.6	516	136.7	696	161.8
110	35.5	212	73.2	314	99.3	416	119.9	518	137.0		
112	36.9	214	73.8	316	99.7	418	120.3	520	137.3		

Subcooling Method — For 38HDR units only, the subcooling method is used to check and adjust charge during the cooling season. Refer to Table 5 and the following procedure:

NOTE: For use with residential fan coils and the 40QA060 under ceiling unit only.

1. Operate unit a minimum of 15 minutes before checking charge.
2. Measure liquid line temperature near liquid line service valve, and measure the liquid pressure at the liquid line service valve. Use a digital thermometer for all temperature measurements. DO NOT use mercury or dial-type thermometers.

3. Refer to Table 5. Find the temperature point at which the required subcooling temperature intersects the measured liquid line pressure.
4. If the measured liquid line temperature does not agree with the required liquid line temperature, ADD refrigerant to lower the temperature, or REMOVE refrigerant to raise the temperature (allow a tolerance of $\pm 3^{\circ}$ F).

Table 5 — Subcooling Charging Table

LIQUID PRESSURE AT SERVICE VALVE (psig)	REQUIRED LIQUID LINE TEMPERATURE (F)					
	Required Subcooling Temperature (F)					
	8	10	12	14	16	18
189	58	56	54	52	50	48
195	60	58	56	54	52	50
202	62	60	58	56	54	52
208	64	62	60	58	56	54
215	66	64	62	60	58	56
222	68	66	64	62	60	58
229	70	68	66	64	62	60
236	72	70	68	66	64	62
243	74	72	70	68	66	64
251	76	74	72	70	68	66
259	78	76	74	72	70	68
266	80	78	76	74	72	70
274	82	80	78	76	74	72
283	84	82	80	78	76	74
291	86	84	82	80	78	76
299	88	86	84	82	80	78
308	90	88	86	84	82	80
317	92	90	88	86	84	82
326	94	92	90	88	86	84
335	96	94	92	90	88	86
345	98	96	94	92	90	88
354	100	98	96	94	92	90
364	102	100	98	96	94	92
374	104	102	100	98	96	94
384	106	104	102	100	98	96
395	108	106	104	102	100	98
406	110	108	106	104	102	100
416	112	110	108	106	104	102
427	114	112	110	108	106	104
439	116	114	112	110	108	106
450	118	116	114	112	110	108
462	120	118	116	114	112	110
474	122	120	118	116	114	112
486	124	122	120	118	116	114
499	126	124	122	120	118	116
511	128	126	124	122	120	118

Compressor Lockout Switch — The 38HDR units are provided with a compressor lockout protective device. If the compressor shuts down due to any safety device, a current loop monitoring the compressor current senses no current flow. The unit will lock out until the control power is interrupted to reset the lockout. Determine the reason for the safety trip. To restart the lockout, turn the thermostat to the OFF position and then set the thermostat to an operating position.

MAINTENANCE

▲ WARNING

Before performing recommended maintenance, be sure unit main power switch is turned off. Failure to do so may result in electric shock or injury from rotating fan blade.

Lubrication

COMPRESSOR — Compressor contains factory oil charge; replace oil when lost. Use Mobile 3MA-POE oil.

Cleaning Coils — Coil should be washed out with water or blown out with compressor air. Note that the blow-thru design causes dirt and debris to build up on the inside of the coils.

Clean coil annually or as required by location and outdoor air conditions. Inspect coil monthly and clean as required. Fins are not continuous through coil sections. Dirt and debris may pass through first section, become trapped between the row of fins and restrict condenser airflow. Use a flashlight to determine if dirt or debris has collected between coil sections. Clean coil as follows:

1. Turn off unit power.
2. Using a garden hose or other suitable equipment, flush coil from the outside to remove dirt. Be sure to flush all dirt and debris from drain holes in base of unit. Fan motors are waterproof.

TROUBLESHOOTING

See Fig. 9 for troubleshooting information.

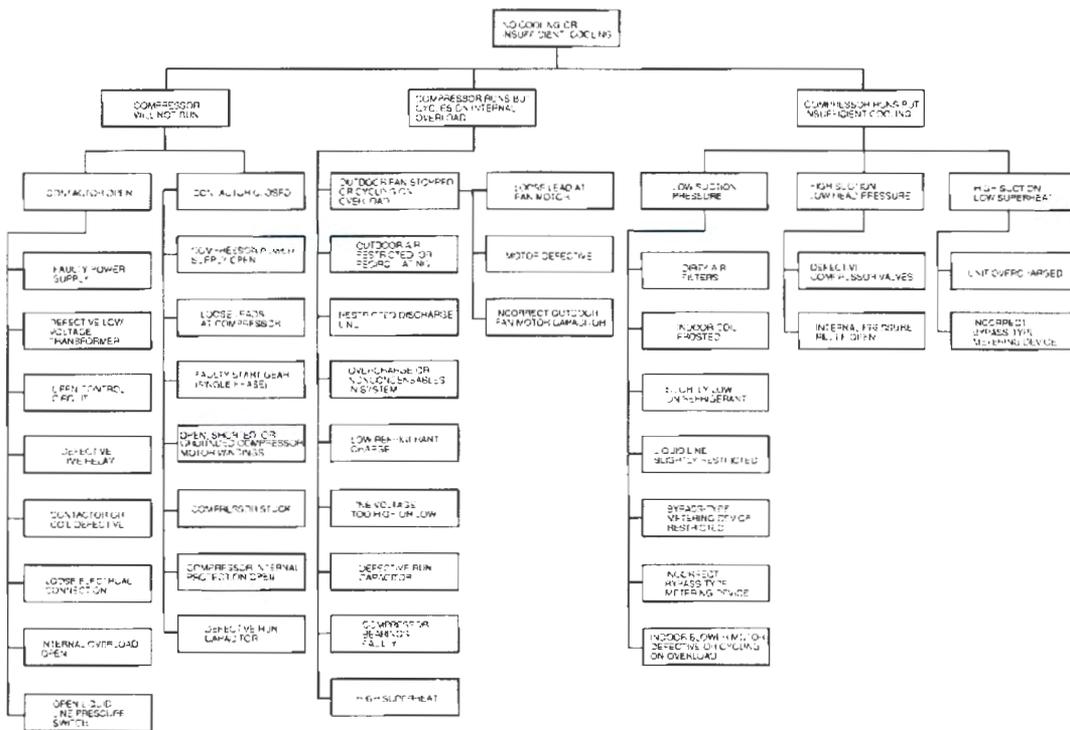


Fig. 9 — Troubleshooting the Cooling Cycle

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Tab 3a							

Attachment K-3
Greenheck Exhaust Fan

Receiving

Upon receiving the product, check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Note: The filtered supply unit ships with all ordered components completely factory assembled. The optional weatherhood ships knocked down for field assembly and installation.

Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

INDOOR

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F (-1° to 43°C), wide temperature swings may cause condensation and "sweating" of metal parts. All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid "sweating" of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to remove any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ inches (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

OUTDOOR

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles. Fan wheels should be blocked to prevent spinning caused by strong winds.

Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

Pre-Installation Checks

- Check chart below for correct wall opening dimensions.
- Check motor voltage and amperage rating for compatibility with electrical supply. Supply wiring must be properly fused and conform to local and national codes.
- Motor load amperage must be checked and compared to nameplate rating to avoid serious damage to motor when speed is increased.

Wall Opening Requirements

Wall opening size and propeller-to-damper distance are two important dimensions for fan installation.

Fans mounted to the wall require a different wall opening (W.O.) size than those mounted in collars or wall housings. Propeller-to-damper distance (M) is important to reduce turbulence and damper flutter which may lead to premature damper failure.

Figure 1 and 2 show the wall opening (W.O.) required for installations with either a wall housing or collar.

Figure 3 shows the recommended wall opening (W.O.) and the minimum distance (M) suggested between the fan and damper for direct to wall installations.

Figure 4 shows the dimensions and wall opening (W.O.) required for installations with a filtered supply wall housing.

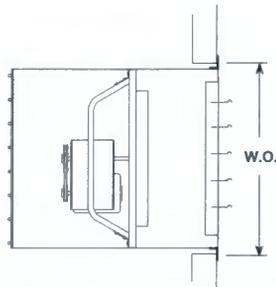


Figure 1 - Wall Housing Installation

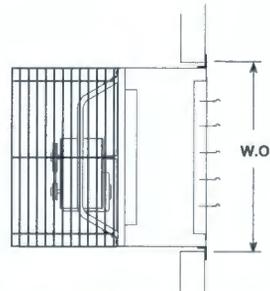


Figure 2 - Wall Collar Installation

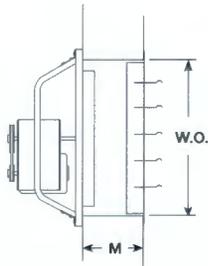


Figure 3 - Direct to Wall Installation

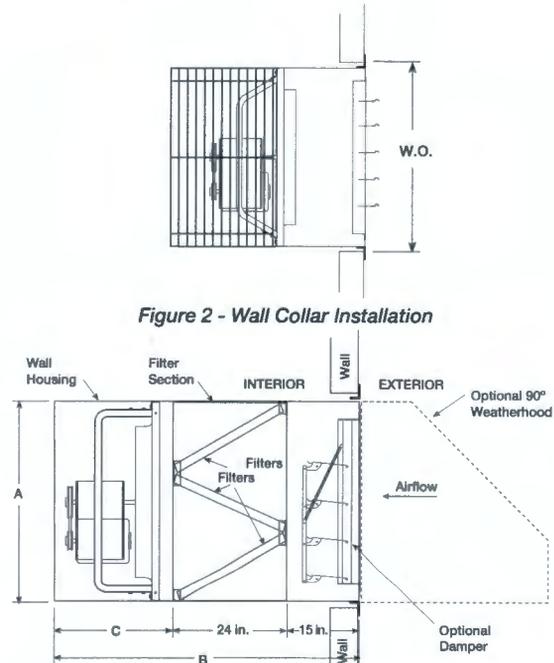


Figure 4 - Filtered Supply Wall Housing Installation

Fan Size	Damper Size Square	Recommended Wall Opening (W.O.) Square			M Minimum	Filtered Supply Wall Housing Only				
		Figures 1 and 2	Figure 3	Figure 4		A	B	C	Filter Quantity & Size	
8	10 (254)	14¼ (362)	10½ (267)	-	6 (152)	-	-	-	-	
10	12 (305)	16¼ (413)	12½ (318)	-	6 (152)	-	-	-	-	
12	14 (356)	19¼ (489)	14½ (368)	-	7 (178)	-	-	-	-	
14	16 (406)	21¼ (540)	16½ (419)	-	8 (203)	-	-	-	-	
16	18 (457)	23¼ (591)	18½ (470)	-	9 (229)	-	-	-	-	
18	20 (508)	25¼ (641)	20½ (521)	-	10 (254)	-	-	-	-	
20	22 (559)	27¼ (692)	22½ (572)	-	12 (305)	-	-	-	-	
24	26 (660)	33¼ (857)	26½ (673)	33¼ (857)	13 (330)	32¼ (819)	63 (1600)	24 (610)	4	23¼ x 16¼ (591 x 413)
30	32 (813)	39¼ (1010)	32½ (826)	39¼ (1010)	13 (330)	38¼ (972)	65 (1651)	26 (660)	4	24¼ x 19¼ (625 x 489)
36	38 (965)	45¼ (1162)	38½ (978)	45¼ (1162)	14 (356)	44¼ (1124)	67¼ (1708)	28¼ (718)	6	23¼ x 22½ (591 x 562)
42	44 (1118)	51¼ (1314)	44½ (1130)	51¼ (1314)	15 (381)	50¼ (1273)	72¼ (1851)	34 (864)	6	24¼ x 25½ (613 x 638)
48	50 (1270)	57¼ (1467)	50½ (1283)	57¼ (1467)	16 (406)	56¼ (1426)	72¼ (1851)	34 (864)	12	23¼ x 18¼ (591 x 476)
54	56 (1422)	63¼ (1619)	56½ (1435)	63¼ (1619)	17 (432)	62¼ (1584)	79¼ (2024)	40¼ (1033)	12	23¼ x 20¼ (591 x 527)
60	62 (1575)	69¼ (1772)	62½ (1588)	-	19 (483)	-	-	-	-	-
72	74 (1880)	84¼ (2153)	74½ (1892)	-	19 (483)	-	-	-	-	-

All dimensions given in inches (millimeters). Filters are 2 inch (51 mm) nominal thickness. Above filter sizes are actual dimensions.



WARNING

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

Typical Installation

Move fan to the desired location and determine the method by which the fan is to be mounted as shown in Figures 1-4 shown on page 3. Optional wall mount housings (Figure 1) and wall mount collars (Figure 2) provide a convenient means of mounting sidewall propeller fans while maintaining the proper distance between the propeller and damper.

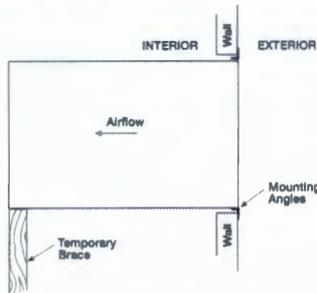
Attach the fan by inserting a suitable fastener through each of the prepunched mounting holes in the fan panel. Care should be taken not to bend or distort the fan panel or drive components during installation.

Support Braces

Wall Housing sizes 42 and larger with heavy motors and all Filtered Supply Wall Housings need additional bracing.

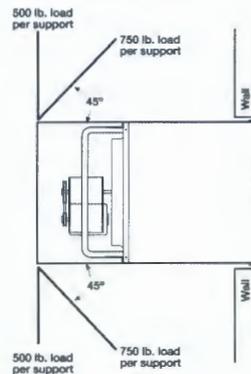
Filtered Supply Wall Housing Installation

Step 1 Install Housing



Install housing through wall opening from outside. Temporarily brace end of unit until permanent support braces are installed. Secure through prepunched holes in angles with suitable fasteners.

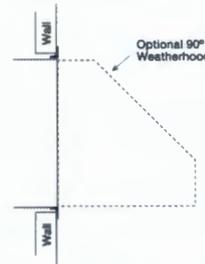
Step 2 Install Support Braces



Choose method of support. Attach support to end of unit (above or below housing) with rods, cable, angle, etc. (supplied by others) as shown.

Vertical braces must carry a minimum load of 500 pounds per support, and angled (45°) braces a minimum of 750 pounds per support based on two supports.

Step 3 Install Weatherhood



Position weatherhood over end of wall housing and fasten through mounting holes with self-tapping screws. Caulk, flash and complete electrical hook-up to finish installation.

Pre-Starting Checks

Check all fasteners and setscrews for tightness. This is especially important for bearing setscrews.

The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Propeller blade should cup and throw the air when rotating in the correct rotation as shown in the figure below. Rotation should be in the same direction as the rotation decal affixed to the unit.



For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single-phase installations follow the wiring diagram located on the motor.

For Belt Drive Fans: The adjustable motor pulley is preset at the factory for the specified fan RPM. Fan speed can be increased by the closing or opening the adjustable pulley. Two or three groove variable pitch pulleys must be adjusted an equal



number of turns open. Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to nameplate rating when changing fan speed.

Routine Maintenance

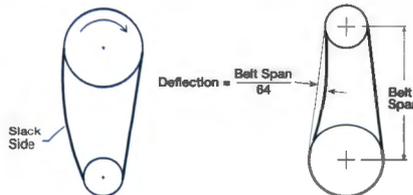
Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are: Belts, Bearings, Fasteners and Setscrews, Lubrication, and Removal of Dust and Dirt.

WARNING

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

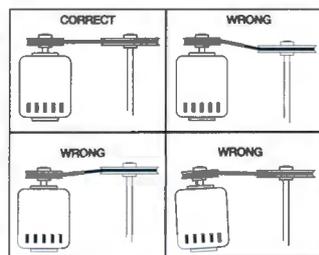
Belts

Premature belt failures are frequently caused by improper belt tension (either too tight or too loose) or misaligned pulleys. The proper tension for operating a V-belt is the lowest tension at which the belts will not slip at peak load conditions. For initial tensioning, the proper belt deflection halfway between pulley centers is 1/64 inch (0.4 mm) for each inch of belt span. For example, if the belt span is 64 inches (1626 mm), the belt deflection should be one inch (25 mm) using moderate thumb pressure at midpoint of the drive. See figure shown below.



Check belt tension two times during the first 24 hours of operation and periodically thereafter. To adjust belt tension, simply loosen four fasteners (two on each side of the motor plate) and slide the motor plate away from the fan shaft until proper belt tension is attained. On some fans, fasteners attaching the motor to the motor plate must be loosened in order to adjust the belt.

It is very important that the drive pulleys remain in proper alignment after adjustments are made. Misalignment of pulleys will result in premature belt wear noise, vibration and power loss.



Bearings (For belt drive fans only)

Bearings are the most critical moving part of the fan and should be inspected at periodic intervals. Locking collars and setscrews, in addition to fasteners attaching the bearings to the bearing plate, must be checked for tightness. In a clean environment and temperatures above 32°F (0°C) and below 200°F (93°C), fan shaft bearings with grease fittings should be lubricated semi-annually using a high-quality lithium based grease. If unusual environmental conditions exist, temperatures below 32°F (0°C) and above 200°F (93°C), moisture or contaminants, more frequent lubrication is required.

With the unit running, add grease very slowly with a manual grease gun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating or using excessive pressure. Bearings without grease fittings are lubricated for life.

Fasteners and Setscrews

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners and setscrews for tightness. Particular attention should be paid to setscrews or taper-lock bushings attaching the propeller to the motor shaft and the motor shaft to the bearings. Loose bearing setscrews will lead to premature failure of the fan shaft. In addition, check all fasteners attaching the motor to the motor plate.

Lubrication

Refer to the paragraph on bearings for bearing lubrication. Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further attention. Motors equipped with oil holes should be oiled in accordance with the manufacturer's instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate. Motors supplied with grease fittings should be greased according to directions printed on the motor.

Removal of Dust and Dirt

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water or solvents to enter the motor or bearings. Motors or bearings must not be sprayed with steam or water.

The filters also require periodic cleaning. The 2 inch (51 mm) washable aluminum filters are accessed through the bolted access panel.

Troubleshooting		
WARNING: Before taking any corrective action, make certain unit is not capable of operation during repairs.		
PROBLEM	CAUSE	CORRECTIVE ACTION
Too Much Airflow	Resistance lower than designed	Decrease fan speed.
Reduced Airflow	System resistance too high	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply air for exhaust fans or exhaust air for supply fans.
	Fan too close to damper	Increase distance between fan and damper.
	Fan speed too low	Increase fan speed.
	Excessive dirt buildup on propeller	Clean propeller.
Excessive Noise	Bearings	Tighten collars and fasteners. Lubricate bearings. Replace defective bearings.
	V-Belt drive	Tighten pulleys on motor and fan shaft. Adjust belt tension. Align pulleys properly. Replace worn belts or pulleys. See Maintenance.
	Excessive vibration	Clean dirt buildup from propeller. Check all setscrews and fasteners for tightness. Check for worn bearing. Correct propeller imbalance. Check for loose dampers, guards or ductwork.
	Defective motor	Replace motor.
	Variable Frequency Drive (VFD)	Check VFD for drive setting, some controllers are able to be adjust to lower the harmonic noises sometimes heard during operation by adjusting a simple setting on the controller.
	Debris	Remove all debris from the fan.
Fan Does Not Operate	Electrical Supply	Check fuses/circuit breakers. Check for switches turned off or disconnected. Check for correct supply voltage.
	Drive	Check for broken or worn belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.

Maintenance Documentation

Job Information

Job Name: _____ Service Organization: _____
 Address: _____ Address: _____
 City: _____ City: _____
 State: _____ Zip: _____ State: _____ Zip: _____
 Phone: _____ Phone: _____
 Contact Person: _____ Work Done By: _____

Nameplate Information

Model: _____
 Volts: _____ Hertz: _____ Phase: _____
 Amps: _____ Mark: _____
 Supply hp: _____ Exhaust hp: _____
 Serial Number: _____
 Model Voltage: _____
 Motor Amperage: _____
 Fan RPM: _____

Field Start-Up Documentation

Actual Voltage: _____ Hertz: _____ Phase: _____
 Actual Amperage: _____
 Blower Rotation: _____
 Air Volume: Design cfm: _____
 Actual cfm: _____
 Level of fan (L or H): _____
 Fan RPM Range (min.) _____ (max.) _____



Parts List

NOTE

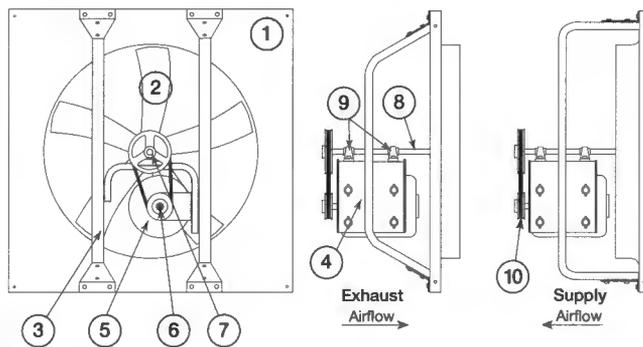
Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

CAUTION

A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof.

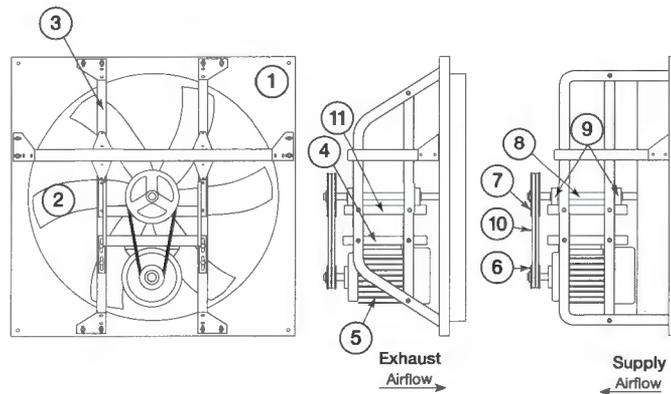
Parts List - Belt Drive

SBE-1, SBS-1, SBE-2 and SBS-2 (L and H propellers)



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor/Bearing Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt

SBE-3, SBS-3, SBCE, SBCS, and SBCR (L and H propellers)



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt
11. Bearing Plate

Parts List - Direct Drive	
SE1 and SS1 (Sizes 8 thru 12 - D, G and E motor speeds)	
	<ol style="list-style-type: none"> 1. Fan Panel 2. Propeller 3. Drive Frame/Motor Support 4. Motor 5. Riser Blocks (4) - supply fan only 6. Shaft Extension- supply fan only
SE1 and SS1 (Sizes 12 thru 24 - A, B and C motor speeds)	
SE2 and SS2	
SCE3, SCS3 and SCR3	
	<ol style="list-style-type: none"> 1. Fan Panel 2. Propeller 3. Drive Frame Channels (2) 4. Motor Plate 5. Motor

Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Greenheck Catalog Sidewall Propeller Fans provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: www.amca.org.



Phone: (715) 359-6171 • Fax: (715) 355-2399 • E-mail: gfcinfo@greenheck.com • Website: www.greenheck.com

8 471755 • Sidewall Propeller Fans IOM • Rev. 2, October 2008

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Attachment K-4
Indeeco Unit Heater



UHIR Series

Horizontal or Vertical Mounting
Industrial / Commercial Electric Unit Heater

Owner's Manual



This manual covers installation, maintenance and repair parts. Read carefully before attempting to install, operate or service the UHIR Series Unit Heater.

IMPORTANT: RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE.

INDUSTRIAL ENGINEERING & EQUIPMENT COMPANY
425 HANLEY INDUSTRIAL COURT • ST. LOUIS, MO 63144
314-644-4300 • 800-243-8162 • FAX: 314-644-5332
www.indeeco.com

WARNINGS

Installation and maintenance personnel should familiarize themselves with this manual and all the **WARNINGS** before installing or working on this heater to avoid potential unsafe conditions, severe property damage, personal injury or death.

1. Read all instructions before using this heater.
2. Verify that the supply voltage and phase to the heater matches the nameplate rating before energizing.
3. Potentially lethal voltages are present. Be sure to lock the branch circuit disconnect switch in the OFF position and tag the circuit "Out for Maintenance" before working on this equipment.
4. Keep electrical enclosure cover tightly closed while in operation.
5. Hazard of Electric Shock. Heater must be grounded in accordance with the N.E.C. and/or C.E.C.
6. This heater should be installed by qualified personnel familiar with the National Electric Code and/or the Canadian Electrical Code. It is the responsibility of the installer to verify the safety and suitability of the installation.
7. Disassembly of the unit for installation is not required or authorized.
8. Replacement electrical components must be obtained from the factory in order to maintain the Agency Listing.
9. Use this heater only as described in this manual. Any other use is not recommended by the manufacturer and may result in fire, electric shock or personal injury.
10. The heater and discharge air are hot when in use. To avoid burns, do not let bare skin touch hot surfaces.
11. To prevent a possible fire, do not block or allow foreign objects to enter air intakes or exhaust in any manner.
12. High Temperature, risk of fire, keep electrical cords, drapery, furnishings, insulation and other combustibles at least 3 feet (0.9m) from the front of the heater and away from the sides, rear and top.
13. Installation minimum mounting clearances specified both on heater nameplate and in this owner's manual must be maintained.
14. Use copper wire rated 75°C min. for supply connections according to size specified on heater nameplate.
15. Do not attempt to override louver stops. Do not operate unit with louvers turned above level of unit.
16. This heater should not be used in potentially explosive atmospheres. Do not use in areas where gasoline, paint, or flammable liquids are used or stored.
17. This heater should not be used in outdoor, wet and/or corrosive locations.
18. Risk of fire. Do not use as a residential or household heater.
19. **SAVE THESE INSTRUCTIONS.**

WARRANTY WILL BE VOID IF INSTRUCTIONS ARE NOT FOLLOWED.

GENERAL

The air heaters are designed for comfort heating and should not be used in ambient temperatures exceeding 104°F (40°C). They are to be permanently mounted to the wall or ceiling for either horizontal or vertical discharge. The unit is designed to give years of safe, trouble-free operation when properly installed and maintained.

INSTALLATION

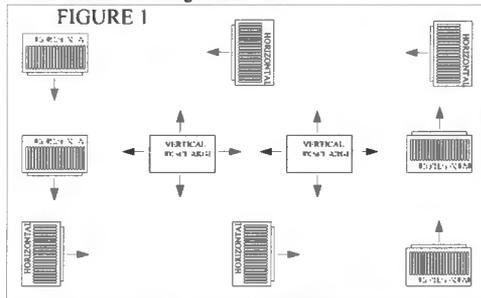
A. Site Selection:

The Heaters should not be mounted close to insulation, drapery or similar materials which could come in contact with the cabinet, or block the inlet or outlet of the heater. The heaters are intended for elevated mounting locations so that they blow warm air down to the floor area. A mounting height should be selected so that the heater is out of the way of possible moving equipment or personnel, yet low enough to deliver warm air to the selected area. See the mechanical installation section for recommended installation heights.

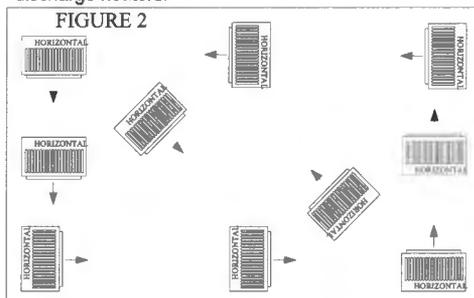
Heater airflow should be directed to areas of greatest heat loss. In general, greater numbers of small heaters will provide more uniform and even heat distributions than a few large ones. In order to help move heated air around the room, multiple heaters should be spaced out and direct air in a circular pattern around the room perimeter such that each heater supports the next heater's airstreams.

Additional vertical discharge heaters with appropriate diffusers can be located to direct heated air to the room center and offset any ceiling heat losses. See the figures below for some typical airflow pattern arrangements:

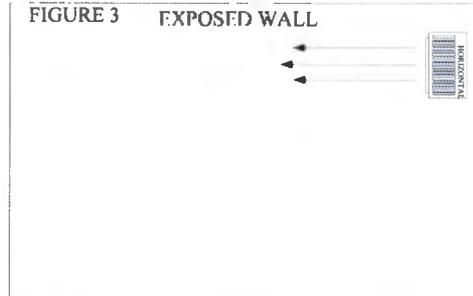
- a. Large room with exposed walls and roof – both horizontal and vertical discharge heaters:



- b. Large room with exposed walls and roof - only horizontal discharge heaters:



- c. Small room with one exposed wall – horizontal discharge heater:



B. Mechanical Installation:

These heaters may be mounted for either horizontal or vertical discharge by means of threaded rods (supplied by others). The heaters may also be mounted by means of an optional mounting kit which includes a bracket and cantilever arm which allows horizontal pivoting of the heater. Lock washers should be used on all mounting nuts and bolts to ensure they don't vibrate or work loose due to fan vibration or other vibration transmitted to the heater.

The supporting structure that the heater is attached to must have adequate strength to safely support the heater. The heater dimensions and maximum unit weights are:

TABLE 1:

KW	Cabinet Size	W	H	Depth	Weight
<=5	1	12.875" (327mm)	17.750" (450mm)	7.625" (194mm)	25 lbs (11.3 kg)
5.1 to 10	2	16.875" (429mm)	24.250" (616mm)	7.625" (194mm)	40 lbs (18.2 kg)
10.1 to 20	3	16.875" (429mm)	24.250" (616mm)	11.375" (289mm)	55 lbs (25.0 kg)
20.1 to 50	4	26.937" (684mm)	35.500" (902mm)	15.625" (397mm)	155 lbs (70.3 kg)

These heaters are provided with either directional louvers, a radial diffuser or an anemostat diffuser. Select an installation location such that the outlet air is not directed at an adjacent wall.

Once an acceptable location has been determined, see the following instructions to complete the mechanical installation:

Horizontal Discharge:

- To ensure proper heating of floor surfaces, observe the following recommended mounting height limitations (to bottom of heater):

TABLE 2:

Maximum Mounting Height from Floor, feet (m)			
<= 5 KW	5.1 to 10 KW	10.1 to 20 KW	20.1 to 50 KW
10' (3m)	15' (4.6m)	20' (6.1m)	25' (7.6m)

The minimum mounting distance from the floor to the bottom of the heater is 8 feet (2.4m).

- Remove the four bolts located in the top of the heater and install four threaded rods (not supplied by INDEECO) using locknuts to secure. Do not remove the four bolts from the back of the heater case.
- Secure the four threaded rods to the ceiling using locknuts to complete the installation.
- Refer to table 3 and figure 4 below for minimum mounting clearances to the walls and ceiling:

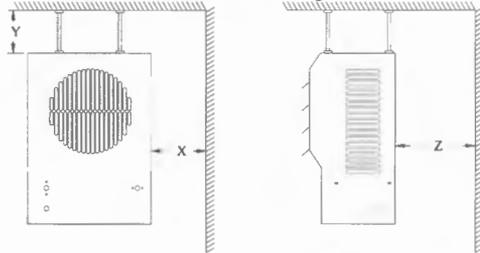


FIGURE 4

TABLE 3:

Minimum Clearances – Horizontal Discharge, inches (mm)			
KW	X	Y	Z
<= 5	6 (152)	10 (254)	6 (152)
5.1 to 10	6 (152)	10 (254)	6 (152)
10.1 to 20	6 (152)	12 (305)	6 (152)
20.1 to 50	6 (152)	12 (305)	6 (152)

- Refer to the table and figure below for mounting point size and locations:

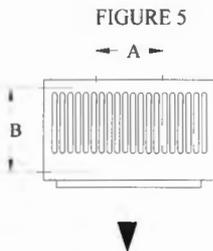


FIGURE 5

TABLE 4:

KW	Thread Size	A, in (mm)	B, in (mm)
<= 5	3/8 – 16	5 (127)	6.44 (164)
5.1 to 10	3/8 – 16	5 (127)	6.44 (164)
10.1 to 20	3/8 – 16	5 (127)	10.13 (257)
20.1 to 50	3/8 – 16	7 (178)	12.92 (328)

- Adjustable louvers should be set to achieve the desired airflow direction.

Vertical Discharge:

- When mounting for vertical discharge, ensure there is enough clearance to the wall to fully open the access cover to the wiring compartment.
- To ensure proper heating of floor surfaces, observe the following recommended mounting height limitations (to bottom of heater):

TABLE 5:

Maximum Mounting Height from Floor, feet (m)				
KW	No Louvers	Standard Louvers	Anemostat Diffuser	Radial Diffuser
<= 5	10' (3.0m)	10' (3.0m)	9' (2.7m)	10' (3.0m)
5.1 to 10	15' (4.6m)	15' (4.6m)	13' (4.0m)	15' (4.6m)
10.1 to 20	20' (6.1m)	20' (6.1m)	17' (5.2m)	20' (6.1m)
20.1 to 50	25' (7.6m)	25' (7.6m)	21' (6.4m)	25' (7.6m)

The minimum mounting distance from the floor to the bottom of the heater is 8 feet (2.4m).

- Remove the four bolts from back of heater cabinet and install four threaded rods (not supplied by INDEECO) using locknuts to secure. Do not remove the four bolts from the top of the heater cabinet.
- Secure the four threaded rods to the ceiling using locknuts to complete the installation.
- Refer to the table and figures below for minimum mounting clearances to the walls and ceiling:

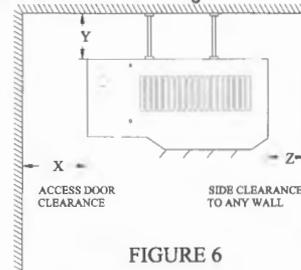


FIGURE 6

TABLE 6:

Minimum Clearances – Vertical Discharge, inches (mm)			
KW	X	Y	Z
<= 5	8 (203)	6 (152)	16 (406)
5.1 to 10	8 (203)	6 (152)	16 (406)
10.1 to 20	12 (305)	5 (127)	32 (813)
20.1 to 50	18 (400)	3 (152)	22 (512)

- Refer to the table and figure below for threaded mounting point size and locations:

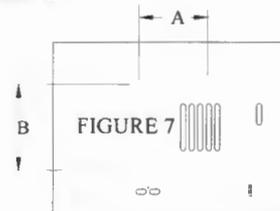


FIGURE 7

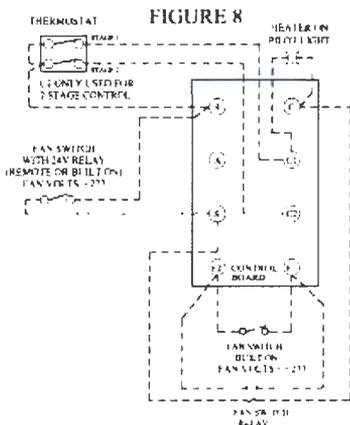
TABLE 7:

KW	Thread Size	A, in (mm)	B, in (mm)
<= 5	3/8 – 16	5 (127)	6.44 (164)
5.1 to 10	3/8 – 16	5 (127)	6.44 (164)
10.1 to 20	3/8 – 16	10.13 (257)	5 (127)
20.1 to 50	3/8 – 16	12.92 (328)	7 (178)

C. Electrical Installation:

Follow these instructions to complete the electrical installation:

1. External branch circuit protection is required. See nameplate ratings and follow Code recommendations.
2. Follow the NEC and/or CEC and any local electrical and building codes related to the installation and intended use of the heater.
3. When doing any work on a heater, including the initial electrical connection, disconnect the electrical supply at the main branch circuit switch, and lock the switch in the off (open) position. Tag the circuit "Out for Maintenance" to prevent potential lethal shock hazards.
4. Confirm that the electrical power supply matches the nameplate voltage, phase, amperage and frequency rating of the heater to be connected.
5. Ensure conductors are of appropriate gauge size as specified on the heater nameplate. Use copper conductors rated 75°C minimum.
6. Proper installation of the heater requires that an adequate grounding conductor be connected to the ground terminal. This terminal marked with the letter "G" and is located on the inside of the control enclosure.
7. A wiring diagram is supplied with each heater. Optional electrical controls, either kits or factory installed, are connected to the control wiring board and are shown as dashed lines. The figure below shows control wiring board connections for field wired options:



8. Install any electrical option kits according to the instructions provided.
9. Use min. 600 volts, NEC Class 1 insulated wire for all control circuit wiring.
10. Check and confirm all connections are securely tightened. Remove any foreign objects from the control box and close access door.
11. On single phase heaters rated less than 5 KW that do not contain a contactor and transformer, any remote thermostat used must be rated for the full load of the heater as shown on the heater nameplate.
12. See section titled "operation" before energizing the heater.

OPERATION

The unit heater may be operated normally at ambient temperatures of 104°F (40°C) or less. Each heater contains a normally open bimetal cutout which delays the fan motor until the heating elements have warmed up and also keeps the fan running after shutdown until the heating elements have cooled down.

A. Initial Operation:

Check to make sure the mechanical and electrical installation is complete and that it is safe to operate the heater.

- 1.) Heaters without built on or remotely mounted fan switch:
 - a.) Set the temperature control thermostat to a setting above the current room temperature.
 - b.) Energize the heater electrical supply circuit.
 - c.) The heater should come on and the fan should start within approximately 1 to 2 minutes. If the room ambient temperature is high or the heater is mounted too close to the ceiling or walls, the unit may cycle on the thermal high limits of the motor and/or the heater.
 - d.) Check out and report any unusual or questionable operating characteristics, such as noise, vibration, etc.
 - e.) Set the temperature control thermostat to the desired room temperature setting.
 - f.) De-energize the heater electrical supply circuit until heater operation is required.
- 2.) Heater with fan switch:
 - a.) Place the fan switch in the "ON" position.
 - b.) Set the temperature control thermostat to a setting below the current room temperature.
 - c.) Energize the heater electrical supply circuit.
 - d.) The heater fan should come on but the heater should remain off.
 - e.) Place the fan switch in the "OFF" position.
 - f.) The fan should go off.
 - g.) Set the temperature control thermostat to a setting above the current room temperature.
 - h.) The heater should come on and the fan should energize in approximately 1 to 2 minutes. If the room ambient temperature is high or the heater is mounted too close to the ceiling or walls, the unit may cycle on the thermal high limits of the motor and/or the heater.
 - i.) Check out and report any unusual or questionable operating characteristics, such as noise, vibration, etc.
 - j.) Set the fan switch and temperature control thermostat to the desired operating positions.

B. Normal Operation:

Prior to the start of the heating season, perform the electrical and mechanical steps outlined in the section titled "maintenance".

- a.) Perform the operation steps for the applicable temperature control option.
- b.) Place all switches in their normal operating position and place the unit heater in service.

MAINTENANCE

Maintenance and repair must be performed by qualified personnel only.

A. Electrical:

1. Inspect all terminal connections, contactor and conductor insulation for damage, looseness, fraying, etc., as applicable. Tighten any loose terminals and replace or repair wire with damaged or deteriorated insulation. If contactor contacts are badly pitted, welded together, or burned, replace the contactor.
2. If reduced heat output is suspected, perform the mechanical checks. If low heat output is still suspected after completing the mechanical checks, verify the condition of the heating elements by visual inspection and by using an amperage meter to check the current draw of each input line. Adjust the room thermostat to its highest temperature to ensure all stages of heat are energized. All input lines should draw approximately equal current which should agree with the nameplate rating. If they do not, one or more of the heating elements could be burned out and should be replaced.

B. Mechanical:

1. Annually check the tightness of all visible bolts and nuts, in particular the support structure bolts and nuts. Similarly check the motor mounting bolts located in the top and back of the heater case.
2. Periodically, check the motor, fan, discharge openings, intake openings, heating elements and control compartment for cleanliness. If necessary, clean by using a vacuum or compressed air. Be careful not to bend the fan blade propeller.
3. Check motor and fan for smooth running operation. Any unusual noise or vibration must be investigated and rectified.
4. The electric motors are permanently lubricated and thermally protected. Check for smooth and quiet running at all inspections. Replace motor if excessive bearing play is detected.

REPAIR AND REPLACEMENT

Maintenance and repair must be performed by qualified personnel only.

A. Replacing the High-Limit or Fan Delay Cutouts:

1. Disconnect the heater electrical power supply.
2. For horizontal discharge heaters, the heater will need to be disconnected and lowered.
3. For heaters with an optional "Heater On" pilot light, built on fan switch or built on room thermostat, mark wiring at control board and disconnect.
4. Remove any adjustable louvers and the front cabinet section to expose the fan motor and heating elements.
5. Remove the fan blade, careful not to bend.
6. The temperature high limit and fan delay are located on a stepped sheet metal bracket directly below the back heating element. The fan delay is the cutout directly

against the heating element fin; the temperature high limit is approximately 5/8" below.

7. Mark and disconnect the appropriate wires.
8. Lower the cutout bracket by removing the side sheet metal screws.
9. Replace the appropriate cutout.
10. Reattach the sheet metal bracket and wiring.
11. Reinstall the fan blade and verify that it rotates freely.
12. Reassemble the cabinet, remount and connect heater.
13. Reconnect any wires disconnected in step 3.
14. Perform steps in section titled "OPERATION" to verify heater performance.

B. Resetting the Optional Manual Cutout:

1. Disconnect the heater electrical power supply.
2. Determine the reason for the manual reset thermal cutout actuating and rectify the situation. See section titled "maintenance".
3. Reset the manual reset thermal cutout by pressing on the red button located in the back of the heater marked "RESET". It may be necessary to wait for the cutout to cool.
4. Energize the heater electrical supply circuit.
5. Perform the steps outlined in the section "OPERATION" to verify heater performance.
6. Check out and report any unusual or questionable operating characteristics, such as noise, vibration, etc.
7. If heater operation appears normal, place the unit into normal operation.

C. Replacing the Fan Motor and Blade:

The fan motor is permanently lubricated and does not require any maintenance. If the fan motor is defective, a replacement must be obtained from the factory.

1. Disconnect the electrical power supply.
2. For horizontal discharge heaters, the heater will need to be disconnected and lowered.
3. For heaters with an optional "Heater On" pilot light, built on fan switch or built on room thermostat, mark wiring at control board and disconnect.
4. Remove any louvers and the front cabinet section to expose the motor and blade.
5. Remove the fan blade, careful not to bend. If motor is not being replaced, skip to step 11.
6. Disconnect the motor supply wires, noting their location.
7. Remove motor mounting screws and lift motor out of heater assembly.
8. Install new motor to heater using existing motor mounting hardware.
9. Feed motor wires through snap bushing and into wiring compartment.
10. Reconnect motor wires.
11. Reinstall fan blade and ensure that it rotates freely.
12. Reassemble the cabinet, remount and connect heater.
13. Reconnect any wires disconnected in step 3.
14. Perform steps in section titled OPERATION to verify heater performance.

REPLACEMENT PARTS

1. All replacements must be factory supplied to ensure safe heater operation.
2. Mark wires and refer to wiring diagram to ensure proper electrical connections.

Reference heater model number and the bubble number from the figures below when contacting factory for replacement parts. Contact factory for items not shown.

FIGURE 9 - CABINET, MOTOR AND HEATING ELEMENTS:

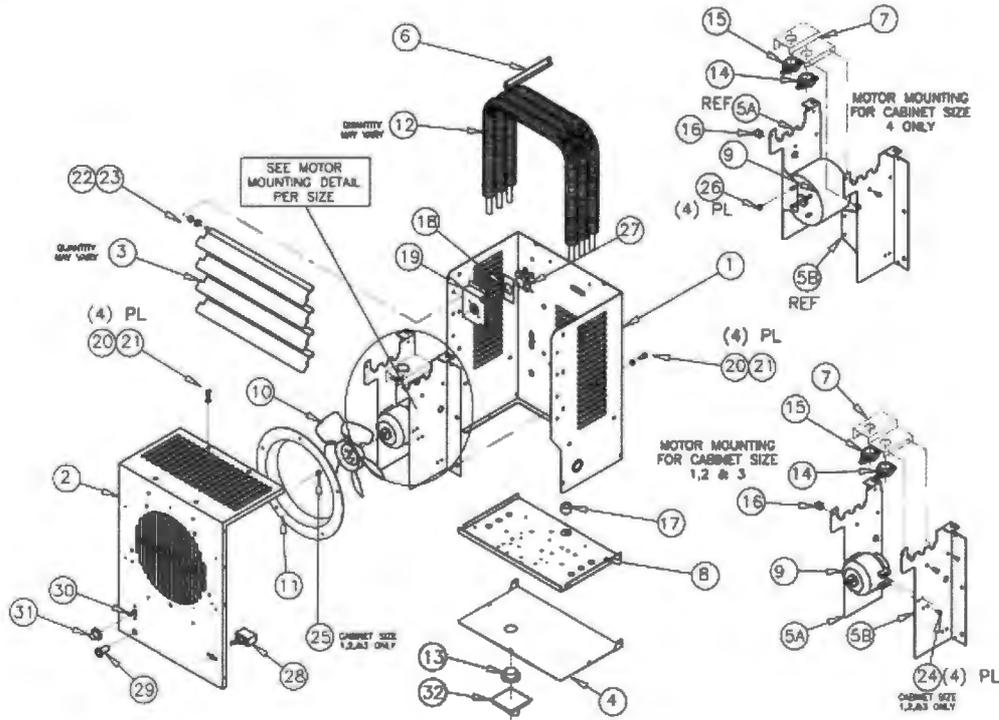


TABLE 8

BUBBLE	DESCRIPTION	Qty
01	Cabinet Back	1
02	Cabinet Front	1
03	Louver	A/R
04	Terminal Box Cover	1
5A	Element Support - Left	1
5B	Element Support - Right	1
06	Element Anchor	1
07	Thermal Cutout Bracket	1
08	Component Bridge	1
09	Motor	1
10	Fan Blade	1
11	Fan Ring	1
12	Heating Element	A/R
13	Plug	1
14	Automatic Reset Cutout	1
15	Fan Delay Cutout	1
16	Manual Reset Wire Grommet	1

BUBBLE	DESCRIPTION	Qty
17	Wiring Grommet	1
18	Manual Cutout Barrier	1
19	Manual Reset Cutout Bracket	1
20	Bolt	8
21	Split Lockwasher	8
22	Neoprene Spacer	A/R
23	#10 Flat Washer	A/R
24	#8-36x1/2 Bolt	4
25	1/4-20 Keps Nut	1
26	10-32 Nut	4
27	Manual Reset Cutout - Optional	1
28	Fan Switch - Optional	1
29	Pilot Light - Optional	1
30	Built On Thermostat - Optional	1
31	Thermostat Knob - Optional	1
32	Disconnect Handle - Optional	1

FIGURE 10 - ELECTRICAL COMPONENTS:

The figure below shows a typical layout of the heater electrical components for reference only. Locations and quantity of parts will vary.

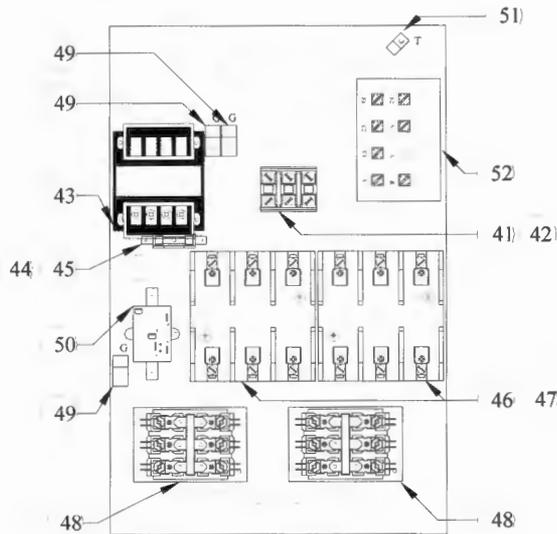


TABLE 9:

BUBBLE	DESCRIPTION
41	Disconnect Switch (not shown)
42	Power Terminal Block
43	Control Transformer
44	Secondary Transformer Fuse Block
45	Secondary Transformer Fuse
46	Power Fuse Block
47	Power Fuse
48	Control Contactor
49	Ground Lug
50	Fan Switch Relay
51	Thermostat Capillary Clamp
52	Motor Capacitor (not shown)

FIELD INSTALLABLE ACCESSORIES

The following items are available from the factory for field installation:

TABLE 11: Mechanical Accessories:

Item	Description
1024149	Universal wall & ceiling mounting bracket kit; <=10 KW
1024150	Universal wall & ceiling mounting bracket kit; 10< KW <=20
1024151	Universal wall & ceiling mounting bracket kit; > 20 KW
1024155	Anemostat (Cone) Diffuser <=5 KW
1024156	Anemostat (Cone) Diffuser 5< KW <=20
1024157	Anemostat (Cone) Diffuser >20 KW
1024152	Radial Diffuser <=5 KW
1024153	Radial Diffuser 5< KW <=20
1024154	Radial Diffuser >20 KW
1023941	Horizontal Dust Shield <=10 KW
1024059	Horizontal Dust Shield 10< KW <=20
1024060	Horizontal Dust Shield >20 KW

TABLE 12: Electrical Accessories:

Item	Description	Ratings
1024162	Disconnect Switch 40A	40 Amps, 600V, 3 Pole
1024163	Disconnect Switch 80A	80 Amps, 600V, 3 Pole
1024164	Disconnect Switch 100A	100 Amps, 600V, 3 Pole
1024166	Built On Room Thermostat - 1 Stage	25A @ 240V, 22A @ 277V ; 125VA Pilot Duty
1024167	Built On Room Thermostat - 2 Stage	25A @ 240V, 22A @ 277V ; 125VA Pilot Duty
1024168	"Heater On" Pilot Light - 24V	24 Vac Control Voltage
1024169	"Heater On" Pilot Light - 120V	120 Vac Control Voltage
1024170	Summer Fan Switch - Built On	Heater Voltage<= 277V
1024171	Summer Fan Switch with 24V Relay - Built On	24Vac Control, Heater Supply Voltage > 277V
1024172	Summer Fan Switch with 24V Relay - Remote	24Vac Control



Série UHIR

Installation horizontale ou verticale
Appareil de chauffage industriel/commercial localisé

Manuel de propriétaire



Ce manuel traite de l'installation, de l'entretien et des éléments de réparation. Lisez-le avec soin avant de tenter l'installation, l'opération ou l'entretien l'appareil de chauffage local série UHIR.

IMPORTANT: GARDEZ CES INSTRUCTIONS AFIN DE POUVOIR LES CONSULTER DANS UN TEMPS FUTUR.

INDUSTRIAL ENGINEERING & EQUIPMENT COMPANY
425 HANLEY INDUSTRIAL COURT • ST. LOUIS, MO 63144
314-644-4300 • 800-243-8162 • FAX: 314-644-5332
www.indeeco.com

AVERTISSEMENT

Les personnes reponsables pour l'installation et l'entretien devaient étudier ce manuel et faire attention à tous les avertissements avant d'installer ou d'entretenir cet appareil de chauffage afin d'éviter des conditions possiblement dangereuses, ou des dommages sérieux aux biens, des blessures personnelles ou même la mort.

1. Lisez toutes les instructions avant d'utiliser cet appareil de chauffage.
2. Vérifiez que le voltage et la phase électrique sont en accord avec les spécifications de la plaque avant d'alimenter.
3. Le voltage actuel peut être fatal. Faites certain que l'interrupteur du circuit électrique soit bloqué en position débranché. Marquez le circuit " Débranché pour entretien" avant de travailler sur cet appareillage électrique.
4. Pendant l'opération de l'appareil de chauffage il est nécessaire que le couvercle de l'enclos de l'appareil soit fermé soigneusement.
5. Danger de choc électrique. L'appareil de chauffage doit être mis à la masse en accord avec les règlements N.E.C ou C.E.C
6. Cet appareil de chauffage devait être installé par du personnel qualifié qui connaisse bien Le Code Electrique National ou le Code Electrique Canadien. C'est la responsabilité de l'installateur de vérifier la sécurité de l'installation ainsi que de l'à-propos de la même.
7. Il n'est pas nécessaire ni est-il permis de démonter l'appareil afin de l'installer.
8. Des éléments de remplacement doivent être obtenus de la fabrique afin de préserver la registration de l'agence.
9. Il ne faut pas utiliser cet appareil de chauffage que pour l'usage indiqué dans ce manuel. Tout autre usage n'est pas recommandé par la manufacture et pourrait résulter dans une incendie ou un choc électrique ou des blessures.
10. L'appareil de chauffage même comme l'air diversé sont chaud pendant l'usage. Afin d'éviter des brûlures il ne faut pas laisser toucher aux surfaces chaudes la peau sans protection.
11. Afin d'éviter des incendies potentielles il ne faut pas bloquer l'arrivée ou l'échappement ou laisser entrer des objets étrangers là dedans.
12. Attention! Température haute! Danger d'incendie! Donnez au moins 0.9 mètres d'espace à des cordes électriques, des rideaux, des meubles, des matériaux d'isolation et d'autres inflammables du front et aussi des côtés de l'arrière et du surface de l'appareil de chauffage.
13. Il est essentiel de maintenir les dégagements minimums pour l'installation comme spécifié sur la plaque et dans le manuel d'installation de l'appareil de chauffage.
14. Il faut utiliser du fil de cuivre nominal à 75 degrés Celsius pour la ligne d'alimentation de l'appareil comme spécifié sur la plaque de l'appareil.
15. Ne pas chercher à annuler les contrôles des volets. Ne pas utiliser l'appareil avec les volets ouverts au delà de la position l'appareil.
16. Cet appareil de chauffage ne devrait pas être utilisé dans une atmosphère possiblement explosive. Ne pas utiliser dans un espace où se trouvent de l'essence, des liquides inflammables ou des peintures.
17. Cet appareil de chauffage ne devrait pas être utilisé dans des endroits extérieurs humides ou corrosifs.
18. Danger d'incendie! Ne pas utiliser comme appareil de chauffage résidentiel ou de ménage.
19. SAUVER CES INSTRUCTIONS.

La garantie sera annulée si les instructions ne seront pas suivies.

Description générale

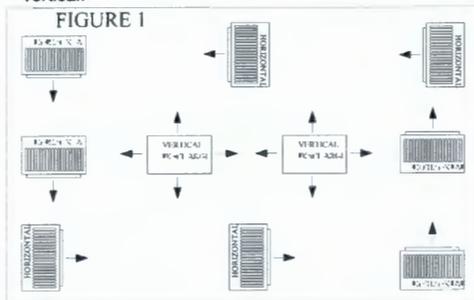
Les appareils de chauffage à l'air sont intentionnés à un usage de confort et ne devraient pas être engagés dans des températures ambiantes en excès de 104 degrés Fahrenheit (40 degrés C). Il faut les installer en permanence au mur ou au plafond avec un échappement horizontal ou vertical. L'appareil est manufacturé afin de donner des années de service sans danger et sans difficulté donnés une installation et un entretien correctes.

INSTALLATION

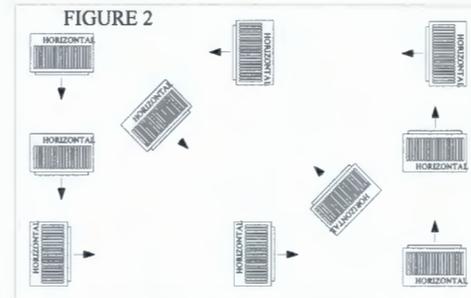
A. Choix d'endroit:

Les appareils de chauffage ne doivent pas être installés en proximité des matériaux d'isolation, des rideaux ou des matériaux pareils qui pourraient faire contact avec l'appareil ou en bloquer les ouvertures d'admission ou d'échappement. Les appareils de chauffage sont dessinés pour être installés dans des endroits élevés afin qu'ils soufflent de l'air en bas sur le sol. Il est nécessaire de choisir une hauteur d'installation afin que l'appareil de chauffage soit écarté de l'équipement quelconque mouvant aussi que du personnel sans être trop élevé pour délivrer de l'air chaud à l'espace désigné. Voir la partie d'installation mécanique du manuel pour des hauteurs recommandées. Le courant d'air venant de l'appareil de chauffage devrait être dirigé aux espaces avec la plus grande perte de chaleur. En général un plus grand nombre de petits appareils de chauffage va délivrer une plus uniforme distribution de chaleur qu'un petit nombre de grands appareils de chauffage. Afin que l'air circule bien dans l'espace un nombre d'appareils de chauffage doit être distribué dans un arrangement circulaire au périmètre de l'espace afin que chaque appareil aide le courant d'air de l'appareil prochain. En plus, on peut installer des appareils de chauffage avec un échappement vertical au centre de l'espace afin de réduire la perte de chaleur par le plafond. Regarder les illustrations ci-dessous pour des arrangements de circulation d'air typiques.

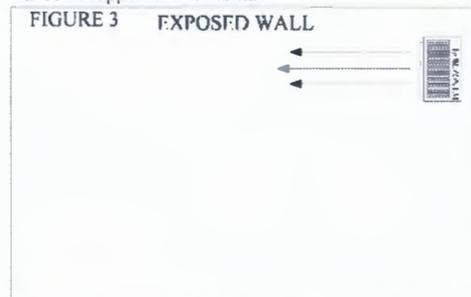
- a. Une grande salle avec des murs exposés et un toit et des appareils de chauffage à échappement horizontal et vertical.



- b. Une grande salle avec des murs exposés et un toit et des appareils de chauffage à échappement horizontal:



- c. Petite salle avec un mur exposé --appareil de chauffage avec échappement horizontal:



B. Installation Mécanique:

Ces appareils de chauffage peuvent être installés avec un échappement horizontal ou vertical en utilisant une tige filetée (non fournie par nous). Ces appareils peuvent être installés aussi en utilisant un kit d'installation qui contient un corbeau et un cantilever qui permettent le pivotement horizontal de l'appareil. Il est nécessaire d'utiliser des rondelles frein pour tous les écrous et boulons afin d'assurer qu'ils ne vibrent ni se desserrent par la vibration du ventilateur ou d'autre vibration transmis à l'appareil de chauffage.

La construction supportante à laquelle l'appareil de chauffage est attaché doit avoir une solidité suffisante pour supporter l'appareil de chauffage en sécurité. Voici les dimensions et les poids maximums des unités individuelles:

TABLE 1:

KW	Taille du meuble	largeur	hauteur	profondeur	poids
<=5	1	12.875" (327mm)	17.750" (450mm)	7.625" (194mm)	25 lbs (11.3 kg)
5.1 to 10	2	16.875" (429mm)	24.250" (616mm)	7.625" (194mm)	40 lbs (18.2 kg)
10.1 to 20	3	16.875" (429mm)	24.250" (616mm)	11.375" (289mm)	55 lbs (25.0 kg)
20.1 to 50	4	26.937" (684mm)	35.500" (902mm)	15.625" (397mm)	155 lbs (70.3 kg)

Ces appareils de chauffage sont provisionnés ou avec des louveres directifs ou un diffuseur de ventilation radiale ou un diffuseur anemostat. Choisissez un endroit ainsi que l'air d'échappement ne soit dirigé vers un mur voisin.

Après avoir choisi un placement acceptable suivre les instructions ci-dessous afin de compléter l'installation mécanique.

Echappement Horizontal:

1. Afin d'assurer le chauffage correcte des surfaces du sol observer les limites d'hauteur de l'installation de l'appareil de chauffage (mesuré jusqu'au bas de l'appareil):

TABLE 2:

Hauteur maximum mesurée du sol, feet (m)			
<= 5 KW	5.1 à 10 KW	10.1 à 20 KW	20.1 à 50 KW
10' (3m)	15' (4.6m)	20' (6.1m)	25' (7.6m)

La distance minimum d'installation du sol au bas de l'appareil de chauffage est 8(huit) pieds (2.4 m).

2. Ôtez les quatre boulons au dessus de l'appareil et installez quatre tiges filetées (ne pas fournies par INDEECO) en utilisant des écrous frein afin de fixer les tiges. Ne pas ôter les quatre boulons à l'arrière du cabinet de l'appareil.
3. Fixez les quatre tiges filetées au plafond avec des écrous frein afin de compléter l'installation.
4. Utilisez table 3 et illustration 4 ci-dessous pour le dégagement

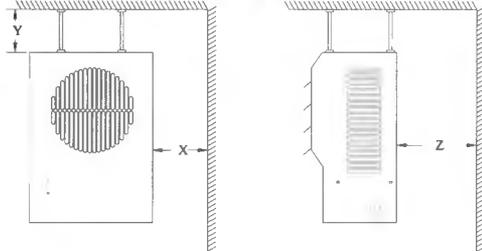


FIGURE 4

TABLE 3:

Espace minimum – échappement horizontal, inches (mm)			
KW	X	Y	Z
<= 5	6 (152)	10 (254)	6 (152)
5.1 to 10	6 (152)	10 (254)	6 (152)
10.1 to 20	6 (152)	12 (305)	6 (152)
20.1 to 50	6 (152)	12 (305)	6 (152)

5. Utilisez la table et l'illustration ci-dessous pour les dimensions et placements du point fileté d'installation:

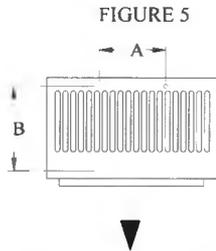


TABLE 4:

KW	Dimension de filet	A, in (mm)	B, in (mm)
<= 5	3/8 – 16	5 (127)	6.44 (164)
5.1 to 10	3/8 – 16	5 (127)	6.44 (164)
10.1 to 20	3/8 – 16	5 (127)	10.13 (257)
20.1 to 50	3/8 – 16	7 (178)	12.92 (328)

6. Les louveres réglables doivent être mis dans un position qui donne la direction de l'écoulement d'air désirée.

Echappement Vertical:

1. Pendant l'installation de l'appareil de chauffage pour échappement vertical il faut s'assurer d'avoir de l'espace suffisant pour ouvrir complètement le couvercle d'accès au compartiment de cablage.
2. Afin d'assurer le chauffage correcte des surfaces du sol observez les limites d'hauteur recommandées (mesuré au bas de l'appareil):

TABLE 5:

Hauteur maximum mesurée du sol, feet (m)				
KW	Pas de volets	Volets normaux	Diffusier Anemostat	Diffusier radial
<= 5	10' (3.0m)	10' (3.0m)	9' (2.7m)	10' (3.0m)
5.1 to 10	15' (4.6m)	15' (4.6m)	13' (4.0m)	15' (4.6m)
10.1 to 20	20' (6.1m)	20' (6.1m)	17' (5.2m)	20' (6.1m)
20.1 to 50	25' (7.6m)	25' (7.6m)	21' (6.4m)	25' (7.6m)

La distance minimum d'installation du sol au bas de l'appareil de chauffage est 8(huit) pieds (2.4 m).

3. Ôtez les quatre boulons de l'arrière du cabinet de l'appareil de chauffage et installez quatre tiges filetées (ne pas fournies par INDEECO) en utilisant des écrous frein afin de fixer les tiges. Ne pas ôter les quatre boulons au dessus de l'appareil.
4. Fixez les quatre tiges filetées au plafond en utilisant des écrous frein pour finaliser l'installation.
5. Utilisez la table et l'illustration ci-dessous pour les dimensions et placements d'installation:

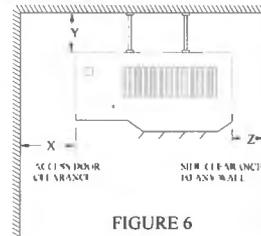


FIGURE 6

TABLE 6:

Espace minimum – échappement vertical, inches (mm)			
KW	X	Y	Z
<= 5	8 (203)	6 (152)	16 (406)
5.1 to 10	8 (203)	6 (152)	16 (406)
10.1 to 20	12 (305)	6 (152)	32 (813)
20.1 to 50	16 (406)	6 (152)	32 (813)

6. Utilisez la table et l'illustration ci-dessous pour les dimensions et placements du point fileté d'installation:

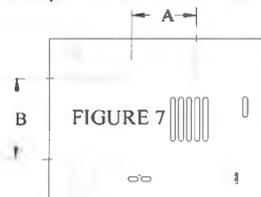


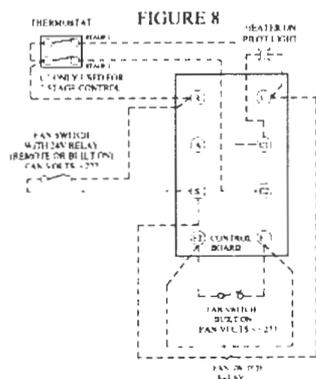
TABLE 7:

KW	Dimension de filet	A, in (mm)	B, in (mm)
<= 5	3/8 – 16	5 (127)	6.44 (164)
5.1 to 10	3/8 – 16	5 (127)	6.44 (164)
10.1 to 20	3/8 – 16	10.13 (257)	5 (127)
20.1 to 50	3/8 – 16	12.92 (328)	7 (178)

C. Installation Electrique:

Suivez les instructions ci-dessous afin de compléter l'installation électrique.

1. Il est nécessaire d'avoir de la protection pour le circuit de derivation. Voir les valeurs nominales sur la plaque et suivre les recommandations du code.
2. Suivre le NEC ou le CEC et aussi quelconque code d'électricité ou de bâtiment local qui relatif à l'installation ou l'usage intentionné de l'appareil de chauffage.
3. Débranchez l'alimentation électrique pour de la modification quelconque de l'appareil de chauffage- y inclut le branchement initial à l'interrupteur de la barre d'alimentation et serrez l'interrupteur dans la position "hors de tension". Affichez une fiche "Hors d'opération pour entretien" afin d'éviter le danger des chocs électriques possiblement fatales.
4. Faites certain que l'alimentation électrique soit adaptée à la tension, la phase, l'intensité du courant de l'appareil de chauffage en question comme indiqué par la plaque.
5. Faites certain que le cablage soit de calibre correcte comme spécifié sur la plaque de l'appareil de chauffage. Utilisez de fil de cuivre nominal à un minimum de 75°.
6. L'installation correcte de l'appareil de chauffage exige qu'un fil à masse soit branché au borne de masse indiquée par un "G" à l'intérieur du coffret de contrôle.
7. Un schéma de cablage est inclut avec chaque appareil de chauffage. Tout autre contrôle électrique soit nécessaire accessoire soit appareillage original est indiqué par lignes de traits. L'illustration ci-dessous montre le cablage du tableau de contrôle pour les options de branchement en site.



8. Installez tout nécessaire accessoire électrique poursuivant les instructions inclues.
9. Au minimum utilisez du fil nominal à 600V NEC classe 1 pour tout cablage du circuit de contrôle.
10. Examinez tous connexions et faites certain qu'elles soient bien serrées. Enlevez tous objets étrangers du coffret de contrôle et fermez la porte d'accès
11. Les appareils de chauffage à une phase nominaux à moins de 5KW qui ne contiennent ni contacteur ni transformateur exigent que tout thermorelais à distance soit nominal à la charge maximum come indiqué sur la plaque de l'appareil de chauffage.
12. Consultez la section "operation" avant de brancher l'appareil de chauffage.

OPERATION

L'appareil de chauffage peut être utilisé dans des températures ambiantes normales de 104°F (40°C) ou moins. L'appareil de chauffage contient un interrupteur bimétallique qui retarde l'opération du moteur du ventilateur jusqu'à la température correcte des éléments de chauffage et qui continue à opérer le moteur du ventilateur après l'arrêt de l'appareil jusqu'à les éléments soient refroidis.

A. Opération initiale:

Faites certain que les installations mécaniques et électriques soient complètes et qu'il n'y ait pas de risque d'opérer l'appareil de chauffage.

- 1.) Des appareils de chauffage sans interrupteur de ventilateur ou avec un interrupteur de ventilateur à distance:
 - a.) Mettez le réglage du thermostat d'ambiance plus haut que la température ambiante actuelle.
 - b.) Branchez le circuit d'alimentation de l'appareil de chauffage.
 - c.) L'appareil de chauffage devrait se mettre en marche pendant que le ventilateur devrait se mettre en marche après une ou deux minutes à peu près. Si la température ambiante est élevée ou si l'appareil est situé en trop de proximité du plafond ou des murs le cycle de l'appareil pourrait être contrôlé par les limites de température du moteur ou de l'appareil.
 - d.) Examinez et faites reportage de tout caractéristique d'opération anormale comme du bruit ou des vibrations, etc.
 - e.) Mettez le réglage du thermostat d'ambiance à la température désirée.
 - f.) Débranchez le circuit d'alimentation jusqu'à l'opération de l'appareil de chauffage soit nécessaire.
- 2.) Interrupteur de ventilateur de l'appareil de chauffage:
 - a.) Mettez l'interrupteur du ventilateur dans la position "Marche".
 - b.) Mettez le réglage du thermostat d'ambiance plus bas que la température ambiante actuelle.
 - c.) Branchez le circuit d'alimentation de l'appareil de chauffage.
 - d.) Le ventilateur devrait se mettre en marche mais l'appareil de chauffage devrait rester hors d'opération.
 - e.) Mettez l'interrupteur du ventilateur dans la position "d'arrêt".
 - f.) Le ventilateur devrait s'arrêter.
 - g.) Mettez le réglage du thermostat d'ambiance plus haut que la température ambiante actuelle
 - h.) L'appareil de chauffage devrait se mettre en marche et dans à peu près une ou deux minutes le ventilateur aussi devrait commencer à marcher. Si la température ambiante est élevé ou si l'appareil est situé en trop de proximité du plafond ou des murs le cycle de l'appareil pourrait être contrôlé par les limites de température du moteur ou de l'appareil.

- i.) Examinez et faites reportage de tout caractéristique d'opération anormale comme du bruit ou des vibrations, etc.
- j.) Mettez le réglage du thermostat d'ambiance et l'interrupteur du ventilateur aux positions désirées

B. Opération normale:

Avant que la saison de chauffage commence, suivez les étapes mécaniques comme décrit dans la section "Entretien."

- a.) Suivez les étapes d'opération pour l'option de contrôle de la température qui convient.
- b.) Mettez tous les interrupteurs en position "en marche" et mettez le appareil de chauffage en service.

Entretien

Tout entretien et réparation ne doit être effectué que par du personnel qualifié.

A. Electrique:

1. Contrôlez toutes connexions de borne, tout contacteur tout fil électrique pour de desserrages, fautes d'isolation etc. comme convient. Resserrez les bornes; remplacez ou reprenez les fils électriques qui ont d'isolation défectueuse ou défaillante. Si les contacteurs sont très piqués, soudés, ou brûlés il faut les remplacer.
2. En cas de débit réduit de chaleur faites les contrôles mécaniques. Si, après la contrôle mécanique, il y a encore un débit de chaleur vérifiez la condition des éléments de chauffage par inspection visuelle et aussi par l'utilisation d'un ampèremètre afin de déterminer l'usage de courant de chaque ligne électrique. Ajustez le thermostat d'ambiance au réglage le plus haut afin d'assurer que toutes étapes de réglage soient activés. Chaque ligne d'alimentation devrait avoir à peu près le même usage de courant électrique comme indiqué par la plaque. S'il y a une différence significative l'un ou l'autre élément de chauffage pourrait être brûlé et doit être remplacé.

B. Mécanique:

1. Faites une inspection annuelle de tous boulons et écrous visibles qu'ils soient bien serrés particulièrement les boulons et écrous des supports. Contrôlez aussi que les boulons de montage du moteur qui se trouvent au dessus à l'arrière du cabinet de l'appareil de chauffage.
2. Contrôlez périodiquement les embrasures du moteur, du ventilateur les ouvertures d'aspiration et d'échappement, les éléments de chauffage et la boîte de contrôle qu'ils soient propres. Si non nettoyer par aspirateur ou de l'air comprimé. Prenez soin de ne pas courber les hélices.
3. Faites certain que l'opération du moteur et du ventilateur soit aisé et silencieux. Tout bruit et vibration doit être examiné et corrigé.
4. Les moteurs électriques sont lubrifiés en permanence et sont protégés thermiquement. Les moteurs doivent opérer aisément et silencieusement. Il faut remplacer le moteur en cas de jeu excessif du roulement.

Remise en état et remplacement

Entretien et réparation ne doit être effectué que par du personnel qualifié.

A. Remplacement des coupes circuit haute température ou de retard du ventilateur.

1. Débranchez le circuit d'alimentation de l'appareil de chauffage.
2. En cas des appareils de chauffage avec échappement horizontal il faut dégager et descendre l'appareil de chauffage.
3. En cas des appareils de chauffage avec une lampe témoin optionnelle "Appareil en marche", avec un interrupteur extérieur ou thermostat extérieur identifiez les cables au tableau de contrôle et dégagez-les.
4. Enlevez les louveres réglables et aussi le front du cabinet afin de donner accès aux éléments de chauffage et au moteur du ventilateur.
5. Enlevez l'hélice prenant soin de ne pas la courber.
6. Les coupes-circuit de haute température et du retardement du ventilateur se trouvent directement sous l'arrière élément de chauffage sur un support de tôle. Le coupe-circuit de retard du ventilateur se trouve immédiatement à côté de l'ailette de l'élément de chauffage; celui de haute température se trouve 2 cm en bas.
7. Marquez et dégagez les fils électriques correctes.
8. Descendez le coupe-circuit en enlevant les vis de tôle.
9. Remplacez le coupe-circuit correcte.
10. Rattachez le support de tôle et le cablage.
11. Installez l'hélice prenant soin qu'elle tourne avec aisé.
12. Après rasssemblage du cabinet remontez et rattachez l'appareil de chauffage.
13. Rattachez tous fils électriques détachés en étape 3.
14. Suivez les étapes détaillées dans la rubrique "Opération" afin de vérifier l'opération de l'appareil de chauffage.

B. Remise en circuit du coupe circuit.

1. Débranchez le circuit d'alimentation de l'appareil de chauffage.
2. Déterminez la cause de l'activation du coupe circuit manuel de température et corrigez la situation. Voir section "Entretien".
3. Remette en circuit du coupe circuit de température en appuyant sur le bouton rouge qui se trouve à l'arrière de l'appareil marquée "reset". Il pourrait être nécessaire d'attendre afin que l'interrupteur se refroidisse.
4. Rebranchez le circuit d'alimentation de l'appareil de chauffage.
5. Suivez les étapes détaillées dans la rubrique "Opération" afin de vérifier l'opération de l'appareil de chauffage.
6. Examinez tout caractéristique étrange ou douteux comme du bruit, de la vibration etc. et en faites reportage

7. Si l'appareil fonctionne normalement mettez l'appareil en operation normale.

C. Remplacement du moteur du ventilateur et de l'hélice.

Le moteur du ventilateur est lubrifié en permanence et n'a pas besoin d'entretien. Si le moteur du ventilateur est en mauvais état il est nécessaire d'en obtenir un remplacement de la fabrique.

1. Débranchez le circuit d'alimentation de l'appareil de chauffage
2. En cas des appareils de chauffage avec échappement horizontal il faut dégager et descendre l'appareil de chauffage
3. En cas des appareils de chauffage avec une lampe témoin optionelle "Appareil en marche", avec un interrupteur extérieur ou thermostat extérieur identifiez les cables au tableau de contrôle et dégagez les.
4. Enlevez les louveres réglables et aussi le front du cabinet afin de donner accès aux éléments de chauffage et au moteur du ventilateur.
5. Enlever l'hélice prenant soin de ne pas la courber. Si le moteur ne doit pas être remplacé, continuez avec étape 11.
6. Notez le placement des fils électriques alimentaires du moteur et débranchez-les.
7. Deserrez les vis de montage du moteur et enlevez le moteur de l'assemblage de l'appareil de chauffage.
8. Installez un nouveau moteur dans l'apareil de chauffage en utilisant la caincallerie présente.
9. Faites avancer les fils électriques d'alimentation du moteur par l'isolateur de traverse dans la boîte de cablage.
10. Rebranchez les fils électriques du moteur.
11. Installez l'hélice prenant soin qu'elle tourne avec aise
12. Après rassamblage du cabinet remontez et rattachez l'apareil de chauffage.
13. Rattachez tous fils électriques détachés en étape 3.
14. Suivez les étapes détaillées dans la rubrique "Opération" afin de vérifier l'opération de l'appareil de chauffage.

PIÈCES DE REMPLACEMENT

1. Toutes pièces de remplacement doivent être approvisionnées par la fabrique afin d'assurer une opération de l'appareil de chauffage sans danger.
2. Marquez les fils électriques et consultez le schéma de câblage afin de garantir les connexions électriques correctes.

Faites référence au numéro de modèle de l'appareil de chauffage et le numéro cerclé de l'illustration ci-dessous quand vous contactez l'usine pour des pièces de remplacement. Contactez l'usine pour des pièces de remplacement pas montrées dans la table.

Illustration 9 - CABINET, MOTEUR ET ELEMENTS DE CHAUFFAGE:

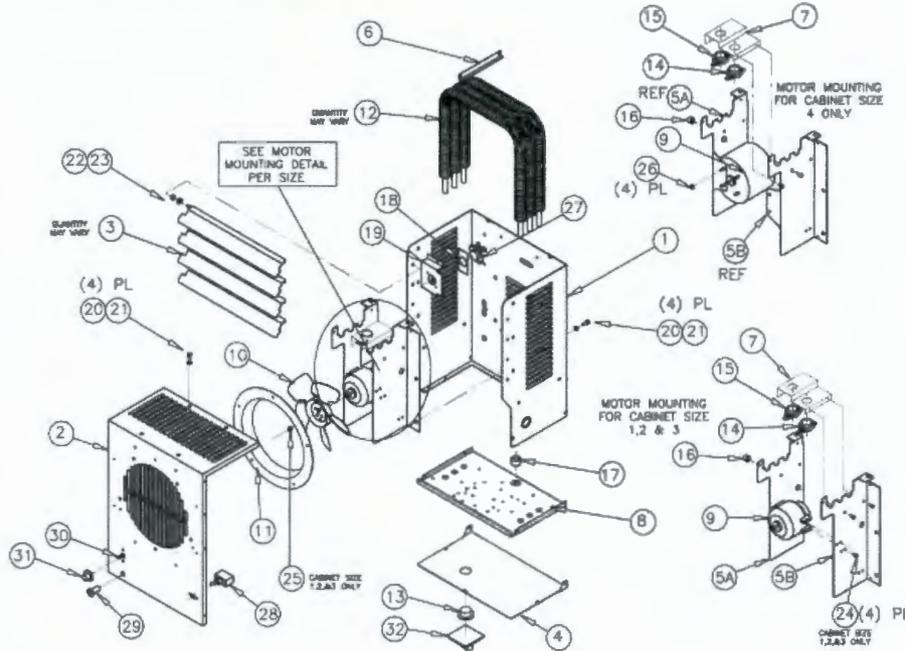


TABLE 8

bulle	DESCRIPTION	qté
01	Cabinet arrière	1
02	Cabinet Front	1
03	Louvre	A/R
04	Couvercle de la boîte de contrôle	1
5A	Element de support gauche	1
5B	Element de support droite	1
06	Element d'attachement	1
07	Bras support du coupe circuit de température	1
08	Pont des éléments	1
09	moteur	1
10	hélice	1
11	Rondelle du ventilateur	1
12	Element de chauffage	A/R
13	bouchon	1
14	Coupe circuit automatique	1
15	Coupe circuit de retard du ventilateur	1
16	Passe-fil de remis en circuit manuel	1

bulle	DESCRIPTION	Qty
17	Passe- fil	1
18	Barrier coupe circuit manuel	1
19	support remis en circuit manuel	1
20	boulon	8
21	Rondelle frein fendue	8
22	entretoise néoprène	A/R
23	#10 rondelle plate	A/R
24	#8-36x1/2 boulon	4
25	1/4-20 écrou à rondelle dentée	1
26	10-32 écrou	4
27	Coupe circuit manuel- optionel	1
28	Interrupteur du ventilateur-optionel	1
29	Lampe témoin - optionelle	1
30	Thermostat extérieur -optionel	1
31	Poignée de thermostat optionelle	1
32	Poignée de débranchement optionelle	1

Illustration 10 – Composantes électriques:

L'illustration ci-dessous montre une configuration typique des composantes électriques de l'appareil de chauffage seulement pour référence. Le placement et la quantité des composantes va changer.

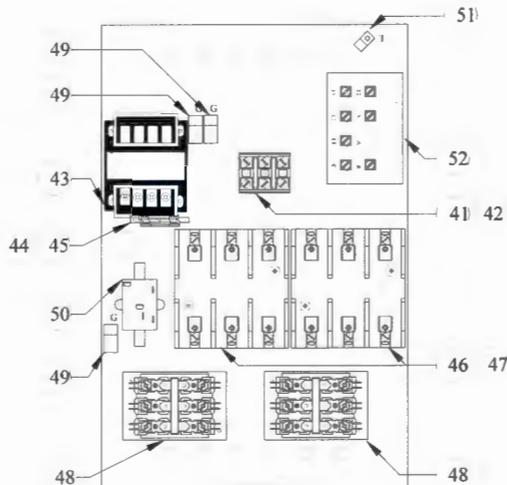


TABLE 9:

bulle	DESCRIPTION
41	Interrupteur (ne pas indiqué)
42	Bloc de jonction
43	Transformateur de contrôle
44	Bloc-fusibles de transformateur secondaire
45	Fusible de transformateur secondaire
46	Bloc-fusible d'alimentation
47	Fusible d'alimentation
48	Contacteur de contrôle
49	Borne à masse
50	Relais d'interupteur du ventilateur
51	Collier pour le tube capillaire du thermostat
52	Condensateur du moteur (ne pas indiqué)

DES ACCESSOIRES QUI PEUVENT ÊTRE INSTALLÉS CHEZ LE CLIENT

Les articles nommés ci-dessous sont disponible à la fabrique pour être installé chez le client.

TABLE 11: Mechanical Accessories:

article	description
1024149	Necessaire de support de montage universel mur ou plafond; <=10 KW
1024150	Necessaire de support de montage universel mur ou plafond; 5< KW <=20
1024151	Necessaire de support de montage universel mur ou plafond; > 20 KW
1024155	Anemostat (cône) diffuseur <=5 KW
1024156	Anemostat (cône) diffuseur 5< KW <=20
1024157	Anemostat (cône) diffuseur >20 KW
1024152	Diffuseur ventilation radiale <=5 KW
1024153	Diffuseur ventilation radiale 5< KW <=20
1024154	Diffuseur ventilation radiale >20 KW
1023941	Pare-poussière horizontale <=10 KW
1024059	Pare-poussière horizontale 10,1< KW <=20
1024060	Pare-poussière horizontale >20 KW

TABLE 12: Electrical Accessories:

article	description	Ratings
1024162	Interrupteur sectionneur 40A	40 Amps, 600V, 3 pôles
1024163	Interrupteur sectionneur 80A	80 Amps, 600V, 3 pôles
1024164	Interrupteur sectionneur 100A	100 Amps, 600V, 3 pôles
1024166	Thermostat d'ambiance extérieur, une stage	25A @ 240V, 22A @ 277V ; 125VA service témoin
1024167	Thermostat d'ambiance extérieur, deux stages	25A @ 240V, 22A @ 277V ; 125VA service témoin
1024168	"lampe témoin – 24V "Heater On" (appareil de chauffage en marche)	24 Vac tension de contrôle
1024169	"lampe témoin – 120V "Heater On" (appareil de chauffage en marche)	120 Vac tension de contrôle
1024170	Interrupteur de ventilateur d'été extérieur	Tension de l'appareil de chauffage <= 277V
1024171	Interrupteur de ventilateur d'été extérieur avec relais à 24V	24Vac contrôle, tension d'alimentation de l'appareil de chauffage > 277V
1024172	Interrupteur de ventilateur d'été avec relais à 24V – commande à distance	24Vac contrôle

APPENDIX L
Leak Detection and Influent Flow Meters

Attachment L-1
ISCO 4200 Series Flow Meter

Additional information vendor information can be found in Hanford Site
Integrated Document Management System (IDMS)

Attachment L-2
Seametrics FT 400-Series

FT400-Series

Seametrics

RATE/TOTAL INDICATOR INSTRUCTIONS

- FT415
- FT420



FT400-SERIES RATE TOTAL/INDICATOR INSTRUCTIONS

ISO 9001:2008
CERTIFIED COMPANY

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GENERAL INFORMATION

The FT400-Series flow computers are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. The FT420 is powered by external DC voltage and has both pulse and 4-20 mA analog outputs. When the FT420 is being used in the 4-20 mA mode, it is a "two-wire" or "loop-powered" device, meaning that the 4-20 mA output signal doubles as its power supply.

The addition of a dual-relay output board (FT420 only) allows for certain applications requiring contact output isolation (e.g., certain metering pumps and water treatment controls). Dual solid state relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a plastic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters.

FEATURES

Both the FT415 and the FT420 can be factory-mounted on the meter (-M) or remotely wall mounted with the brackets provided (-W). The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure. Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

Housings for the -W and -M models are rugged cast aluminum, potted and gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

**Includes password protection for tamper prevention when needed



SPECIFICATIONS*		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable, 3-5 year life	12-30 Vdc, 4mA (4-20 mA when loop-powered)
Display	Rate	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Outputs	Current Sinking Pulse	Scaled Pulse output (0.1 sec duration 6.1 Hz max) (or High Alarm output or Low Alarm output) Sensor pass-through Pulse output (unscaled)	
	Analog	None	4-20 mA loop; 24-30 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GMR Sensor (square wave)	5V pulse or contact closure
Input Range		1.0 - 150 pulses/second	1.0 - 1,500 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Operating Temperature		-30° to 65° C (-22° to 148° F)	-30° to 65° C (-22° to 148° F)
Environmental		NEMA 4X, IP66	NEMA 4X, IP66
Regulatory		None	CE Mark

*Specifications subject to change • Please consult our website for current data (www.seametrics.com).

INSTALLATION

Wall Mount. To mount an FT400-Series indicator to the wall, hold the unit in the desired position, mark the holes in the mounting feet, drill and mount with screws. With the FT420W-65 option, first remove the front cover to gain access to the mounting screw holes.

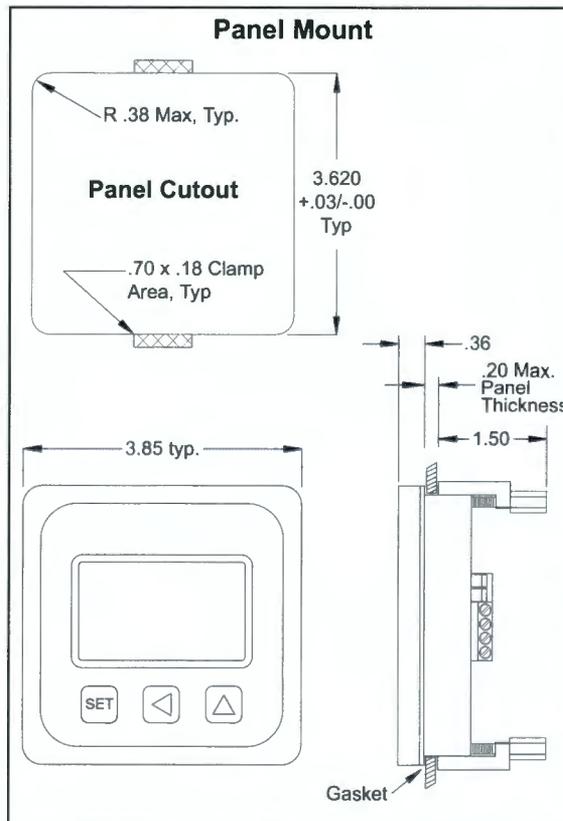
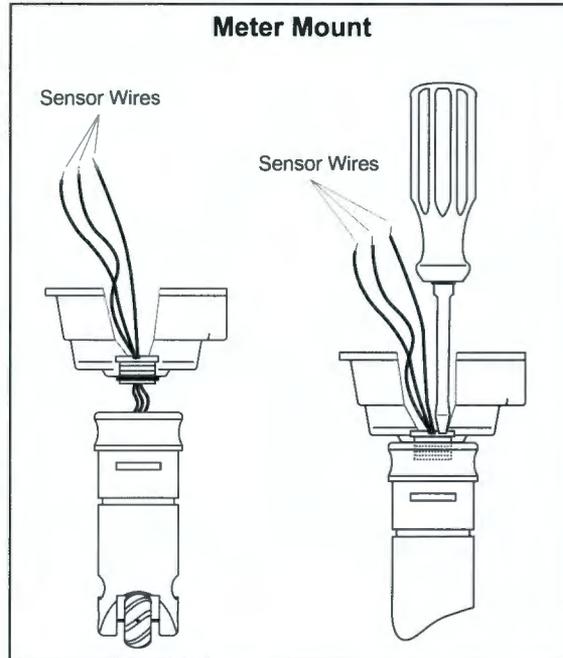
A meter-mounted FT400-Series can be converted to a wall mount using an MK20 mounting kit.

Meter Mount. If the FT400-Series indicator was ordered as an -M model, the housing is already directly mounted to the flow sensor and needs no further installation.

An FT400-Series module can be converted from a wall-to a meter-mount using the MK10 adapter kit that includes a lower housing and associated hardware as follows:

- 1) Remove the strain relief through which the flow sensor cable runs.
- 2) Cut the cable to about 6" in length. Carefully strip the cable jacket to expose the three colored wires (red, white, and black) inside.
- 3) Route the wires through the threaded connector pre-installed in the bottom of the housing.
- 4) Start the threaded connector into the female thread on the top of the flow sensor. Be sure to match the oblong shape on the bottom of the housing to the depression on the top of the flow sensor.
- 5) Using an ordinary screwdriver inserted in one side of the slot (see drawing), tighten the screw as much as possible.
- 6) Strip the wire ends, make the connections to the FT400-Series indicator as shown in Connections Diagrams, and then use the cover screws to attach the indicator to the top of the housing.

Panel Mount (FT420 Only). Using the "Panel Cutout" drawing as a guide, cut a square hole in the panel. Remove the clamps from the back of the FT420P and insert the indicator unit through the cutout, taking care that the panel sealing gasket is in place between the front of the panel and the flange of the indicator. Hold the indicator in place while starting the screw of one of the two clamps. Finger tighten the screw, then install the other clamp. When both are in place, firmly tighten the clamps with a small wrench or nut driver.



INSTALLATION

Connections. To connect the FT400-Series flow computer to a flow sensor or an external device such as a chemical metering pump, follow the Standard Connections diagrams on pages 4-6.

If the FT420's 4-20 mA current signal is not required, connect the power terminals to any 12-30 Vdc voltage source.

Dual Relay Output (Option -98). If you purchase the FT420 with option 98, the required component will come preinstalled, and no extra procedures are required.

If you are retrofitting an existing installation of an FT420 with the dual relay board, please follow the instructions below:

- 1) Peel the backing off of the double-stick tape and affix it to the bottom of the relay board (part #30221).
- 2) Carefully attach the board to the FT420 as shown in the FT420-98 Connection diagram on page 5. Be sure that the red wire faces the "Sensor Input" side of the FT420, and that the white wire faces the "Pulse Output" side.
- 3) Connect the white wire to the "Pulse Scaled" positive terminal, and the red wire to the "Power 4-20 mA" positive terminal.
- 4) Connect devices to the relays as desired.



Caution: If output is being used to control an external device, such as a metering pump, do not connect the device until programming is completed. If malfunction or incorrect programming of the output could cause personal injury or property damage, separate safeguards must be installed to prevent such injury or damage.

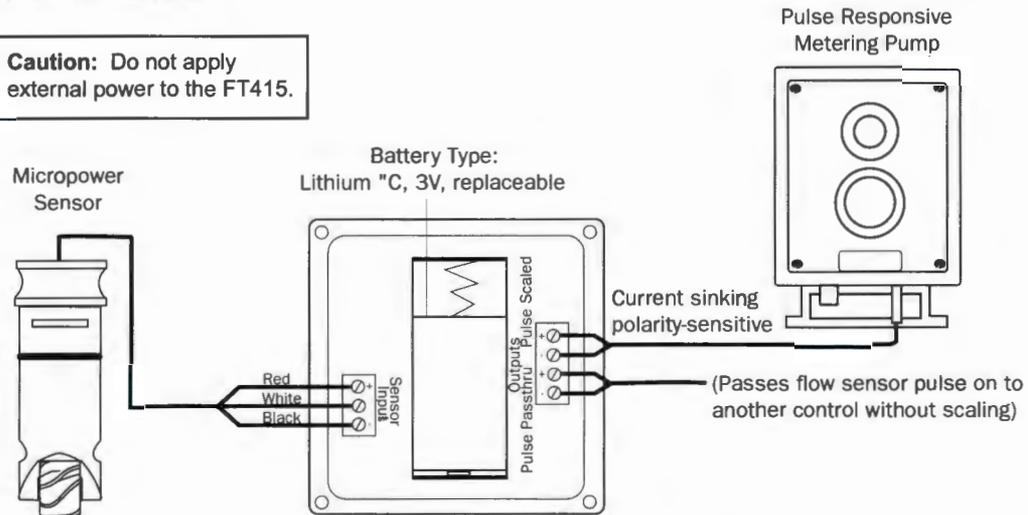
-98 Relay Board Specifications

Output Voltage	0-130 VAC/DC	
Output Current (each output)		
Temperature	50° C	85° C
Current Limit	100 mA	50 mA
Max Pulses/Second	5	
Contact Time Per Output	100 ms	

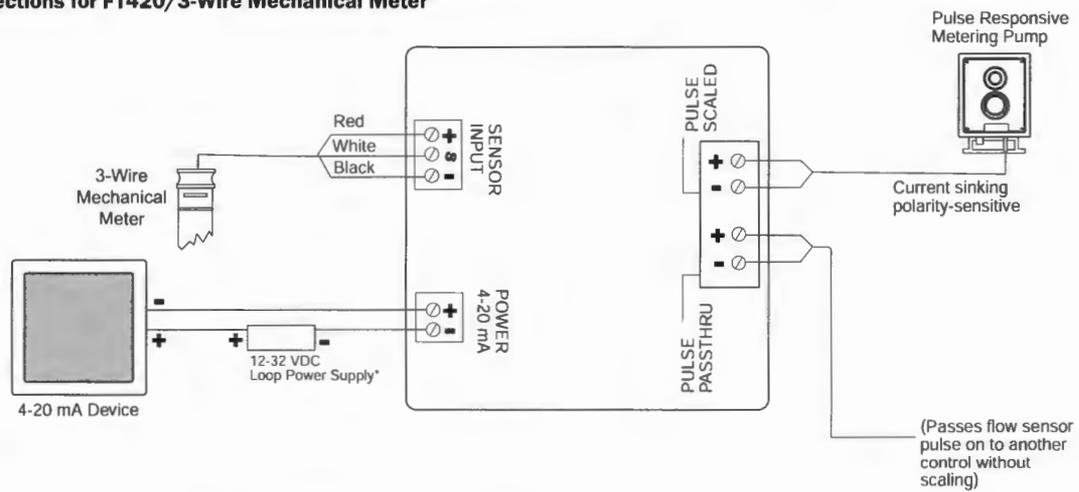
CONNECTION DIAGRAMS

FT415 Standard Connections

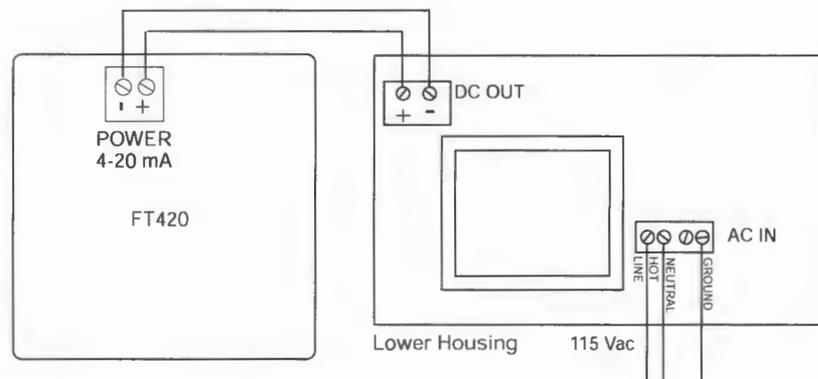
Caution: Do not apply external power to the FT415.



Connections for FT420/3-Wire Mechanical Meter

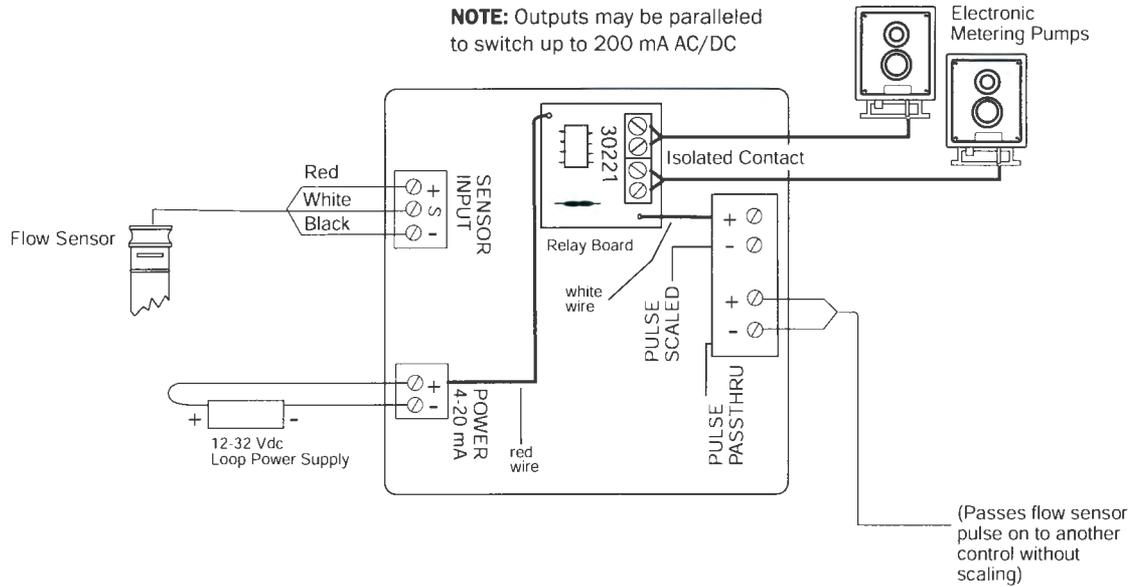


Connections for FT420-65 (115 Vac Option)

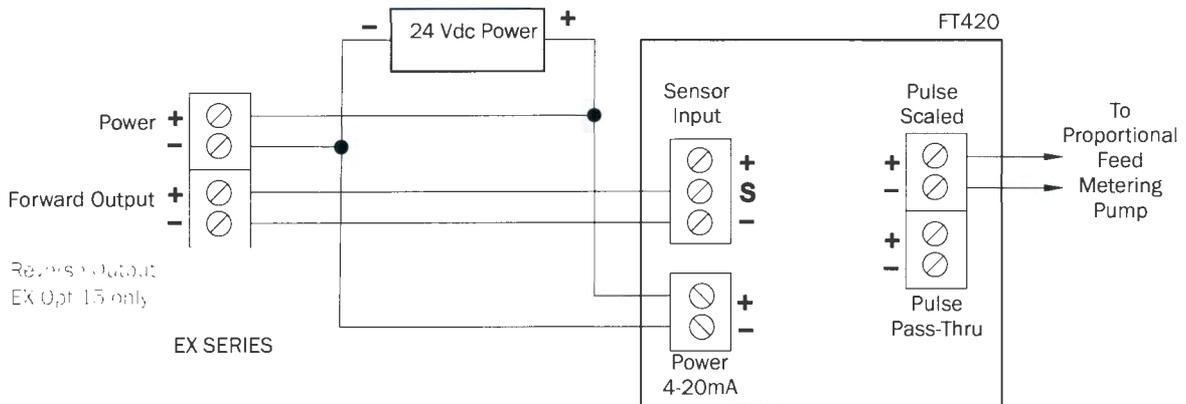


CONNECTION DIAGRAMS

Connections for FT420-98 (Dual Relay Output Option)



Connections for FT420/EX Magmeter



CONNECTION DIAGRAMS

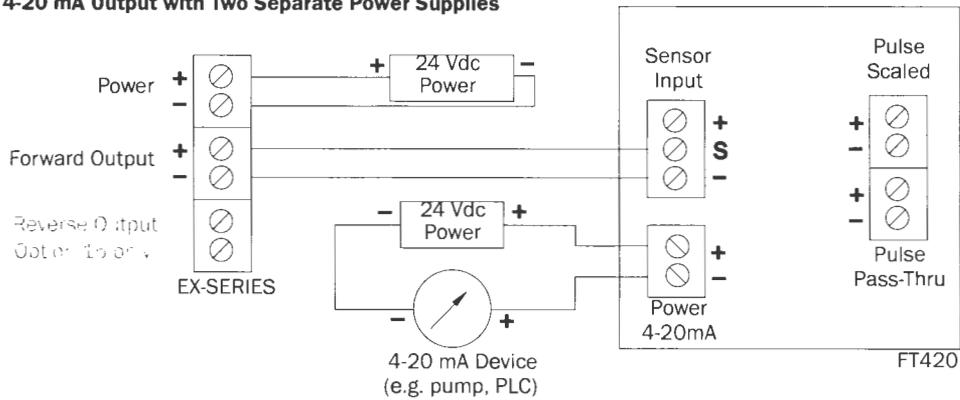
FT420 Display with 4-20 mA Output

When running the FT420 with a magmeter (which requires power), the FT420 must be connected to two power supplies, one for the magmeter and one for the 4-20 mA loop. You may either use a dual power supply (available from Seametrics as the PC42), or two single power supplies (one of which may be the 4-20 mA loop itself). See diagrams below.



Caution: Important! Do not connect power to the power supply until all connections have been made and confirmed correct, and the cover has been put back into place.

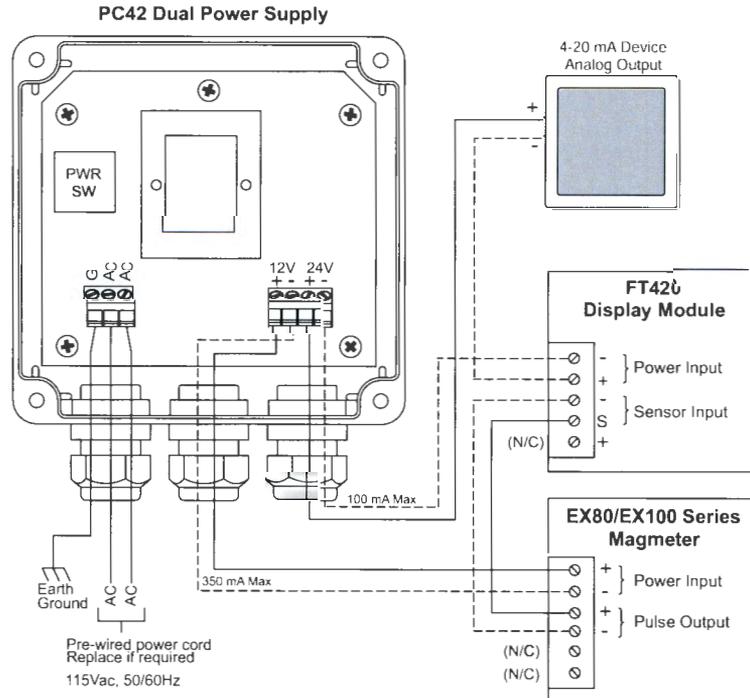
FT420/4-20 mA Output with Two Separate Power Supplies



FT420/4-20 mA Output with PC42 Dual Power Supplies



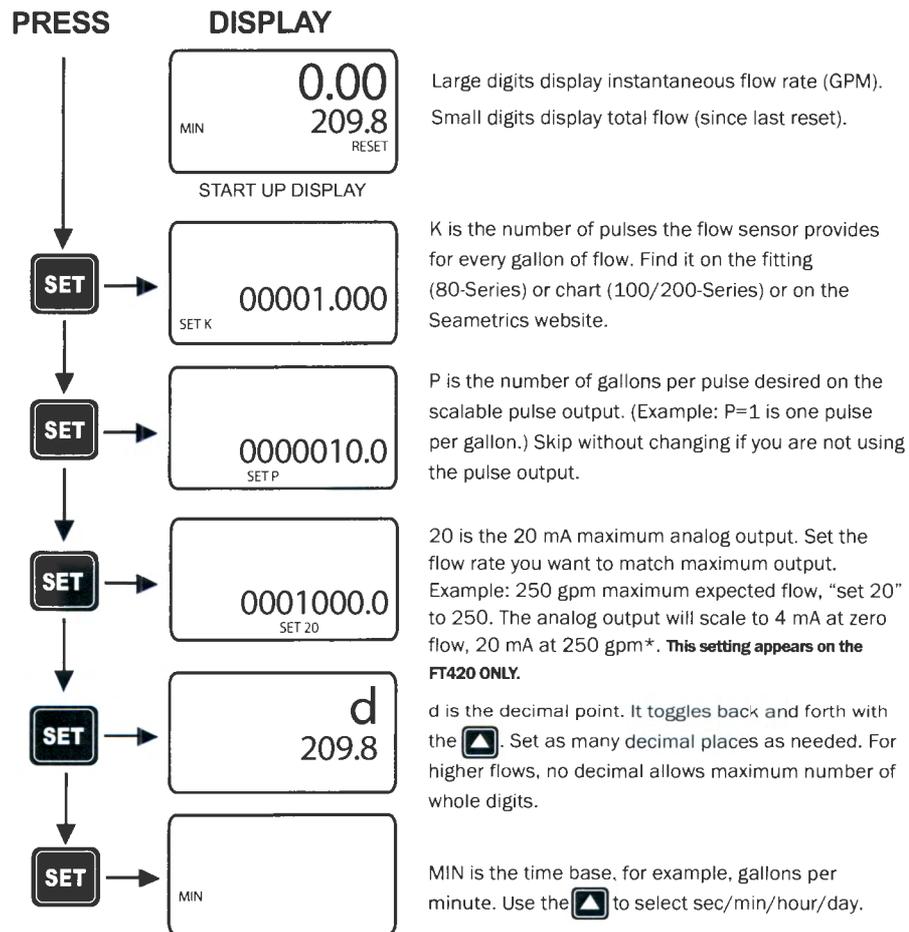
Caution: It is essential for safety and proper operation to use a ground connection for the 115 Vac power. Do not use this power supply without proper grounding.



(QUICK) SETTINGS

QUICK SETTINGS OVERVIEW

See following page for step-by-step instructions on changing these settings
Pass through all settings and return to original display to save settings.



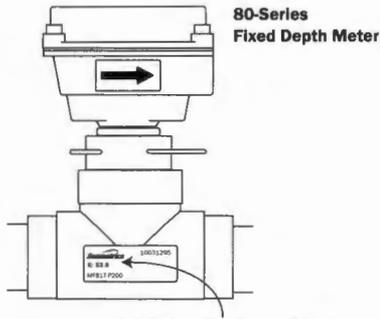
***NOTE:** Use the up arrow key to reach your desired digit. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered.

SETTINGS

K-FACTOR

At a minimum, every FT400-Series flow computer must be programmed with the "K-factor". (This is the number of pulses that the meter produces per gallon of flow.) If you wish the FT400 to read in units other than gallons, see below.

The K-factor on any Seametrics flow sensor fitting or in-line meter can be found on the model-serial label. The line reading K = xxx gives the desired number. For depth-adjustable sensors (101,201,115,215 models), look in the instruction manual under your pipe size. For EX meters, use the calculator on our website.



Find Your K-Factor Here

READING IN OTHER UNITS

Changing Volume Units. The default K-factor units are pulses per gallon. To read your total in metric or other units instead, the standard K-factor must be converted to the desired volume units. For example, to read in pulses per liter, the K-factor must be multiplied by the applicable number shown below.

NOTE: Both rate & total will read in whatever units you choose.

To Convert K to:	Multiply by:
Liters	.26418
Cubic Meters	264.18
Fluid Ounces	.0078
Cubic Feet	7.48

Changing Time Units: To read your rate in liters per second (for example), convert the K-factor volume units as shown above and change the time units to Seconds, using the Set Time Unit instructions at right.

Set K. Begin by pressing the SET key once. The prompt SET K should appear on the display. The digit to the far right will be blinking. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. (Note that the decimal is fixed at three places. If you only have two decimal places for your K-factor, enter a zero for the third digit.) Press SET to advance. (**Note:** If unable to set K-factor, the unit is "locked" to prevent tampering. Please contact your Distributor for assistance.)

Set P/Flow Alarm. At this screen you may select between pulse output (P) or flow alarm (A) functions. If the pulse output and flow alarm features are not being used, this step can be skipped. The P (pulse output) setting does not affect anything if it is not being used.

Set P is the default that appears on a new FT400-Series. On an FT400 that has been previously set up with flow alarm function, an A will appear on this screen. To move between P and A screens, firmly press all three keys for 5-10 seconds, then use the up arrow to scroll through the three options: P, AL HI (high flow alarm) and AL LO (low flow alarm).

Set P. From this screen, follow the same process as for Set K to enter the desired pulse rate. This is the number of gallons (or whatever units are programmed) between pulses. (**Note:** Using the pulse output function disables the high and low flow alarm functions.) (6.1 Hz max output)

Set Flow Alarm. From the A screen, use the up arrow key to choose either AL HI or AL LO and then press the SET key to set the alarm rate. Use the up arrow and left arrow as above to reach the desired digits. (**Note:** Using the flow alarm function disables the pulse output function.)

Set 20 mA (FT420 Only). Press the SET key to advance to SET 20, to set the flow rate, in volume units per time unit, at which 20 mA is desired. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. The processor will automatically scale the 4-20 mA loop accordingly, with 4 mA at zero flow.

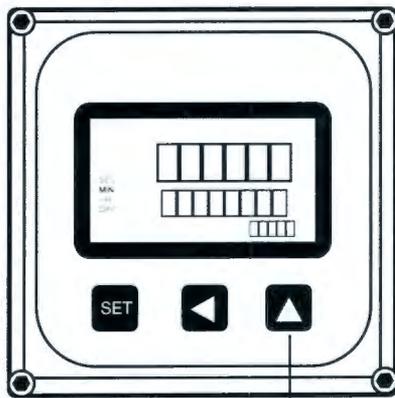
Set Decimal Point. Press the SET key again for the D prompt. Pressing the up arrow key switches among no decimal place, one decimal place and two decimal places.

Set Time Unit. When the SET key is pressed again, a blinking time unit appears. Press the up arrow key to select SEC (seconds), MIN (minutes), HR (hours) or DAY (days) (for example, gal/min, or gal/hr).

To save settings and return to normal operation after entering settings, press SET again. When the unit is connected to an operating flow sensor, the rate (larger digits) and total (smaller digits) indicator numbers should appear in the display.

OPERATION

Resettable/Non-Resettable Totalizer. Unless the unit has been ordered with the non-reset option, a RESET prompt is visible in the lower right corner above the up arrow key, when the display is in use. Press the up arrow key at any time to reset the totalizer to zero. (**Note:** If you need to reset a unit that has been ordered with a non-resettable totalizer, contact your distributor.)



This key resets total to zero
when in normal run mode.



CAUTION: Do not touch up Arrow button unless you intend to RESET Total to Zero. TOTAL IS NOT RECOVERABLE.

Operation of 4-20 mA Output (FT420 Only). If the 4-20 mA output is in use and is correctly connected, the signal should vary between 4 mA and 20 mA in proportion to the flow, with the top flow rate set by the user (see Settings, page 8). At no time should the signal drop below 4 mA. A reading between 0 and 4 mA indicates a fault of some type, typically in the loop power supply or the connections (see Troubleshooting, back page). In the rare instance that the 4-20 signal fluctuates excessively ("paints") it may need to be damped by additional averaging. Contact Seametrics for information on how to increase filtering.

Operation of the Pulse Output. If the pulse output is being used

(either standard electronic or relay-type), it should pulse for 0.1 second every time the set number of gallons has been totalized. If a pulse-responsive metering pump is properly connected to this output, it should stroke periodically. If this does not occur, see Troubleshooting, back page.

FT415 Battery Change. The expected average life of the battery ranges between 3-5 years depending on the frequency of the input. The battery is easily pulled and replaced. When the battery is removed, all of the settings will be retained.



CAUTION: During a battery change, the totalizer will reset to a previous total, which represents the last auto-backup (auto backups occur at approximately 4 minute intervals). If it is necessary to save the exact current total at the time of the battery change, save before removing the battery as follows:

- 1) Simultaneously press the SET and up arrow keys
- 2) Press SET again
- 3) Again simultaneously press the SET and up arrow keys

TROUBLESHOOTING

Problem	Probable Cause	Try...
Display blank	No power to the unit	Check for minimum 12 Vdc at power terminals
	Short in sensor circuit	Disconnect sensor, see if display returns (zero flow rate)
	Battery dead or loose (FT415 only)	Wiggle battery, replace if over three years old
Display missing segments	Damaged display module	Contact distributor for return/replacement
Display reading meaningless characters	Unit's microcontroller crashed	Disconnect and reconnect power, if problem repeats, contact distributor for return/replacement
	Battery nearly dead	Replace battery if over three years old
Display reads normally, flow rate incorrect	Wrong K-factor or time base entered	Enter correct K-factor from meter, fitting, or manual
Display reads normally, incorrect pulse output	Wrong pulse output setting	Use "Set P" to correct pulse output setting
	Polarity reversed on pulse output terminals	Reverse leads
Display reads normally, but no (or incorrect) 4-20 mA output (FT420 only)	Wrong 20 mA setting	Use "Set 20" to correct target top flow rate
	Inadequate loop power supply voltage	Check voltage (For 4-20 mA applications, 24 Vdc recommended)
	Polarity incorrect in 4-20 mA loop circuit	Compare to Connections diagram
Display reads zero when there is flow	Flow sensor failed	Consult flow sensor manual for how to test
	Break in flow sensor circuit	Check for continuity with multimeter
	Flow sensor not battery-compatible	Check flow sensor model number for "micropower option"
Display reads flow rate when there is none	Long flow sensor wire, running parallel to power wires	Reroute wire or change to shielded wire
	Flow sensor malfunction	See flow sensor manual to check
	Flow "jitter" (oscillating slosh) reads as flow	Consult factory for "anti-jitter" setting



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LT-6520063-D
9/20/10



Seametrics, Inc.
Limited Warranty Policy
(July 20, 2011)

The limited warranty set forth below is given by Seametrics, Inc. ("Seametrics") with respect to Seametrics brand products purchased in the United States.

Seametrics products, when delivered to you in new condition in their original containers, are warranted against defects in materials or workmanship for a period of two (2) years from the date of original purchase (proof of purchase may be required).

Defective products, or parts thereof, which are returned to Seametrics and proven to be defective upon inspection, will be repaired to factory specifications and returned to you. Warranty repair shall not extend the original warranty period of the Seametrics product. This limited warranty shall only apply if the products are used for their intended purpose: the measurement of flow in such liquids whose temperature, pressure, velocity, viscosity, density or chemical composition render them suitable to pass through the product, and the product is located in a non-hazardous area. This limited warranty covers all defects encountered in normal use of Seametrics' products, and does not apply in the following cases:

- (a) Loss of or damage to Seametrics' product due to abuse, mishandling, improper packaging by you, alteration, accident, electrical current fluctuations, failure to follow operating, maintenance and environmental instructions prescribed in Seametrics' instruction manual, or service performed by other than Seametrics, or any Seametrics Authorized Service Facility which may be established separately from this limited warranty policy.
- (b) Use of parts or supplies (other than those sold by Seametrics) which cause damage to the products, or cause abnormally frequent service calls or service problems.

NO IMPLIED WARRANTY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, APPLIED TO THE PRODUCTS AFTER THE APPLICABLE PERIOD OF THE EXPRESS LIMITED WARRANTY STATED ABOVE, AND NO OTHER EXPRESS WARRANTY OR GUARANTY, EXCEPT AS MENTIONED ABOVE, GIVEN BY ANY PERSON OR ENTITY WITH RESPECT TO THE PRODUCTS, SHALL BIND SEAMETRICS. (SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.) SEAMETRICS SHALL NOT BE LIABLE FOR LOSS OF REVENUES, OR PROFITS, OR INCONVENIENCE, EXPENSE FOR SUBSTITUTE EQUIPMENT OR SERVICE, STORAGE CHARGES, LOSS OF DATA, OR ANY OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES CAUSED BY THE USE OR MISUSE OF, OR INABILITY TO USE, THE PRODUCTS, REGARDLESS OF THE LEGAL THEORY ON WHICH THE CLAIM IS BASED, AND EVEN IF SEAMETRICS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, IN NO EVENT SHALL RECOVERY OF ANY KIND AGAINST SEAMETRICS BE GREATER IN AMOUNT THAN THE PURCHASE PRICE OF THE PRODUCT SOLD BY SEAMETRICS AND CAUSING THE ALLEGED DAMAGE. WITHOUT LIMITING THE FOREGOING, YOU ASSUME ALL RISK OF LIABILITY FOR LOSS, DAMAGE, OR INJURY TO YOU AND YOUR PROPERTY AND TO OTHERS AND THEIR PROPERTY ARISING OUT OF USE OR MISUSE OF, OR INABILITY TO USE, THE PRODUCTS NOT CAUSED DIRECTLY BY THE NEGLIGENCE OF SEAMETRICS. (SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU.) THIS LIMITED WARRANTY STATES YOUR EXCLUSIVE REMEDY.

You must contact Seametrics for a case number in order to receive an RMA (Return Material Authorization). When an RMA is assigned, **properly** package and send the product to Seametrics at your expense, together with a complete explanation of the problem and your product's model name, serial number, and date of purchase. Seametrics products covered by this warranty will be repaired and returned to you without charge by Seametrics. Expedited repair and return may be subject to service charges.

ADVANCED REPLACEMENT PROCEDURES

If an advanced replacement is required, it must be stated at the time of the RMA request. If a Purchase Order (PO) is required, it must be referenced on the RMA request (otherwise the RMA will be substituted for the PO). The advanced replacement is charged as a normal order (new or refurbished) including a non-refundable 10% Advanced Replacement Fee. Upon receipt and inspection of the returned parts, a determination will be made in regards to the returned item: The advanced replacement fee will be fully credited (100%) for defective product(s), 0% for non-warranty items, and 50% for no problem found.

OUT-OF-WARRANTY SERVICE

The following applies to factory service on Seametrics products which are either out of warranty, or which have been determined to be suffering from non-warranty damage. You must contact Seametrics to arrange for out-of-warranty factory service and obtain a case number to be assigned an RMA number. You must **properly** package and send the product to Seametrics at your expense, together with a complete explanation of the problem and our product's model name, serial number, and date of purchase. Seametrics products not covered by this warranty will be repaired and returned to you by Seametrics for a net charge, established separately from this limited warranty policy. Expedited repair and return may be subject to service charges. Seametrics may elect to substitute a reconditioned product of the same or equivalent model. The warranty period covering such repaired or replaced products shall be ninety (90) days from the date the product is shipped to you from Seametrics.

This limited warranty gives you specific legal rights and you may also have other rights which vary from state to state.

19026 72nd Ave. S. Kent, WA 98032 Phone: (253) 872-0284 Fax: (253) 872-0285 email: sales@seametrics.com

LT-65200068-B

APPENDIX M
pH Instrumentation

Instruction Sheet

PN 51A-396R/rev.L
January 2011

Model 396R

UpH Retractable pH/ORP Sensor

For additional information, please visit our website
at www.emersonprocess.com/raihome/liquid/.

SPECIFICATIONS	MODEL 396R
Measurements and Ranges	pH: 0-14; ORP: -1500 to 1500 mV*
Available pH AccuGLASS Types	GPLR hemi bulb or GPLR flat bulb
Wetted Materials	Polypropylene, EPDM, titanium, glass, (platinum: ORP only)
Process Connection	None, use 1 inch process connector or ball valve kit (1-1/2 inch or 1-1/4 inch — sold separately)
Temperature Range	0 to 100°C (32 to 212°F)
Pressure Range - Hemi bulb	100 to 1136 kPa (abs) (0 to 150 psig)
Pressure Range - Flat bulb	100 to 790 kPa (abs) (0 to 100 psig)
Maximum Pressure at Retraction or Insertion	Code 21: 542 kPa (abs) (64 psig) Code 25: 343 kPa (abs) (35 psig)
Minimum Conductivity	100 µS/cm, nominal
Preamplifier Options	Remote

Specifications subject to change without notice.

PERCENT LINEARITY FOR MODEL 396R		
pH range	GPLR Hemi bulb	GPLR Flat bulb
0-2	94%	93%
2-12	99%	98%
12-13	97%	95%
13-14	92%	—

ATEX DIRECTIVE

Special Conditions for safe use

- All pH/ORP sensors have a plastic enclosure which must only be cleaned with a damp cloth to avoid the danger due to a build up of an electrostatic charge.
- All pH/ORP sensor Models are intended to be in contact with the process fluid and may not meet the 500V r.m.s. a.c. test to earth. This must be taken into consideration at installation.

STORAGE

- It is recommended that electrodes be stored in their original shipping containers until needed.
- Do not store at temperatures below -5°C (23°F).
- Electrodes should be stored with a protective cap containing KCl solution (PN 9210342).
- For overnight storage, immerse the sensor in tap water or 4 pH buffer solution.
- A pH glass electrode does have a limited shelf life of one year.

⚠ WARNING

System pressure may cause the sensor to blow out with great force unless care is taken during removal. Allow sufficient room for safe retraction and insertion of the sensor. Personnel should have room for stable footing while performing removal or insertion of the sensor.

⚠ WARNING

RETRACTABLE SENSORS

Retractable sensors must not be inserted nor retracted when process pressures are in excess of 64 psig (542kPa) for option 21 or 35 psig (343 kPa) for option 25.

⚠ CAUTION

SENSOR/PROCESS APPLICATION COMPATIBILITY

The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.

ELECTRODE PREPARATION

- Remove electrode from shipping container.
- Remove the protective boot covering the electrode bulb.
- Rinse away salt film with clean water, then gently shake the electrode so that the internal solution fills the bulb, thus removing any air trapped there.

INSTALLATION

For sensor dimensions, see Figures 1 and 2.
For sensor orientation and installation, see Figures 3 - 5.
For wiring, see Figures 6 - 20.

pH SENSOR CALIBRATION AND MAINTENANCE

TWO POINT pH BUFFER CALIBRATION

Select two stable buffer solutions, preferably pH 4.0 and 10.0 (pH buffers other than pH 4.0 and pH 10.0 can be used as long as the pH values are at least two pH units apart).

NOTE

A pH 7 buffer solution reads a mV value of approx. zero, and pH buffers read approximately ± 59.1 mV for each pH unit above or below pH 7. Check the pH buffer manufacturer specifications for millivolt values at various temperatures since it may affect the actual value of the buffer solution mV/pH value.

1. Immerse sensor in the first buffer solution. Allow sensor to equilibrate to the buffer temperature (to avoid errors due to temperature differences between the buffer solution and sensor temperature) and wait for reading to stabilize. Value of buffer can now be acknowledged by analyzer/transmitter.
2. Once the first buffer has been acknowledged by the analyzer/transmitter, rinse the buffer solution off of the sensor with distilled or deionized water.
3. Repeat steps 1 and 2 using the second buffer solution.
4. The theoretical slope value, according to the Nernst equation for calculating pH, is approximately 59.17 mV/pH. Over time the sensor will age, both in the process and in storage, and will result in reduced slope values. To ensure accurate readings, it is recommended that the electrode be replaced when the slope value falls below 47 to 49 mV/pH.

RECOMMENDED pH SENSOR STANDARDIZATION

For maximum accuracy, the sensor can be standardized on-line or with a process grab sample after a buffer calibration has been performed and the sensor has been conditioned to the process. Standardization accounts for the sensor junction potential and other interferences. Standardization will not change the sensor's slope but will simply adjust the analyzer's reading to match that of the known process pH.

MAINTENANCE FOR pH ELECTRODES

Electrodes should respond rapidly. Sluggishness, offsets, and erratic readings are indicators that the electrodes may need cleaning or replacement.

1. To remove oil deposit, clean the electrode with a mild non-abrasive detergent.

2. To remove scale deposits, soak electrodes for 30 to 60 minutes in a 5% hydrochloric acid solution.
3. Temperature effect on life expectancy: If glass electrode life expectancy is 100% @ 25°C (77°F), then it will be approximately 25% @ 80°C (176°F).

ORP SENSOR CALIBRATION AND MAINTENANCE

CALIBRATION

1. After making an electrical connection between the sensor and the instrument, obtain a standard solution of saturated quinhydrone. This can also be made quite simply by adding a few crystals of quinhydrone to either pH 4 or pH 7 buffer. Quinhydrone is only slightly soluble, therefore only a few crystals will be required.
2. Immerse the sensor in the standard solution. Allow 1-2 minutes for the ORP sensor to stabilize.
3. Adjust the standardize control of the instrument to the solution value shown in the table below. The resulting potentials, measured with a clean platinum electrode and saturated KCl/AgCl reference electrode, should be within ± 20 millivolts of the value shown in the table below. Solution temperature must be noted to ensure accurate interpretation of results. The ORP value of saturated quinhydrone solution is not stable over long periods of time. Therefore, these standards should be made up fresh each time they are used.
4. Remove the sensor from the buffer, rinse, and install in the process.

ORP of Saturated Quinhydrone Solution (millivolts)

Temp °C	pH 4 Solution			pH 7 Solution		
	20	25	30	20	25	30
mV Potential	268	264	260	94	87	80

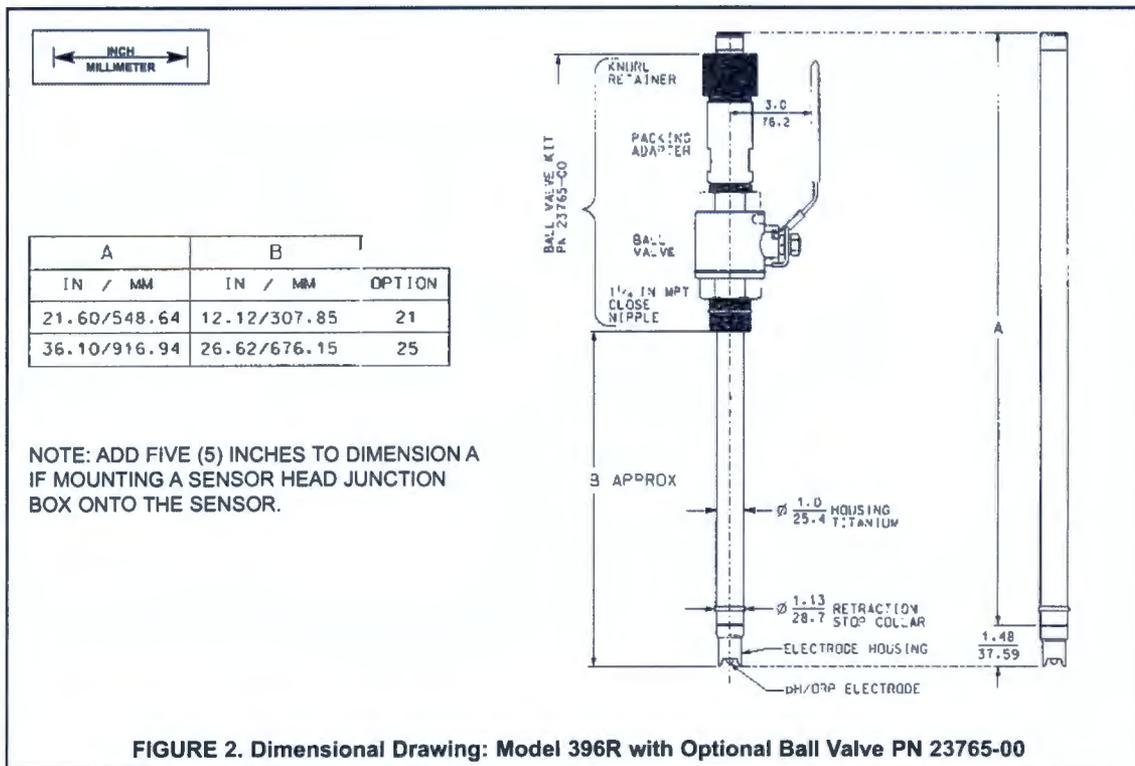
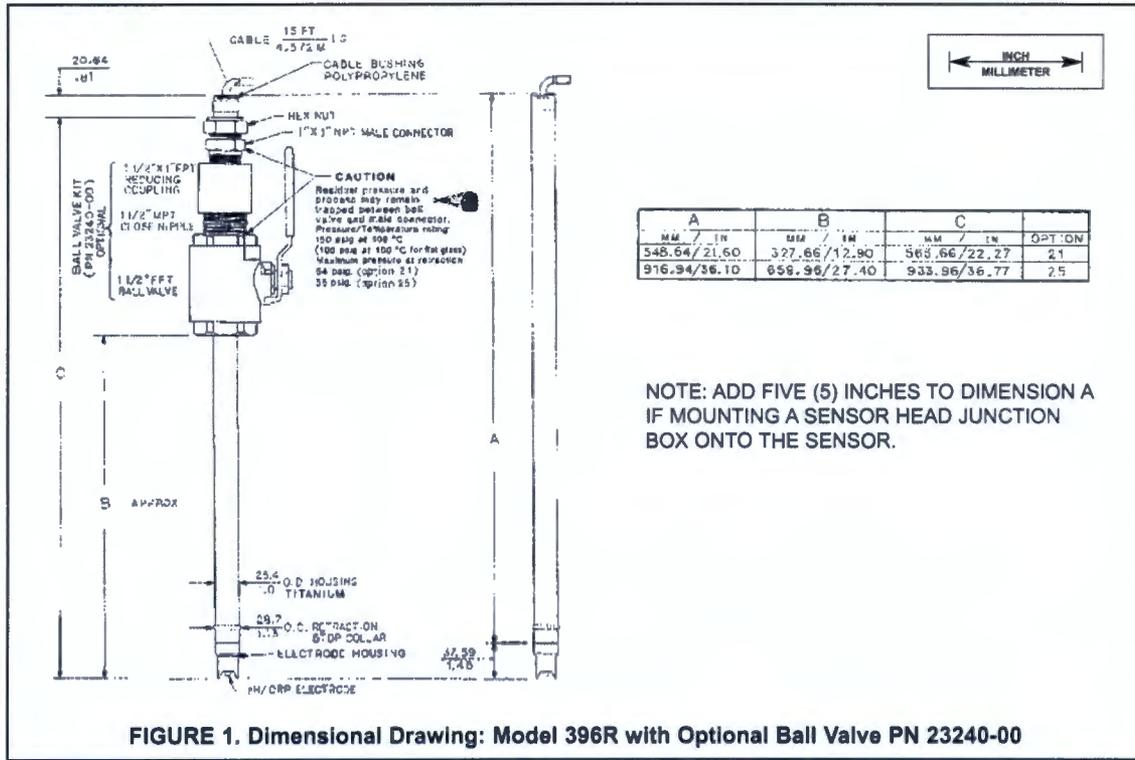
MAINTENANCE FOR ORP ELECTRODES

Electrodes should respond rapidly. Sluggishness, offsets, and erratic readings are indicators that the electrodes may need cleaning or replacement.

1. To remove oil deposit, clean the electrode with a mild non-abrasive detergent.
2. To remove scale deposits, soak electrodes for 30 to 60 minutes in a 5% hydrochloric acid solution.
3. ORP (metallic) electrodes should be polished with moistened baking soda.

NOTE

Remove electrical tape or shrink sleeve from gray reference wire before connecting wire to terminal.



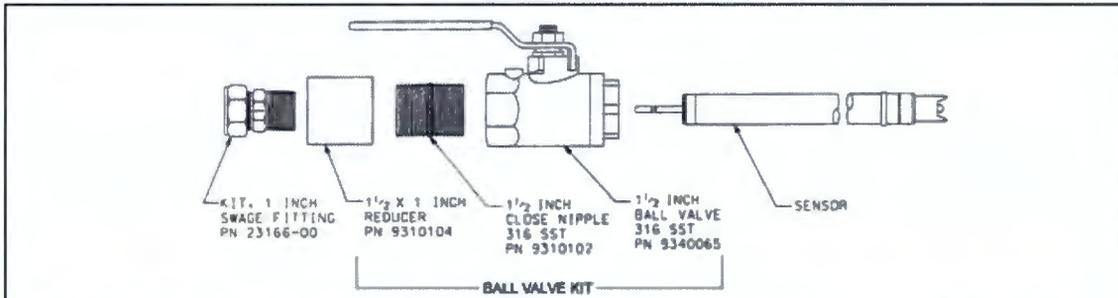


FIGURE 3. Exploded View of Ball Valve Kit PN 23240-00 used with process connector PN 23166-00 (or PN 23166-01) [Ball Valve Kit includes 1-1/2 in. x 1 in. reducer, 1-1/2 in. close nipple, and 1-1/2 in. ball valve]

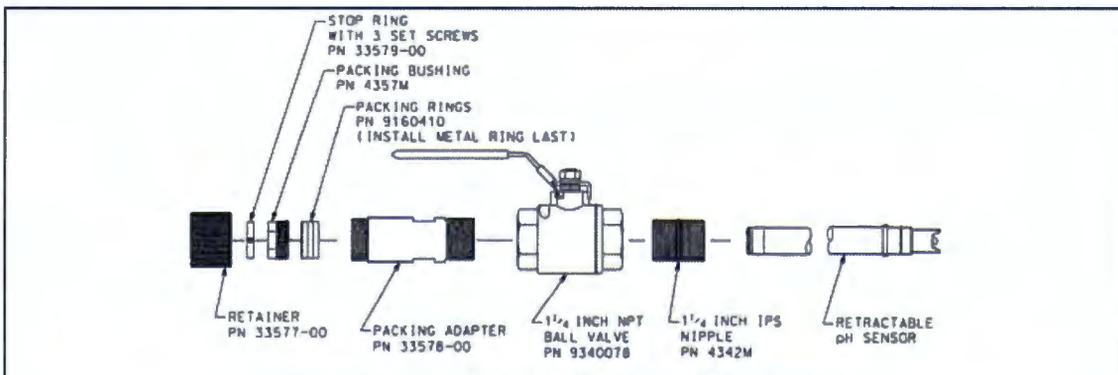


FIGURE 4. Exploded View of Ball Valve Kit PN 23765-00

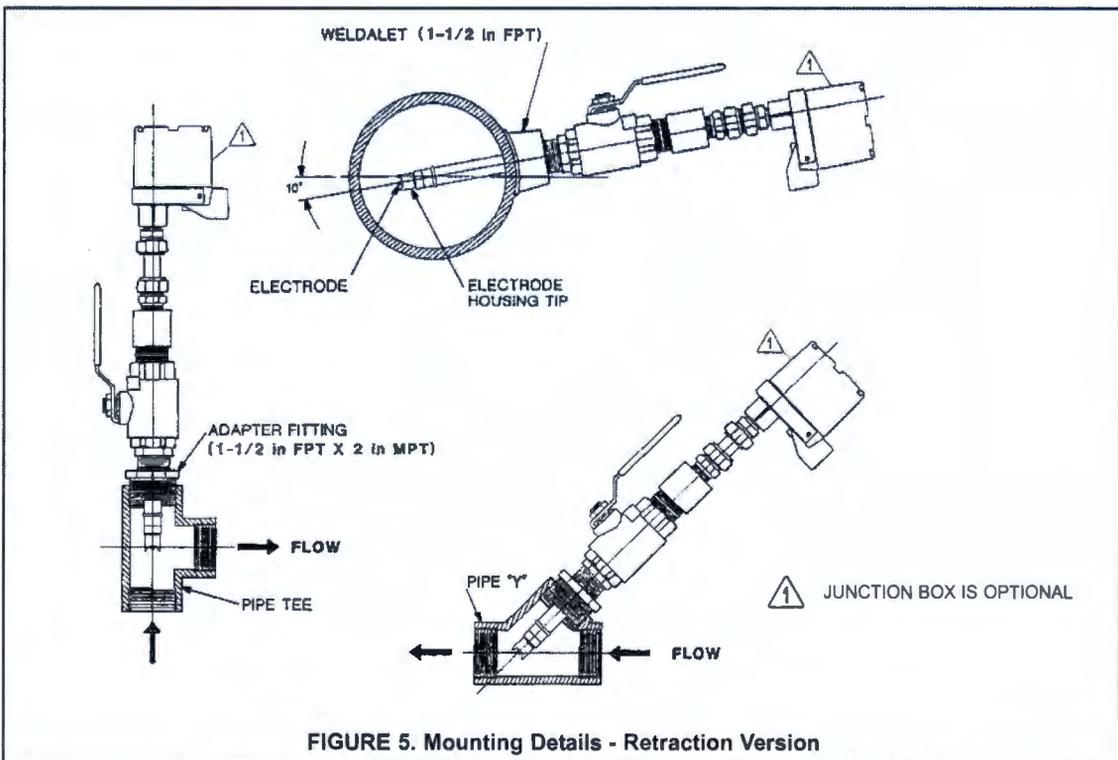


FIGURE 5. Mounting Details - Retraction Version

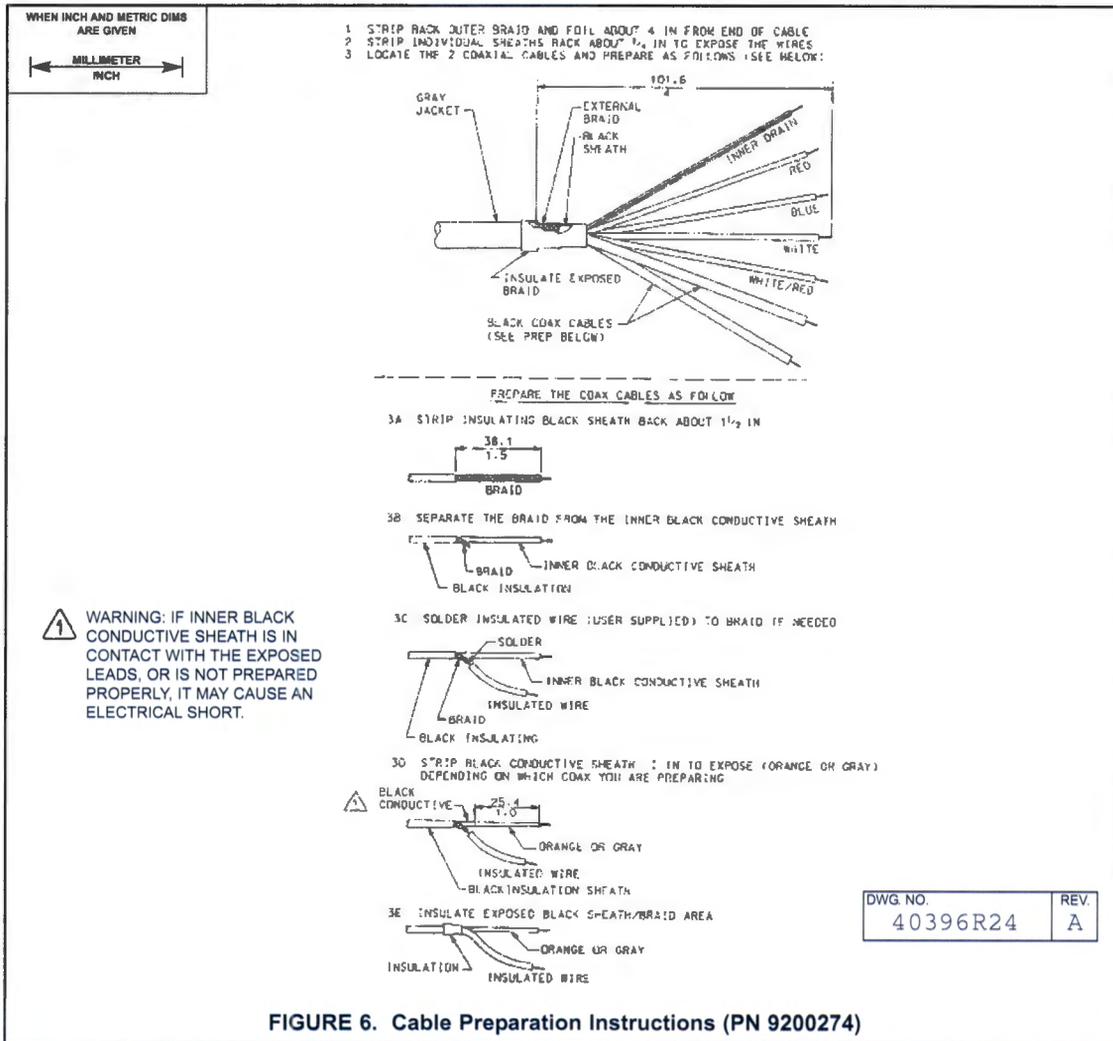


FIGURE 6. Cable Preparation Instructions (PN 9200274)

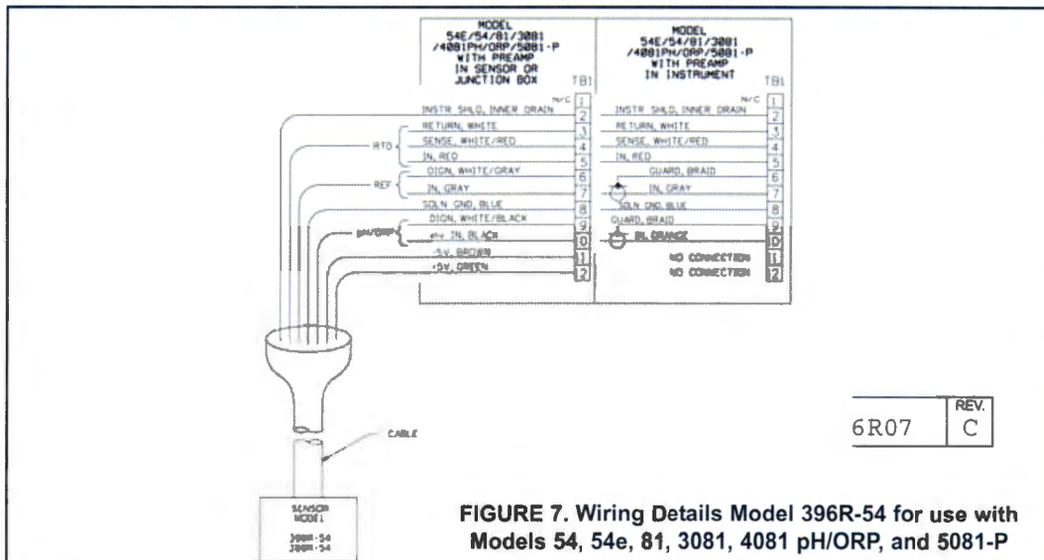
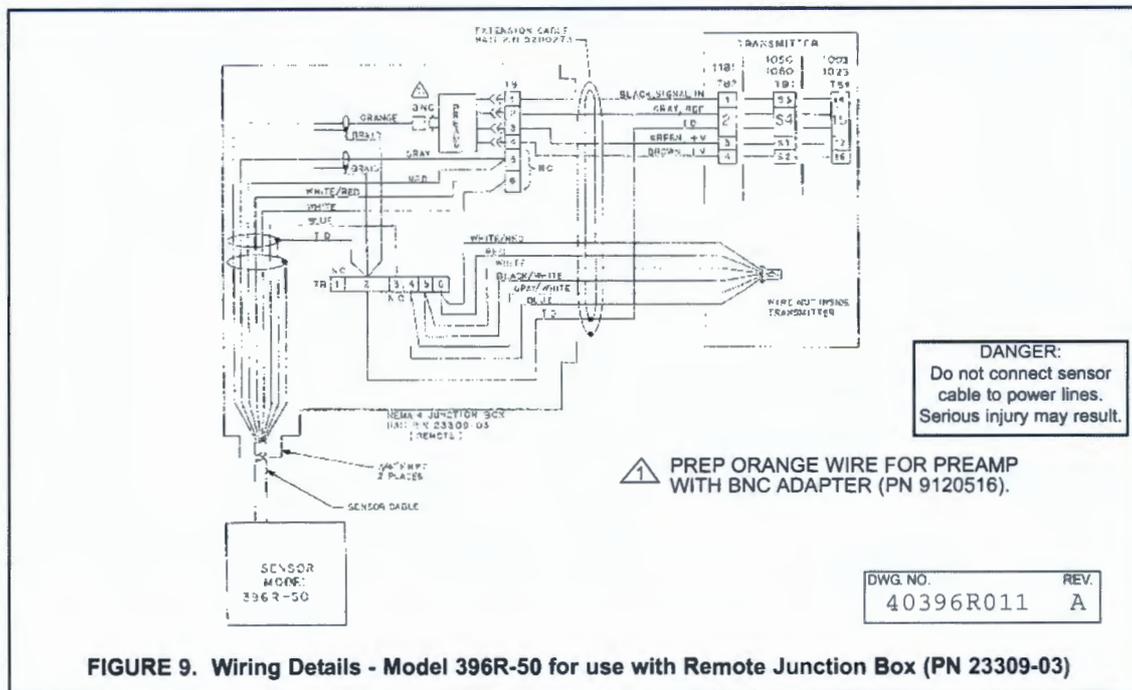
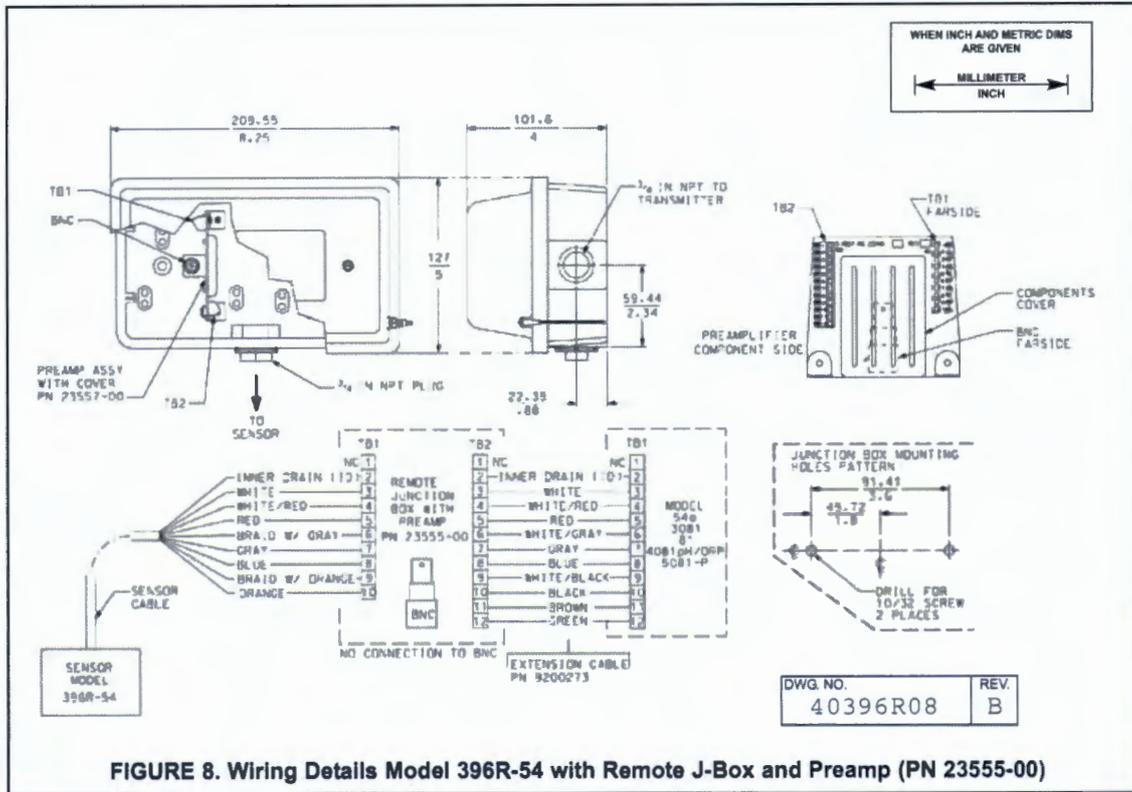


FIGURE 7. Wiring Details Model 396R-54 for use with Models 54, 54e, 81, 3081, 4081 pH/ORP, and 5081-P



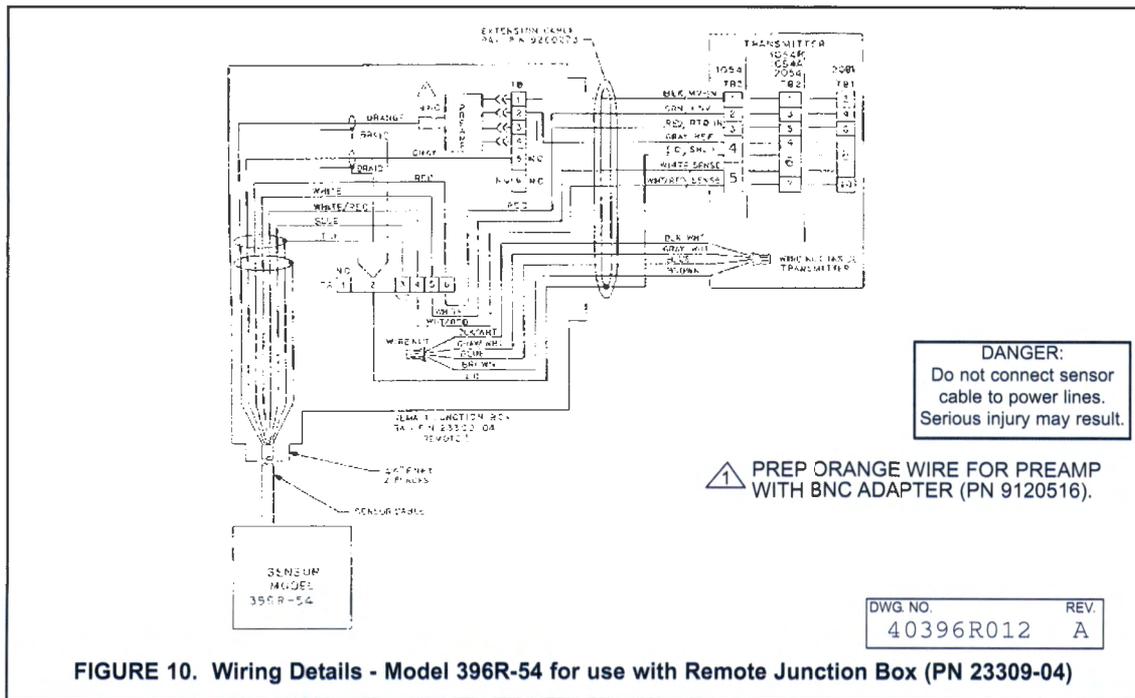


FIGURE 10. Wiring Details - Model 396R-54 for use with Remote Junction Box (PN 23309-04)

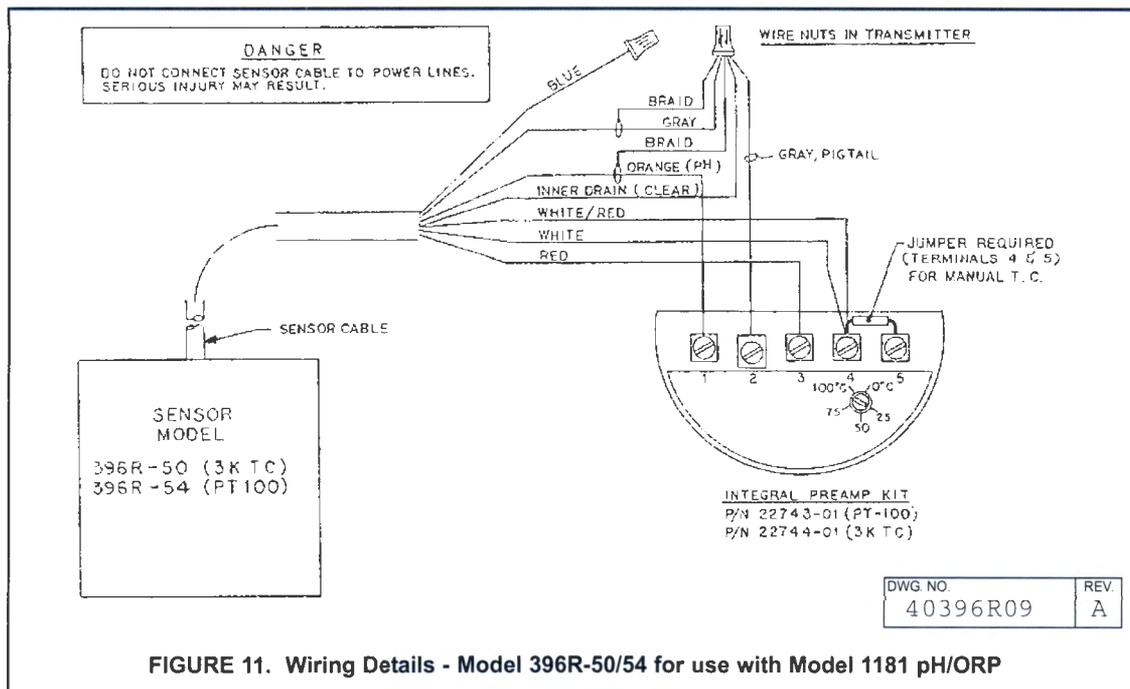
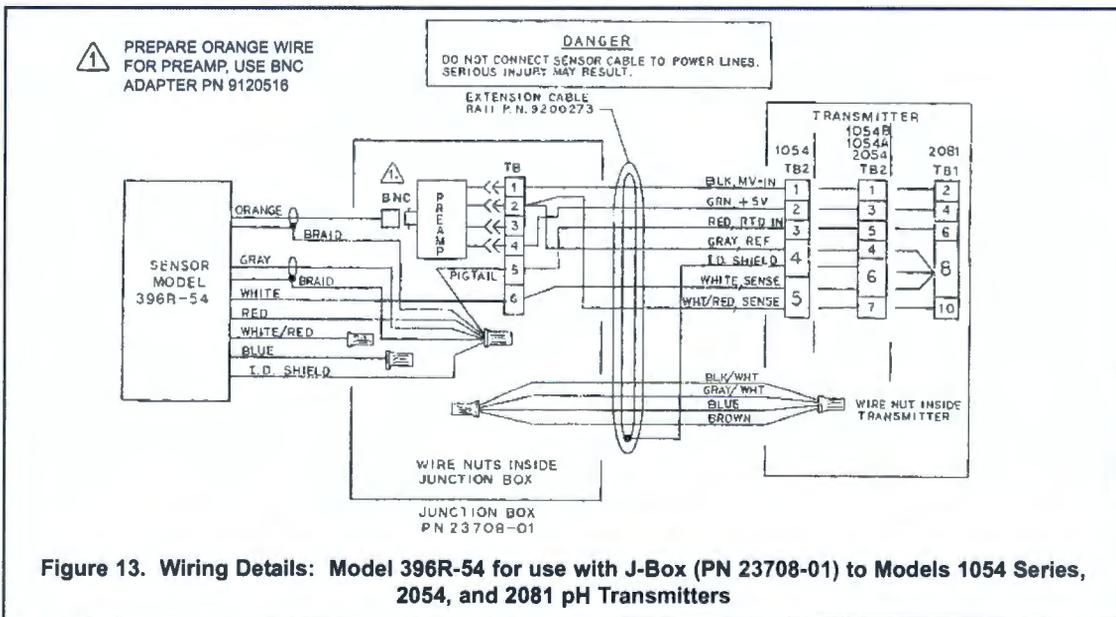
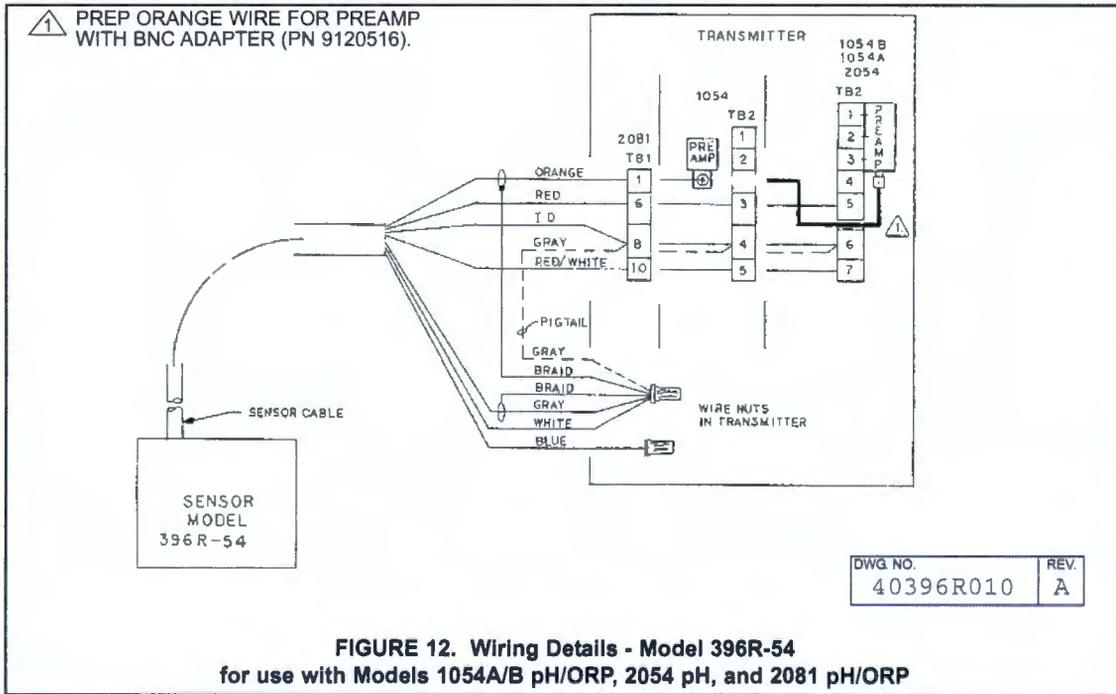
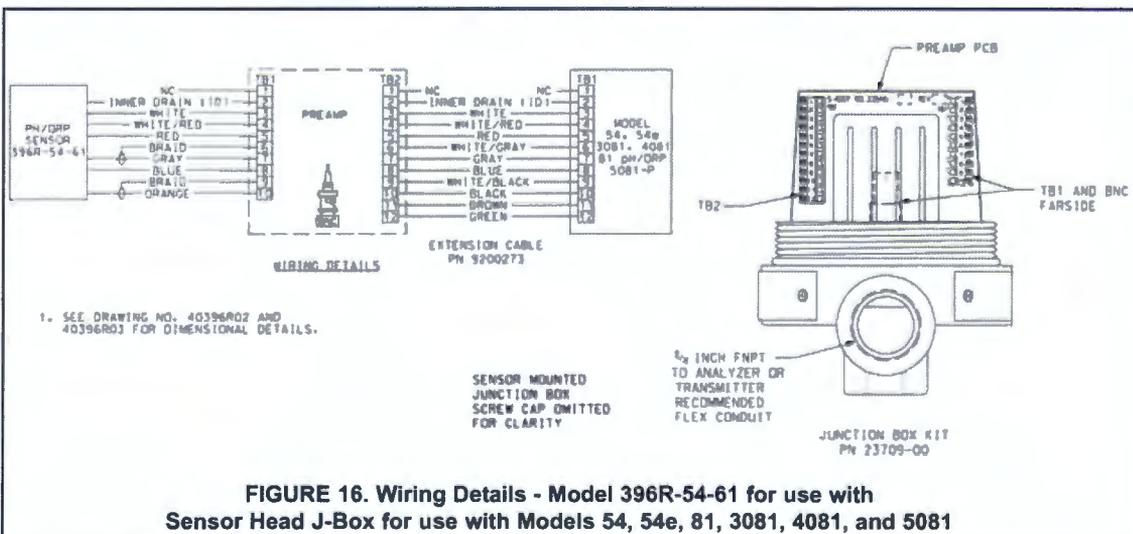
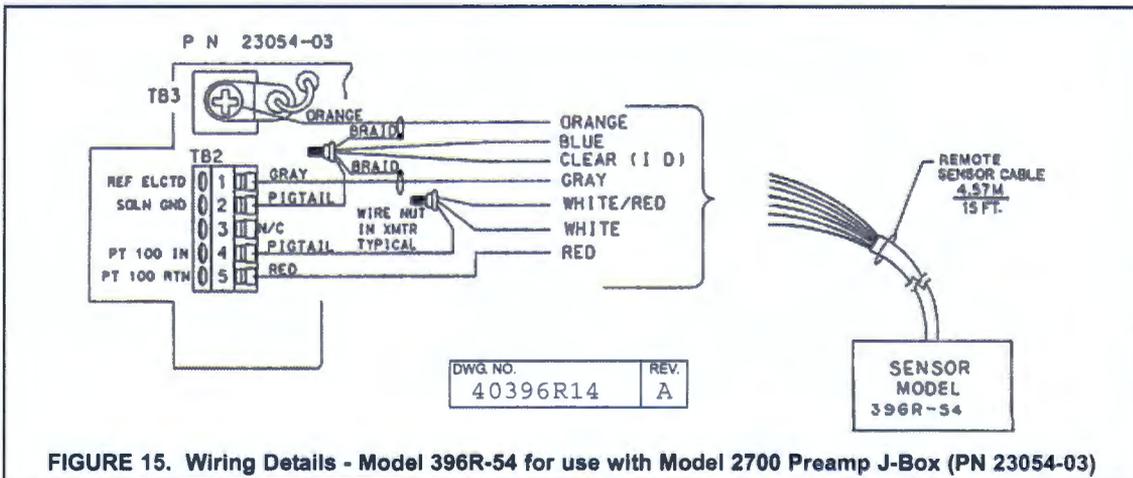
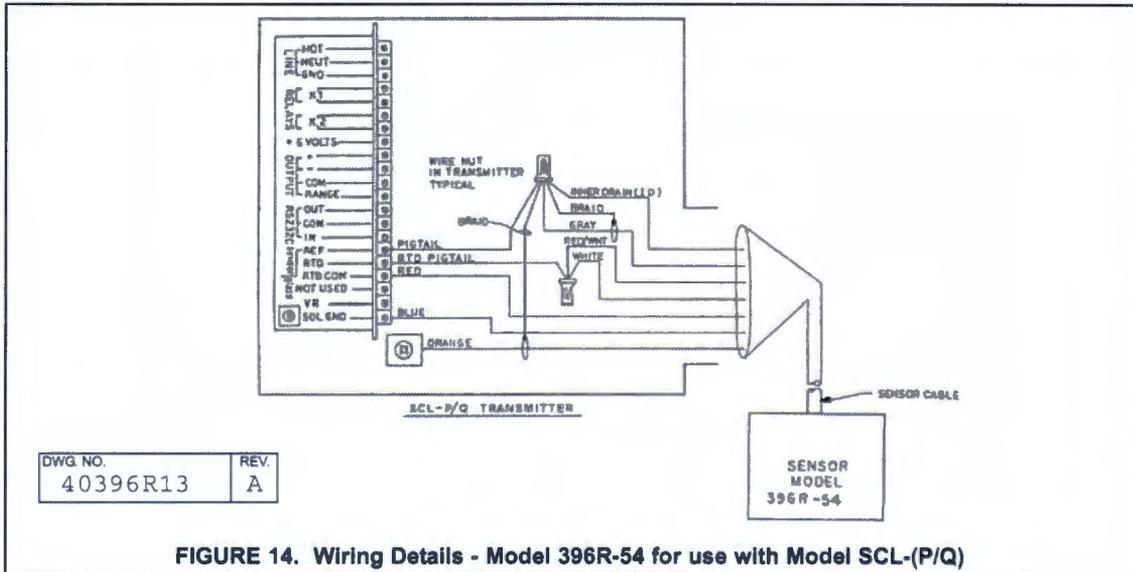
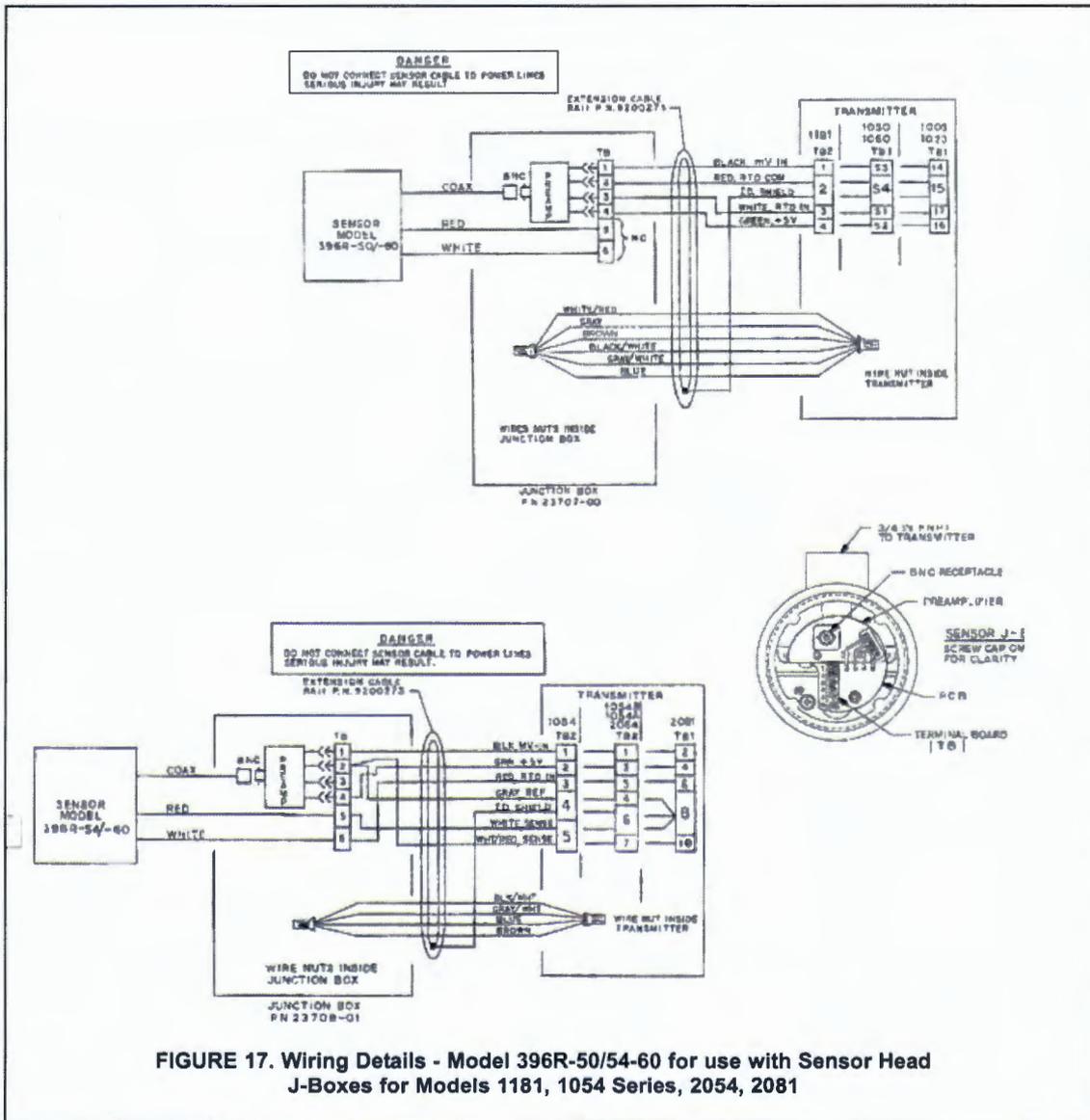


FIGURE 11. Wiring Details - Model 396R-50/54 for use with Model 1181 pH/ORP







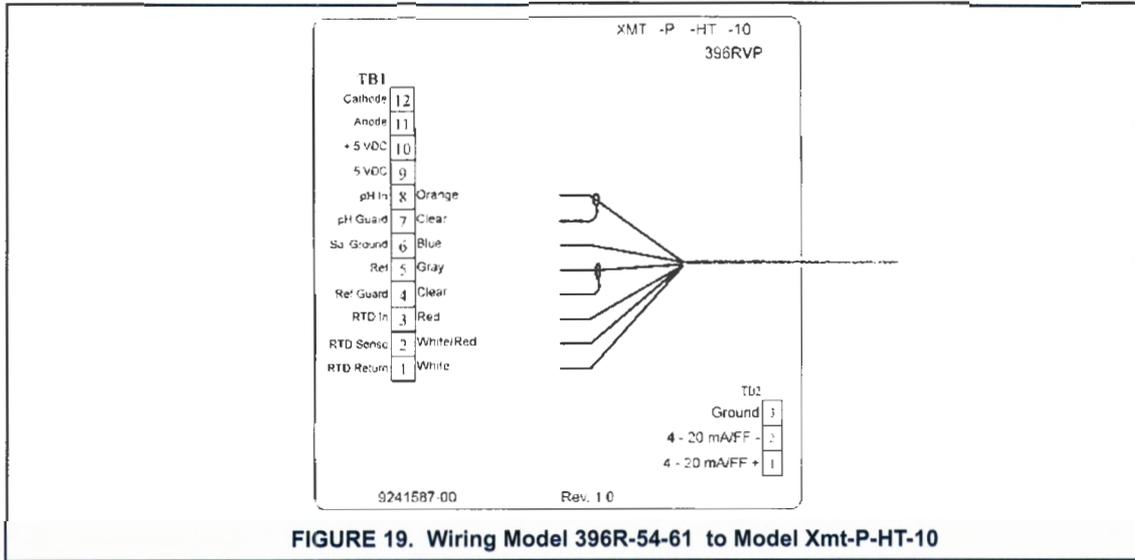


FIGURE 19. Wiring Model 396R-54-61 to Model Xmt-P-HT-10

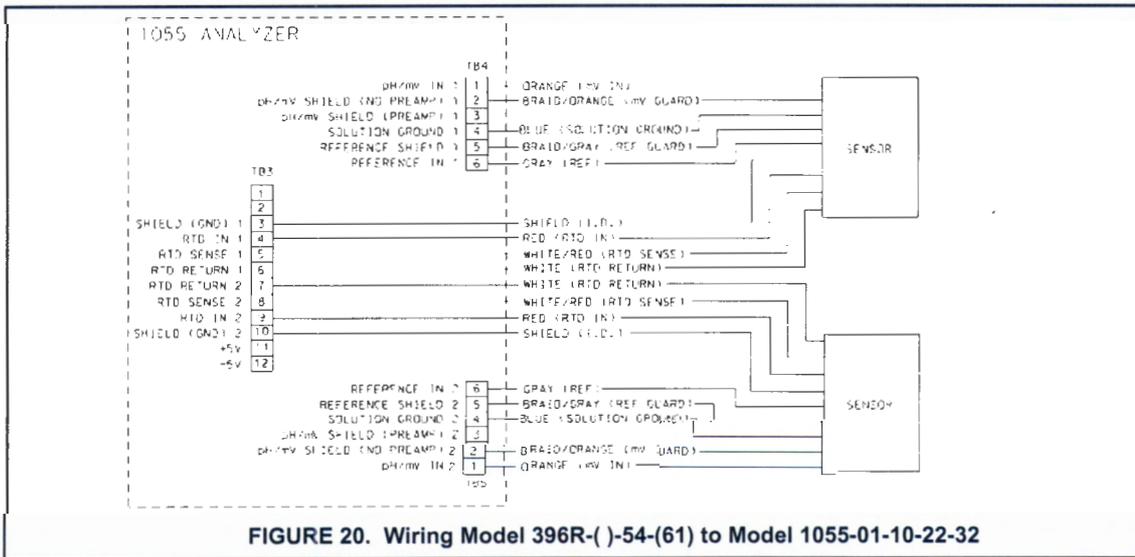


FIGURE 20. Wiring Model 396R-(-)54-(61) to Model 1055-01-10-22-32

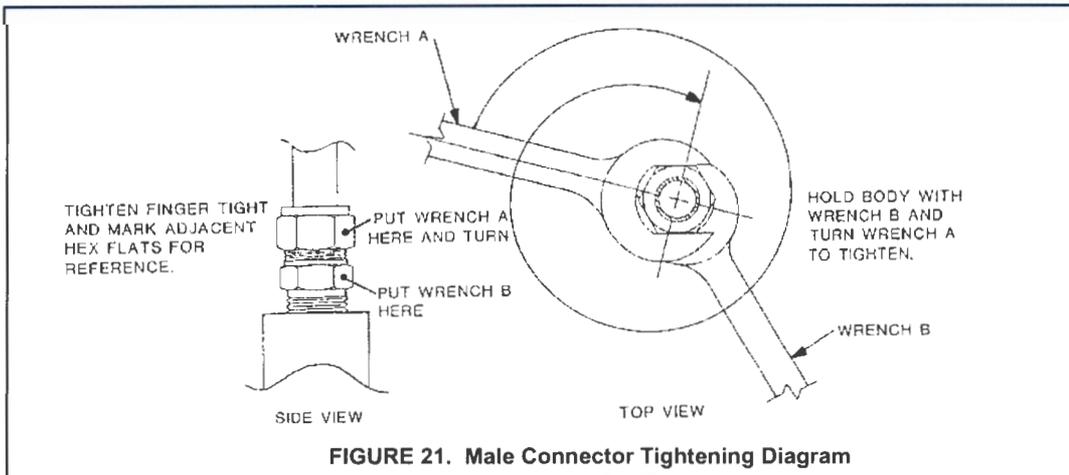


FIGURE 21. Male Connector Tightening Diagram

RETRACTION WITH KIT PN 23240-00

WARNING

System pressure may cause the sensor to blow out with great force unless care is taken during removal. Make sure the following steps are adhered to.



A. Model 396R-21 (21" tube)

1. Be certain system pressure at the sensor is below 64 psig (542 kPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figures 21 and 22. Push in on the sensor end or the top of the J-box and slowly loosen the hex nut (B) of the process end male connector (A).

B. Model 396R-25 (36" tube)

2. Be certain that pressure at the sensor is below 35 psig (343 KPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figures 21 and 22. Push in on the sensor end or the top of the J-box and slowly loosen the hex nut (B) of the process end male connector (A).

CAUTION

Do not remove nut at this time.

3. When the hex nut is loose enough, slowly ease the sensor back completely until the retraction stop collar is reached.

CAUTION

Failure to withdraw the sensor completely may result in damage to the sensor when the valve is closed.

4. Close the ball valve slowly. If there is resistance, the valve may be hitting the sensor. Double check that the sensor has been retracted to the retraction stop collar.

WARNING



Before removing the sensor from the ball valve, be absolutely certain that the ball valve is fully closed. Leakage from the male connector threads may indicate that the male connector is still under pressure. Leakage through a partially open valve could be hazardous, however with the ball valve closed, some residual process fluid may leak from the connector's pipe threads.

5. The Male Connector Body (A) may now be completely unthreaded from the reducing coupling and the sensor removed for servicing.

CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550099) in the male connector A.

6. For more detailed instructions, see electronic file 51-396R on the enclosed "Instruction Manuals" CD-rom.

NOTE

Information on Retraction Kit PN 23765-00 can be found in the electronic file 51-396R on the enclosed "Instruction Manuals" CD-rom.

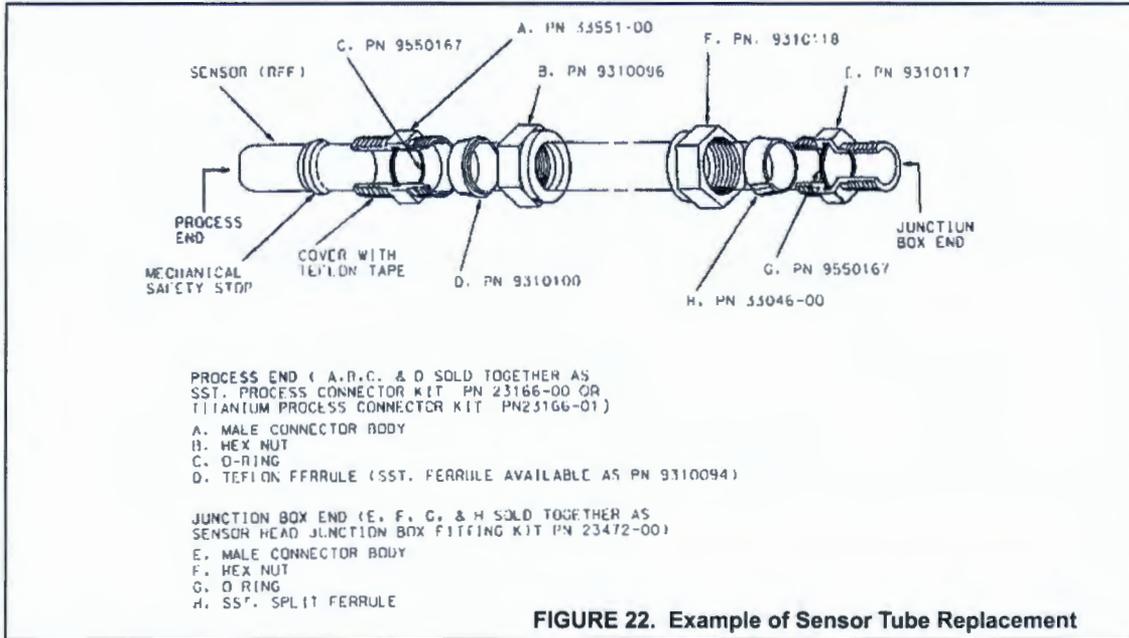


FIGURE 22. Example of Sensor Tube Replacement

Emerson Process Management

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Irvine, CA 92606 USA
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<http://www.raihome.com>

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Instruction Manual

PN 51-396R/rev.J
February 2011

Model 396R and 396RVP

TU_{pH} Retractable pH/ORP Sensors



ROSEMOUNT
Analytical


EMERSON
Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, telephone 1-800-654-7768 and the requested manual will be provided. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except while maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

DANGER

HAZARDOUS AREA INSTALLATION

Installations near flammable liquids or in hazardous area locations must be carefully evaluated by qualified on site safety personnel. This sensor is not Intrinsically Safe or Explosion Proof.

To secure and maintain an intrinsically safe installation, the certified safety barrier, transmitter, and sensor combination must be used. The installation system must comply with the governing approval agency (FM, CSA or BASEEFA/CENELEC) hazardous area classification requirements. Consult your analyzer/transmitter instruction manual for details.

Proper installation, operation and servicing of this sensor in a Hazardous Area Installation is entirely the responsibility of the user.

WARNING

RETRACTABLE SENSORS

Retractable sensors must not be inserted nor retracted when process pressures are in excess of 64 psig (542kPa) for option 21 or 35 psig (343 kPa) for option 25.

CAUTION

SENSOR/PROCESS APPLICATION COMPATIBILITY

The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.

ATEX DIRECTIVE

Special Conditions for safe use

1. All pH/ORP sensors have a plastic enclosure which must only be cleaned with a damp cloth to avoid the danger due to a build up of an electrostatic charge.
2. All pH/ORP sensor Models are intended to be in contact with the process fluid and may not meet the 500V r.m.s. a.c. test to earth. This must be taken into consideration at installation.

About This Document

This manual contains instructions for installation and operation of the Model 396R & 396RVP TU_pH Retractable pH/ORP Sensors. The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
A	1/96-1/01	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering.
B	7/02	Revised multiple drawings.
C	8/02	Added drawing #40105549, rev. D.
D	4/03	Revised drawing #40396R21/22 on page 18.
E	8/03	Added Silcore information.
F	9/04	Updated ordering info and added/revised wiring drawings.
G	1/05	Delete obsolete options.
H	1/07	Miscellaneous revisions.
I	11/10	Removed mention of patents and updated dnv logo.
J	2/11	Added ATEX directive and updated caution boxes per ANSI standard.

MODEL 396R pH/ORP

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MODEL 396R AND 396RVP RETRACTABLE pH/ORP SENSORS

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MODEL 396R pH/ORP

SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

SECTION 1.0 DESCRIPTION AND SPECIFICATIONS

1.1 FEATURES AND APPLICATIONS

The Model 396R and 396RVP Sensors are specifically designed for improved life in harsh, dirty applications where a separate sample stream is difficult to provide and greater insertion depths are required. Model 396R is designed for use with a 1-1/4 in. or 1-1/2 in. ball valve for hot tap installation. The Model 396R is constructed of molded polypropylene housed in a titanium tube with EPDM seals to provide maximum chemical resistance^{2,3}.

Model 396R also features a titanium solution ground for advanced sensor diagnostics when used with the Models 1055, Xmt-P, 54e, 81, 3081, or 5081 pH/ORP Analyzer/Transmitter. Advanced sensor diagnostics provide preventative maintenance by notifying the operator for replacement and cleaning of an aged or fouled sensor for continuous optimum performance.

The sensor also features a shrouded tip for protection from breakage while allowing process to flow by the glass electrode for accurate and reliable pH measurement.

The Model 396R is available without an integral preamplifier only and 15 ft or 9.5 in. of integral high quality 9 conductor cable. The preamplifier must be housed in a remote location or in a J-Box kit for attachment at the rear, cable end of the sensor (order separately) or integral to the Analyzer/

Transmitter. The Model 396R is compatible with all Rosemount Analytical and various other manufacturers instruments.

The entire line of TUpH model sensors now incorporate the new SILCORE¹ technology contaminant barrier. This triple-seal barrier prevents moisture and material impurities from migrating to the pH sensor's reference electrode's metal lead wire. By preventing these contaminants from compromising the integrity of the pH measurement, sensor life is increased, especially at higher temperatures where increased migrations occur. In addition, the SILCORE technology provides added protection against sensor failure due to vibrations and shock by transferring damaging energy away from the glass-to-metal seal.

Model 396RVP: Rosemount Analytical has recently released Model 396RVP. This model has identical performance and physical specifications to the Model 396R (see Section 1.2) with the following exception: the Model 396RVP has a Variopol (VP) connector on the back end of the sensor in place of a cable.

¹ Silcore is a trademark of Rosemount Analytical.

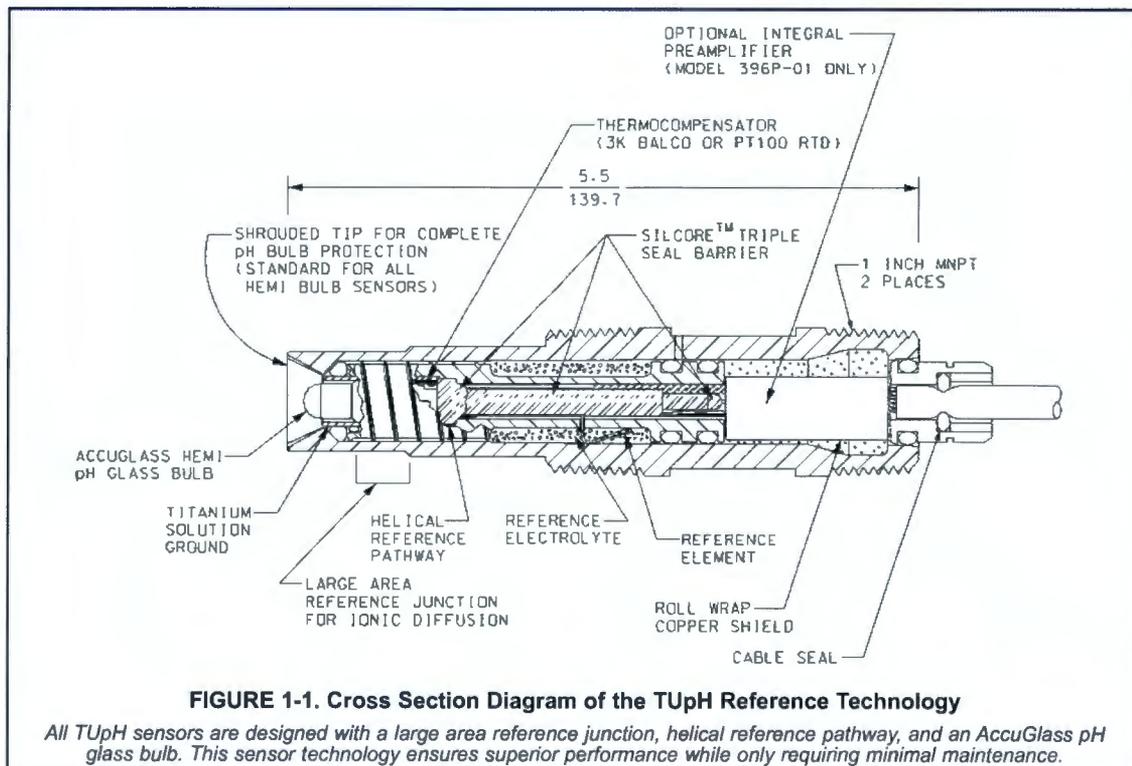


FIGURE 1-1. Cross Section Diagram of the TUpH Reference Technology

All TUpH sensors are designed with a large area reference junction, helical reference pathway, and an AccuGlass pH glass bulb. This sensor technology ensures superior performance while only requiring minimal maintenance.

MODEL 396R pH/ORP

SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

1.2 PERFORMANCE AND PHYSICAL SPECIFICATIONS

MODEL 396R

Measured Range:

ORP: -1500 to 1500mV
pH: 0 to 14

Percent Linearity Over pH Range:

	Hemi Bulb	Flat Bulb
0-2 pH	94%	93%
2-12 pH	99%	98%
12-13 pH	97%	95%
13-14 pH	92%	—

Wetted Materials: Polypropylene, EPDM, titanium, glass, (platinum: ORP only)

Process Connections: 1-1/2 or 1-1/4 in. with ball valve, 1 in. without ball valve

Cable: Integral 15 ft or 9.5 in. 9 conductor cable except option 60 (9.5 in. coaxial cable with BNC) Recommended Interconnect (PN 9200273)

Maximum Process Pressure and Temperature:

Hemi bulb: 150 psig (1136 kPa abs) at 212°F (100°C)

Flat bulb: 100 psig (790 kPa abs) at 212°F (100°C)

Maximum Pressure at Retraction or Insertion:

Code 21: 64 psig (542 kPa abs)

Code 25: 35 psig (343 kPa abs)

Minimum Conductivity: 100 µS/cm

Weight/Shipping Weight:

Sensor:

Code 21: 2.0 lb/3.0 lb (.9 kg/1.40 kg)

Code 25: 3.0 lb/4.0 lb (1.40 kg/1.80 kg)

Ball Valve:

PN 23240-00; 5 lb/7 lb (2.25 kg /3.20 kg)

PN 23634-00 8 lb/10 lb (3.65 kg/4.55 kg)

J-Box: 3 lb/4 lb (1.40 kg/1.80 kg)

MODEL 396RVP

Measured Range:

ORP: -1500 to 1500mV
pH: 0 to 14

Available pH glass types: GPLR hemi bulb or flat bulb

Wetted Materials: Polypropylene, EPDM, titanium, glass, (platinum: ORP only)

Process Connections: none, use 1-inch process connector or ball valve kit (1-1/2 inch or 1-1/4 inch)

Temperature Range: 0 to 100C (32 to 212F)

Pressure Range (hemi bulb): 100-1136 kPa abs (0-150 psig)

Pressure Range (flat bulb): 100-790 kPa abs (0-100 psig)

Maximum Pressure at Retraction or Insertion:

Code 21: 64 psig (542 kPa abs)

Code 25: 35 psig (343 kPa abs)

Minimum Conductivity: 75 µS/cm, nominal

Preamplifier options: remote

Weight/Shipping Weight:

Sensor: Code 21: 2.0 lb/ 3.0 lb (.9 kg/1.40 kg)

Code 25: 3.0 lb/4.0 lb (1.40 kg/1.80 kg)

Ball Valve: PN 23240-00; 5 lb/7 lb (2.25 kg /3.20 kg)

MODEL 396R pH/ORP

SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

1.3 ORDERING INFORMATION

The **Model 396R Sensor** is housed in a titanium tube, with a polypropylene reference junction and titanium solution ground for use with a ball valve (order separately) for hot tap applications. The sensor is available with either a hemi or flat glass pH electrode and features a shrouded glass/platinum electrode and PT100 or 3K temperature compensation. The 396R is available with 9.5 in. or 15 ft of integral cable. The 396R sensor is not available with a preamp. Junction box kits with preamps must be ordered separately if the analyzer/transmitter does not have an integral preamp within 15 ft. of the probe. Process connector and ball valve assemblies must also be ordered separately.

MODEL 396R TU _p H RETRACTABLE pH SENSOR	
CODE	MEASURING ELECTRODE TYPE (Required Selection)
10	GPLR hemi glass, General Purpose Low Resistivity
12	ORP
13	GPLR flat glass, General Purpose Low Resistivity
CODE	SENSOR LENGTH
21	21 in. Titanium Tube
25	36 in. Titanium Tube
CODE	ANALYZER/TC COMPATIBILITY (Required Selection)
50	For Models 1181 (3K TC)
54	For Models 1054B, 1055, 2081,54e, 81, 3081, 4081, 5081, Xmt, SCL-(P/Q), (PT 100 RTD)
CODE	OPTIONAL OPTIONS
60	9.5 in. Cable with BNC (for use with Model 1181, 1054 series, 2054, 2081 Sensor Head J-Boxes)
61	9.5 in. Cable no BNC (Not Valid w/Option 50) (for use with Model 54e, 1055, 81, 3081, 4081, 5081, Xmt Sensor Head J-Boxes)
396R - 10 - 21 - 54 EXAMPLE	

The **Model 396RVP ball valve retractable sensor** features a gel-filled electrolyte solution with the large area, coating resistant TU_pH polypropylene reference junction and a standard hemi or optional flat glass bulb. Model 396RVP is housed in a Titanium sensor tube and can be mounted directly into the process using a 1 in. MNPT threaded process connector and a ball valve assembly kit (both ordered separately). It is offered with the water-tight Variopool sensor-to-cable connector and uses the mating connector cable (ordered separately). Also available is a choice of temperature element, 3 K Balco or Pt 100 RTD. A remote preamplifier found in the analyzer/transmitter or in a junction box (ordered separately) must be used with this sensor for a reliable signal transmission.

MODEL 396RVP TU _p H RETRACTABLE pH/ORP SENSOR	
CODE	MEASURING ELECTRODE TYPE (Required Selection)
10	Hemi bulb, General Purpose Low Resistivity
12	ORP
13	Flat, GPLR glass
CODE	SENSOR LENGTH (Required Selection)
21	21 in. Titanium Tube
25	36 in. Titanium Tube
CODE	ANALYZER/TC COMPATIBILITY (Required Selection)
50	For Models 1181 (3K TC)
54	For Models 1054B, 1055, 2081,54e, 81, 3081, 4081, 5081, Xmt, SCL-(P/Q), (Pt 100 RTD)
396RVP - 10 - 21 - 54 EXAMPLE	

MODEL 396R pH/ORP

SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

TABLE 1-1. COMMONLY USED ACCESSORIES FOR MODEL 396R

<i>For first time installations, Rosemount Analytical recommends using the following guide</i>	
1. Retractable Mounting	
A. Choose one (required for all first time installations):	
PN 23166-00, 1 in. x 1 in. NPT process connector, 316 SST	
PN 23166-01, 1 in. x 1 in. NPT process connector, Titanium	
B. Choose one:	
PN 23240-00, 1-1/2 in. ball valve assembly, 316 SST	
PN 23765-00, 1-1/4 in. ball valve assembly, 316 SST	
2. Junction Boxes (Optional; Choose either Sensor Head or Remote)	
A. Sensor Head Junction Boxes (used with options -60 or -61 sensor) - Choose one:	
PN 23709-00; includes preamplifier for Models 54e, 81, 3081, 4081, 5081, Xmt, 1055	
PN 23708-01; includes preamplifier for Models 1054 series, 2054, 2081	
PN 23707-00; includes preamplifier for Model 1181	
B. Remote Junction Boxes (used with standard 15 ft. cable length sensor) - Choose one:	
PN 23555-00; includes preamplifier for Models 54e, 81, 3081, 4081, 5081, Xmt, 1055	
PN 23309-03; includes preamplifier for Model 1181	
PN 23309-04; includes preamplifier for Models 1054 series, 2054, 2081	
3. BNC Adapter - Choose one:	
PN 9120516, BNC Adapter for use with remote junction boxes PN's 23309-03 and 23309-04	
Order option -60 (standard with BNC connector) for PN 23707-00 or 23708-01 sensor head junction boxes	
4. Extension Cables - Choose one:	
PN 23646-01, 11 conductor, shielded, prepped	
PN 9200273, 11 conductor, shielded, unprepped	

TABLE 1-2. OTHER ACCESSORIES FOR MODEL 396R

PART	DESCRIPTION
22698-00	Preamplifier plug-in for J-box, for Model 1003.
22698-02	Preamplifier plug-in for J-box, for Models 1181/1050
22698-03	Preamplifier plug-in for J-box, for Models 1054A/B, 2054, 2081
23550-00	Remote Junction box with extension board
9550167	O-ring, 2-214, EPDM for process connector
9210012	Buffer solution, 4.01 pH, 16 oz
9210013	Buffer solution, 6.86 pH, 16 oz
9210014	Buffer solution, 9.18 pH, 16 oz
22743-01	Pt100 preamp for Model 1181
22744-01	3K Preamp for Model 1181
23557-00	Preamplifier for junction box for Models 1055, 54e, 81, 3081, 4081, 5081, Xmt

MODEL 396R pH/ORP

SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

TABLE 1-3. COMMONLY USED ACCESSORIES FOR MODEL 396RVP

FOR FIRST TIME 396RVP AND 398RVP INSTALLATIONS, ROSEMOUNT ANALYTICAL RECOMMENDS USING THE FOLLOWING GUIDE:

1. Variopool Cable (required for all first time installations)	
Choose one: PN 23645-06, 15 ft cable with mating VP connector, prepped with BNC on analyzer end	
PN 23645-07, 15 ft cable with mating VP connector, prepped without BNC on analyzer end*	
2. Retractable Mounting	
1A. Choose one (required for all first time installations, except as noted):	
PN 23166-00 1 in. x 1 in. NPT process connector, 316 SST	
PN 23166-01 1 in. x 1 in. NPT process connector, Titanium	
Choose one (optional process connector o-rings):	
PN 9550220, Kalrez [®] o-ring, 2-214	
PN 9550099, Viton [®] o-ring, 2-214	
1B. Choose one:	
PN 23240-00 1-1/2 in. ball valve assembly, 316 SST	
PN 23765-00 1-1/4 in. ball valve assembly, 316 SST (process connector not needed)	
3. Remote Junction Boxes (Optional)	
Choose one: PN 23555-00 includes preamplifier for Models 54e, 81, 3081, 4081, 1055, 5081, Xmt	
PN 23309-03 and PN 22698-02 plug-in preamplifier for Model 1181 Analyzer	
PN 23309-04 and PN 22698-03 plug-in preamplifier for Models 1054 series and 2081 Analyzers	
4. Extension cables	
Choose one: PN 23646-01, 11 conductor, shielded, prepped	
PN 9200273, 11 conductor, shielded, unprepped	

* Used for connections to Models 1181, 2081, 54e, 81, 3081, 4081, 5081, Xmt, 1055, and remote junction box PN 23555-00.

² kalrez and Viton are registered trademarks of DuPont Performance Elastomers.

TABLE 1-4. OTHER ACCESSORIES FOR MODEL 396RVP

PART	DESCRIPTION
22698-00	Preamplifier plug-in for junction box, for Model 1003
22698-02	Preamplifier plug-in for junction box, for Models 1181, 1050
22698-03	Preamplifier plug-in for junction box, for Models 1054B, 2081
22743-01	Pt100 preamplifier for Model 1181
22744-01	3K Preamplifier for Model 1181
23557-00	Preamplifier for junction box for Models 54e, 81, 3081, 4081, 5081, Xmt, 1055
33046-00	Ferrule, 1 in., split 316SS
9310096	Nut, swage, 1 in. 316SST
9210012	Buffer solution, 4.01 pH, 16 oz
9210013	Buffer solution, 6.86 pH, 16 oz
9210014	Buffer solution, 9.18 pH, 16oz
R508-80Z	ORP solution, 460 mv ± 10 at 20°C
9550167	EPDM O-ring for Process Connector (PN 23166-00 or 23166-01)
12707-00	Jet Spray Cleaner

MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION

SECTION 2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION. Inspect the outside of the carton for any damage. If damage is detected, contact the carrier immediately. Inspect the instrument and hardware. Make sure all items in the packing list are present and in good condition. Notify the factory if any part is missing.

NOTE

If the sensor is to be stored, the protective boot should be filled with either KCl electrolyte solution or pH 4.0 buffer solution and replaced on sensor tip until ready to use.

NOTE

Save the original packing cartons and materials as most carriers require proof of damage due to mishandling, etc. Also, if it is necessary to return the instrument to the factory, you must pack the instrument in the same manner as it was received. Refer to Section 8.0 for instructions.

WARNING

Glass electrode must be wetted at all times (in storage and in line) to maximize sensor life.

2.2 MECHANICAL INSTALLATION. The Model 396R Sensor may be installed through a weldolet or in a pipe tee or "Y", as shown in Figure 2-1, when used with a ball valve. Insert the end of the sensor to a depth sufficient to ensure that the glass bulb is continuously wetted by the process fluid. The Model 396R can also be inserted directly into the process without the use of a ball valve for applications not requiring continuous operation during sensor maintenance.

CAUTION

Allow sufficient room for safe retraction and insertion of the sensor. Personnel should have room for stable footing while performing removal or insertion of the sensor.

The sensor must be mounted within 10-90 degrees of the horizontal with the tip pointed downward, thus keeping air bubbles off of the pH sensitive glass bulb. Bubbles settled on the glass bulb disrupt the electrical continuity between the pH sensitive glass and the silver/silver chloride measuring element.

If the retraction version is to be installed without a ball valve follow the installation procedure for insertion service (Section 2.2.2). Perform the following steps for sensor installation through a ball valve:

2.2.1 INSTALLATION THROUGH BALL VALVE.

1. Carefully remove the liquid filled rubber boot which protects the glass electrode and keeps the liquid junction wet during shipping and storage. Discard the liquid and boot. Make sure the lubricated O-ring is in place in the groove inside the male connector on the sensor body.

CAUTION

Buffer solution, in the protective boot, may cause skin or eye irritation.

2. With the male connector on the sensor's body, insert the sensor into the ball valve until it gently touches the closed valve. The molded electrode guard will protect the glass bulb from breakage.
3. Thread the male connector body tightly into the ball valve assembly. **DO NOT** tighten the hex nut on the male connector body; doing so would not allow the sensor to be inserted through the ball valve.
4. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free of the ball valve assembly. The built-in retraction stop will butt against the shoulder of the male connector if properly installed.

CAUTION

The sensor must be captured by the valve assembly and the male connector so that it cannot be blown free by process pressure if mishandled during insertion or retraction.

5. After confirming that the sensor assembly is properly secured by the valve assembly, the valve may be opened and the sensor positioned into the process at the desired depth and orientation.

MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION

6. While holding the sensor in position, tighten the hex nut of the male connector to firmly secure the sensor in place. When the hex nut is tightened, the Teflon ferrule inside the compression fitting clamps the sensor tube.

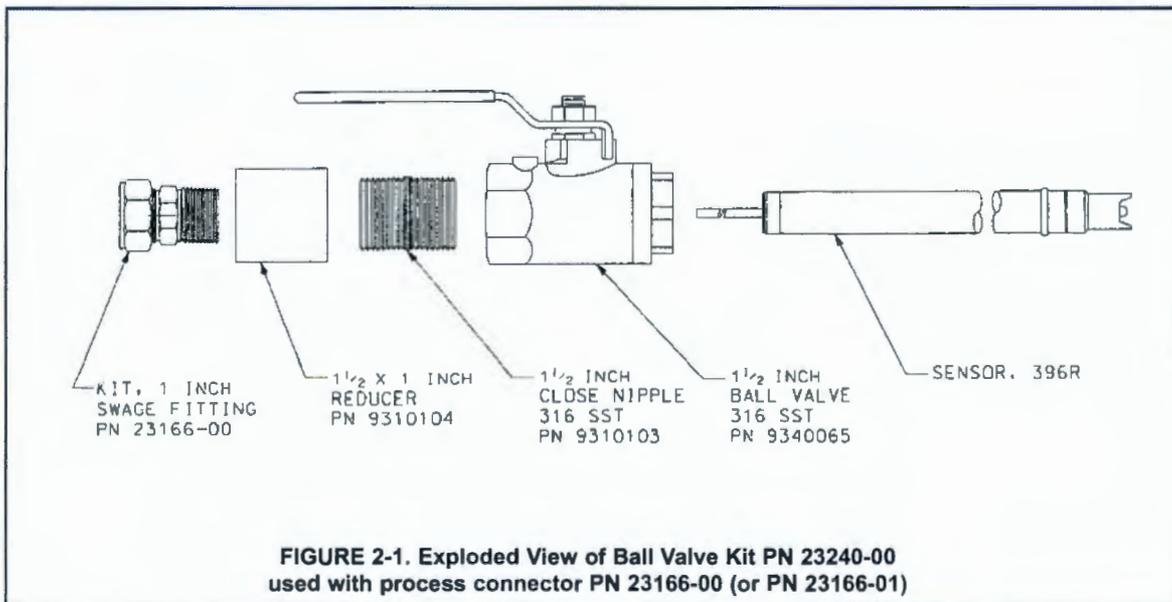
2.2.2 INSTALLATION WITHOUT A BALL VALVE. The Model 396R Sensor may be installed through a weldolet or pipe tee or "Y" when used with a process connector (PN 23166-00 or 23166-01). The sensor should be installed within 80° of vertical, with the electrode facing down.

CAUTION

Over tightening the hex nut may damage the ferrule.

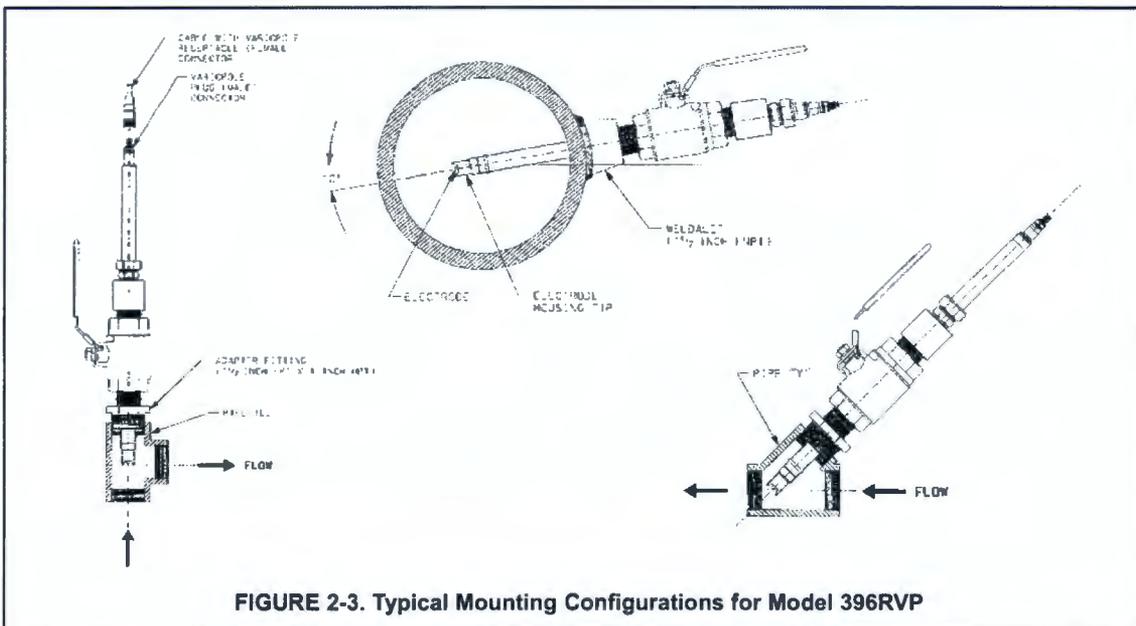
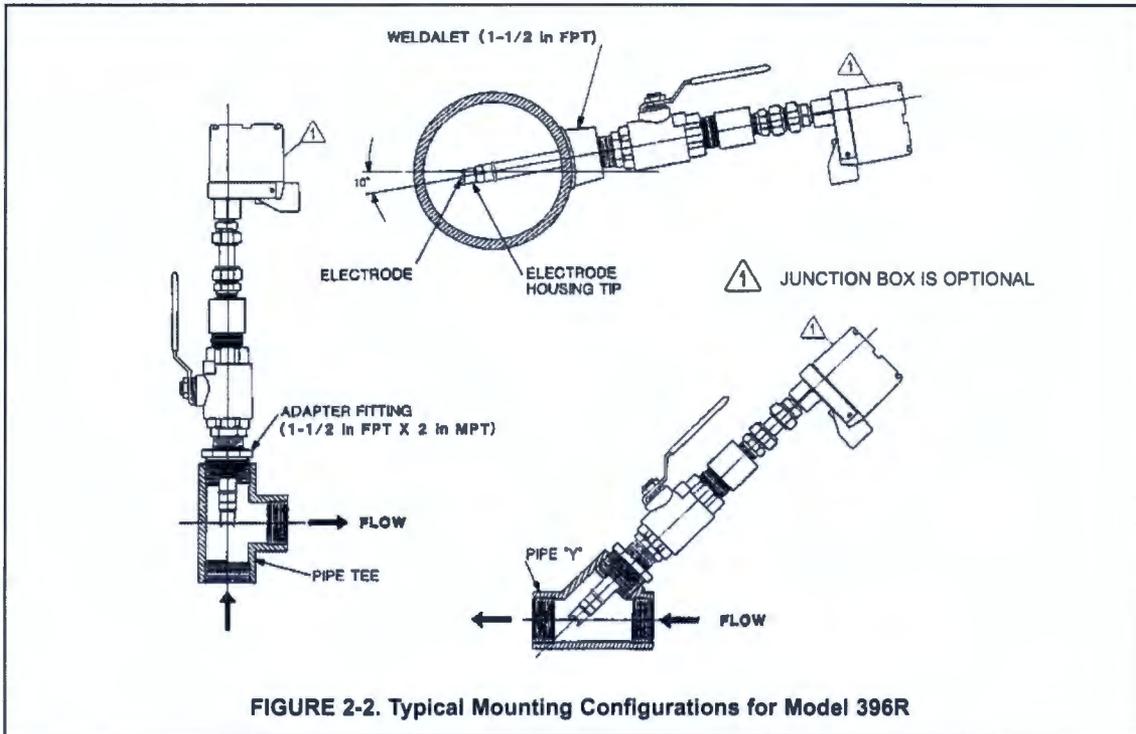
NOTE

A stainless steel ferrule is available if the Teflon ferrule does not inadequately grip. When using the metallic ferrule, care must be taken to avoid over tightening and damaging the sensor tube. If the male connector leaks during insertion or retraction, replace the O-ring in the male connector.



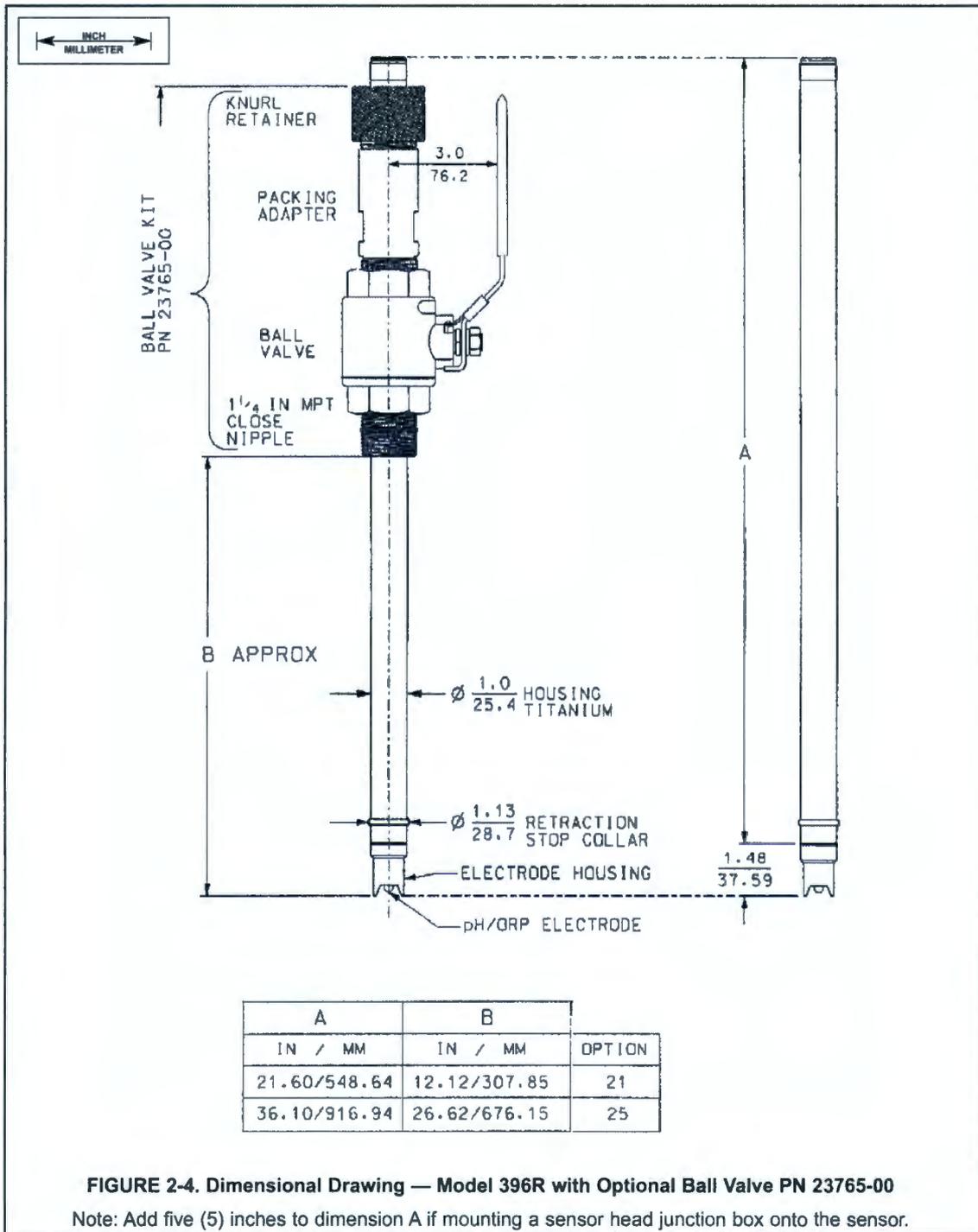
MODEL 396R pH/ORP

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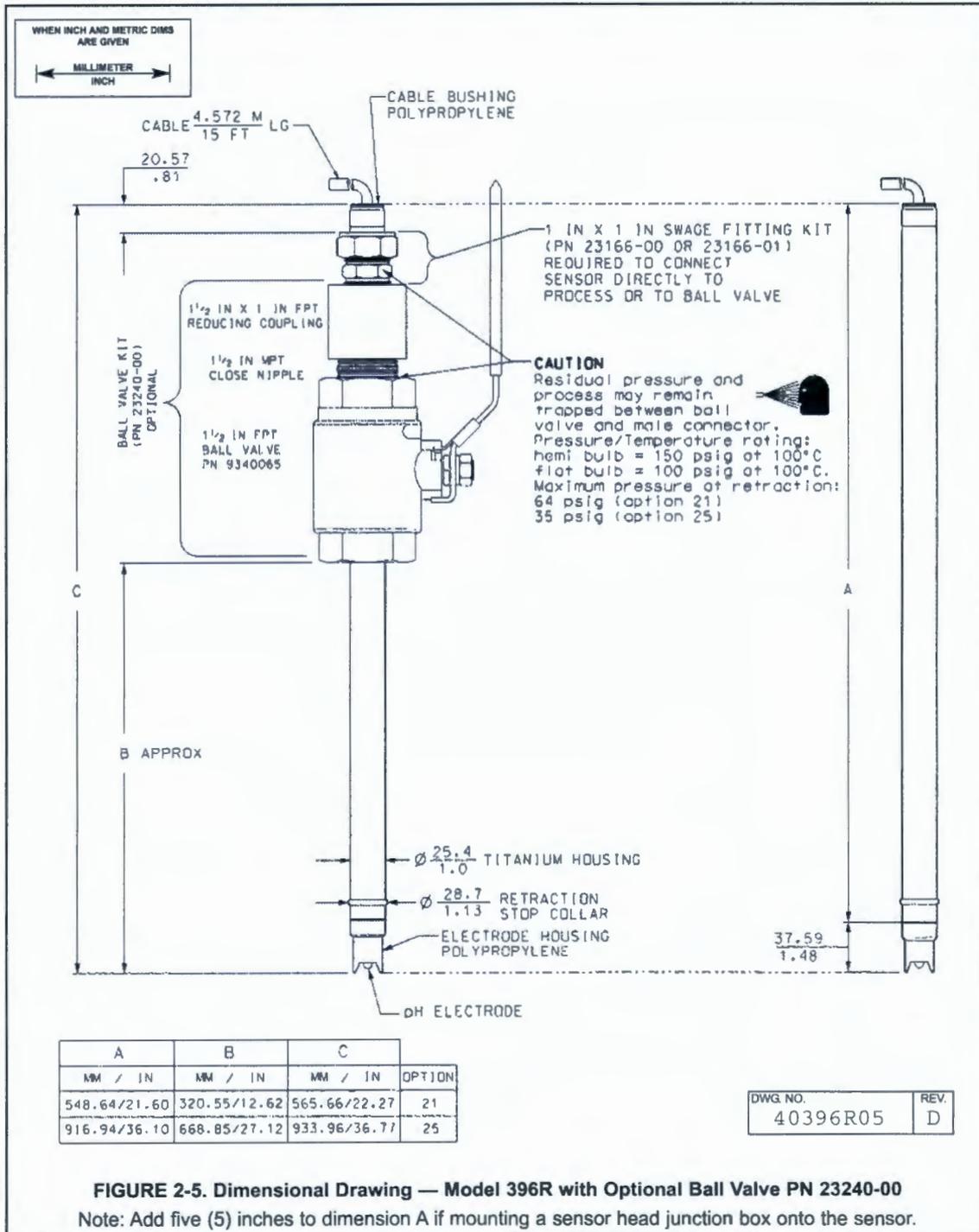
MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION



MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION



MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION

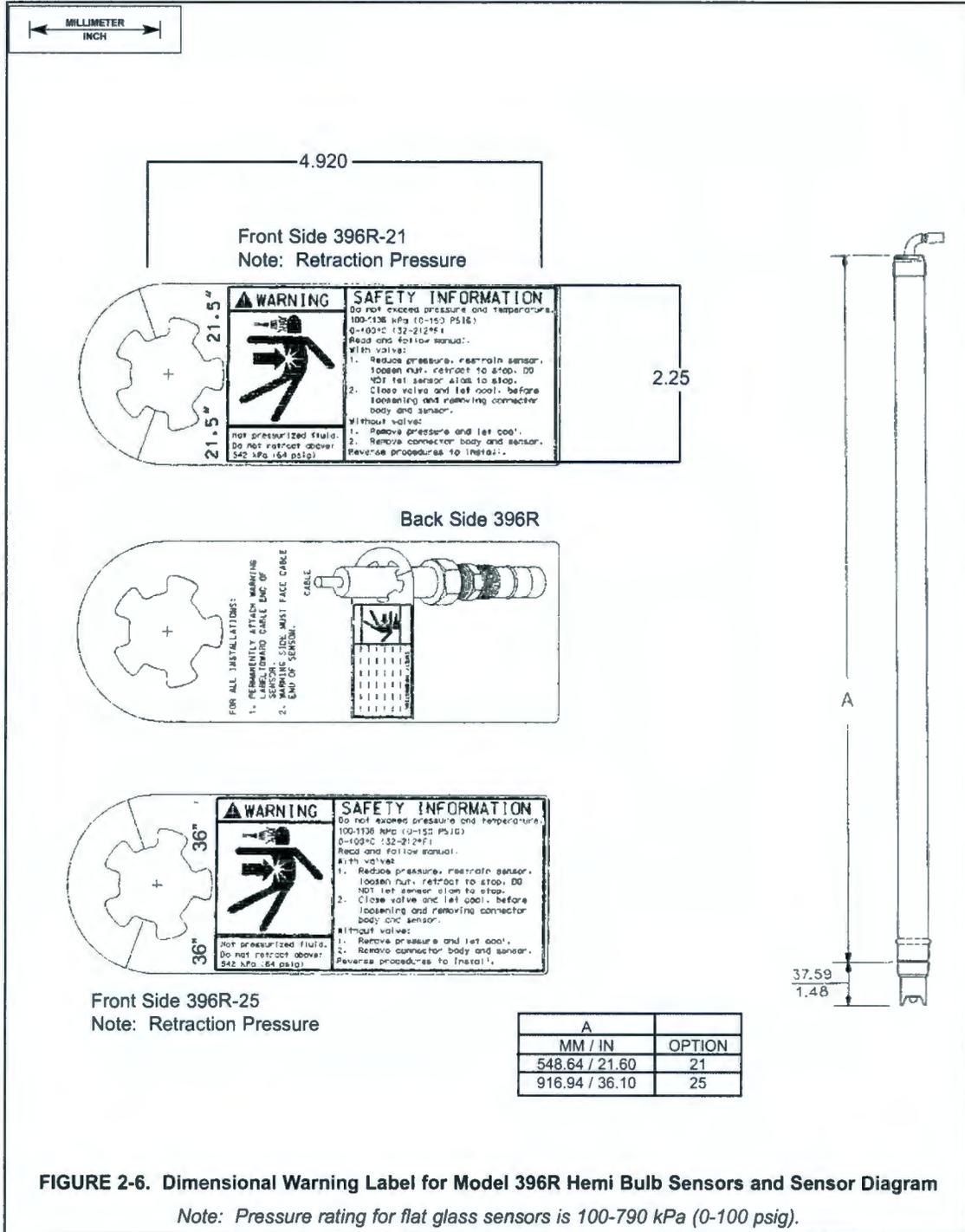
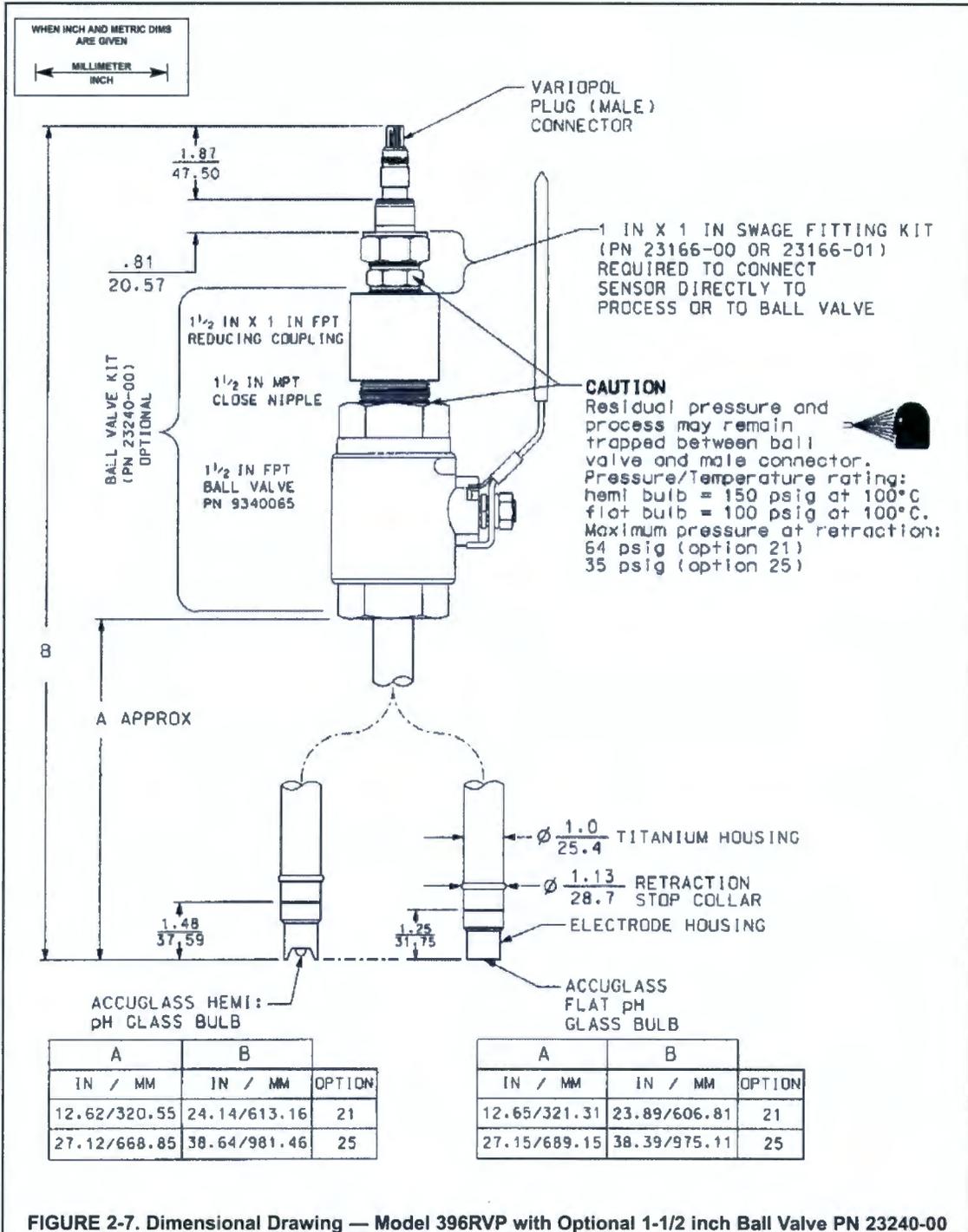


FIGURE 2-6. Dimensional Warning Label for Model 396R Hemi Bulb Sensors and Sensor Diagram
Note: Pressure rating for flat glass sensors is 100-790 kPa (0-100 psig).

MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION



MODEL 396R pH/ORP

SECTION 2.0
INSTALLATION

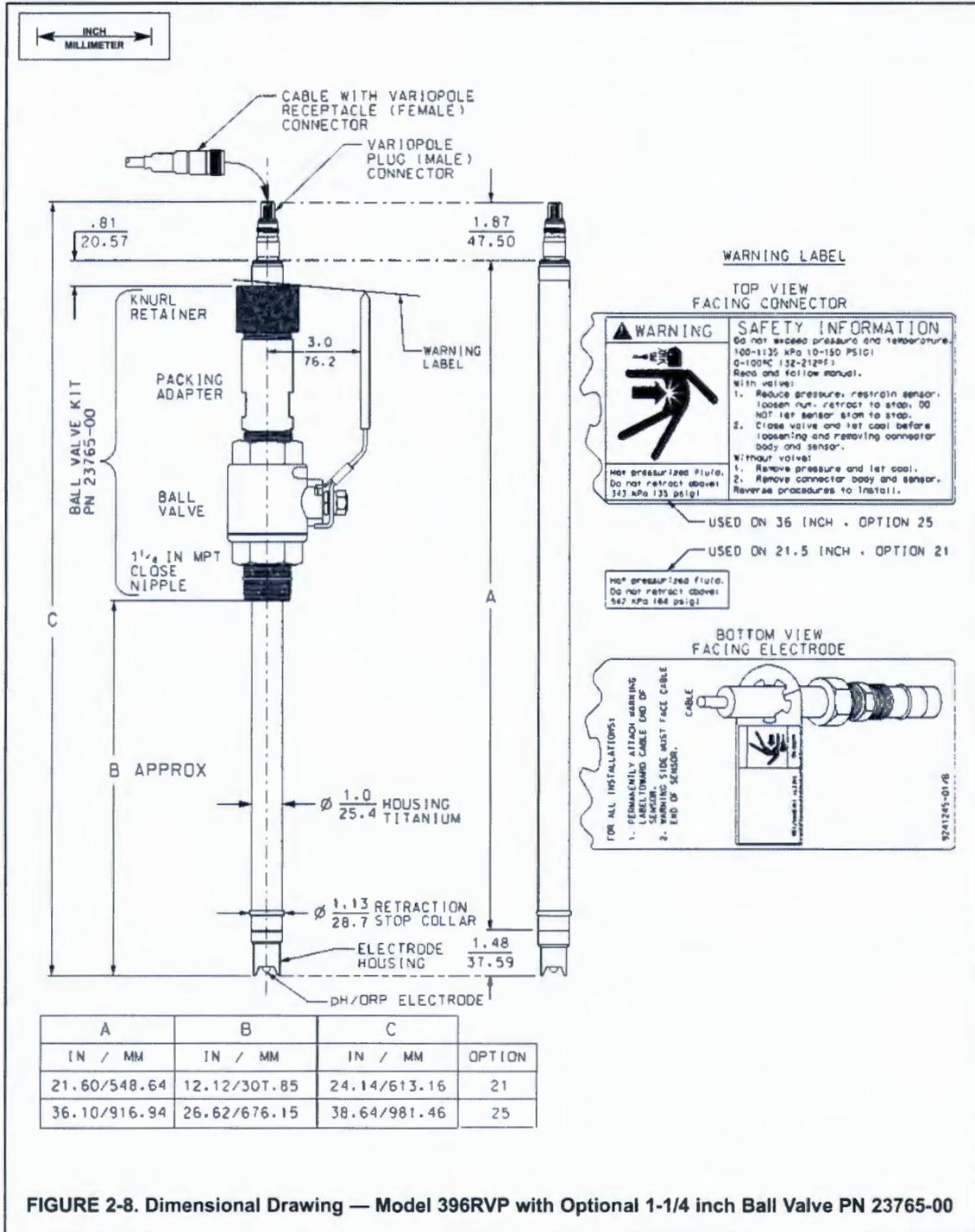


FIGURE 2-8. Dimensional Drawing — Model 396RVP with Optional 1-1/4 inch Ball Valve PN 23765-00

MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R

SECTION 3.0 WIRING MODEL 396R

WIRING MODEL 396R.

Make electrical connections as shown on Figures 3-1 through 3-15 using the following guidelines. For wiring Model 396RVP, see Section 4.0.

1. Pay particular attention to the analyzer or transmitter model number when following details on the wiring diagrams to ensure that the connections are made to the proper terminals.
2. Use Rosemount custom cable Part Number 9200273 for interconnect.
3. The maximum distance from the sensor to the analyzer is 15 ft without an integral preamplifier.

4. Signal cable should be run in a dedicated conduit and should be kept away from AC power lines.

NOTE

For maximum EMI/RFI protection when wiring from the sensor to the junction box, the outer braid of the sensor should be connected to the outer braided shield of the extension cable. The outer braid of the extension cable to the instrument must be terminated at earth ground or by using an appropriate metal cable gland fitting, that provides a secure connection to the instrument cable.

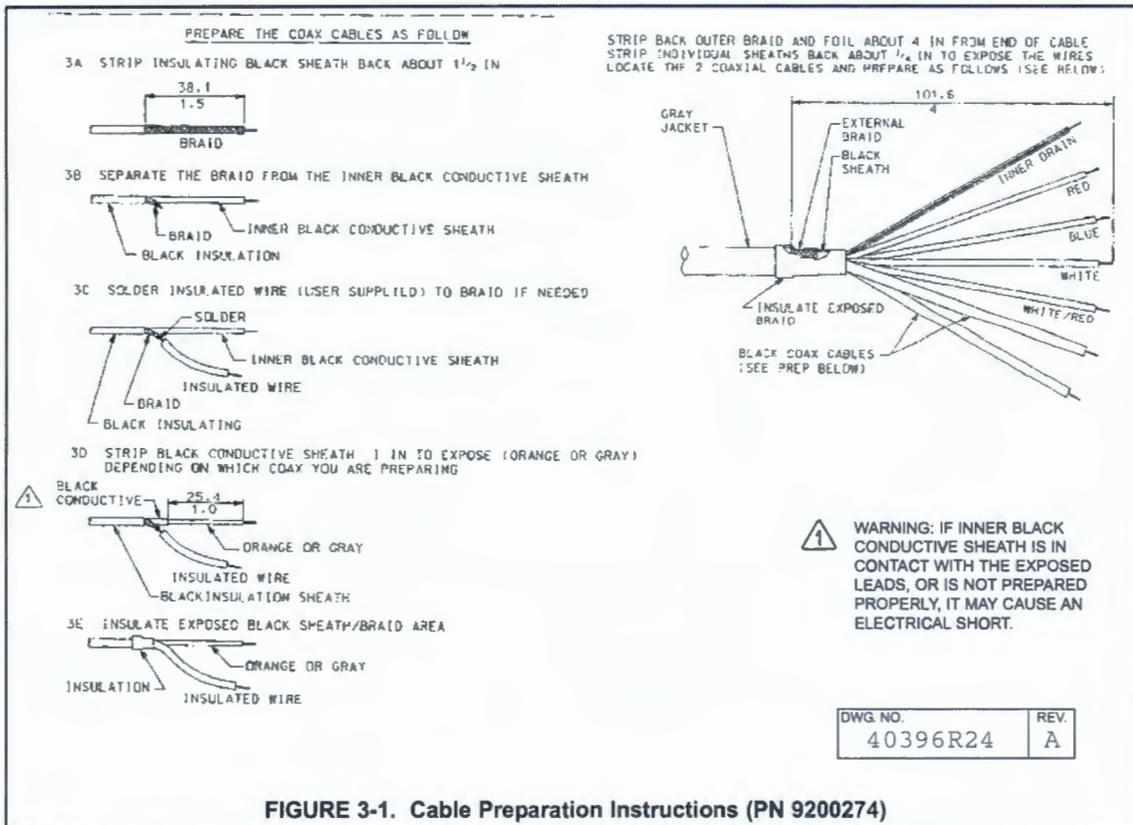


FIGURE 3-1. Cable Preparation Instructions (PN 9200274)

MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R

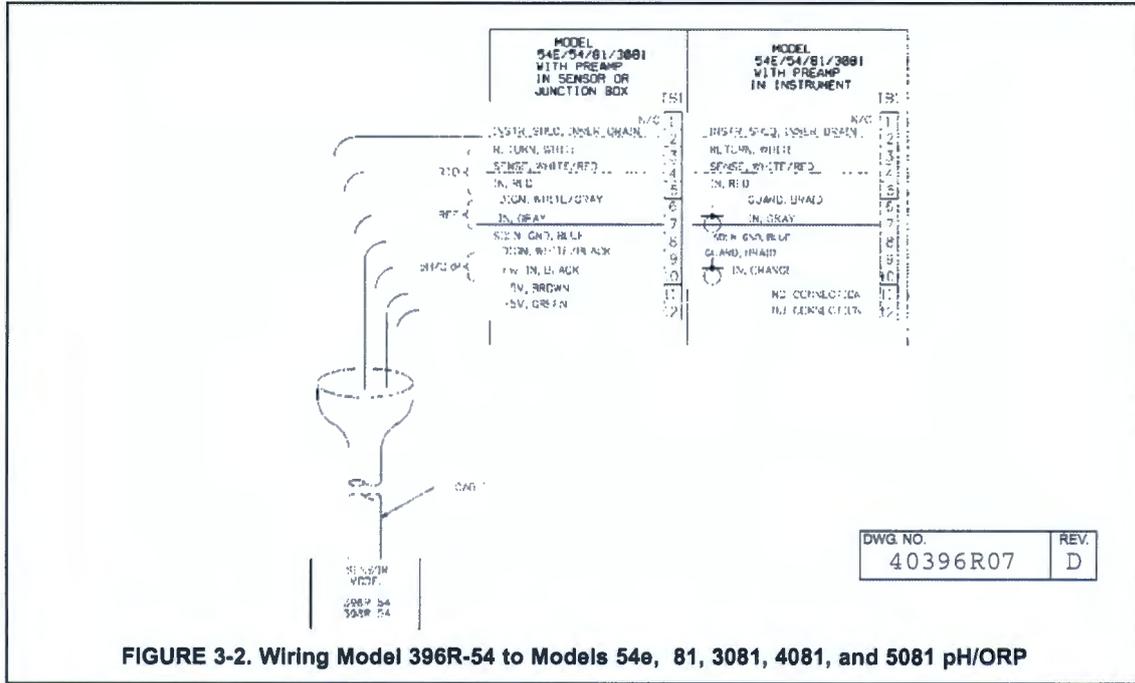


FIGURE 3-2. Wiring Model 396R-54 to Models 54e, 81, 3081, 4081, and 5081 pH/ORP

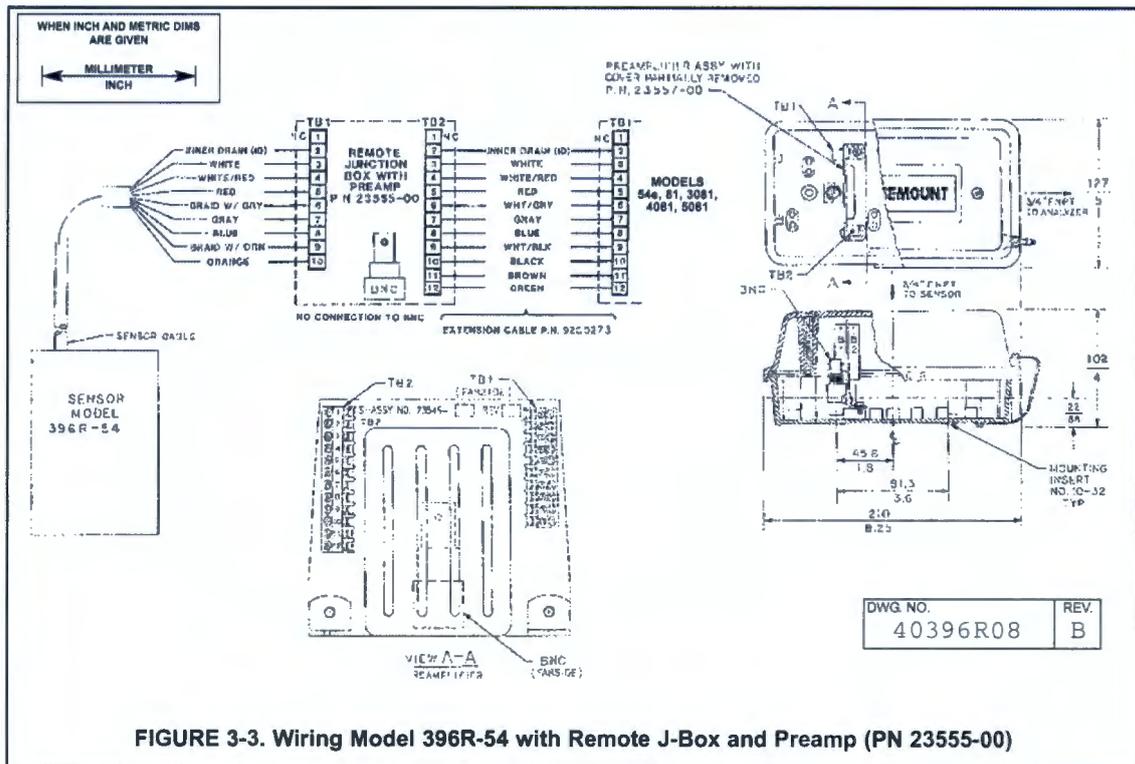
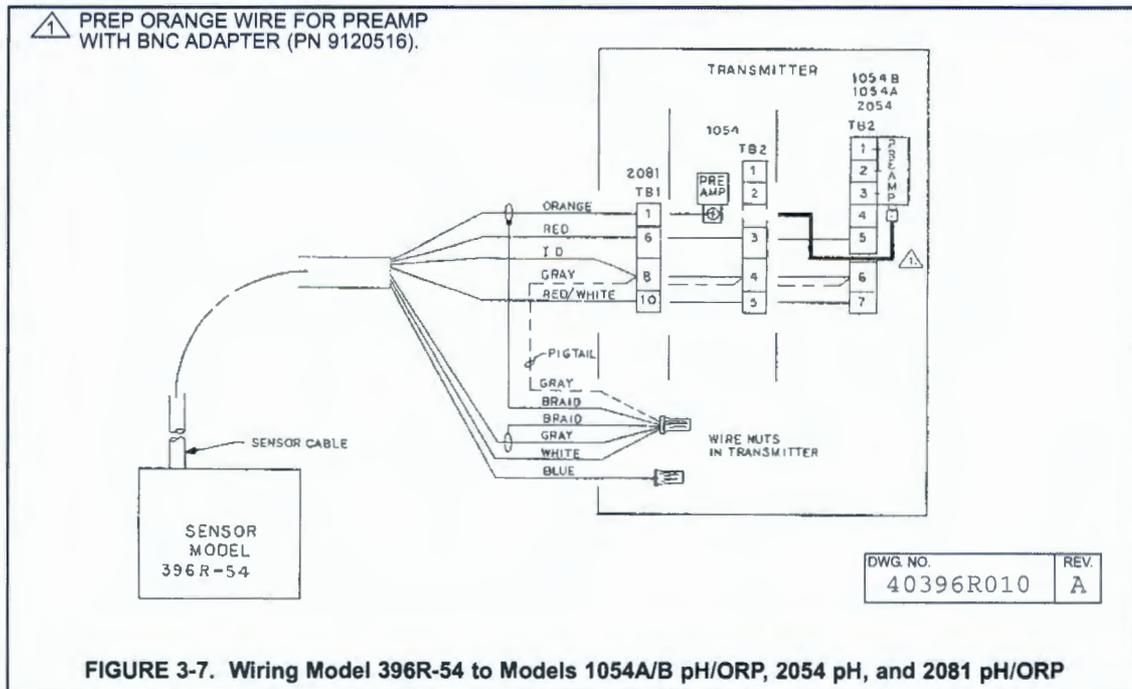
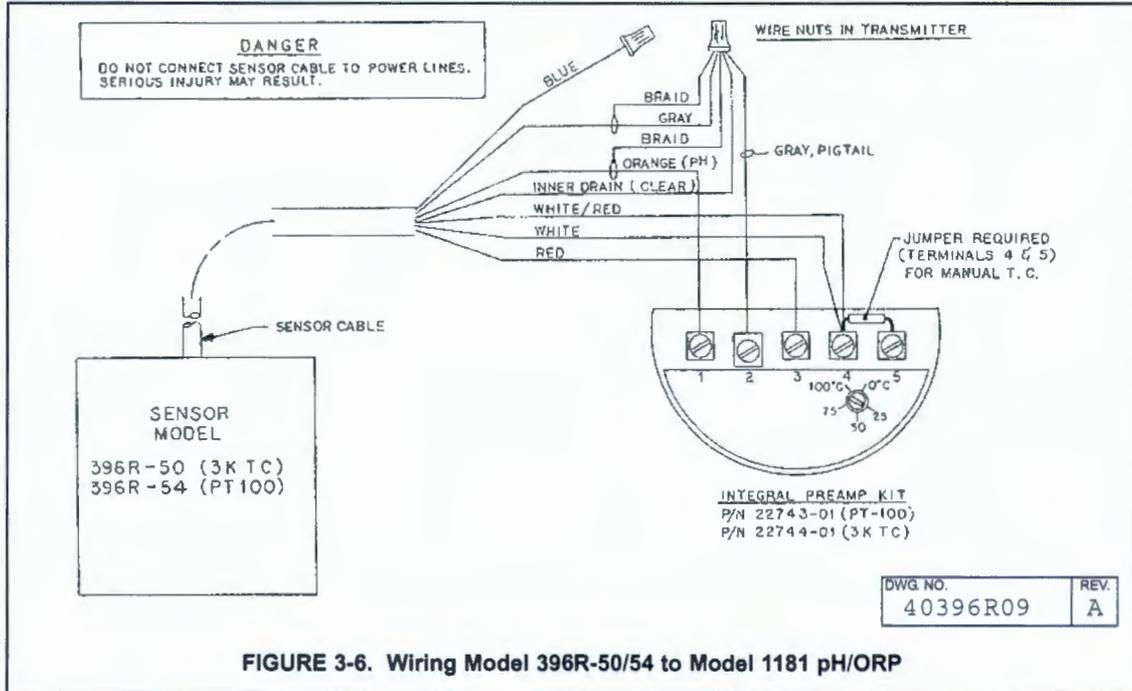


FIGURE 3-3. Wiring Model 396R-54 with Remote J-Box and Preamp (PN 23555-00)

MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R



MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R

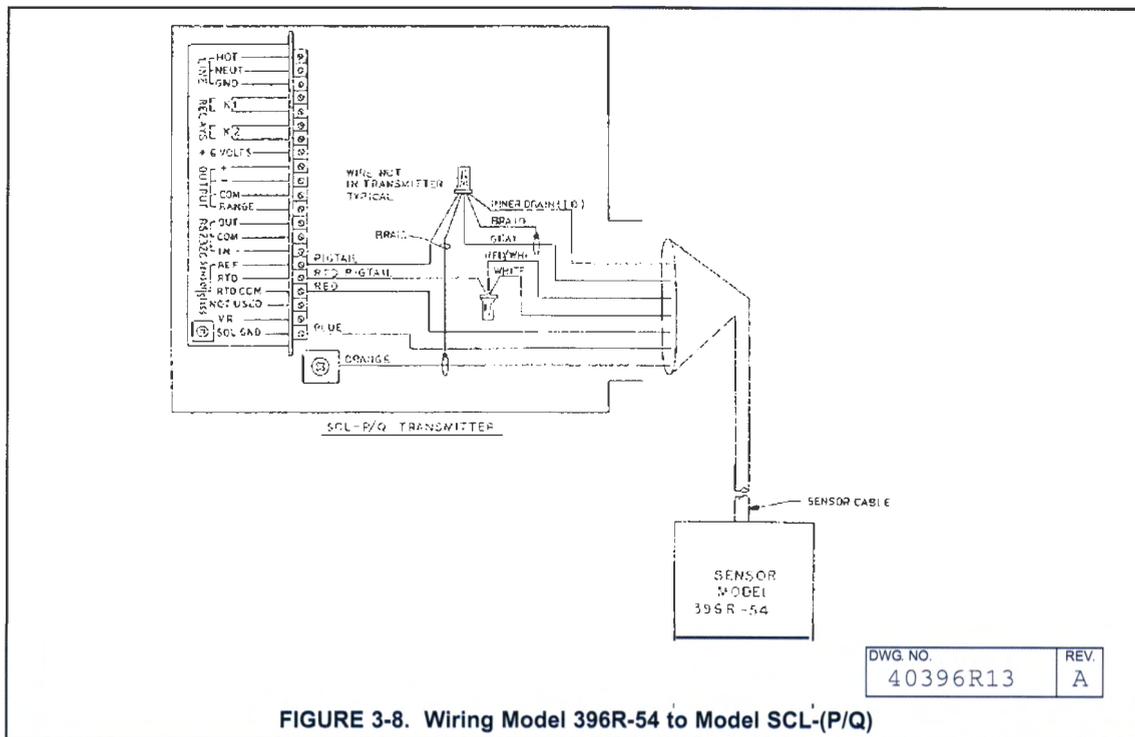


FIGURE 3-8. Wiring Model 396R-54 to Model SCL-(P/Q)

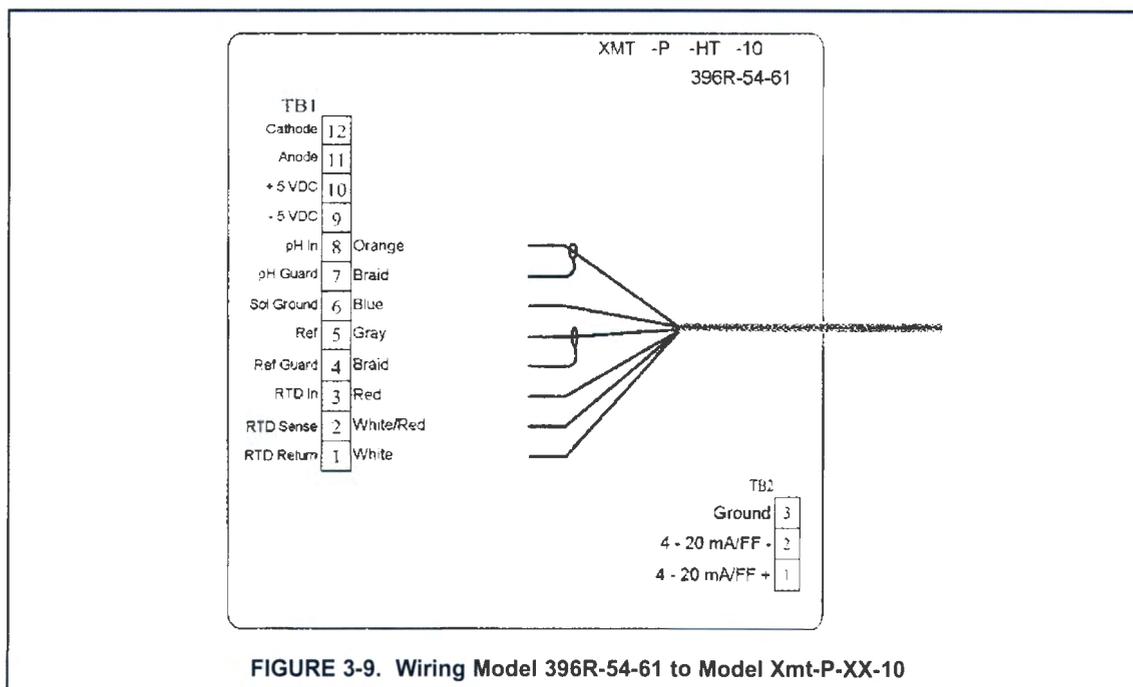


FIGURE 3-9. Wiring Model 396R-54-61 to Model Xmt-P-XX-10

MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R

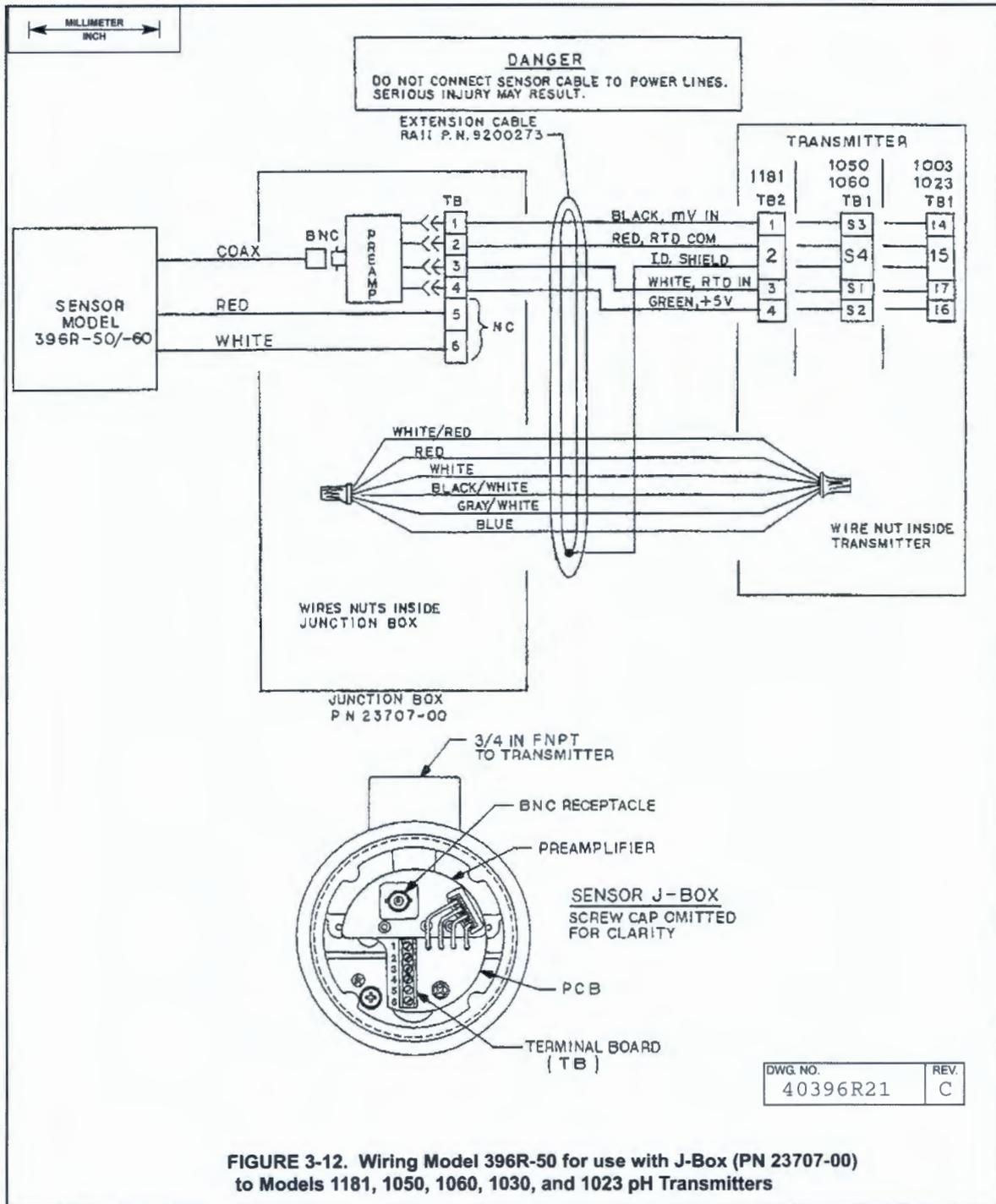
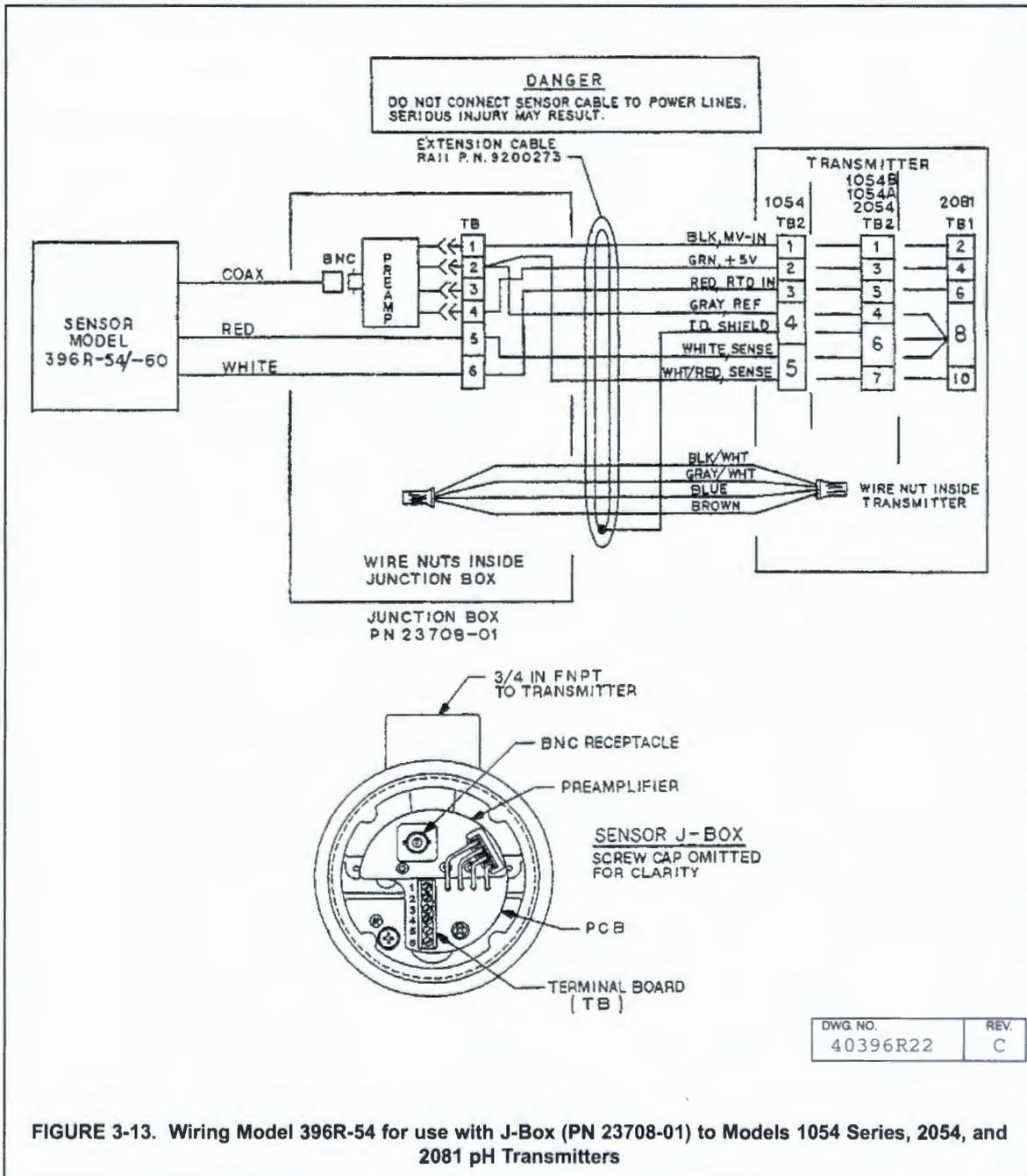


FIGURE 3-12. Wiring Model 396R-50 for use with J-Box (PN 23707-00) to Models 1181, 1050, 1060, 1030, and 1023 pH Transmitters

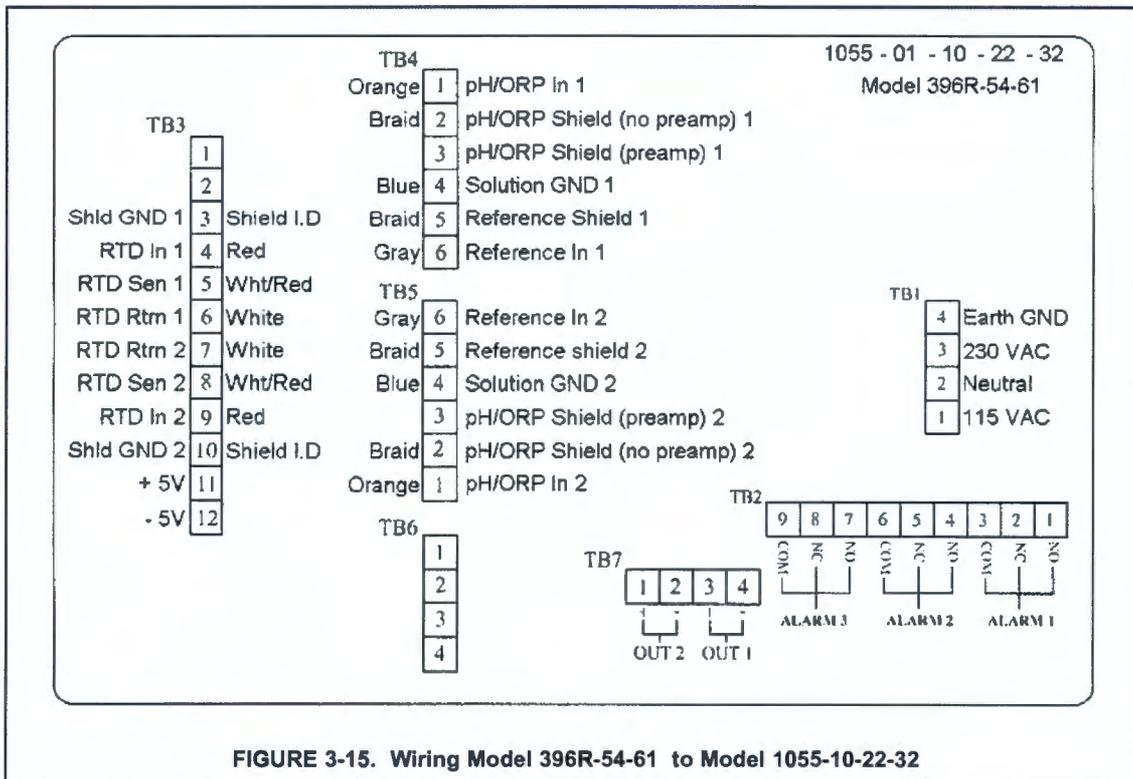
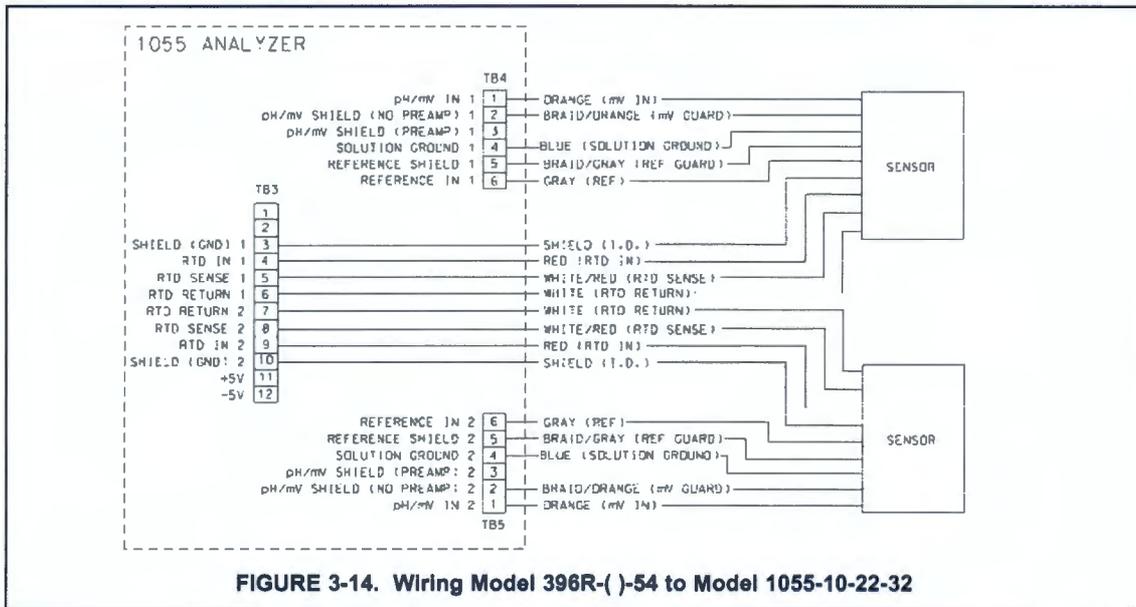
MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R



MODEL 396R pH/ORP

SECTION 3.0
WIRING MODEL 396R



MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP

SECTION 4.0 WIRING MODEL 396RVP

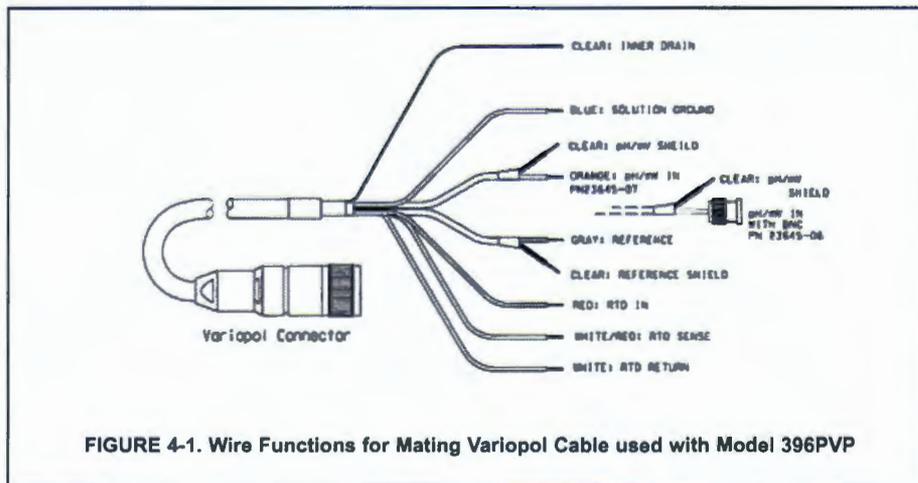
WIRING MODEL 396RVP.

Make electrical connections as shown on Figures 4-1 through 4-21 using the following guidelines. For wiring Model 396R, see Section 3.0.

1. Pay particular attention to the analyzer or transmitter model number when following details on the wiring diagrams to ensure that the connections are made to the proper terminals.
2. The Model 396RVP uses a mating VP cable. The cable part numbers are 23645-06 and 23645-07. See attached wiring sheet for wire functions of the cables and wiring diagrams to various analyzers.
3. The maximum distance from the sensor to the analyzer is 15 ft without an integral preamplifier.
4. Signal cable should be run in a dedicated conduit and should be kept away from AC power lines.

NOTE

For maximum EMI/RFI protection when wiring from the sensor to the junction box, the outer braid of the sensor should be connected to the outer braided shield of the extension cable. The outer braid of the extension cable to the instrument must be terminated at earth ground or by using an appropriate metal cable gland fitting, that provides a secure connection to the instrument cable.



MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP

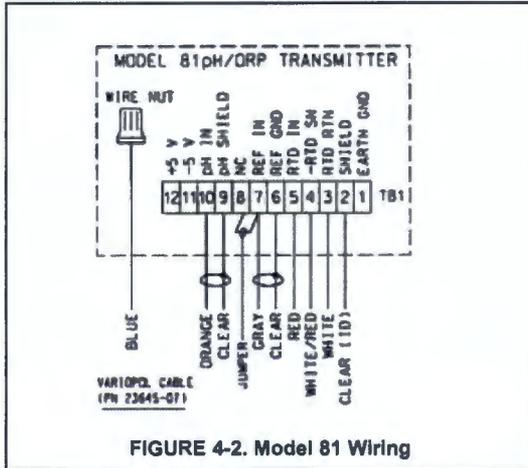


FIGURE 4-2. Model 81 Wiring

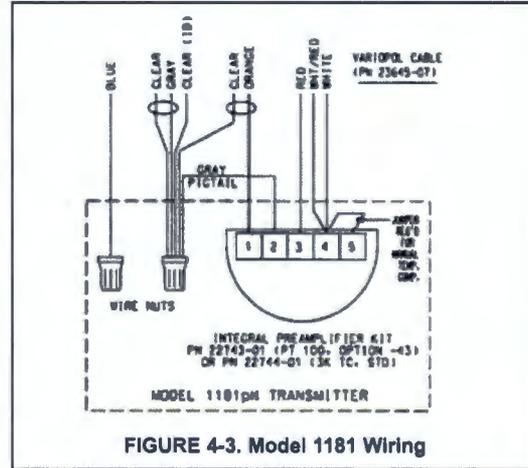


FIGURE 4-3. Model 1181 Wiring

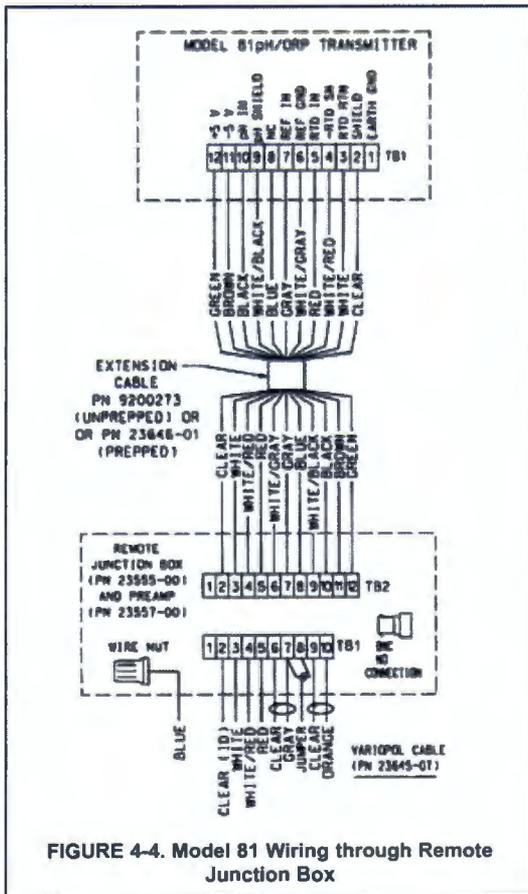


FIGURE 4-4. Model 81 Wiring through Remote Junction Box

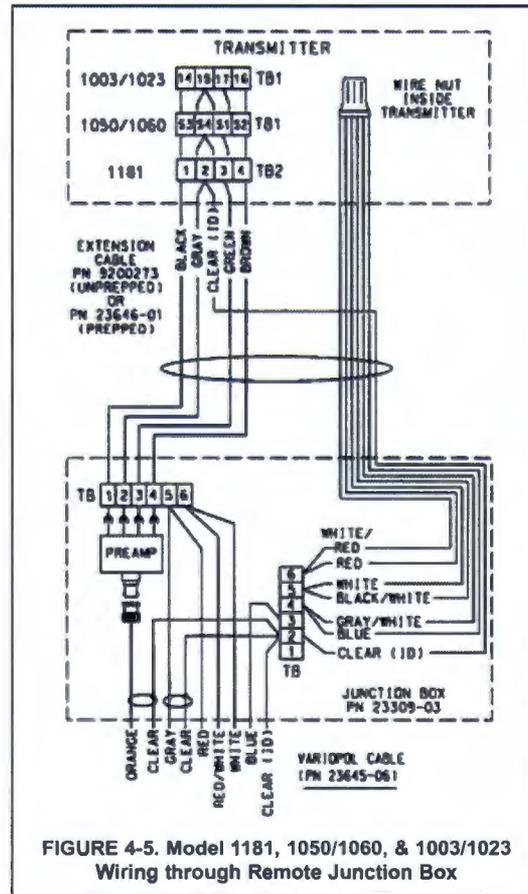


FIGURE 4-5. Model 1181, 1050/1060, & 1003/1023 Wiring through Remote Junction Box

MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP

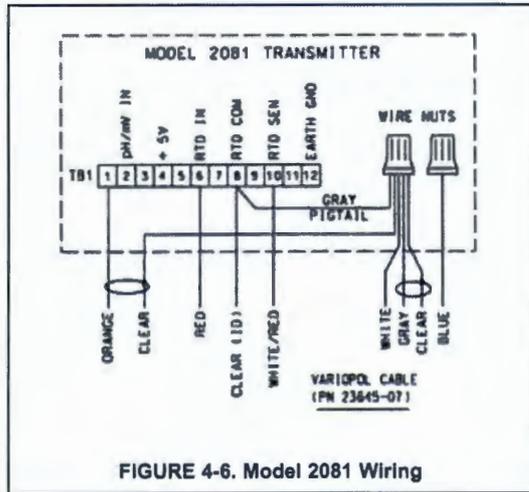


FIGURE 4-6. Model 2081 Wiring

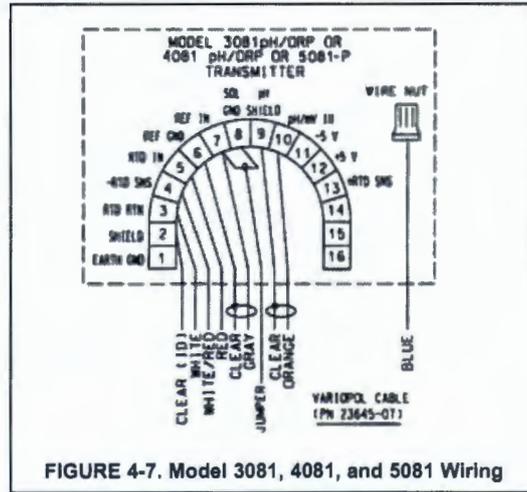


FIGURE 4-7. Model 3081, 4081, and 5081 Wiring

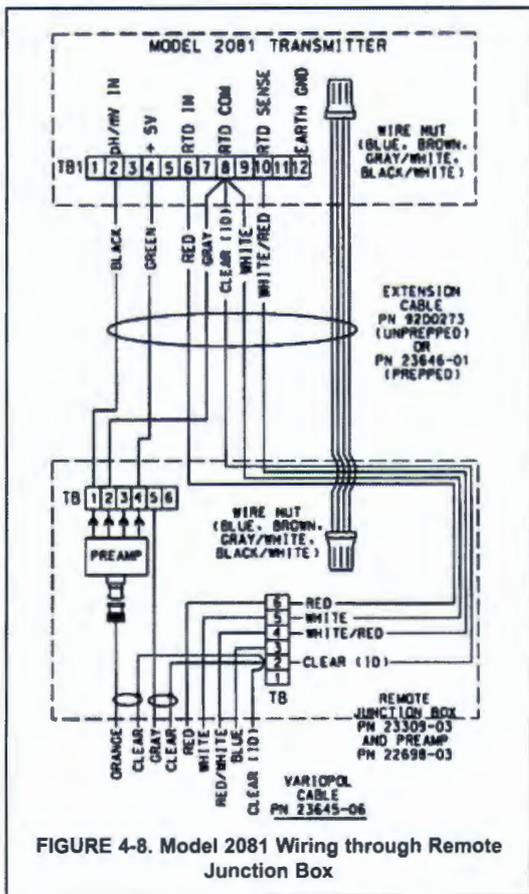


FIGURE 4-8. Model 2081 Wiring through Remote Junction Box

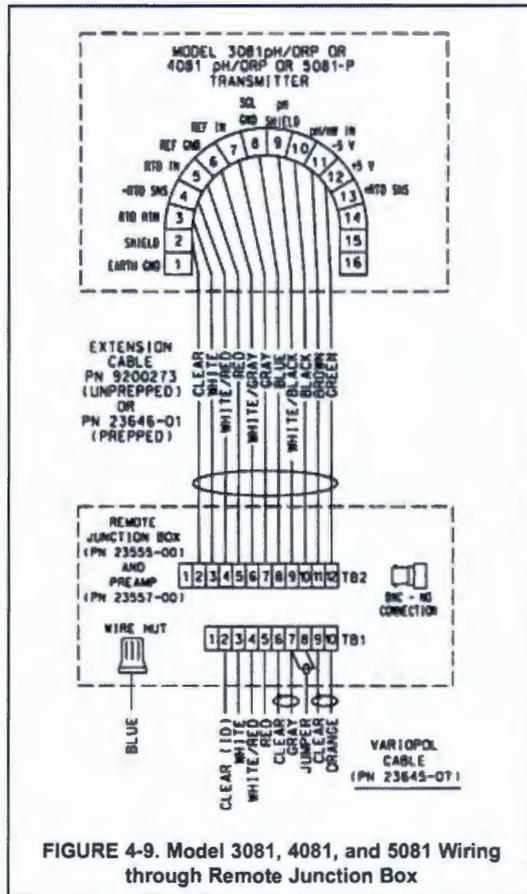
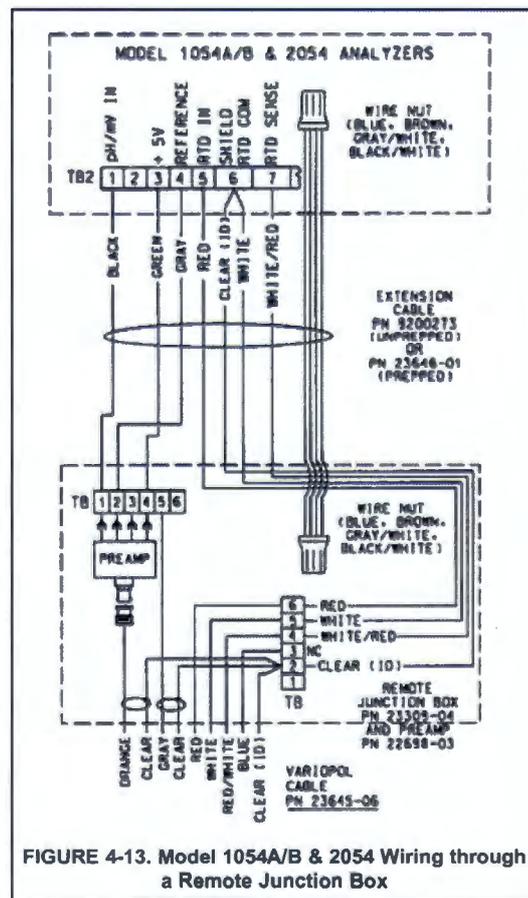
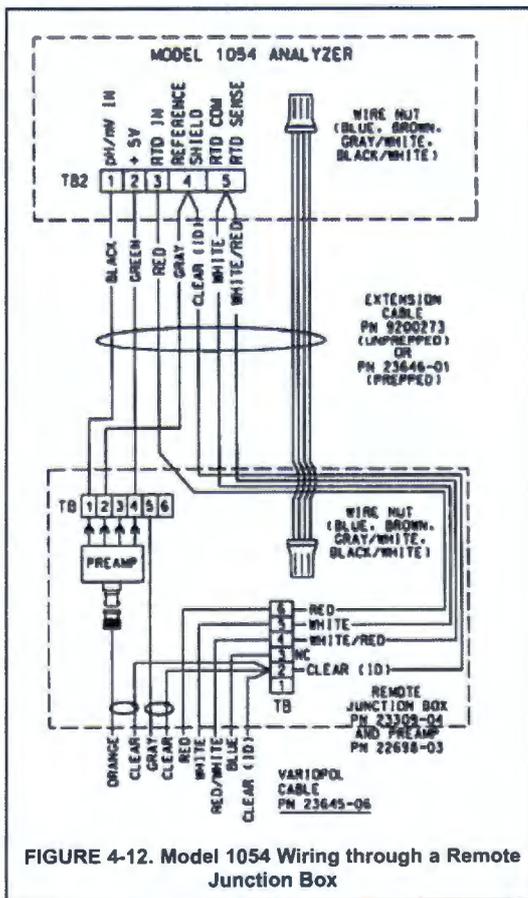
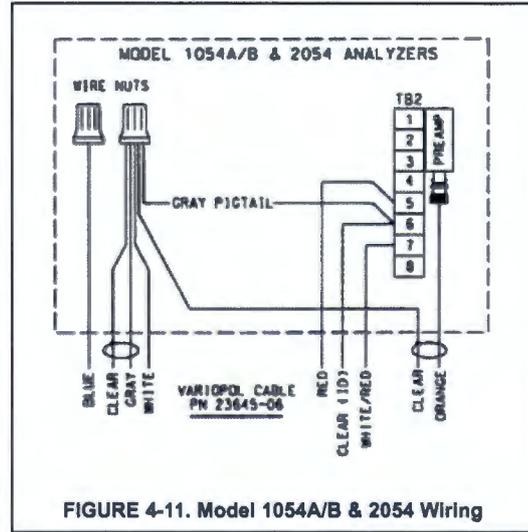
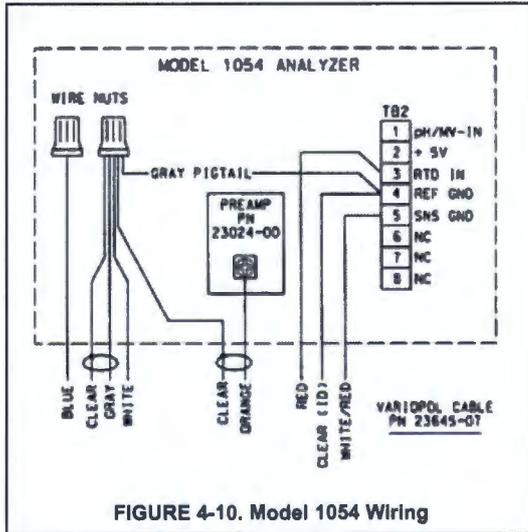


FIGURE 4-9. Model 3081, 4081, and 5081 Wiring through Remote Junction Box

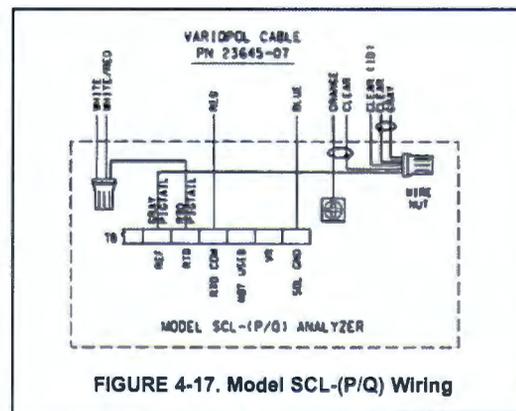
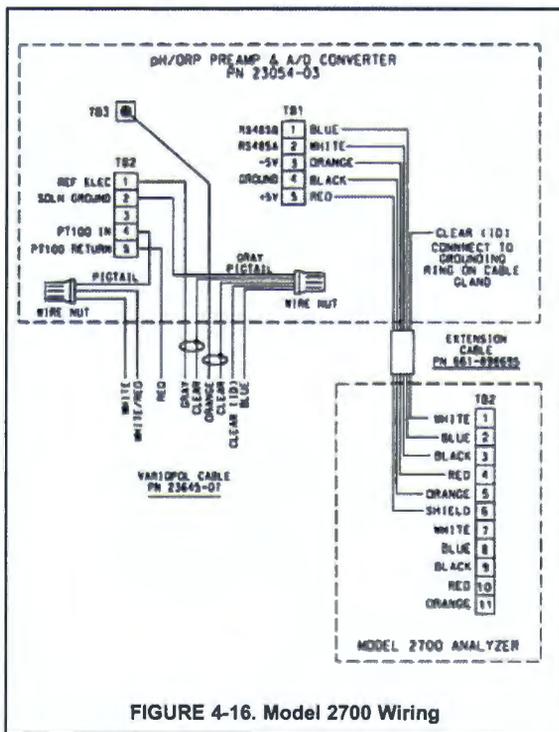
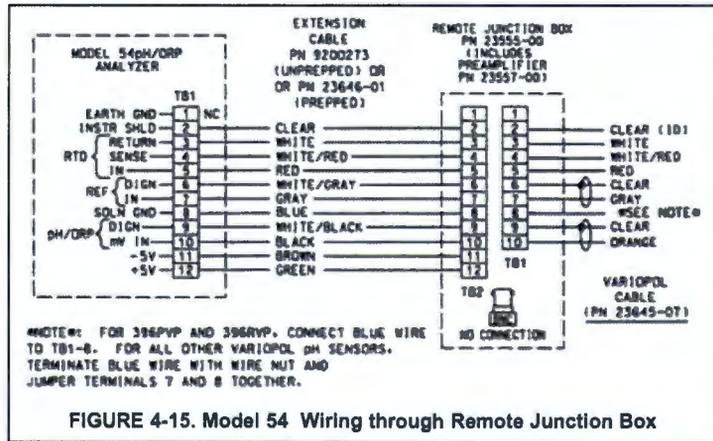
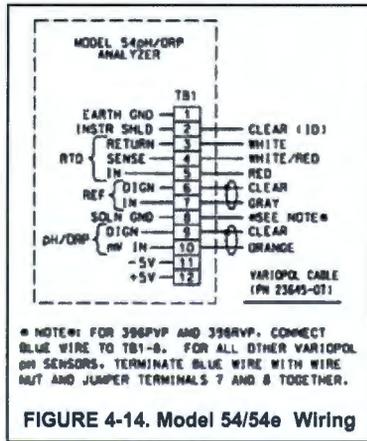
MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP



MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP



MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP

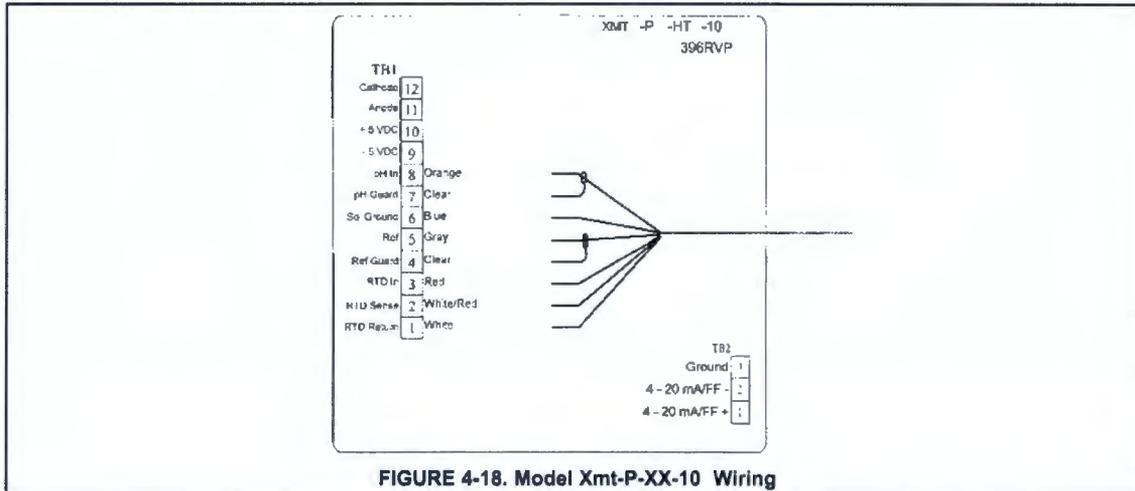


FIGURE 4-18. Model Xmt-P-XX-10 Wiring

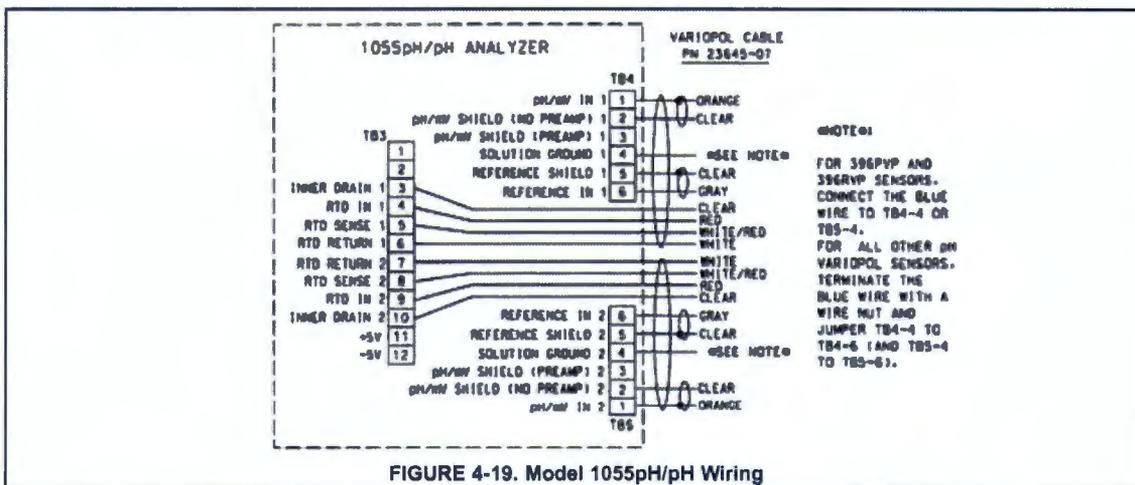


FIGURE 4-19. Model 1055pH/pH Wiring

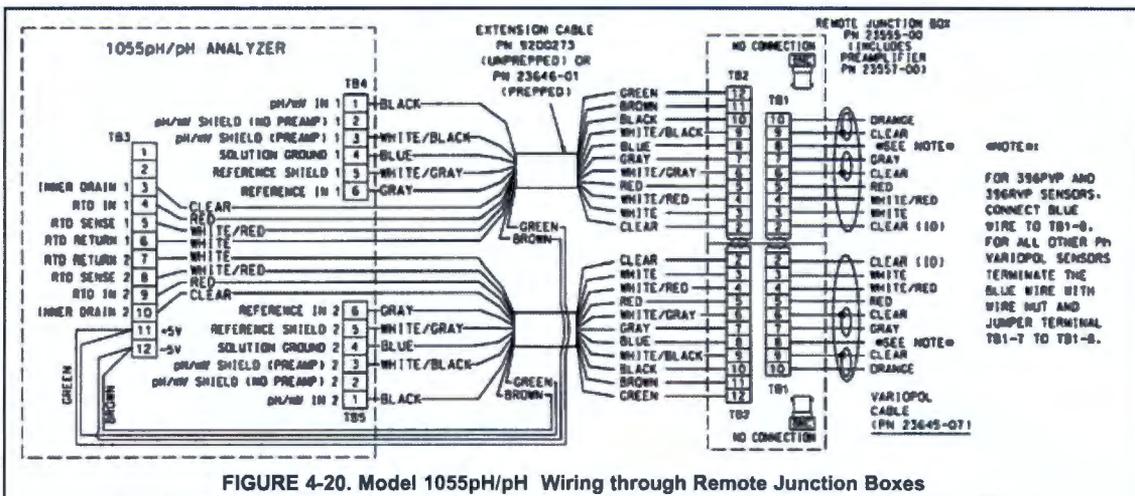
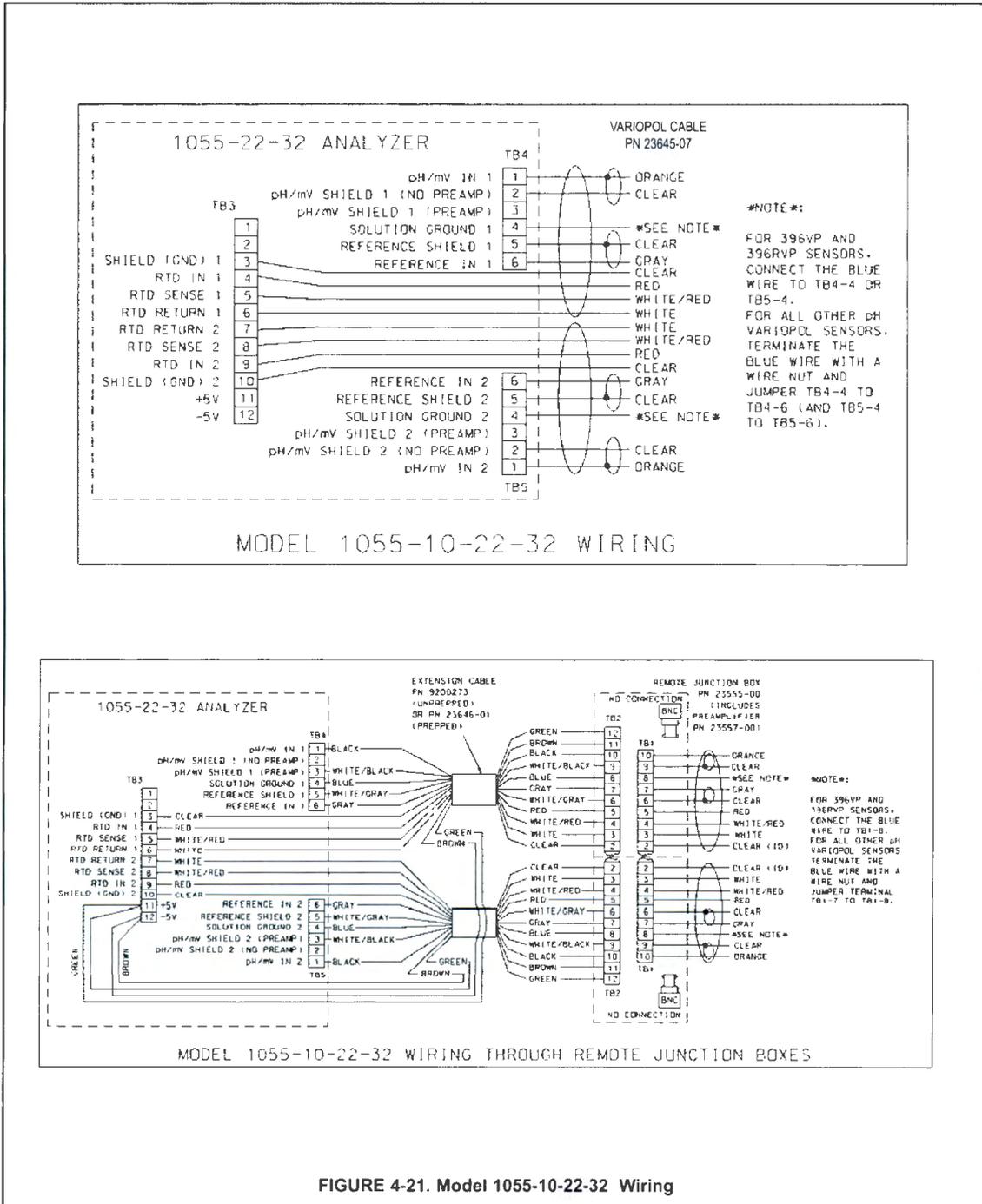


FIGURE 4-20. Model 1055pH/pH Wiring through Remote Junction Boxes

MODEL 396R pH/ORP

SECTION 4.0
WIRING MODEL 396RVP



MODEL 396R pH/ORP

SECTION 5.0
START UP AND CALIBRATION

SECTION 5.0 START UP AND CALIBRATION

5.1 START UP. To obtain best accuracy, the sensor must be calibrated as a loop with the analyzer. Please refer to the respective analyzer/transmitter instruction manual for proper calibration procedures.

5.2 396R pH CALIBRATION

1. After a temporary connection is established between the sensor and the instrument, a buffer calibration may be performed.
2. Consult appropriate pH/ORP analyzer or transmitter instruction manual for specific calibration and standardization procedures or see below for recommended two point buffer calibration procedure.

5.2.1 Recommended two point buffer calibration procedure:

Select two stable buffer solutions, preferably pH 4.0 and 10.0 (pH buffers other than pH 4.0 and pH 10.0 can be used as long as the pH values are at least two pH units apart).

Note: A pH 7 buffer solution reads a mV value of approx. zero, and pH buffers read approx. +/- 59.1 mV for each pH unit above or below pH 7. Check the pH buffer manufacturer specifications for millivolt values at various temperatures since it may affect the actual value of the buffer solution mV/pH value.

1. Immerse sensor in the first buffer solution. Allow sensor to adjust to the buffer temperature (to avoid errors due to temperature differences between the buffer solution and sensor temperature) and wait for reading to stabilize. Value of buffer can now be acknowledged by analyzer/transmitter
2. Once the first buffer has been acknowledged by the analyzer/transmitter, rinse the buffer solution off of the sensor with distilled or deionized water.

3. Repeat steps 1 and 2 using the second buffer solution.
4. Once the analyzer/transmitter has acknowledged both buffer solutions, a sensor slope (mV/pH) is established (the slope value can be found within the analyzer/transmitter).
5. The slope value should read about 59.1 mV/pH for a new sensor and will decrease over time to approximately 47 - 49 mV/pH. Once the slope reads below the 47-49 mV/pH range, a new sensor should be installed to maintain accurate readings.

5.2.2 Recommended pH Sensor Standardization

For maximum accuracy, the sensor can be standardized on-line or with a process grab sample after a buffer calibration has been performed and the sensor has been conditioned to the process. Standardization accounts for the sensor junction potential and other interferences. Standardization will not change the sensor's slope but will simply adjust the analyzer's reading to match that of the known process pH.

1. While obtaining a process solution sample (it is recommended that the sample is taken close to the sensor), record the pH value that is shown on the analyzer/transmitter display.
2. Measure and record the pH of the process solution sample with a another temperature compensated, calibrated pH instrument. For best results, standardization should be performed at the process temperature.
3. Adjust the analyzer/transmitter value to the standardized value.

MODEL 396R pH/ORP

SECTION 5.0
START UP AND CALIBRATION

5.3 396R ORP CALIBRATION. An ORP loop is best calibrated using an ORP standard solution. Most industrial applications have a number of ORP reactions occurring in sequence or simultaneously. There can be several components that are oxidized or reduced by the reagents that are used. Theoretically, the ORP potential is absolute because it is the result of the oxidation-reduction equilibrium. However, the actual measured potential is dependent on many factors, including the condition of the surface of the ORP platinum electrode. **Therefore, the sensor should be allowed 1-2 hours to become "conditioned" to the stream when first set-up or after being cleaned.**

5.3.1 ORP Calibration Procedure

1. Make a temporary electrical connection between the sensor and the instrument.
2. Obtain a ORP standard solution (PN R508-8oz) or one can be made quite simply by adding a few crystals of quinhydrone to either pH 4 or pH 7 buffer. Quinhydrone is only slightly soluble; therefore, only a few crystals will be required.

3. Immerse the sensor in the standard solution. Allow 1-2 minutes for the ORP sensor to stabilize.
4. Adjust the standardize control of the instrument to the solution value shown in Table 5-1. The resulting potentials, measured with a clean platinum electrode and saturated KCl/AgCl reference electrode, should be within ± 20 millivolts of the value shown in Table 5-1. Solution temperature must be noted to insure accurate interpretation of results. The ORP value of saturated quinhydrone solution is not stable over long periods of time. Therefore, these standards should be made up fresh each time they are used.
5. Remove the sensor from the buffer, rinse and install in the process.

TABLE 5-1
ORP of Saturated Quinhydrone Solution

	pH 4			pH 7		
TEMPERATURE °C	20	25	30	20	25	30
Millivolt Potential	268	264	260	94	87	80

MODEL 396R pH/ORP

SECTION 6.0
MAINTENANCE

SECTION 6.0 MAINTENANCE

6.1 Maintenance. The Model 396R Sensor is a disposal type sensor and therefore requires minimum maintenance. The sensor should be removed from the process periodically and checked in buffer solutions. If the sensor will not calibrate, refer to your analyzer/transmitters instruction manual for proper test procedures. If the sensor has failed, it should be discarded and replaced.

6.2 Sensor Removal. Please refer to the appropriate paragraph for instructions regarding removal of the sensor for periodic maintenance.

6.2.1 Retractable Version.

WARNING

System pressure may cause the sensor to blow out with great force unless care is taken during removal. Make sure the following steps are adhered to.

A. Model 396R-21 (21" tube)

1. Be certain system pressure at the sensor is below 64 psig (542 kPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 6-1. Push in on the sensor end or the top of the J-box and slowly loosen the hex nut (B) of the process end male connector (A).

B. Model 396R-25 (36" tube)

2. Be certain that pressure at the sensor is below 35 psig (343 KPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 6-1. Push in on the sensor end or the top of the J-box and slowly loosen the hex nut (B) of the process end male connector (A).

CAUTION

Do not remove nut at this time.

3. When the hex nut is loose enough, slowly ease the sensor back completely until the retraction stop collar is reached.

CAUTION

Failure to withdraw the sensor completely may result in damage to the sensor when the valve is closed.

4. Close the ball valve slowly. If there is resistance, the valve may be hitting the sensor. Double check that the sensor has been retracted to the retraction stop collar.

WARNING

Before removing the sensor from the ball valve, be absolutely certain that the ball valve is fully closed. Leakage from the male connector threads may indicate that the male connector is still under pressure. Leakage through a partially open valve could be hazardous, however with the ball valve closed, some residual process fluid may leak from the connector's pipe threads.

5. The Male Connector Body (A) may now be completely unthreaded from the reducing coupling and the sensor removed for servicing.

CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550099) in the male connector A.

6.3 pH Electrode Cleaning. If the electrode is coated or dirty, it may be cleaned as follows:

1. Remove the sensor from process as instructed in Section 6.2.
2. Wipe the glass bulb with a soft, clean, lint free cloth or tissue. If this does not remove the dirt or coating, proceed to step 3. If the sensor appears to be clean, go to step 5.
3. Wash the glass bulb in a strong detergent solution and thoroughly rinse with tap water. If the bulb still appears to have a coating, proceed to step 4.

CAUTION

The solution used in the following step is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper protective equipment. Do not let the solution come in contact with skin or clothing. If contact with the skin is made, immediately rinse with clean water.

MODEL 396R pH/ORP

SECTION 6.0
MAINTENANCE

4. Following the caution above, wash the glass bulb in dilute 5% hydrochloric acid solution and then rinse it thoroughly in tap water. Replace the sensor if it cannot be cleaned. If the glass bulb appears clean, proceed to step 5.
5. Buffer calibrate the sensor (Refer to Section 5.0). If the sensor appears to respond sluggishly to pH change, soaking it overnight in a weak acid solution (5% hydrochloric acid) may improve its response. Be sure to follow the CAUTION above and to rinse the sensor's tip thoroughly with tap water. If the sensor will not calibrate, it must be replaced.

6.4 Cleaning Platinum Electrode. The electrode is never exposed to these undesirable compounds. In the event poisoning is suspected, the electrode can be restored to normal operation by simply cleaning the platinum electrode with baking soda. Polish it by rubbing it with a damp paper towel and baking soda until a bright, shiny appearance is attained.

6.5 Automatic Temperature Compensator. The temperature compensator element is temperature sensitive and can be checked with an ohmmeter. Resistance increases with temperature.

The 3K element will read 3000 ohms $\pm 1\%$ at 25°C (77°F) and a Pt-100 will read 110 ohms. Resistance varies with temperature for a 3K and Pt-100 element and can be determined according to Table 6-2 or the following formula:

$$R_T = R_0 [1 + R_1 (T - 20)]$$

Where R_T = Resistance
T = Temperature in °C

Refer to Table 6-1 for R_0 and R_1 values:

TABLE 6-1
 R_0 and R_1 VALUES FOR TEMPERATURE
COMPENSATION ELEMENTS

Temperature Compensation Element	R_0	R_1
3K	2934	.0045
PT-100	107.7	.00385

TABLE 6-2
TEMPERATURE vs RESISTANCE OF AUTO
T.C. ELEMENTS

Temperature °C	Resistance (Ohms) $\pm 1\%$	
	3K	PT-100
0	2670	100.0
10	2802	103.8
20	2934	107.7
25	3000	109.6
30	3066	111.5
40	3198	115.4
50	3330	119.2
60	3462	123.1
70	3594	126.9
80	3726	130.8
90	3858	134.6
100	3990	138.5

6.6 Sensor Tube Replacement When Used With A Sensor Head Junction Box. Replacement of the retraction versions sensor tube assembly involves the removal and installation of two sets of male connectors: One at the process end of the sensor, and the other at the junction box end (See Figures 6-1, 6-2). Refer to Section 6.2 for proper removal of the sensor from process.

1. Remove sensor from process before proceeding. The junction box with attached male connector must be recovered from the old sensor for reuse. Unscrew the junction box cover and set aside. Disconnect electrical connections from printed circuit board inside junction box. Disconnect BNC connector to preamp. Unscrew hex nut (D) from male connector body (C). Separate junction box from used sensor. Set aside.
2. Pry off split ferrule from sensor and set aside for reuse. Remove hex nut (D) and set aside for reuse. Check that the internal O-ring is in place in the male connector body (C) attached to the junction box.
3. Remove hex nut (B) from male connector body (A) at process end of sensor and set aside. Slide the Teflon ferrule and the male connector off sensor in the direction of junction box and set

NOTE

If stainless steel ferrule was used, male connector body (A) will have to be discarded with the sensor tube.

MODEL 396R pH/ORP

SECTION 6.0
MAINTENANCE

4. Discard used O-ring from male connector body (A). Coat new O-ring with a thin film of the O-ring lubricant provided. Position it in the machined O-ring groove in place of the discarded O-ring.

CAUTION

Make sure lubricant does not contact any part of the sensor tip particularly the glass bulb.

5. Cover the 1" MNPT pipe threads of the male connector body (A) with Teflon tape (not provided) to protect them from galling during reinstallation.
6. Pass the wires from the new sensor through the process end male connector (A). Make sure that the beveled edge of the ferrule faces the process end of the sensor. Snug the hex nut (B) to keep it in place. Do not tighten down fully on the hex nut at this time.
7. Pass the wires from the new sensor through the hex nut (D), the split ferrule (from the old sensor), male connector body (C), O-ring, and through the junction box from the "neck" opening and out to the printed circuit board in the junction box. Butt the ferrule's beveled edge and the sensor tube against the junction male connector (C). Screw the hex nut (D) by hand until the tube is "locked" into the male connector body. Make sure that the male connector body (C) is sufficiently tightened. The sensor will "click" into place by pulling the sensor tube away from the junction box, but will not move from side to side or pull clear of the male connector. If the sensor tube is correctly attached to the junction box, wrench tighten hex nut (D) on male connector body (C) (see Figure 6-1). Do not put the sensor tube in a vise or use a pipe wrench to tighten the hardware as these will damage the sensor. If sensor tube is not correctly attached to the junction box, loosen hex nut (D) and repeat.
8. Connect the sensor wires to the terminals on the printed circuit board in the junction box in the manner recommended on the junction box cover, and reattach the BNC connector to the preamp. Screw on the cover of the junction box aside. Discard sensor tube.
9. Insert the sensor in the process fitting. Stop it against the closed ball valve. Slide the process-end male connector down the sensor tube to mate with the process fitting. Tighten the male connector into the process fitting.

10. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free from the valve assembly and male connector. The built-in retraction stop collar at the end of the sensor will butt against the shoulder of the male connector.

11. Open ball valve and position the sensor at the desired insertion depth and orientation. Using a crescent or open end wrench, tighten the hex nut (B) to secure the sensor in place. See Figure 6-2.

NOTE

A stainless steel ferrule is available if the Teflon ferrule does not adequately grip, be careful and avoid over tightening. This can damage the sensor tube.

CAUTION

If the male connector leaks during insertion or retraction, replace the O-Ring (PN 9550099) in the male connector body (A).

If the sensor is to be stored, the rubber boot should be filled with 7pH buffer solution and replaced on sensor tip until ready to use.

MODEL 396R pH/ORP

SECTION 6.0
MAINTENANCE

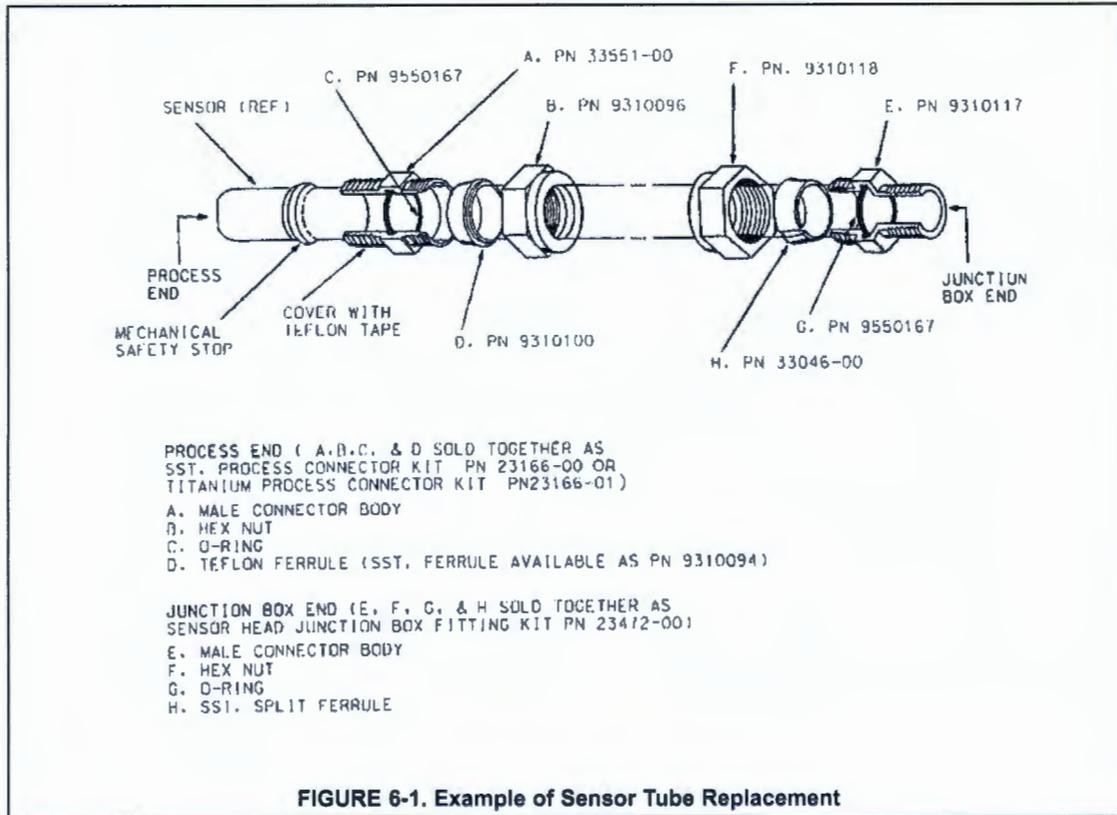


FIGURE 6-1. Example of Sensor Tube Replacement

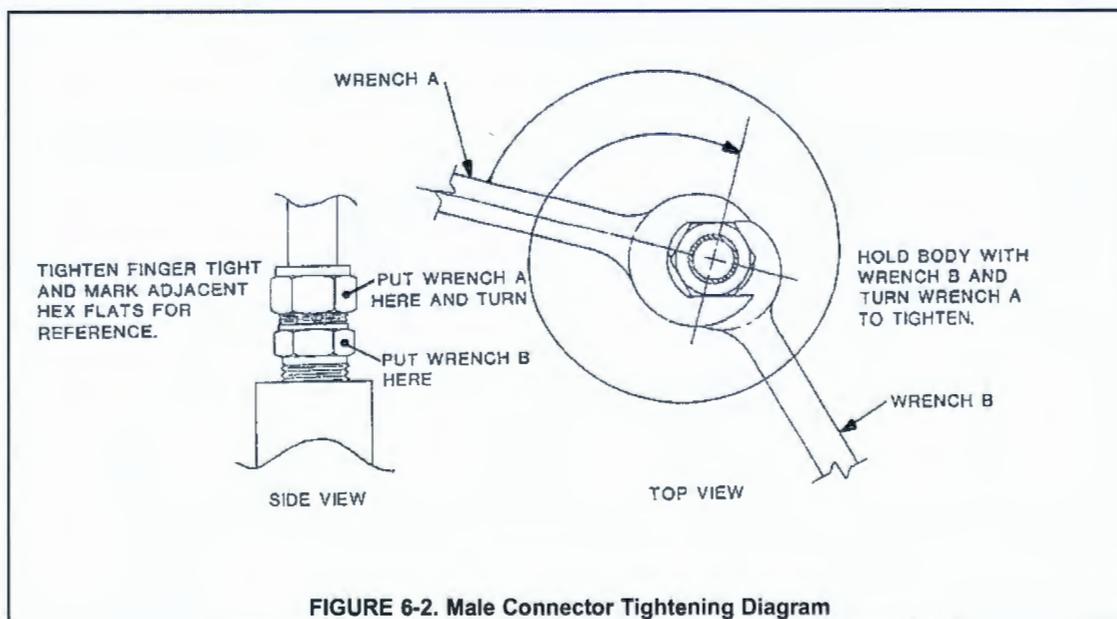


FIGURE 6-2. Male Connector Tightening Diagram

MODEL 396R pH/ORP

SECTION 7.0
DIAGNOSTICS AND TROUBLESHOOTING

SECTION 7.0 DIAGNOSTICS AND TROUBLESHOOTING

7.1 DIAGNOSTICS AND TROUBLESHOOTING WITH MODEL 54/81/3081 pH/ORP. The Model 54 and 54e Analyzers and Models 81 and 3081 pH Transmitters automatically search for fault conditions that would cause an error in the measured pH value, as does the Model 1054A/B pH/ORP Analyzer to a lesser degree. Refer to the respective manual for a complete description of the analyzer's fault conditions.

Table 7-1 lists the Analyzer/Transmitters diagnostic messages that indicate a possible sensor problem. A more complete description of the problem and a suggested remedy corresponding to each message is also listed.

TABLE 7-1 Troubleshooting with Diagnostics

DIAGNOSTIC MESSAGE 54 and 54e 81/3081	DESCRIPTION OF PROBLEM	REMEDY
"Calibration Warning" CALIB-ATE	1. Aged glass. 2. Sensor not immersed.	1. Perform buffer calibration. 2. Be sure electrode measuring tip is in process.
"Cracked glass failure" GLASS FAIL	Broken or cracked glass.	Replace Sensor.
"High reference impeded" REF FAIL or REF WARN	1. Liquid junction coated. 2. Reference Cell gel depleted. 3. Sensor not immersed.	1. Clean sensor; replace if necessary. 2. Replace sensor. 3. Be sure electrode measuring tip is in process.
"Input voltage high" "Input voltage low"	pH input shorted or sensor miswired.	Check wiring. Replace sensor if necessary.
"Old glass warning" GLASS WARN	1. Glass electrode worn out. 2. Sensor not immersed.	1. Replace sensor. 2. Be sure electrode measuring tip is in process.
"Reference offset err" (offline only) Std Err	Reference electrode poisoned.	Replace sensor.
"Ref voltage high" "Ref voltage low"	1. Reference shorted or sensor miswired. 2. Sensor not immersed.	Check wiring. Replace sensor if necessary.
"Sensor line open" LHE FAIL	1. Open wire between sensor and analyzer. 2. Interconnecting cable greater than 1000 ft.	1. Check sensor wiring. 2. Relocate analyzer.
"Sensor miswired"	1. Open wire between sensor and analyzer. 2. Bad preamplifier.	1. Check wiring. 2. Replace preamplifier.
"Temp error high" "Temp error low" TEMP HI TEMP LO	1. Open or shorted RTD. 2. Temperature out of range.	1. Replace sensor. 2. Check process temperature.

MODEL 396R pH/ORP

SECTION 7.0
DIAGNOSTICS AND TROUBLESHOOTING

7.2 TROUBLESHOOTING WITHOUT DIAGNOSTICS. Table 7-2 lists common problems, causes and remedies typically encountered in process measurement.

TABLE 7-2. Troubleshooting without Diagnostics

Problem	Probable Cause	Remedy
Meter reads off scale. (Display reads overrange).	Defective preamplifier.	Replace preamplifier (for code 02 sensors). For code 01, replace sensor.
	T.C. element shorted.	Check T.C. element as instructed in Section 6.5 and replace sensor if defective.
	Sensor not in process or sample stream is low.	Make sure sensor is in process with sufficient sample stream (refer to Section 2.0 for installation details).
	Open glass electrode.	Replace sensor.
	Reference element open - no contact.	Replace sensor.
Display reads between 3 and 6 pH regardless of actual pH of solution or sample.	Electrode cracked.	Replace sensor.
Meter or display indication swings or jumps widely in AUTO T.C. Mode.	T.C. element shorted.	Check T.C. element as instructed in Section 6.5 and replace sensor if defective.
Span between buffers extremely short in AUTO T.C. Mode.	T.C. element open.	Check T.C. element as instructed in Section 6.5 and replace sensor if defective.
Sluggish or slow meter indication for real changes in pH level.	Electrode coated.	Clean sensor as instructed in Sections 6.3 or 6.4. Replace sensor if cracked.
	Electrode defective.	Replace sensor.
Transmitter cannot be standardized.	Electrode coated or cracked.	Clean Sensor as instructed in Sections 6.3 or 6.4 Replace sensor if cracked.
	Defective preamplifier.	Replace preamplifier.
Transmitter short spans between two different buffer values.	Aged glass electrode or high temperature exposure.	Replace sensor.
	Electrode coated .	Clean Sensor as instructed in Sections 6.3 or 6.4. Replace sensor if cracked.

Model 396R pH/ORP

SECTION 8.0
RETURN OF MATERIAL

SECTION 8.0 RETURN OF MATERIAL

8.1 GENERAL.

To expedite the repair and return of instruments, please call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

8.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your "Letter of Transmittal" (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606

Attn: Factory Repair

RMA No. _____

Mark the package: Returned for Repair

Model No. _____

8.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 8.2.

NOTE

Consult the factory for additional information regarding service or repair.

WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

**Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606**

The shipping container should be marked:

Return for Repair

Model _____

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.



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Emerson Process Management

2400 Barranca Parkway
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Tel: (949) 757-8500
Fax: (949) 474-7250
<http://www.raihome.com>

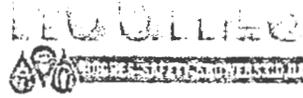
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APPENDIX N
Safety Shower & Eyewash

Submittal #73, Section 15412

**DATA SHEET FOR HUGHES
SAFETY SHOWER MODEL
EXP-J-14K/1200
OUTDOOR/INDOOR**



HUGHES SAFETY SHOWERS LTD

E-mail: info@hughes-safety-showers.co.uk
Web Site: www.hughes-safety-showers.co.uk
Whitefield Road, Bredbury, Stockport,
Cheshire SK6 2SS, England
Tel: +44(0)161 430 6618 Fax: +44(0)161 430 7928
Europe's Largest Manufacturer of Emergency Safety
Showers, Eyebaths and Decontamination Showers

TANK CAPACITY		1200L	
FRAME	GALVANISED MILD STEEL BOX SECTION (K)		
TANK	ROTARY MOULDED POLYETHYLENE		
INLET CONNECTION SIZE & TYPE	¾ INCH NPT FEMALE		
OUTLET CONNECTION SIZE & TYPE	GRP DRAIN SUMP 2 INCH NPT		
PIPING AND VALVE MATERIALS	UPVC PIPING & SHOWER VALVE. STAINLESS STEEL EYEBATH VALVE.		
SHOWER OPERATION	PANIC BAR OR OPTIONAL FOOT PANEL		
EYEBATH OPERATION	LIFT LID		
OPERATING PRESSURE	7.5 P.S.I		
FLOW AT OPERATING PRESSURE	SHOWER: 20GAL/MIN EYEBATH: 2.4GAL/MIN		
OVERALL DIMENSIONS	4'-7"	4'-7"	12'-6 ½"
UNIT WEIGHT (DRY)		895 LBS	
HEATING TYPE			
HEATER LOAD			
ELECTRICAL EQUIPMENT CLASSIFICATION			
ELECTRIC SUPPLY			

INSTALLATION OPERATION & MAINTENANCE INSTRUCTIONS



EMERGENCY TANK SHOWERS

MODELS COVERED		
STD-MH-14K/350	STD-MH-14K/750	STD-MH-14K/1200
EXP-MH-14K/350	EXP-MH-14K/750	EXP-MH-14K/1200
STD-J-14K/350	STD-J-14K/750	STD-J-14K/1200
EXP-J-14K/350	EXP-J-14K/750	EXP-J-14K/1200

INSTALLATION INSTRUCTIONS	GENERAL OPERATION & TRAINING INSTRUCTIONS	GENERAL MAINTENANCE & SERVICING INSTRUCTIONS
1.1 GENERAL	2.1 CODE OF PRACTICE	3.1 SERVICING
1.2 MOUNTING	2.2 TRAINING	3.2 WATER QUALITY
1.3 WATER SUPPLY	2.3 KNOW WHERE THEY ARE	3.3 SHOWER MAINTENANCE
1.4 WATER SUPPLY PIPE MATERIAL	2.4 KNOW HOW TO USE THEM	3.4 EYEBATH AND EYE/FACEWASH MAINTENANCE
1.5 FITTING SHOWER EQUIPMENT	2.6 SAFETY POSTERS AND TRAINING FILMS	3.5 FLUSHING
1.6 FITTING EYEBATH EQUIPMENT		3.6 SHOWER EYEBATH CLEANING
1.7 ELECTRICAL SUPPLY		3.7 MAINTENANCE AND SERVICING OF ELECTRICAL EQUIPMENT
1.8 ALARMS		3.8 IMPORTANT NOTES
1.9 NOTES		3.9 OUT OF SERVICE PROCEDURE



Hughes Safety Showers Ltd
Whitesfield Road Bredbury Stockport Cheshire SK6 2SS England
Tel: +44(0)161 430 6618 Fax: +44(0)161 430 7928
Email: info@hughes-safety-showers.co.uk



<h1>INSTALLATION INSTRUCTIONS</h1>	EMERGENCY SHOWER MODELS COVERED	
	STD-MH-14K/350 EXP-MH-14K/350 STD-J-14K/350 STD-J-14K/350 EXP-J-14K/350 EXP-J-14K/350	STD-MH-14K/750 STD-MH-14K/1200 EXP-MH-14K/750 EXP-MH-14K/1200 STD-J-14K/750 STD-J-14K/1200 EXP-J-14K/750 EXP-J-14K/1200

1.1 GENERAL

When planning the installation of Emergency Safety Showers, Eyebaths and Eye/Facewash equipment the advice of a qualified first-aid person or medical advisor should be sought to establish the most suitable choice of equipment, location and procedures for first-aid and decontamination.

There is a possibility with some dangerous substances that drenching with water could accelerate a chemical reaction. Water temperature may also have a bearing on the effectiveness of the equipment chosen. Consideration should also be made for disabled persons, including people in wheelchairs or people with special requirements due to their height.

In all circumstances installation procedures should be in accordance with proper plumbing practices. Multiple models with different types of activation should be avoided wherever possible. Emergency Shower, Eyebath and Eye/Facewash equipment is not a substitute for proper primary protective devices. As a defence against splashing injurious liquids and flying solid particles, workers should wear Personal Protective Equipment (PPE) as needed, which includes eye protection, face protection and protective clothing.

LOCATION

For Emergency Safety Shower, Eyebath or Eye/Facewash equipment to work effectively when needed, it must be installed properly and in the correct location. Such equipment should be installed within 10 seconds reach if an accident occurs; no closer than 3 metres or further than 15 metres.

The nature, severity and environment of the hazard should be considered in determining the maximum allowable unobstructed distance. For hazards involving strong acids or caustics such equipment must be immediately adjacent to the hazard and outside the most likely spray paths.

Emergency Shower, Eyebath and Eye/Facewash units should be located in a prominent position on the same level as the hazard and the path of travel shall be free from obstructions such as heavy traffic

or doorways that may prevent the immediate use of the equipment. If there is a doorway in the path of travel, it must not be possible to lock or latch the door against the direction of travel and the swing of the door must also be in the direction of travel of the exposed person.

The area around and underneath the shower should provide good drainage, especially if there is a possibility of the water freezing.

Consideration should be given to the location of equipment sensitive to heavy deluges of water or diluted chemicals, in particular electrical equipment. The work areas beneath elevated showers should also be considered in this regard.

When equipment is located indoors waste water must be contained for subsequent safe disposal or there must be adequate drainage.

Furthermore, procedures must be in place for cleaning away residue waste water after the use of this equipment.

Walk-on Panel type foot controls or Foot Treadles must be installed so that loose objects or gravel cannot obstruct their operation.

Where there is a possibility of freezing, equipment shall be suitably protected or alternatively a unit specifically designed to operate in such conditions shall be installed. When units are installed outdoors in very hot climates, they should be self-draining, or insulated from the effects of overheating caused by solar radiation. Emergency Shower, Eyebath and Eye/Facewash water temperatures must never exceed 38.6°C or drop below 10°C.

VISIBILITY

All units should be clearly labeled with a pictogram sign to EC Standard S2159/EEC for international equivalent when outside the EC) and the sign should be positioned so that it is highly visible within the area served by the equipment. Also, wherever possible, green/white stripes/hatching or green lights should be used to help identify the Emergency Shower, Eyebath and Eye/Facewash position, and the area under the unit should be well lit at all times and the operating mechanism must be clearly visible.

1.2 MOUNTING

Assembly

EXP models

The shower is supplied partially disassembled to reduce transport costs. Assembly instructions are enclosed with the unit.

Mounting

Emergency Shower, Eyebath and Eye/Facewash units must be mounted in accordance with the specific mounting instructions. Once installed their stability should be tested to ensure they are safe and pose no hazard to the user.

- STD-MH-14K/350
- EXP-MH-14K/350
- STD-J-14K/350
- STD-J-14K/350
- EXP-J-14K/350
- EXP-J-14K/350

Fix to suitable level surface using M12 bolts of a length and type

to suit the base material. The 15mm diameter holes for fixing bolts are on centre distances of 980mm wide, 550mm deep (approx), as shown on the General Arrangement Drawing.

- STD-MH-14K/750
- STD-MH-14K/1200
- EXP-MH-14K/750
- EXP-MH-14K/1200
- STD-J-14K/750
- STD-J-14K/1200
- EXP-J-14K/750
- EXP-J-14K/1200

Fix to suitable level surface using M12 bolts of a length and type to suit the base material. The 15mm diameter holes for fixing bolts are on centre distances of 1270mm wide, 1050mm deep (approx), as shown on the General Arrangement Drawing.

1.3 WATER SUPPLY

Emergency Shower, Eyebath and Eye/Facewash units should be fed from a potable water supply (drinking water or water of similar quality) and where necessary a non-return check valve should be fitted to the supply pipe feeding the unit.

The use of a long supply run should be avoided, especially where it requires heating to prevent freezing or where it can be heated up due to the climatic conditions.

The supply pipe should have at least the same diameter as the inlet pipe on the equipment (even larger if long lengths of pipe are being used to feed this equipment and especially if only low water pressures are available).

Where more than one unit is fed from the same water supply the capacity should be such that all units should be operable at the same time without impeded performance. Furthermore, no permanent or temporary connections shall be made to the water supply that can affect the flow rate or pressure such that they drop below the recommended minimum.

Tests must be carried out following installation to check the water supply pressure cannot drop below the recommended minimum when other demands are made on it.

Where a high unregulated pressure is experienced the pressure must be monitored to ensure that it does not exceed the recommended maximum. If the water pressure exceeds the manufacturers recommended maximum a pressure reducing valve should be fitted within the supply line. For first-aid treatment of casualties that have been involved in accidents with certain specially chemicals it may be recommended that additives be added to the water flow.

Inlet Connection
¾ inch BSP Female inlet situated under the tank near the shower rose, as shown on General Arrangement Drawing.

Minimum Supply Pressure 0.5 bar g.

Maximum Supply Pressure 2.75 bar g.
Higher pressures can be accommodated using the appropriate inserts fitted within the ballcock valves to enable them to cope with the increased pressure (available free of charge from HUGHES with fitting instructions).

The maximum supply pressure should not exceed 6 bar g. If it is possible for the supply water pressure to exceed 6 bar g then a pressure reducing valve should be fitted in the supply pipe.

1.4 WATER SUPPLY PIPE MATERIAL

The water supply pipe connected to the Emergency Shower, Eyebath and Eye/Facewash equipment must be either of the same material or of a material compatible with that of the unit to avoid corrosion.

The use of dissimilar metals in the supply pipe should be avoided as this could cause corrosion throughout the system. Cast iron or mild steel pipe and fittings must not be used unless they are protected with a galvanised finish.

IMPORTANT NOTE: Isolation Valves should be fitted to the supply pipes in an accessible position for use during maintenance. The isolation valves should have locking mechanisms to prevent unauthorised shutoff and should be labelled accordingly with fixed permanent tags.

Pipework material

Water inlet connection and shower pipework material is uPVC. If the supply pipe is metal it is recommended that it should be earthed electrically immediately before it connects to the plastic inlet on the header tank.

1.5 FITTING SHOWER EQUIPMENT

All pipework should be flushed out prior to connecting the shower to clear the line of jointing tape, pipe sealants and other commissioning debris.

After installation the shower should be flushed out to ensure proper operation and where necessary the shower head should be removed and cleaned. In the early part of the life of this equipment, this procedure must be regularly repeated. (Refer to Maintenance and Servicing Instructions for further details).

SHOWER EQUIPMENT

The Shower Rose should be removed during initial flushing after installation. The 3 self-tapping screws should be removed before unscrewing the shower rose. After flushing, the rose should be replaced using silicone grease.

Care must be taken not to over-tighten the shower roses when replacing them.

1.5 FITTING EYEBATH EQUIPMENT

EYEBATH & EYE/FACEWASH EQUIPMENT

Before operating the Eye/Facewash equipment for the first time, it is advisable to remove the strainer (where fitted) and spray heads and flush the unit until the water is clean and free from contamination and commissioning debris. The strainer and spray heads should then be replaced and a test should be carried out to verify proper operation. The fine mesh strainer should be monitored for build-up of debris or other solids, and in the early part of the life of this equipment this procedure must be repeated more regularly.

Poor performance should be logged and immediately reported to the management and rectified as soon as possible.

Strainer Removal

Remove the labelled cover on the underside of the tank to gain access to the eyebath strainer. Once the strainer head is removed (this is easily achieved using a 22mm box spanner or socket) the gauze filter can be removed for cleaning.

Care must be taken not to over-tighten the strainer head when replacing it.

1.7 ELECTRICAL SUPPLY

Where an Emergency Shower, Eyebath and Eye/Facewash unit requires an electrical supply, either for heating, cooling or lighting, then the supply should conform to the requirements as detailed in

Tank Shower Electrical Rating

• STD-MH-14KJ360

Immersion heaters are suitable for use in Non-Flammable areas, or areas

the specific instructions. Electrical equipment fitted to these units should be supplied through a sensitive circuit breaker. An Earth Leakage Circuit Breaker (ELCB) is also highly recommended. Where an electrical supply is fitted it should be connected through a lock-on switch to allow the electricity supply to be switched off for maintenance purposes only and should be labelled accordingly with fixed permanent tags.

Tank Shower Electrical Details

The electrical components of the shower are wired into junction boxes positioned as shown on the General Arrangement Drawing. Wiring diagrams and electrical loadings are provided with each shower and are placed inside each junction box. The cable entries on the junction box are suitable for M20 glands. Connections are live, neutral and earth, with a Single Phase supply of either 50Hz or 60Hz, and of 110 or 240Volts (dependent on customer specifications, 240Volts being standard). The electrical supply should be fitted with a circuit breaker rated 30mA 30ms.

1.8 ALARMS (where fitted)

Alarms are generally fitted where personnel work in areas where hazardous chemicals are present and in particular, where communications may not be readily available. In all circumstances the nature of the hazard and its location should be evaluated and alarms should be considered for Emergency Shower, Eyebath and Eye/Facewash equipment.

An alarm system (if fitted) should be activated when the Emergency Shower, Eyebath or Eye/Facewash is operated.

- The alarm shall be activated by a flow switch on the supply pipe or by a switch on the valve operating mechanism.
- The alarm shall sound on the unit as well as at a remote location that is attended during all working hours.
- The alarm shall show on a visual display board in the attended location to identify the location of the emergency.

designated as Zone 1 & 2, Gas Groups Ila, Iib & Iic, Temperature Class T3, when specified. The heater rating is 1KW @ 110 or 240Volts.

- STD-MH-14K760
- STD-MH-14K1200

Immersion heaters are suitable for use in Non-Flameproof areas, or areas designated as Zone 1 & 2, Gas Groups Ila, Iib & Iic, Temperature Class T3, when specified. The heater rating is 3KW @ 240Volts or 1.7 KW @ 110Volts.

Lights

(where optional lights are fitted)

For a Non-Flameproof indicator light the power rating is 2 x 60Watts (max) and the lights are fitted with bayonet type (E22d) lamp holders. Flameproof indicator lights are rated at 100Watts (max) and have E27 type lamp holders.

Note: It is acceptable and common practice to fit low wattage energy saving lamps.

Alarm facility

Magnetically operated Proximity Switches are suitable for use with electric supplies up to 250Volts, but it is generally preferable to use a low voltage on an intrinsically safe circuit. When two Proximity Switches are wired into one junction box, they will normally be wired in parallel for 'normally open', but could if required, be wired in series for 'normally closed'. It is possible to change the contacts to the normally closed position by rewiring the junction box. A wiring diagram is supplied and can be found within the junction box.

Alternatively one is available from the Service Department at HUGHES SAFETY SHOWERS.

A level switch can be fitted inside the shower tank, to indicate by an alarm at a remote control position, when the water reaches a low level. The level switch is wired into an independent junction box, suitable for electrical supplies of up to 250Volts.

1.9 NOTES

During the installation, if advice is required or further copies of drawings are needed, HUGHES SAFETY SHOWERS should be contacted immediately.

One week after commissioning, or once the plant is fully operational, the Emergency Shower, Eyebath and Eye/Facewash units should be operated and checked for correct performance.

2.1 OPERATION AND TRAINING INSTRUCTIONS	EMERGENCY TANK SHOWER MODELS COVERED	
	STD-MH-14K/350	STD-MH-14K/750
	EXP-MH-14K/350	STD-MH-14K/1200
	STD-J-14K/350	EXP-MH-14K/750
	STD-J-14K/350	EXP-MH-14K/1200
	EXP-J-14K/350	STD-J-14K/750
	EXP-J-14K/350	STD-J-14K/1200

2.1 CODE OF PRACTICE

<p>Chemical burns Remove any contaminated clothing which is not stuck to the skin. Flush with plenty of clean, cool water for 10-15 minutes. Apply a sterilised dressing to exposed, damaged skin and send the casualty to hospital.</p>	<p>Chemical in the eye Wash out the open eye continuously with clean, cool water for 10 to 15 minutes. People with eye injuries should be sent to hospital with a pad over the eye. <i>The first few seconds following an eye injury are often critical to minimising the severity of the injury.</i></p>
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2.2 TRAINING

<p>All employees that enter potentially hazardous areas in the workplace must be trained in the use of Emergency Showers, Eyebaths and Eye/Facewash equipment. Where multiple models with different types of activation are installed within the same working area additional training must be carried out covering the different methods of activation. Employees should also be aware of the exact location of all Emergency Shower, Eyebath and Eye/Facewash units and a record of their training must be kept for a period of 5 years.</p>	<p>It is the responsibility of all employers to ensure that their employees are fully trained with regard to Health and Safety at work. In the case where employees may be exposed to hazardous materials they shall be instructed as to the location and proper use of Emergency Safety Showers, Eyebaths and Facewash Fountains. Instructions for all emergency equipment shall be readily available and accessible to personnel, whether or not they are employees of the company.</p> <p>The most important factors are to 'know where they are' and 'know how to use them'.</p>
--	--

2.3 'Know where they are'

<p>Initially, this involves showing trainees where the units are located in areas where they will work or may work in the future. In most instances this involves a limited number of units.</p>	<p>It is important to make each person aware of the position of emergency safety equipment before starting work in any area. Furthermore, it is also important to remind current employees of their locations.</p>
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2.4 'Know how to use them'

<p>It is most important that the affected part should be flushed with plenty of clean cool water for 10 to 15 minutes. For highly toxic materials such as Hydrofluoric Acid it is recommended that this be extended to 'up to 30 minutes' dependant on individual circumstances.</p> <p>During showering any contaminated clothing, which is not stuck to the skin, should be removed. This includes shoes, rings, watches, etc.</p> <p>Medical advice must always be sought following any incident involving dangerous chemicals or corrosive substances. Contaminated clothing must be bagged and disposed of properly.</p> <p>For washing of the eyes, training shall stipulate the importance of holding the eyelids open and rolling the eyeballs so that flushing fluid will flow on all surfaces of the eyes and under the eyelids. Where contact lenses are being worn these should be removed as quickly as possible during the flushing period.</p> <p>For facial splashes where goggles have been worn and chemicals have not come into contact with the eyes, the face must be given an initial flushing with the goggles on to avoid washing chemicals into the eyes. After a few seconds the goggles must be removed and both eyes and face should be flushed for the full recommended duration.</p> <p>After using a plumbed-in Eyebath or Eye/Facewash unit it is advisable to use an Eyebath Bottle filled with sterile saline solution or medically accepted equivalent (this may be</p>	<p>carried out by the Company's qualified first-aid person or medical expert).</p> <p><i>Note: For any incident that involves chemicals in the eyes it is recommended that the patient should always visit hospital to ensure that the first-aid treatment has been successful.</i></p> <p>Shower Actuation The Tank Shower is actuated by means of a distinctive red 'Panic' push bar. If the optional 'Walk-on' Panel type foot control is fitted actuation is by foot pressure on the Panel. The foot control linkage is designed so that hand operation is always available should this become necessary due to restrictions immobilising the foot control.</p> <p>Eye/Facewash Actuation (where fitted) The Eye/Facewash Fountain is actuated by simply lifting the lid, or, if an optional Foot Treadle is fitted, by pushing this down with the foot. In the latter case, the linkage pulls the lid clear of the facewash diffusers and activates the valve simultaneously.</p> <p>The two facewash diffusers can have their flow rates adjusted together, by the three pronged regulator, or separately, by means of the grub screws on each side of the tee-piece in the centre of the facewash bowl. A 4mm Allen Key will be required for this adjustment.</p> <p><i>Note: Ensure the diffusers are clean prior to adjusting their flow rate.</i></p> <p>Handheld Eyebath Actuation (where fitted) Pulling down the operating lever actuates the Eyebath. This should be done once the Eyebath diffuser is firmly held in the other hand.</p>
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2.5 SAFETY POSTERS AND TRAINING FILMS

<p>Safety Posters or Safety Training Films are an important way of informing employees and visitors. Safety Posters should be displayed in prominent positions to increase awareness in the workplace of the existence of this equipment and to show how it is operated in case of an emergency.</p>	<p>Safety Training Films and Safety Posters are available from HUGHES SAFETY SHOWERS and these give clear and concise instructions as to the use of this important life saving equipment.</p> <p>See HUGHES web site for examples. www.hughes-safety-showers.co.uk</p>
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3. MAINTENANCE AND SERVICING INSTRUCTIONS	EMERGENCY TANK SHOWER MODELS COVERED	
	STD-MH-14K/350 EXP-MH-14K/350 STD-J-14K/350 STD-J-14K/350 EXP-J-14K/350 EXP-J-14K/350	STD-MH-14K/750 STD-MH-14K/1200 EXP-MH-14K/750 EXP-MH-14K/1200 STD-J-14K/760 STD-J-14K/1200 EXP-J-14K/750 EXP-J-14K/1200
3.1 SERVICING		

All Emergency Shower, Eyebath and Eye/Facewash equipment should be serviced and cleaned regularly and at least every six months in order to ensure proper operation. Records must be kept for a period of at least five years of the examinations and tests carried out.

IMPORTANT NOTES:
Maintenance and servicing must only be carried out when no other activities are being undertaken in the plant area.

serviced by the Emergency Shower, Eyebath and Eye/Facewash equipment. Only trained personnel with in-depth knowledge of this life-saving equipment should carry out maintenance and servicing. Full training available from the Service Department at HUGHES SAFETY SHOWERS.

3.2 WATER QUALITY

Periodic analysis of the water quality within the Emergency Shower, Eyebath and Eye/Facewash equipment is recommended to ensure there is no build up of harmful bacteria. If necessary, following the test, the unit should be thoroughly cleaned and chlorinated/disinfected.

Tank Disinfecting
Firstly, isolate the water (and electricity) supply and drain the tank. Then remove the shower rose and eyebath strainer and place them in a container of 50 P.P.M. (Parts Per Million) dissolved free chlorine for one hour. The Tank Shower lid

should then be removed and the tank and lid should be thoroughly cleaned taking care not to damage any parts inside the tank such as the ball cocks or the immersion heater (where fitted). The tank should then be filled with chlorinated water of 50 P.P.M. chlorine strength. This should then be left for one hour and the shower and eyebath should be identified as being 'Out of Service'. The eyebath should be operated to hold chlorinated water in the feed line for one hour, after which time the system should be emptied and flushed out with clean water then refilled. The shower rose and eyebath strainer should then be replaced.

3.3 SHOWER MAINTENANCE

The shower head should be unscrewed, cleaned and disinfected periodically, to ensure that any build-up of debris is removed and that no bacteria are present.

Remove the three retaining screws before unscrewing the shower rose. After flushing, the rose should be replaced using silicone grease.

Care must be taken not to over-tighten the shower rose when replacing it.

3.4 EYEBATH & EYE/FACEWASH MAINTENANCE

Eyebath and Eye/Facwash units are fitted with fine mesh strainers to prevent the passage of any foreign bodies in the water. These strainers should be cleaned regularly, particularly in the first 6 months of service as there may be contamination of the water from dirt, jointing compounds, etc. which may have remained in the pipework following installation, despite the recommended flushing procedure.

The Eyebath and/or Eye/Facwash nozzles should also be cleaned regularly and the frequency will depend on the ambient conditions of the installation. In corrosive environments the Eyebath and Eye/Facwash diffusers should be cleaned and where necessary replaced more frequently.

After any maintenance work has been carried out on this equipment it is imperative that the Eyebath and Eye/Facwash units are given a full operational test and that any flow regulator or volume control screws are re-adjusted to ensure optimum performance.

Eyebath and Eye/Facwash

To clean the eyebath diffusers, unscrew them and clean thoroughly. This procedure should be carried out at regular intervals.

To ensure hygienic operation, these diffusers should be replaced if they become excessively dirty or damaged. Spare diffusers and strainers can be obtained from Hughes Safety Showers or their local distributor.

3.5 FLUSHING

Emergency Shower, Eyebath and Eye/Facwash units should be activated at least weekly to verify proper operation and ensure that any stored water is clean and fresh.

It is not advisable to flush outdoor units in freezing weather as frozen water on the ground may cause an accident. Special devices can be used to catch the shower water and these can be used during the winter months to ensure continuity of shower flushing.

The duration of routine flushing should be sufficient to ensure both the shower and water feed pipe are fully purged with clean fresh potable water. In practice this can mean flushing for up to several minutes.

Recommended flushing instructions and periods should therefore be individually indicated on each separate unit. Flushing is made easier if the optional extended 'Panic' push bar is fitted.

Flushing should be carried out when personnel are not in the plant area in case an accident occurs and the tank is not full when needed.

If the optional Siphon Dump Valve is fitted the flushing of the Tank Shower is achieved automatically at a frequency of between twice a day and once every three days (dependant on customer requirements).

3.6 SHOWER AND EYEBATH CLEANING

Under most site conditions it is necessary to periodically clean the outside of the Emergency Shower, Eyebath and Eye/Facwash equipment. This must be carried out whenever the unit gets dirty.

Periodic cleaning clearly indicates that this important equipment is being looked after and is safe for use in cases of emergency.

IMPORTANT NOTE: Abrasives or solvents must not be used to clean the unit as this can damage the surface or affect the instruction stickers.

3.7 MAINTENANCE AND SERVICING OF ELECTRICAL EQUIPMENT

Thorough visual inspections should be carried out to check for external damage to the electrical units, their cables or the junction boxes. Should any part be found to be damaged, this must be reported and repaired or replaced as soon as possible. A further test should be carried out to establish that it functions as intended. Any additional electrical tests should be carried out at the discretion of a qualified electrician. Full instructions should be obtained from HUGHES SAFETY SHOWERS. To comply with ATEX requirements for electrical equipment, use only a damp cloth for cleaning electrical devices and cables.

Fault finding

If the shower's frost protection heating system is not functioning a qualified electrician should investigate.

Firstly, an electrical continuity check should be made at the Junction Box. Then, if this does not highlight the fault, remove the labelled cover on the side of the tank to gain access to the Immersion Heater. Remove the locking screw (or 2 x 3mm grub screws on Flameproof version) and unscrew the immersion heater or thermostat cover. Check the heater element for continuity and check the over-temperature cut-out switch. Immersion Heater and thermostat removal and replacement instructions are provided with HUGHES spare parts or by contacting the Service Department at HUGHES SAFETY SHOWERS.

3.8 IMPORTANT NOTES

During servicing and maintenance it is imperative that the temperature of the water delivered from the Emergency Safety Shower, Eyebath and Eye/Facewash equipment is tested to ensure it never exceeds 35°C or drops below 10°C during the operating period of the unit. Temperatures above 25°C can encourage the growth of organisms such as Legionella and temperatures that are too low will discourage the use of the equipment for the full duration of 10-15 minutes as recommended. Temperatures of between 15°C and 25°C are therefore preferred for the safe and effective use of this equipment.

Thermostats fitted on outdoor or heated Emergency Safety Shower, Eyebath and Eye/Facewash equipment must not be set greater than 35°C. The normal setting should be 20°C (factory setting) to minimise the risk of thermal shock to the user whilst remaining below the temperature range that encourages growth of organisms such as Legionella.

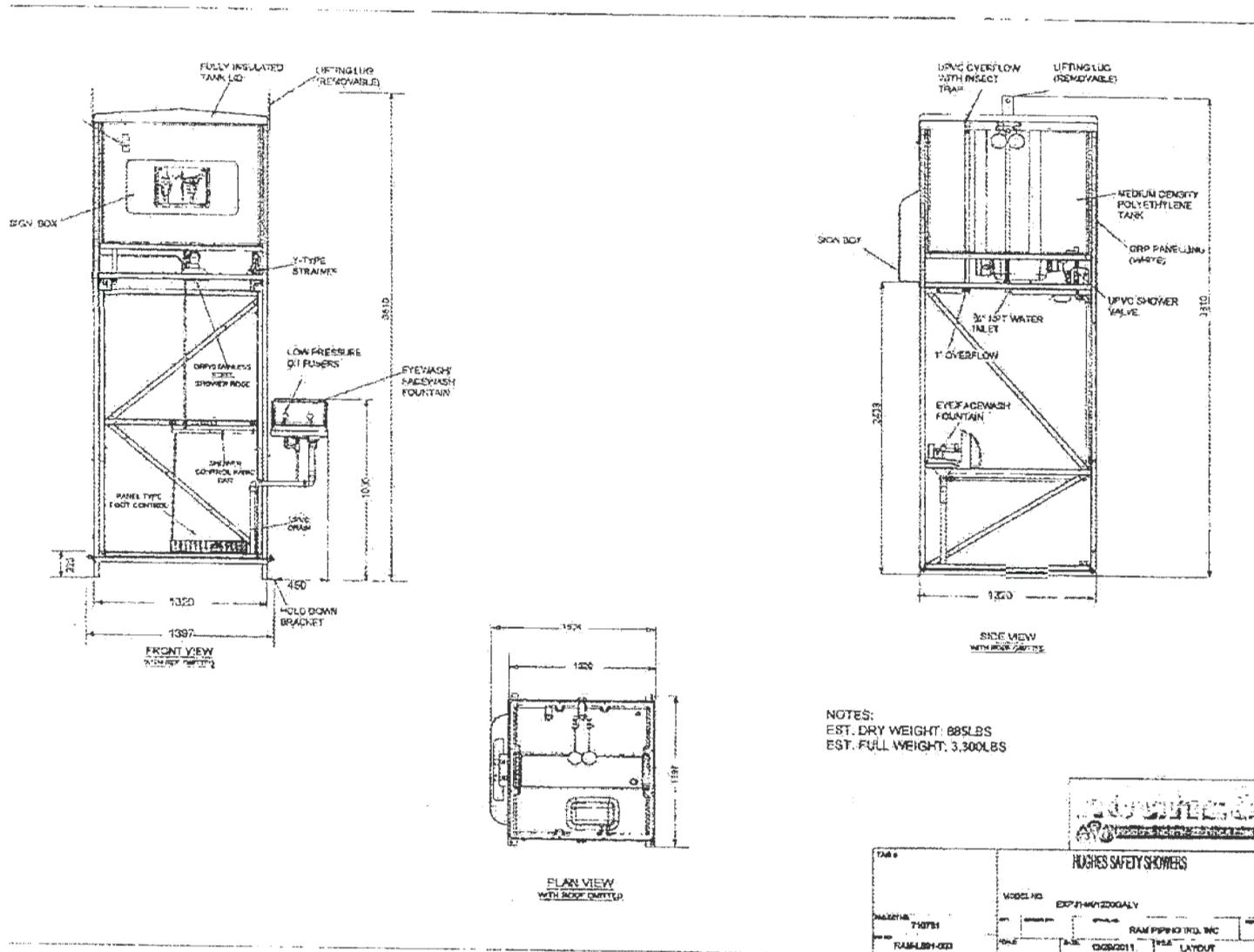
3.9 OUT OF SERVICE PROCEDURE

In the event that an Emergency Safety Shower, Eyebath or Eye/Facewash unit becomes temporarily out of service a standard procedure should be followed.

Place a sign on the unit indicating that it is 'Out of Service'.
Notify all individuals working in the area that the unit is out of service.

Prohibit or suspend any work where there is a significant possibility of having an accident requiring the use of the unit. If work cannot be prohibited or suspended, a portable unit must be provided to supply the initial wash only, after which it will be necessary to move the person to a plumbed Emergency Safety Shower, Eyebath or Eye/Facewash unit to complete the 15 minute wash.

Note: Portable units are not acceptable as a long-term substitute for permanent locations.



APPENDIX O
Material Safety and Data Sheets

Attachment O-1
Hydrated Lime Slurry

Material Safety Data Sheet

May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200. Standard must be
consulted for specific requirements.

U.S. Department of Labor

Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY Hydrated Lime Slurry
Ca(OH)₂ (Calcium hydroxide slurry)

Section I

Manufacturer's Name and Address
Mid-Ohio Valley Lime, Inc.

PO Box 734, 16360 State Route Seven South
Marietta, OH 45750

Emergency Telephone Number

888-847-3090

Information Phone Number

888-847-3090

Date Prepared

12/10/2009

Section II - Ingredients/Identity Information

Components	CAS	Common Name	OSHA PEL	ACGIH TLV	Other Limits	% (optional)
Calcium hydroxide	1305-62-0	Hydrated Lime	5 mg/m ³	5 mg/m ³	7340 mg/kg	25-45%
Magnesium hydroxide	1309-42-8	Brucite	N.A.	N.A.		<5%
Silicon dioxide	14808-60-7	Quartz	*see note below	0.025 mg/m ³	4 mg/m ³	<2%
Dihydrogen oxide	7732-18-5	Water	N.A.	N.A.		Balance

*SiO₂ OSHA PEL: 10 mg/m³ divided by (the percentage of silica in the dust plus 2) (respirable)

Section III - Physical/Chemical Characteristics

Boiling Point	100 °C	Melting Point	dec. 580 °C	Specific Gravity	1.2 - 1.5 g/cc
Vapor Pressure (mm Hg)	N.A.	Vapor Density	N.A.	Evaporation Rate	N.A.
Solubility in Water	Material is a stable suspension of calcium hydroxide in water. pH=12.4@25°C				
Appearance and Odor	White low viscosity liquid, odorless				

Section IV - Fire and Explosion Hazard Data

Flash Point	LEL/UEL	Flammable Limits	Extinguishing Media
N.A.	N.A.	N.A.	Not Combustible -- Use extinguishing agent for surrounding fire

Special Firefighting Procedures/Unusual Fire and Explosion Hazards

Avoid skin contact or inhalation of dust if material becomes dry.

Section V - Reactivity Data

Stability	Conditions to Avoid (stability - related)
Stable	Material is stable

Incompatibility (Materials to Avoid)

Acids: Reacts vigorously and produces heat. Maleic Anhydride: May react explosively. Nitro Organic
Compounds: May react to form explosive salts. Phosphorous: May form flammable products when heated.
Aluminum: May react to form hydrogen gas.

Hazardous Polymerization/Hazardous Decomposition of Byproducts Will not occur (none)

Section VI - Health Hazard Data

Route(s) of Entry: Inhalation, Ingestion

Health Hazards (Acute and Chronic)

Avoid skin and eye contact as irritation will occur. Contact lenses should not be worn when working with lime products.
Inhalation of mist or dried dust can cause coughing, sneezing, or breathing problems.

Carcinogenicity: OSHA? SiO₂ NTP/IARC Monographs? SiO₂

Respirable crystalline silica from occupational sources is classified by IARC as a Group I Carcinogen.

California Proposition 65: Silica is on the Governor's Proposition 65 list. Components used in this product may
contain trace amounts of inherent naturally occurring elements (such as, but not limited to arsenic, cadmium)
that are on the Governor's Proposition 65 list.

Mid-Ohio Valley Lime, Inc. Hydrated Lime Slurry MSDS page 2/2

Section VI - Health Hazard Data (continued)

Signs and Symptoms of Exposure

Skin or eye irritation; coughing or breathing problems.

Medical Conditions Generally Aggravated by Exposure

Respiratory problems, asthma, dermatitis or skin or eye sensitivity.

Emergency and First Aid Procedure

Flush contaminated area with excess water. If eye contact, rinse eye with eye wash solution or excess water and seek medical attention immediately.

Section VII - Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled

Protect skin and eyes from contact and avoid inhalation of mist. Collect by mop or other suitable method. Place in steel container.

Waste Disposal Method

Add water to dilute and flush to sewer. Consult local, state, or federal regulations.

Precautions to be Taken in Handling and Storage

Store in tightly closed containers and keep away from acids or other incompatible substances. Do not store or ship in aluminum containers.

Other Precautions

Avoid eye contact and breathing dust if material becomes dry.

NFPA Rating:	HEALTH: 1	FLAMMABILITY: 0	REACTIVITY: 0
HMS Rating:	HEALTH: 1	FLAMMABILITY: 0	REACTIVITY: 0
WHMIS Rating:	D2A, E		

Section VIII - Control Measures

Respiratory Protection (Specify Type)

Dust masks meeting the NIOSH N95 rating are sufficient for casual exposure to mist or dust. (42 CFR)

Ventilation:	Local Exhaust	Special	Do not dispose of dust with combustible materials.
	N.A.		
	Mechanical (General)	Other	
	N.A.		

Protective Gloves	Other Protective Clothing or Equipment
Clean dry rubber gloves	Full clothing to cover arms and legs, safety glasses or face shield.

Work/Hygienic Practices

Eye wash and shower station should be readily available.

Mid-Ohio Valley Lime, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/or exercise their own judgment in determining its appropriateness for a particular purpose. Mid-Ohio Valley Lime, Inc. makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the information set forth herein or the product(s) to which the information refers. Accordingly, Mid-Ohio Valley Lime, Inc. will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.

References: Sax, N.I. & R.J. Lewis Sr. (1989) "Dangerous Properties of Industrial Materials", New York: Van Nostrand Reinhold Co. Ltd.
Lewis, R.J. (1997) "Hazardous Chemicals Desk Reference", New York: Van Nostrand Reinhold Co. Ltd. KSA

Attachment O-2
Polymer (Cationic Flocculant Slove 9244)



Cationic Flocculant Solve 9244

Material Safety Data Sheet

Date Issued: 05/31/2011
Date Revised: 05/31/2011

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **SOLVE 9244**
CHEMICAL TYPE: Water soluble polymer in emulsion.
COMPANY: WaterSolve, LLC, 4964 Starr St. SE, Grand Rapids, MI 49546, USA
For Product information call 616-575-8693.

2. HAZARDS IDENTIFICATION

Appearance: liquid, white.

- CAUTION! MAY AFFECT THE CENTRAL NERVOUS SYSTEM CAUSING DIZZINESS, HEADACHE OR NAUSEA. PROLONGED OR REPEATED CONTACT MAY DRY THE SKIN AND CAUSE IRRITATION AND BURNS.

Potential health effects

Route of exposure

Inhalation, skin absorption, skin contact, eye contact, ingestion

Eye contact

May cause mild eye irritation. Symptoms include stinging, tearing, redness, and swelling of eyes.

Skin contact

May cause mild skin irritation. Symptoms may include redness and burning of skin. Prolonged or repeated contact may dry the skin. Symptoms may include redness, burning, and drying and cracking of skin, skin burns, and other skin damage.

Ingestion

Swallowing small amounts of this material during normal handling is not likely to cause harmful effects. Swallowing large amounts may be harmful. This material can get into the lungs during swallowing or vomiting. This results in lung inflammation and other lung injury.

Inhalation

Breathing of vapor or mist is possible. Breathing small amounts of this material during normal handling is not likely to cause harmful effects. Breathing large amounts may be harmful. Symptoms are not expected at air concentrations below the recommended exposure limits, if applicable (see Section 8).

Aggravated Medical Conditions

Preexisting disorders of the following organs (or organ systems) may be aggravated by exposure to this material: Skin, lung (for example, asthma-like conditions).

Symptoms

Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include: stomach or intestinal upset (nausea, vomiting, diarrhea), irritation (nose, throat, airways), lung irritation, central nervous system depression (dizziness, drowsiness, weakness, fatigue, nausea, headache, unconsciousness) lack of coordination, confusion, irregular heartbeat, narcosis (dazed or sluggish feeling), convulsions, coma.

Target Organs

Exposure to this material (or a component) has been found to cause kidney damage in male rats. The mechanism by which this toxicity occurs is specific to the male rat and the kidney effects are not expected to occur in humans. Overexposure to this material (or its components) has been suggested as a cause of the following effects in laboratory animals: mild, reversible liver effects.

Solve 9244
Page 2 of 6

Carcinogenicity

Based on the available information, this material cannot be classified with regard to carcinogenicity. This material is not listed as a carcinogen by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or the Occupational Safety and Health Administration (OSHA).

Reproductive hazard

Based on the available information, risk to the fetus from maternal exposure to this material cannot be assessed.

4. **COMPOSITION/INFORMATION ON INGREDIENTS**

Component Analysis – Inventory

Component	CAS#	CONCENTRATION
ALIPHATIC HYDROCARBON	254504001-5164	>=20-<30%
POLYMER	254504001-5817	>=1.5-<5%
Alcohols, C12-18 Ethoxylated>1<2.5 Mole	68213-23-0	>=1.5-<5%

5. **FIRST AID MEASURES**

- Eye Contact:** If symptoms develop, immediately move individual away from exposure and into fresh air. Flush eyes gently with water for at least 15 minutes, while holding eyelids apart. If symptoms persist or there is any visual difficulty, seek medical attention.
- Skin Contact:** Remove contaminated clothing. Flush exposed area with large amounts of water, wash exposed area with soap and water. If skin is damaged, seek immediate medical attention. If skin is not damaged and symptoms persist, seek medical attention. Launder clothing before reuse
- Ingestion:** Seek medical attention. If individual is drowsy or unconscious, do not give anything by mouth; place individual on the left side with the head down. Contact a physician, medical facility, or poison control center for advice about whether to induce vomiting. If possible, do not leave individual unattended.
- Inhalation:** If symptoms develop, move individual away from exposure and into fresh air. If symptoms persist, seek medical attention. If breathing is difficult, administer oxygen. Keep person warm and quiet; seek immediate medical attention.

Notes to physician

- Hazards:** No information available.
Treatment: No information available.

6. **FIRE FIGHTING MEASURES**

Suitable extinguishing media: Water spray, Dry chemical, carbon dioxide (CO₂).

Hazardous combustion products: Hydrocarbons, carbon dioxide and carbon monoxide and nitrogen oxides.

Protective equipment for firefighters: Wear full firefighting turn-out gear (full Bunker gear), and respiratory protection (SCBA). DO NOT direct a solid stream of water or foam into hot, burning pools of liquid since this may cause frothing and increase fire intensity. Frothing can be violent and possibly endanger any firefighter standing too close to the burning liquid. Use water spray to cool fire exposed containers and structure until fire is out if it can be done with minimal risk. Avoid spreading burning liquid with water used for cooling purposes.

Flammability Class for Flammable Liquids:
Combustible Liquid Class IIIB.

7. **ACCIDENTAL RELEASE MEASURES**

Personal precautions

For personal protection see Section 8. Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed.

Solve 9244
Page 3 of 6

Environmental precautions:

Prevent spreading over a wide area (e.g. by containment or oil barriers). Do not let product enter drains. Do not flush into surface water or sanitary sewer system.

Methods for cleaning up:

Keep in suitable, closed containers for disposal. Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).

Other information:

Comply with all applicable federal, state, and local regulations.

8. HANDLING AND STORAGE

Handling: Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in the data sheet must be observed.

Storage: Store in a cool, dry ventilated area. Keep from freezing.

9. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines

ALIPHATIC HYDROCARBON		254504001-5164	
ACGIH	time weighted average	200 mg/m ³	Non-aerosol
NIOSH	Recommended exposure limit (REL)	100 mg/m ³	

General advice: These recommendations provide general guidance for handling this product. Personal Protective Equipment should be selected for individual applications and should consider factors which affect exposure potential, such as handling practices, chemical concentrations and ventilation. It is ultimately the responsibility of the employer to follow regulatory guidelines established by local authorities.

Exposure controls: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below exposure guidelines (if applicable) or below levels that cause known, suspected or apparent adverse effects.

Personal protection equipment

Respiratory protection: A NOISH-approved air-purifying respirator with an appropriate cartridge and/or filter may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits (if applicable) or if overexposure has otherwise been determined. Protection provided by air-purifying respirators is limited. Use a positive pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are not known or any other circumstances where an air-purifying respirator may not provide adequate protection.

Hand Protection: Impervious gloves (butyl-rubber or neoprene) are recommended.

Eye protection: Not required under normal conditions of use. Wear chemical splash-proof goggles if there is the potential for exposure of the eyes to liquid, vapor or mist.

Skin/body protection: Wear resistant gloves such as butyl-rubber (consult your safety equipment supplier). Wear normal work clothing including long pants, long-sleeved shirt and safety shoes, foot covering to prevent direct contact of the product with the skin. Launder clothing before reuse. If skin irritation develops, contact your facility health and safety professional or your local safety equipment supplier to determine the proper personal protective equipment for your use. Discard gloves that show tears, pinholes, or signs of wear.

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10. **PHYSICAL AND CHEMICAL PROPERTIES**

Color:	white, liquid
Odor:	mild hydrocarbon like odor
pH:	(ca.) 3.7@10g/l
Flash point:	>212°F / >100°C, Cleveland open cup
Ignition temperature:	no data available
Solubility (H ₂ O):	water soluble
Solubility:	no data available
Evaporation Rate:	<1 (butyl acetate=1)
Exposure limits:	No data.
Particle size:	no data available
Vapor pressure:	35.00 hPa @ 68°F / 20°C.
Boiling Point/Boiling Range	103.00°C /217°F
Melting point/range	<5°F/-15°C
Sublimation point:	no data available
Relative Vapor density:	No data.
Density:	1.03 – 1.04 g/cm ³
Bulk density:	no data available
Autoignition temperature	No data.
Partition coefficient:n- octanol/water	No data.
log Pow	No data available.
Viscosity, dynamic:	(<) 4,000.000 mPa. s@20°C (>) 7mPa.s @ 40°C
Viscosity, kindmatic:	(>) 7mm ² /s @40°C
Solids in Solution:	no data available
Decomposition temperature	no data available
Burning number	no data available
Dust explosion constant	no data available
Minimum ignition energy	no data available

11. **STABILITY AND REACTIVITY**

Stability:	Stable under usual application conditions.
Conditions to avoid:	None known.
Hazardous Decomposition Products:	Hydrocarbons, carbon dioxide and carbon monoxide, nitrogen oxides.
Hazardous reactions:	Product will not undergo hazardous polymerization.
Incompatibility:	Acid, strong reducing agents, strong oxidizing agents.
Thermal Polymerization:	No data.

12. **TOXICOLOGICAL INFORMATION**

Acute oral toxicity

ALIPHATIC HYDROCARBON	LD50 Rat: >8,000 mg/kg
POLYMER	LD 50 Rat: 2,000 mg/kg
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	LD50 Rat: >2,000 mg/kg

Acute inhalation toxicity

ALIPHATIC HYDROCARBON	LD50 Rat: >2500 PPM; 4H
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

Acute dermal toxicity

ALIPHATIC HYDROCARBON	LD50 Rat: >4,000 mg/kg
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

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13. **ECOLOGICAL INFORMATION**

Biodegradability

ALIPHATIC HYDROCARBON	No data available
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

Bioaccumulation

ALIPHATIC HYDROCARBON	No data available
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

Ecotoxicity effects

Toxicity to fish: 48h LC50 Pimephales promelas (fathead minnow); 11.00 mg/L

Toxicity to daphnia and other aquatic invertebrates: 48h LC50 Water flea (Ceriodaphnia dubia): 1.75

Toxicity to algae

ALIPHATIC HYDROCARBON	No data available
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

Toxicity to bacteria

ALIPHATIC HYDROCARBON	No data available
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

Biochemical Oxygen Demand (BOD): Biochemical oxygen demand: 383,000 mg/L

Chemical Oxygen Demand (COD): 1,930,000 mg/L Method: Chemical oxygen demand

Additional Ecological Information

ALIPHATIC HYDROCARBON	No data available
POLYMER	No data available
ALCOHOLS, C12-18, ETHOXYLATED>1<2.5MOLE	No data available

14. **DISPOSAL CONSIDERATIONS**

General Product Information:

Dispose according to local, state, and federal regulations.

Disposal Instructions:

Contain and collect using absorbent material if needed. Place collected material into suitable containers for proper disposal.

15. **TRANSPORT INFORMATION**

REGULATION

ID NUMBER	PROPER SHIPPING NAME	*HAZARD CLASS	SUBSIDIARY HAZARDS	PACKING GROUP	MARINE POLLUTANT /LTD. QTY.
	U.S. DOT - ROAD				Not dangerous goods
	U.S. DOT - RAIL				Not dangerous goods
	U.S. DOT - INLAND WATERWAYS				Not dangerous goods
	TRANSPORT CANADA - ROAD				Not dangerous goods
	TRANSPORT CANADA - RAIL				Not dangerous goods
	TRANSPORT CANADA - INLAND WATERWAYS				Not dangerous goods
	INTERNATIONAL MARITIME DANGEROUS GOODS				Not dangerous goods
	INTERNATIONAL AIR TRANSPORT ASSOC. - CARGO				Not dangerous goods
	INTERNATIONAL AIR TRANSPORT ASSOC. - PASSENGER				Not dangerous goods

MEXICAN REGULATION FOR THE LAND TRANSPORT OF HAZARDOUS MATERIALS AND WASTES	Not dangerous goods
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***ORM + ORM-D, CBL=COMBUSTIBLE LIQUID**

Dangerous goods descriptions (if indicated above) may not reflect quantity, end-use or region-specific exceptions that can be applied. Consult shipping documents for descriptions that are specific to the shipment.

16. REGULATORY INFORMATION

California Prop. 65

Proposition 65 warnings are not required for this product based on the results of a risk assessment.

SARA Hazard Classification

No SARA Hazards

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

New Jersey RTK Label Information

POLYMER	NJTS 254504001-5464
WATER	7732-18-5
ALIPHATIC HYDROCARBON	127036-24-2
NONIONIC SURFACTANT POLYMER	254504001-5817

Pennsylvania RTK Label Information

POLYMER	NJTS 254504001-5464
WATER	7732-18-5
ALIPHATIC HYDROCARBON	254504001-5164
NONIONIC SURFACTANT POLYMER	254504001-5817

Notification Status

US. TOXIC SUBSTANCES Control Act	Y (positive listing)
Canada. Canadian Environmental Protection Act (CEPA)	Y (positive listing)
Domestic Substances List (DSL). (Can.Gaz. Part II, Vol. 133)	
Japan. Kashin-Hou Law List	n (negative listing)
Korea. Toxic Chemical Control Law (TCCL) List	Y (positive listing)
Australia. Industrial Chemical (Notification and Assessment) Act	Y (positive listing)
New Zealand, Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	n (negative listing)
China. Inventory of Existing Chemical Substances	Y (positive listing)
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	Y (positive listing)

HMIS / NFPA	HEALTH	FLAMMIBILTIY	REACTIVITY	other
	1	1	0	No data

15. OTHER INFORMATION

Reasonable care has been taken in the preparation of this information, but the manufacturer makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The manufacturer makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This information is for the specific material described only and may not be valid if the material is used in combination with any other materials or in any process. The user is responsible to determine the completeness of the information and suitability for the user's own particular use. The knowledge and belief of the company, the information is accurate and reliable as of the date indicated but the company makes no express or implied warranty of merchantability for the material or the information. The company makes no express or implied warranty of fitness for a purpose for the material or for the information.

APPENDIX P
L-691 Sewer Lagoon Permits

Appendix P-1
Non-Radioactive Air Emission Notice of Construction Approval Order
DE12NWP-001

**NON-RADIOACTIVE AIR EMISSIONS
NOTICE OF CONSTRUCTION APPROVAL ORDER
CONDITIONS AND RESTRICTIONS
DE12NWP-001**

REGULATORY AUTHORITY:

Pursuant to the Washington State Department of Ecology (Ecology) General Regulations for Air Pollution Sources, Chapter 173-400 Washington Administrative Code (WAC), and Controls for New Sources of Toxic Air Pollutants, Chapter 173-460 WAC, Ecology now finds the following:

FINDINGS:

1. The United States Department of Energy proposes to modify their existing facility (Hanford) located in Richland, Washington.
2. A Notice of Construction (NOC) application was submitted on December 15, 2011. The application was found to be complete on December 21, 2011.
3. Hanford is an existing major stationary source that emits more than 250 tons of a regulated pollutant per year.
4. The proposed project consists of constructing a wastewater treatment system, referred to as the Lagoon Treatment System (LTS), to provide domestic waste treatment services for the Hanford Site.
5. The proposed project emissions are based on influent wastewater concentrations.
6. Emissions of criteria pollutants from the proposed project are below the Prevention of Significant Deterioration Significant Emission Rates.
7. Hanford is located in a Class II Area designated as "attainment" for the purpose of NOC permitting for all pollutants.
8. Air pollutant emission increases from the proposed project are below the *de minimis* levels in WAC 173-400-110(5)(d) with the exception of ammonia, chloroform, and 1,4-dichlorobenzene.
9. As proposed, the project would emit no Toxic Air Pollutants (TAPs) exceeding small quantity emission rates (SQERs) of WAC 173-460-150. All TAPs met the acceptable source impact levels (ASILs).
10. Best Available Control Technology (BACT) for this project has been determined to be operation of the LTS in conformance with good operating principles, standard industry practices, and conformance with an approved Operations and Maintenance (O&M) program as approved under WAC 173-240.
11. The proposed project, if constructed and operated as herein required, will provide BACT.

12. The proposed project, if operated as herein required, will be in accordance with applicable rules and regulations, as set forth in Chapter 173-400 WAC and Chapter 173-460 WAC, and the operation thereof will not result in ambient air quality standards being exceeded.
13. The project will have no significant impact on air quality.

THEREFORE, IT IS ORDERED that the project as described in said Notice of Construction application, and as detailed in emissions estimates and impact and control technology assessments submitted to the Washington State Department of Ecology in reference thereto, is approved for construction, installation, and operation, provided compliance with the conditions and restrictions described below. This Order shall be identified as NOC Order **DE12NWP-001**.

1.0 APPROVAL CONDITIONS

1.1 Effective Date

The effective date of this authorization shall be that as signed in Section 5.0. All references to procedures or test methods shall be to those in effect as of the effective date of this ORDER.

1.2 Emission Limits

- 1.2.1 All TAPs, as submitted in the Permittee's Notice of Construction Application (Table 1), shall be below their respective ASILs.

Table 1: Toxic Air Pollutants from the Lagoon Treatment System (DE12NWP-001)

Chemical Name	CAS #	ASIL ($\mu\text{g}/\text{m}^3$)
1,4-Dichlorobenzene	106-46-7	0.0909
Chloroform	67-66-3	0.0435
Ammonia	7664-41-7	70.8

1.3 Compliance Demonstration

- 1.3.1 Compliance with Approval Condition 1.2.1 shall be demonstrated by using surrogate wastewater sampling conducted annually (once per calendar year) as described in Section 3.0.
- 1.3.2 Compliance with Approval Conditions 1.2.1 shall be demonstrated through operational record keeping provisions of Section 2.3.

2.0 NOTIFICATIONS AND SUBMITTALS

2.1 Addressing

Any required notifications and submittals required under these Approval Conditions shall be sent to:

Washington State Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

2.2 Operational Notice

Notification will be made at least ten (10) days prior to the Lagoon Treatment System becoming fully operational. This notification may be sent by email to the Nuclear Waste Program and/or to the address listed in section 2.1.

2.3 Recordkeeping

Specific records shall be kept on the Hanford Site by the Permittee and made available for inspection by Ecology upon request. The records shall be organized in a readily accessible manner and cover a minimum of the most recent sixty (60) month period. The records to be kept shall include the following:

1. Records of maintenance activities performed in accordance with the Operations and Maintenance (O&M) program as approved under WAC 173-240.
2. Laboratory analysis result summaries taken in accordance with these approval conditions for wastewater concentrations for pollutants listed in Table 2.
3. Laboratory analysis result summaries taken in accordance with these approval conditions of any samples undertaken after the effective date of this ORDER from the LTS which are examined for organic species or other TAPS.

2.4 Reporting

Results of wastewater sampling conducted pursuant to Section 3.0 shall be submitted to Ecology within ninety (90) days of completion of validated laboratory analysis results of such assessment if any pollutant concentration exceeds Table 2 values.

Notification of identification of any TAP not previously identified within the Notice of Construction Application emissions estimate shall be submitted to Ecology within ninety (90) days of completion of validated laboratory analyses and shall include WATER9 modeling which verify/quantify emissions of that toxic air pollutant from the project.

3.0 EMISSION MONITORING

The following sampling and monitoring are required in order to verify emissions estimates and compliance with Section 1.2.1, above.

3.1 Baseline Assessment

A baseline assessment shall be conducted within ninety (90) days of commencement of operations of the LTS for each of the three applicable TAPs in Table 2 (Ammonia, Chloroform, and 1,4-dichlorobenzene). As the estimated air emissions have been calculated from liquid wastewater influent concentrations, sampling and analysis for Table 2 pollutants in the influent stream will be in accord with an EPA approved method in 40 CFR Part 136.

Table 2: Lagoon Treatment System Wastewater Influent Concentrations

Pollutant	Wastewater Influent	
	Concentration	Units
Ammonia	60	mg/L
Chloroform	50	µg/L
1,4-dichlorobenzene	135	µg/L

3.2 TAPs Emission Assessment using Surrogate Wastewater Concentrations

Permittee will develop and implement an annual sampling and analysis plan (SAP). Each SAP shall address the collection of the wastewater sample between the wastewater truck discharge point and the truck unloading chamber. To minimize potential pollutant loss due to agitation and timeliness, the sample location must be before significant agitation of the wastewater stream occurs and before any holding chamber. Analytical methods for the analyses shall be in accord with an EPA approved method in 40 CFR Part 136.

4.0 APPROVAL ORDER AND RESTRICTIONS

Operation of the subject Lagoon Treatment System is only intended for domestic waste treatment services for the Hanford Site. For the purposes of this Authorization, "domestic waste treatment services" includes two waste streams:

- Primary waste stream consisting of raw wastewater hauled from holding tanks and flows from the Hanford Site sewer collection systems
- Secondary waste stream consisting of hauled septage from outside of the LTS and sludge solids diverted from the LTS settling lagoons

5.0 GENERAL CONDITIONS

All plans, specifications, and other information submitted to the Department of Ecology relative to this project and any authorizations or approvals or denials in relation thereto shall be incorporated herein and made a part thereof.

- 5.1 Availability of Order and O&M Manual:** Legible copies of this Order and the O&M manual shall be available to employees in direct operation of the LTS, and be available for review upon request by Ecology.
- 5.2 Discontinuing Construction or Operations:** It shall be grounds for rescission of this approval if physical construction or operation is discontinued for a period of eighteen (18) months or more. Ecology may extend the 18-month period upon request.
- 5.3 Compliance Assurance Access:** Access to the source by representatives of Ecology or the EPA shall be permitted upon request. Failure to allow such access is grounds for enforcement action under the federal Clean Air Act or the Washington State Clean Air Act, and may result in revocation of this Approval Order.
- 5.4 Equipment Operation:** Operation of the LTS and related equipment shall be conducted in compliance with all data and specifications submitted as part of the NOC application and in accordance with the O&M manual, unless otherwise approved in writing by Ecology.
- 5.5 Activities Inconsistent with the NOC Application and this Approval Order:** Any activity undertaken by the permittee or others, in a manner that is inconsistent with the NOC application and this determination, shall be subject to Ecology enforcement under applicable regulations.
- 5.6 Obligations under Other Laws or Regulations:** Nothing in this Approval Order shall be construed to relieve the permittee of its obligations under any local, state or federal laws or regulations.
- 5.7 Modifications:** Any modifications to the LTS system's operating and maintenance procedures, contrary to information in the NOC application, shall be reported to Ecology at least 60 days before such modification. Such modification may require a new or amended NOC Approval Order.

YOUR RIGHT TO APPEAL

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do all of the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	Department of Ecology Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW STE 301 Tumwater, WA 98501	Pollution Control Hearings Board PO Box 40903 Olympia, WA 98504-0903

This Authorization may be modified, suspended, or revoked in whole, or in part, for cause including, but not limited to, the following:

1. Violation of any terms or conditions of this authorization;
2. Obtaining this authorization by misrepresentation, or failure to fully disclose all relevant facts.

The provisions of this authorization are severable and, if any provision of this authorization, or application of any provisions of this authorization to any circumstance, is held invalid, the application of such provision to their circumstances, and the remainder of this authorization, shall not be affected thereby.

The New Source Review Fee has been assessed according to WAC 173-455. No approval of a permit or service for any activity covered in this Order will be valid until the required fee is paid in full.

DATED at Richland, Washington, this 12th day of January 2012.

REVIEWED AND PREPARED BY:

Philip Gent, P.E.

APPROVED BY:

Jane A. Hedges

Appendix P-2
State Waste Discharge Permit
ST0045514

Page 1 of 20
Permit No. ST0045514

Effective Date: July 1, 2012
Expiration Date: June 30, 2017

State Waste Discharge Permit Number ST0045514

State of Washington
Department Of Ecology
Olympia, Washington 98504-7600
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

In compliance with the provisions of the
State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington, as amended,

United States Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

is authorized to discharge wastewater in accordance with the special and general conditions which follow.

Plant Location: Hanford Site, northeast of the 200 West Area	Discharge Location: Section 31, Range 26EWM, Township 13N
Treatment Type: Non-discharging, lined evaporative lagoon	

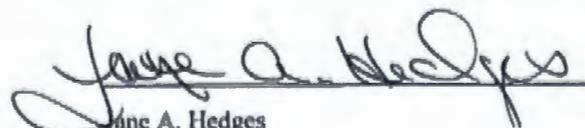

Jane A. Hedges
Program Manager
Nuclear Waste Program

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Summary of Permit Report Submittals

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Discharge Monitoring Report	Quarterly	October 15, 2012
S3.A	Lagoon Sludge Depth	1/permit cycle	June 30, 2017
S3.E	Reporting Permit Violations	As necessary	
S3.F	Other Reporting	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S4.E	Wasteload Assessment	1/permit cycle	By June 30, 2017
S5.F	Reporting Bypasses	As necessary	
S5.G	Operations and Maintenance Manual	1/permit cycle	September 1, 2012
S5.G	Operations and Maintenance Manual Update or Review Confirmation Letter	Annually	September 1
S7	Application for Permit renewal	1/permit cycle	By April 30, 2017
G1	Notice of Change in Authorization	As necessary	
G4	Permit Application for Substantive Changes to the Discharge	As necessary	
G5	Engineering Report for Construction or Modification Activities	As necessary	
G7	Notice of Permit Transfer	As necessary	
G8	Payment of Fees	As assessed	
G10	Duty to Provide Information	As necessary	

Special Conditions

S1. Discharge Limits

S1.A. Effluent Limits

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a concentration in excess of, that authorized by this permit violates the terms and conditions of this permit. Wastewater flows and loadings must not exceed the Design Criteria specified in Section S4.

Beginning on July 1, 2012 and lasting through June 30, 2017, the Permittee is authorized to discharge domestic wastewater to double-lined evaporation ponds at the permitted location subject to the following limits:

Parameter	Annual Average
Flow	55,000 gallons per day (gpd)

S2. Monitoring Requirements

S2.A. Wastewater Monitoring

The Permittee must monitor the wastewater according to the schedule in Table 1 (see page 6). The Permittee must use the specified analytical methods unless the method used produces measurable results in the sample and the United States Environmental Protection Agency (EPA) has listed it as an EPA-approved method in 40 Code of Federal Regulations (CFR) Part 136.

If the Permittee uses an alternative method, not specified in the permit and as allowed above, it must report the test method, Detection Limit (DL), and Quantitation Level (QL) on the discharge monitoring report or in the Discharge Monitoring Report.

Table 1. Wastewater Monitoring Requirements

Parameter	Units	Laboratory Method	Minimum Sampling Frequency	Sample Type
(1) Wastewater Influent Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.				
Flow	55,000 gallons a day (gpd)		Continuous ^a	Metered/Recorded
Biochemical Oxygen Demand (BOD ₅)	Milligrams/Liter	SM 5210 B	4/year ^b	8-Hour Composite ^c
BOD ₅	Pounds/day ^d	Not applicable (NA)	4/year ^b	Calculated ^e
Total Suspended Solids (TSS)	Milligrams/Liter	SM 2540 D	4/year ^b	8-Hour Composite ^c
TSS	Pounds/day	NA	4/year ^b	Calculated
Parameter	Units	Laboratory Method	Minimum Sampling Frequency	Sample Type
(2) Final Wastewater Effluent Final Wastewater Effluent means wastewater which is exiting, or has exited, the last treatment process or operation.				
Evaporative Lagoon Depth	0.1 feet	NA	Monthly	Measured
Evaporative Lagoon Sludge Depth	0.1 inches	NA	1/Permit Cycle	Measured
Leaked Water ^f	Yes/No	NA	Daily, if present	Measured
Volume of Leaked Water	gpd	NA	Weekly, or as measured when pumped	Measured
a	Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Flow must be measured hourly during influent flows when continuous monitoring is not possible.			
b	4/year means 4 times per year. The Permittee must report data on the discharge monitoring report.			
c	8-hour composite means a manual composite collected over an 8 hour period. The composite shall be composed of at least four separate grab samples of equal volume, collected at two to three hour intervals during a normal work day which is at least 8 hours long. All attempts should be made to keep sample timing and methodology consistent over all sample events.			
d	Pounds/day = Concentration (mg/L) x Flow (in MGD) x 8.34			
e	Calculated means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day			
f	If leaked water is observed report yes, if not report no.			

In the event of an emergency discharge to the ditch east of the lagoons, the Permittee will be required to sample the effluent and measure the flow rate. Contact the Department of Ecology for sampling requirements in the event of an emergency discharge.

S2.B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition. Those conditions include bypasses, upsets, and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the water and wastewater monitoring requirements specified in this permit must conform to the latest revision of the following rules and documents unless otherwise specified in this permit or approved in writing by the Department of Ecology (Ecology):

- Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136.
- Standard Methods for the Examination of Water and Wastewater (American Public Health Association).

S2.C. Flow Measurement

The Permittee must:

1. Select and use appropriate flow measurement devices and methods consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard and the manufacturer's recommendation for that type of device.
3. Calibrate these devices at the frequency recommended by the manufacturer.
4. Maintain calibration records for at least three years.

S2.D. Laboratory Accreditation

The Permittee must ensure that all monitoring data required by Ecology is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*. Flow and internal process control parameters are exempt from this requirement.

S2.E. Request for Reduction in Monitoring

After twelve (12) months of monitoring, the Permittee may request a reduction of the sampling frequency. Ecology will review each request and at its discretion grant the request when it reissues the permit or by a permit modification.

To request a reduction in monitoring, the Permittee must:

1. Provide a written request.
2. Clearly state the parameters for which it is requesting reduced monitoring.
3. Clearly state the justification for the reduction.

S3. Reporting and Recordkeeping Requirements

The Permittee must monitor and report in accordance with the following conditions. The falsification of information submitted to Ecology constitutes a violation of the terms and conditions of this permit.

S3.A. Reporting

The first monitoring period begins on the effective date of the permit. The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by Ecology. Include a summary listing daily results for influent flow and volume of water leaked (if applicable). If submitting DMRs electronically, report a value for each day sampling occurred and for the summary values (when applicable) included on the form.
2. Submit the form as required with the words "no discharge" entered in place of the monitoring results, if the facility did not discharge during a given monitoring period. If submitting DMRs electronically, you must enter "no discharge" for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate.
3. Ensure that DMR forms are postmarked or received by Ecology no later than the dates specified in S3.A.4, unless otherwise specified in this permit. If submitting DMRs electronically, submit the DMR no later than the dates specified, unless otherwise specified in this permit.
4. Submit DMRs for parameters with the monitoring frequencies specified in Condition S2 (monthly, quarterly, annual, etc.) at the reporting schedule identified below. The Permittee must:
 - a. Submit **quarterly** DMRs by the 15th day of the month following the completed monitoring period.
 - b. Submit the measured sludge depth in the evaporative lagoons no later than June 30, 2017.
5. Submit reports to Ecology online using Ecology's electronic DMR submittal forms or send reports to Ecology at:

Water Quality Permit Coordinator
Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, WA 99354

S3.B. Records Retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include:

1. All calibration and maintenance records and all original recordings for continuous monitoring instrumentation.
2. Copies of all reports required by this permit.
3. Records of all data used to complete the application for this permit.

The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

The Permittee must retain all records pertaining to the monitoring of sludge for a minimum of five (5) years.

S3.C. Recording of Results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, and time of sampling.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.
4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

S3.D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR.

S3.E. Reporting Permit Violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

1. Immediately take action to stop, contain, and clean up unauthorized discharges or otherwise stop the noncompliance and correct the problem.
2. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

a. Immediate reporting

The Permittee must immediately report to Ecology (at the number listed below):

- Emergency discharge of the lagoons, or any overtopping or catastrophic failure of the lagoons.

- Collection system overflows.
- Plant bypasses resulting in a discharge.
- Any other failures of this sewage system (pipe breaks, etc.)

Nuclear Waste Program 509-372-7950

b. Twenty-four hour reporting

The Permittee must report the following occurrences of noncompliance by telephone to Ecology at the telephone number listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

1. Any noncompliance that may endanger health or the environment, unless previously reported under immediate reporting requirements.
2. Any unanticipated bypass that causes an exceedance of an effluent limit in the permit (See Part S5.F., "Bypass Procedures").
3. Any upset that causes an exceedance of an effluent limit in the permit. Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.
4. Any violation of a discharge limit for any of the parameters in Section S1.A of this permit.
5. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limit in the permit.

c. Report within five or ten days

The Permittee must also provide an electronic submission within five days, or a written submission within 10 days, of the time that the Permittee becomes aware of any reportable event under S3.E.a or b. The submission must contain:

1. A description of the noncompliance and its cause.
2. Maps, drawings, aerial photographs, or pictures to show the location and cause(s) of the non-compliance.
3. The period of noncompliance, including exact dates and times.
4. The estimated time the Permittee expects the noncompliance to continue if not yet corrected.
5. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
6. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

d. Waiver of written reports

Ecology may waive the written report required in S3.E.c, upon request and on a case-by-case basis, if the Permittee has submitted a timely oral report.

e. All other permit violation reporting

All permit violations not requiring immediate or within 24 hours reporting must be reported when the Permittee submits monitoring reports for S3.A ("Reporting").

The reports must contain the information listed in S3.E.c. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

f. Report submittal

The Permittee must submit reports to the address listed in S3.A.

S3.F. Other Reporting

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must submit such facts or information promptly.

S3.G. Maintaining a Copy of this Permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. Facility Loading

S4.A. Design Criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Annual Average Flow	55,000 gpd
BOD ₅ Influent Loading for Maximum Month	105 lb/day

S4.B. Plans for Maintaining Adequate Capacity

a. Conditions triggering plan submittal

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months.
2. The projected plant flow or loading would reach design capacity within five years.

b. Plan and schedule content

The plan and schedule must identify the actions necessary to maintain adequate capacity for the expected population growth and to meet the limits and requirements of the permit. The Permittee must consider the following topics and actions in its plan.

1. Analysis of the present design and proposed process modifications.
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.
3. Limits on future sewer extensions or connections or additional waste loads.
4. Modification or expansion of facilities.
5. Reduction of industrial or commercial flows or waste loads.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

S4.C. Duty to Mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge, sludge use, or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

S4.D. Notification of New or Altered Sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the wastewater treatment plant is proposed which:
 - a. Would interfere with the operation of, or exceed the design capacity of, any portion of the wastewater treatment plant.
 - b. Is not part of an approved general sewer plan or approved plans and specifications.
 - c. Is subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.
2. This notice must include an evaluation of:
 - a. The wastewater treatment plant's ability to adequately transport and treat the added flow and/or waste load.
 - b. The quality and volume of effluent to be discharged to the treatment plant.
 - c. The anticipated impact on the Permittee's effluent (40 CFR 122.42[b]).

S4.E. Wasteload Assessment

The Permittee must conduct an assessment of its influent flow and waste load and submit a report to Ecology by May 31, 2017. The Permittee must submit a paper copy and an electronic copy (preferably in a portable document format [PDF]).

The report must contain:

1. A description of compliance or noncompliance with the permit effluent limits.
2. A comparison between the existing and design:
 - a. Monthly average dry weather and wet weather flows.
 - b. Peak flows.
 - c. BOD₅ loading.
3. The percent change in the above parameters since the previous report (except for the first report).
4. The present and design population or population equivalent.
5. The projected population growth rate.
6. The estimated date the Permittee expects the wastewater treatment plant to reach design capacity, according to the most restrictive of the parameters above.

Ecology may modify the interval for review and reporting if it determines that a different frequency is sufficient.

S5. Operation and Maintenance

The Permittee must, at all times, properly operate and maintain all facilities or systems of treatment and control (and related appurtenances), which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures.

This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

S5.A. Certified Operator

An operator certified for at least a Class I plant by the State of Washington must be in charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class I plant must be in charge during all regularly scheduled shifts.

S5.B. O & M Program

The Permittee must:

1. Institute an adequate operation and maintenance program for this facility.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

S5.C. Short-term Reduction

Any facility maintenance that might require interruption of wastewater treatment and degrade effluent quality must be scheduled during non-critical water quality periods. This maintenance must be carried out in a manner approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.
2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

S5.D. Electrical Power Failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to, alternate power sources, standby generator(s), or retention of inadequately treated wastes.

S5.E. Prevent Connection of Inflow

The Permittee must not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

S5.F. Bypass Procedures

This permit prohibits a bypass, which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

This permit authorizes a bypass if it allows for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass.

The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

This permit authorizes such a bypass only if:

- a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.
 - b. No feasible alternatives to the bypass exist, such as:
 - The use of auxiliary treatment facilities.
 - Retention of untreated wastes.
 - Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass.
 - Transport of untreated wastes to another treatment facility or preventative maintenance, or transport of untreated wastes to another treatment facility.
 - c. Ecology is properly notified of the bypass as required in Condition S3.E of this permit.
3. If bypass is anticipated and has the potential to result in noncompliance of this permit.
- a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:
 - A description of the bypass and its cause.
 - An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
 - A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
 - The minimum and maximum duration of bypass under each alternative.
 - A recommendation as to the preferred alternative for conducting the bypass.
 - The projected date of bypass initiation.
 - A statement of compliance with the State Environmental Policy Act.
 - A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedance of any water quality standard is anticipated.
 - Details of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

- b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during preparation of the engineering report or facilities plan and plans and specifications and must include these to the extent practical.

In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

- c. Ecology will consider the following prior to issuing an administrative order for this type of bypass:
- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
 - If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
 - If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.
 - The adverse effects of the proposed bypass.
 - Any other relevant factors.

After consideration of the above, Ecology will approve or deny the request. Ecology will, to the extent feasible, give the public an opportunity to comment on bypass incidents of significant duration.

Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

S5.G. Operations and Maintenance Manual

a. O&M Manual submittal and requirements

The Permittee must:

1. Prepare an Operations and Maintenance (O&M) Manual that meets the requirements of WAC 173-240-080 and submit it to Ecology by September 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Review the O&M Manual at least annually and confirm this review by letter to Ecology by September 1 of each year. This confirmation may be attached to the Discharge Monitoring Report cover letter. If electronic DMRs are being submitted, an electronic confirmation of the O&M Manual review is acceptable.

3. Submit to Ecology for review substantial changes or updates to the O&M Manual whenever it incorporates them into the manual. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
4. Keep the approved O&M Manual at the permitted facility.
5. Follow the instructions and procedures of the manual.

b. O&M Manual components

At a minimum, the O&M Manual should include the following information to satisfy the specific elements listed in WAC 173-240-150(2):

1. Emergency procedures for plant shutdown and cleanup in the event of wastewater system upset or failure or collection system leak.
2. Wastewater system maintenance procedures that contribute to the generation of wastewater.
3. Any directions to maintenance staff when cleaning, or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank).
4. Treatment plant process control monitoring schedule.
5. Wastewater sampling protocols and procedures for compliance with the sampling and reporting requirements in the wastewater discharge permit.
6. Protocols and procedures for double-lined evaporation pond leak system sampling and testing.
7. Emergency procedures for lagoon overtopping or failure.

S5.H. Best Management Practices/Pollution Prevention Program

The Permittee must utilize Best Management Practices (BMPs) at the facility. The discharges to be controlled by BMPs are plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage.

S6. Solid Wastes

S6.A. Solid Waste Handling

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

S6.B. Leachate

The Permittee must not allow leachate from its solid waste material to enter state waters without providing all known, available, and reasonable methods of treatment. The Permittee must not allow such leachate to cause violations of the State Surface Water Quality Standards, Chapter 173-201A WAC, or the State Ground Water Quality Standards, Chapter 173-200 WAC.

S7. Application for Permit Renewal or Modification for Facility Changes

The Permittee must submit an application for renewal of this permit no later than 60 days prior to the expiration date of this permit. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).

The Permittee must also submit a new application or supplement at least 60 days prior to commencement of discharges which may result in permit violations. These discharges may result from activities such as facility expansions, production increases, or other planned changes in the permitted facility.

GENERAL CONDITIONS

G1. Signatory Requirements

All applications, reports, or information submitted to Ecology must be signed as follows:

1. All permit applications must be signed by either a principal executive officer or ranking elected official.
2. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
 - a. The authorization is made in writing by the person described above and is submitted to Ecology at the time of authorization, and
 - b. The authorization specifies either a named individual or any individual occupying a named position.
3. Changes to authorization. If an authorization under G1.2.b is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.
4. Certification. Any person signing a document under this section must make the following certification:

"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted.

Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G2. Right of Entry

Representatives of Ecology have the right to enter at all reasonable times in or upon any property, public or private, for the purpose of inspecting and investigating conditions relating to the pollution or the possible pollution of any waters of the state.

Reasonable times include:

- Normal business hours.
- Hours during which production, treatment, or discharge occurs.
- Times when Ecology suspects a violation requiring immediate inspection.

Representatives of Ecology must be allowed to:

- Have access to, and copy at reasonable cost, any records required to be kept under terms and conditions of the permit.
- Inspect any monitoring equipment or method required in the permit.
- Sample the discharge, waste treatment processes, or internal waste streams.

G3. Permit Actions

This permit is subject to modification, suspension, or termination, in whole or in part by Ecology for any of the following causes:

1. Violation of any permit term or condition.
2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
3. A material change in quantity or type of waste disposal.
4. A material change in the condition of the waters of the state.
5. Nonpayment of fees assessed pursuant to RCW 90.48.465.

Ecology may also modify this permit, including the schedule of compliance or other conditions, if it determines good and valid cause exists. Good and valid cause includes promulgation or revisions of regulations or new information.

G4. Reporting a Cause for Modification

The Permittee must submit a new application at least 60 days before it wants to discharge more of any pollutant, a new pollutant, or more flow than allowed under this permit. The Permittee should use the State Waste Discharge Permit application, and submit required plans at the same time.

The Permittee must continue to comply with the existing permit until it is modified or reissued. Submitting a notice of dangerous waste discharge (to comply with Pretreatment or Dangerous Waste rules) triggers this requirement as well.

G5. Plan Review Required

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications should be submitted at least 60 days prior to the planned start of construction. Facilities must be constructed and operated in accordance with the approved plans.

G6. Compliance with Other Laws and Statutes

Nothing in this permit excuses the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. Transfer of this Permit

This permit is automatically transferred to a new owner or operator if:

1. A written agreement between the old and new owner or operator containing a specific date for transfer of permit responsibility, coverage, and liability is submitted to Ecology;
2. A copy of the permit is provided to the new owner and;
3. Ecology does not notify the Permittee of the need to modify the permit.

Unless this permit is automatically transferred according to Section G7.1 above, this permit may be transferred only if it is modified to identify the new Permittee and to incorporate such other requirements as determined necessary by Ecology.

G8. Payment of Fees

The Permittee must submit payment of fees associated with this permit as assessed by Ecology. Ecology may revoke this permit if the permit fees established under Chapter 173-224 WAC are not paid.

G9. Penalties for Violating Permit Conditions

Any person who is found guilty of willfully violating the terms and conditions of this permit is guilty of a crime, and upon conviction thereof may be punished by a fine of up to \$10,000 and costs of prosecution, or by imprisonment at the discretion of the court. Each day in which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit incurs, in addition to any other penalty as provided by law, a civil penalty in the amount of up to \$10,000 for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is considered a separate and distinct violation.

G10. Duty to provide information

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit.

G11. Duty to comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of chapter 90.48 RCW and is grounds for:

- Enforcement action.
- Permit termination, revocation and reissuance, or modification.
- Denial of a permit renewal application.