Algas-SDI™

ISO 9001 Certified

...Innovative liquid vaporizing and gas mixing solutions

Stabilaire

Liquid LPG Pump Packages Models: BS 1 through BS 3

Operations & Maintenance Manual

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ECLIPSE Innovative Thermal Solutions

WARNING

Read the OPERATION MANUAL before operating this equipment.

NOTE: Algas-SDI reserves the right to use alternate manufacturers' components as vendor delivery applicability dictates. Literature contained in the Operation Manual has been supplied by vendors. Please check to be sure supplied data matches your configuration. Contact Algas-SDI if any questions exist.

This equipment uses LPG-a flammable fuel, or NH3-a toxic gas, (depending on the model), handled under pressure. Inherent hazards exist and a thorough understanding of the equipment is required to allow safe operation and maintenance.

Allow only a TRAINED and FULLY QUALIFIED PERSON to service this equipment.

Any time a component must be replaced, use the same type, model, etc. DO NOT SUBSTITUTE! The consequence from such actions are unpredictable and may lead to dire consequences. When components are replaced with components not approved for use in our FM/UL listed equipment, the FM/UL listing becomes void for that unit.

Liquid LPG Pump Data Sheet

Job Number: _____ Serial Number: _____ Year Built: _____

Electrical Specifications:

Electrical Drawing: _____ Rev.: _____

Input Electrical Power: _____Volts, _____Amps, _____Phase, _____Hz.

Starter Type:

- ☐ Switch, Not Fused
- ☐ Manual Starter, Overload Heater Size: _____
- ☐ Magnetic Starter, Overload Heater Size: _____

Specifications:

Pump Type: Positive Displacement Sliding Vane
Pump Manufacturer: Blackmer

Pump Model Number:	Internal Relief Setting:	Pump Model Number:	Internal Relief Setting:
☐ LGF1	105 psi	☐ LGL2	150 psi
☐ LGL1 ¼	150 psi	☐ LGL3	150 psi
☐ LGL1 ½	150 psi		

Operating Pressure Range:

BS1 – BS2	BS3	
☐ 25-75 psig	☐ 20-65 psig	☐ Other: _____psig
☐ 70-140 psig	☐ 50-100 psig	
☐ 130-200 psig	☐ 80-170 psig	

Economy Pressure Switch Settings:

- ☐ No Switch Installed
- ☐ Close @ _____psig, re-opens at 10 psig Above Close Pressure.

Pump Speed:

☐ 1750 rpm	☐ 520 rpm
☐ 1450 rpm	☐ 470 rpm
☐ 980 rpm	☐ 420 rpm
☐ 780 rpm	☐ 350 rpm
☐ 640 rpm	

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WARRANTY

Algas-SDI International, LLC (ASDI) warrants that the equipment is free of defects in materials and workmanship under normal use and service. ASDI agrees to repair or replace, at our option, without charge f.o.b. factory, any part which has proven defective to the satisfaction of Algas-SDI International, LLC within one (1) year from the date of the original installation or within 18 months from the date of shipment, whichever is earlier. Equipment, which in the opinion of ASDI, has been damaged by improper installation or operation, or has been abused or tampered with in any way, will not be accepted for return under warranty.

Algas-SDI International, LLC will not accept back charges for work performed by others upon or in conjunction with ASDI equipment, unless prior authorization is given by means of an Algas-SDI International, LLC purchase order. Algas-SDI International, LLC will not be liable by reason of shutdown, non-operation or increased expense of operation of other equipment, or any other loss or damage of any nature, whether direct or consequential, arising from any cause whatsoever.

Algas-SDI International, LLC makes NO other warranty of any kind, whatsoever expressed or implied; and all warranties of merchantability and fitness for a particular purpose are hereby disclaimed by Algas-SDI International, LLC and excluded from these terms of sale. No person has any authority to bind Algas-SDI International, LLC to any representation or warranty other than this warranty.

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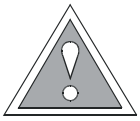
Symbols and Conventions

Special symbols are used to denote hazardous or important information. You should familiarize yourself with their meaning and take special notice of the indicated information.

Please read the following explanations thoroughly.



GENERAL WARNING OR CAUTION

Indicates hazards or unsafe practices which can result in damage to the equipment or cause personal injury. Use care and follow the instructions given.

FLAMMABLE GAS HAZARD

Indicates a potential hazard which can result in severe personal injury or death. Use extreme care and follow the instructions given.

ELECTRICAL DISCONNECT REQUIRED

Indicates a potentially dangerous situation which can result in severe personal injury or death or damage to equipment. Use great care and follow the instruction given.

ASDI CONTACT NUMBERS

If you have questions, need help with your equipment, or want information on other products, contact Algas-SDI at:

Telephone: 206.789.5410

Facsimile: 206.789.5414

Email: sales@algas-sdi.com

Internet: http://www.algas-sdi.com

Table of Contents

1. Introduction

2. Installation

3. Startup

4. Operation

5. Maintenance

6. Troubleshooting

Appendix A: Component Information

Appendix B: Technical Information

Introduction 1

SPECIAL PROBLEMS OF PUMPING LIQUID PETROLEUM GAS

Pump systems manufactured by Algas-SDI are designed to pump Liquid Petroleum Gas, both butane and propane, in their liquid state. Because propane and butane are pumped in an unnatural state, they are difficult to handle. The slightest drop in pressure or the smallest addition of heat will cause the LPG to boil, especially when it is going through a pipe. All necessary safety measures with LPG pump systems should be taken.

ALGAS-SDI PUMPING SYSTEMS

Algas-SDI **STABILAIRE** Liquid Pump Systems are fully packaged pumping systems designed to pump liquid petroleum gas in its liquid state. The systems are pressure stabilized and include a positive displacement sliding vane pump with an internal relief valve, explosion proof motor, bypass line, pressure relief valve, shut-off valve, check valves, and pressure gauges. The pressure relief valve provides a stable delivery pressure by returning excess pump capacity to the storage tank. The **STABILAIRE** systems are designed for continuous use and meet all Class 1, Division 1, Group D requirements. All of the electrical wiring is explosion-proof. An inlet strainer is provided for field installation. Each system is leak tested at the factory.

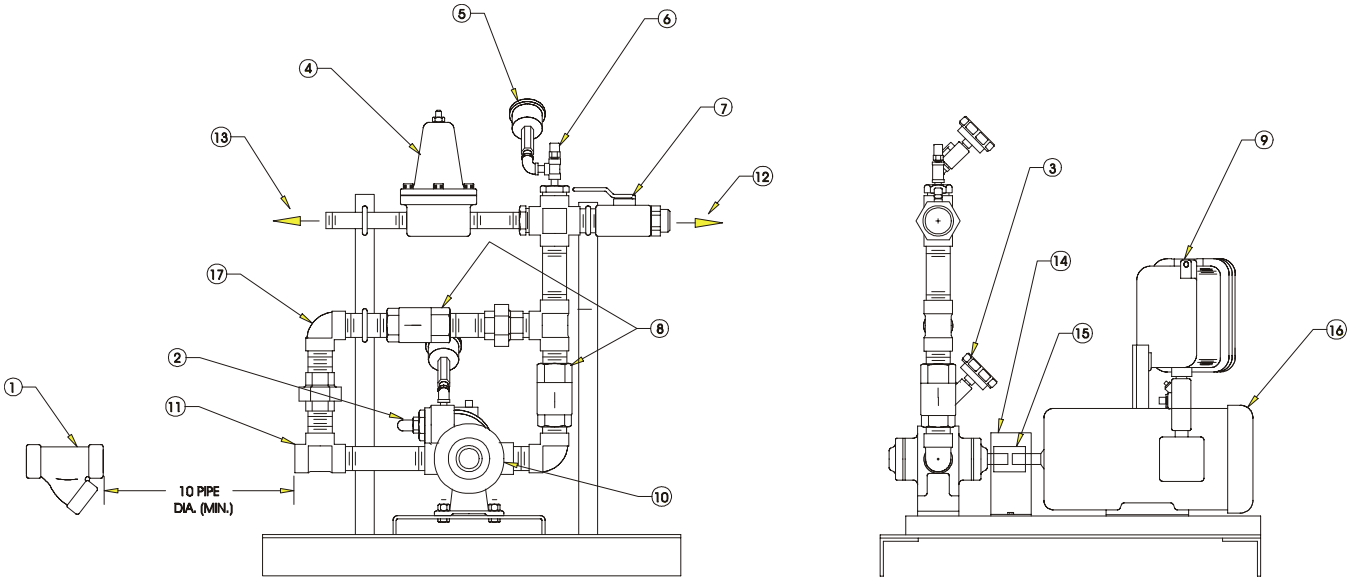
The smaller capacity pump systems, models BS1 through BS1½ are direct drive units; the pumps are either mounted directly on the face of the motor by flange or are connected to electric motors by a flexible coupling. The larger capacity pump systems, models BS2 through BS3, are driven by V-drive belts. The smaller pump systems, BS1, provide 10 to 15 gpm (38 to 57 lpm) at a differential pressure of 125 psi. (862kPa). The BS1½ have capacities from 9 to 35 gpm (34 to 132 lpm) at a differential pressure of 150 psi. Models BS2 and BS3 provide from 30 to 300 gpm (114 to 1135 lpm) at a differential pressure of 150 psi. The pumps used in the larger systems have a special cavitation liner that “cushions” the effects of collapsing vapor bubbles within the pump, reducing noise, vibration, and wear.

The pumps themselves are designed for easy maintenance and feature replaceable end disks, vanes, casing liners and seals which can be easily replaced with basic tools. The sliding vanes are self-adjusting and maintain their efficiency throughout their life.

Both direct coupled and belt driven pumps have heavy duty bolted-down safety covers surrounding their drives. All systems are supplied with industrial duty explosion-proof motors.

The pump systems feature a manual starter located near the motor. Magnetic starters featuring a Hand-Off-Auto switch are available as an option for the systems. Another option includes a pressure switch system and magnetic starter to turn on the pump when the LPG storage tank pressure is below a pre-set level.

Figure 1 – *Component Drawing – BS1 and BS1½*



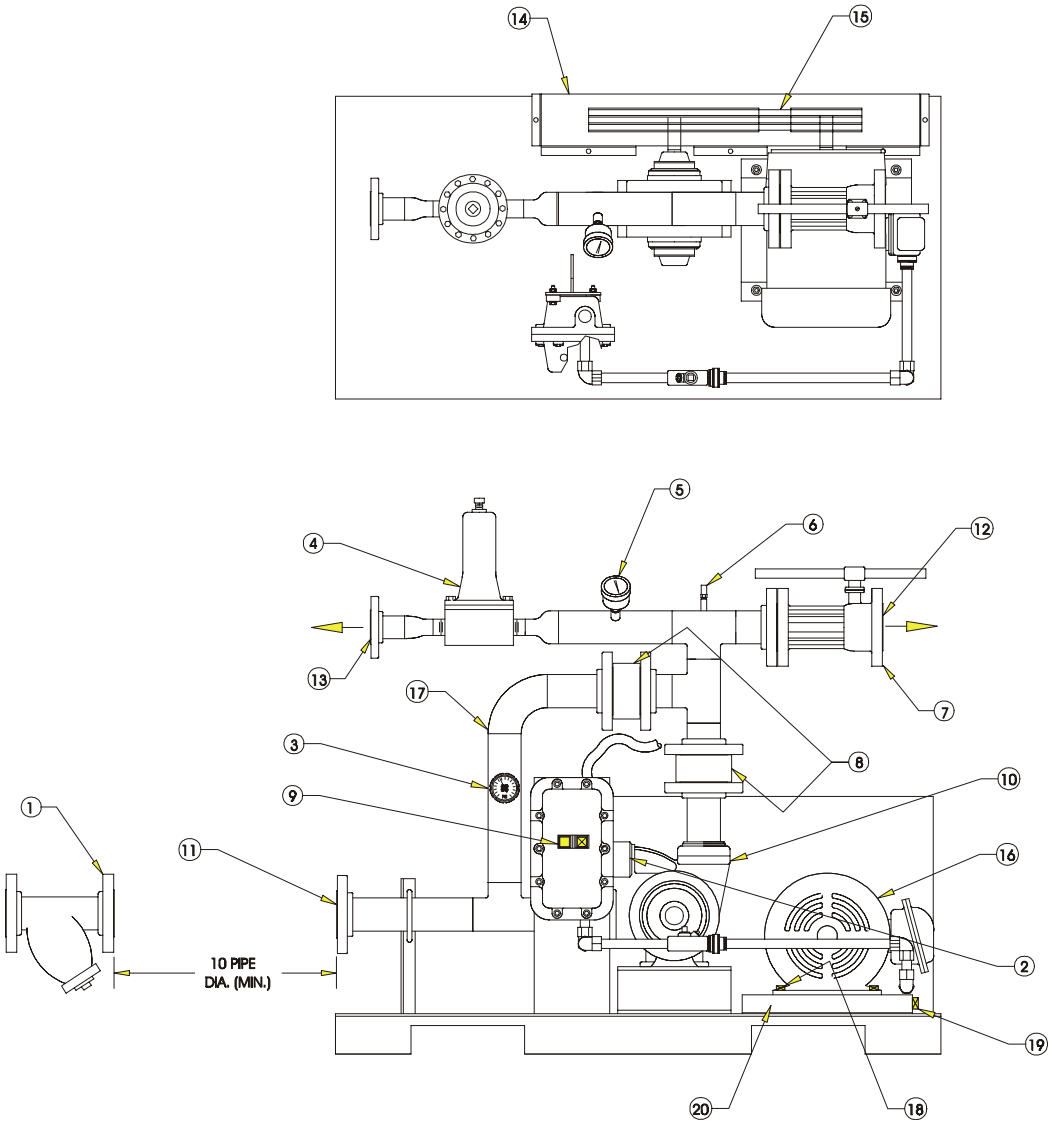
BS1 and BS1½.dxf

1. **LPG Inlet strainer.**
2. **Internal relief/bypass valve.**
3. **LPG inlet pressure gauge.**
4. **Back pressure control valve.**
5. **LPG outlet pressure gauge.**
6. **Hydrostatic relief valve.**
7. **Outlet isolation valve.**
8. **Check valves.**
9. **Starter or on/off control switch.**
10. **Pump – positive displacement sliding vane type.**
11. **LPG inlet.**
12. **LPG outlet.**
13. **LPG excess return.**
14. **Coupling guard.**
15. **Coupling between motor and pump.**
16. **Explosion-proof electric motor.**
17. **LPG bypass line.**

NOTE

These systems are designed for above ground LPG tanks. A special pumping system is required for use with underground tanks.

Figure 2 – *Component Drawing – BS2 and BS3*



BS2 and BS3

1. **LPG inlet strainer.**
2. **Internal relief/bypass valve.**
3. **LPG inlet pressure gauge.**
4. **Back pressure control valve.**
5. **LPG outlet pressure gauge.**
6. **Hydrostatic relief valve.**
7. **Outlet isolation valve.**
8. **Check valves.**
9. **Starter with on/off control switch.**
10. **Pump – positive displacement sliding vane type.**
11. **LPG inlet.**
12. **LPG outlet.**
13. **LPG excess return.**
14. **V-belt guard.**
15. **V-belt drive.**
16. **Explosion-proof electric motor.**
17. **LPG bypass line.**
18. **Motor mounting bolts.**
19. **Motor position adjustment screw.**

Basic Components of Stabilaire Pump Systems

VALVES

Back Pressure Control Valve (Item 4)

This valve adjusts downstream discharge pressure. When discharge pressure exceeds the relief valve setpoint, the LPG returns to the storage tank.

Relief/By-pass Valve (Item 2)

This valve is set to relieve excessive differential pressure if the back pressure control valve malfunctions.

Hydrostatic Relief Valve

The hydrostatic relieve valve protects the pipe from trapped LPG liquid. If liquid is trapped and builds up pressure higher than the factory setting it automatically discharges. It automatically reseats after discharge.

Isolation Valve

Isolation valves allow the gauges to be removed without shutting down the system and can also be used to bleed the system by removing the gauge first. Isolation valves also allow air to be bled out of the system when it is first installed.

Outlet Isolation Valve

The Outlet Isolation valve is used to close the pump discharge when setting the back pressure control valve and also to facilitate pump repair and maintenance.

Check Valves

Check valves prevent the LPG liquid from flowing backward to the pump while allowing a bypass for the LPG when the pump is not used.

INLET STRAINER

Traps dirt and foreign material in the system.

PUMP – POSITIVE DISPLACMENT SLIDING VANE TYPE

For maximum efficiency, the pumps use a rotor with sliding vanes. The LPG is drawn behind each vane through the inlet port and into the pumping chamber. As the rotor turns, the LPG is transferred between the vanes to the port where it is discharged as the pumping chamber narrows. Each vane pushes the LPG before it.

The Pump vanes maintain contact with the chamber by three forces: (1) centrifugal force from the rotor's rotation, (2) push rods moving between opposing vanes, and (3) liquid pressure entering through the vane grooves and acting on the rear of the vanes.

Pump efficiency is maintained as the vanes wear out. New vanes and the pump vane liner can be replaced quickly and easily without removing the pump from the system.

Rotation of the pump is always counter-clockwise when viewing the unit from the pump end. Standard assembly is with the intake to the left and discharge to the right.

EXPLOSION PROOF ELECTRIC MOTOR

The motors are sealed and the bearings do not require lubrication or maintenance of any kind.

The motors are designed for 20% overload for short periods of time. The pump motors have an overload protector and will shut off if they become overheated. Low voltage at the motor will also cause the motor to shut off.

NOTE

Explosion Proof Electric Motors are subject to moisture condensation inside when not used regularly. Moisture inside the motors can cause electrical problems and may short out the motor. To eliminate this problem, operate the motor at least once a week long enough for it to get hot.

START/STOP SWITCH

The start/stop switch is either manual or magnetic. Pumps with magnetic control systems can be operated remotely, by a computer control system or by hand. If pumps with magnetic switches are overloaded, the pump will automatically shut off.

THREE POSITION SWITCH

Pumping systems supplied with the optional magnetic starter use a 3 position switch known as a "Hand-Off-Auto" switch.

The **HAND** Position allows the pump to be started manually. The **OFF** position will stop the unit under any condition. The **AUTO** position allows the unit to be operated from a remote control source.

BY-PASS FLOW OPTION - ECONOMY SETTING

The optional by-pass feature of **STABILAIRE** Pump Systems saves energy by shutting off the pump automatically and letting incoming LPG bypass it if the tank and inlet pressure are adequate. Algas-SDI terms this "Economy Setting."

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Installation 2

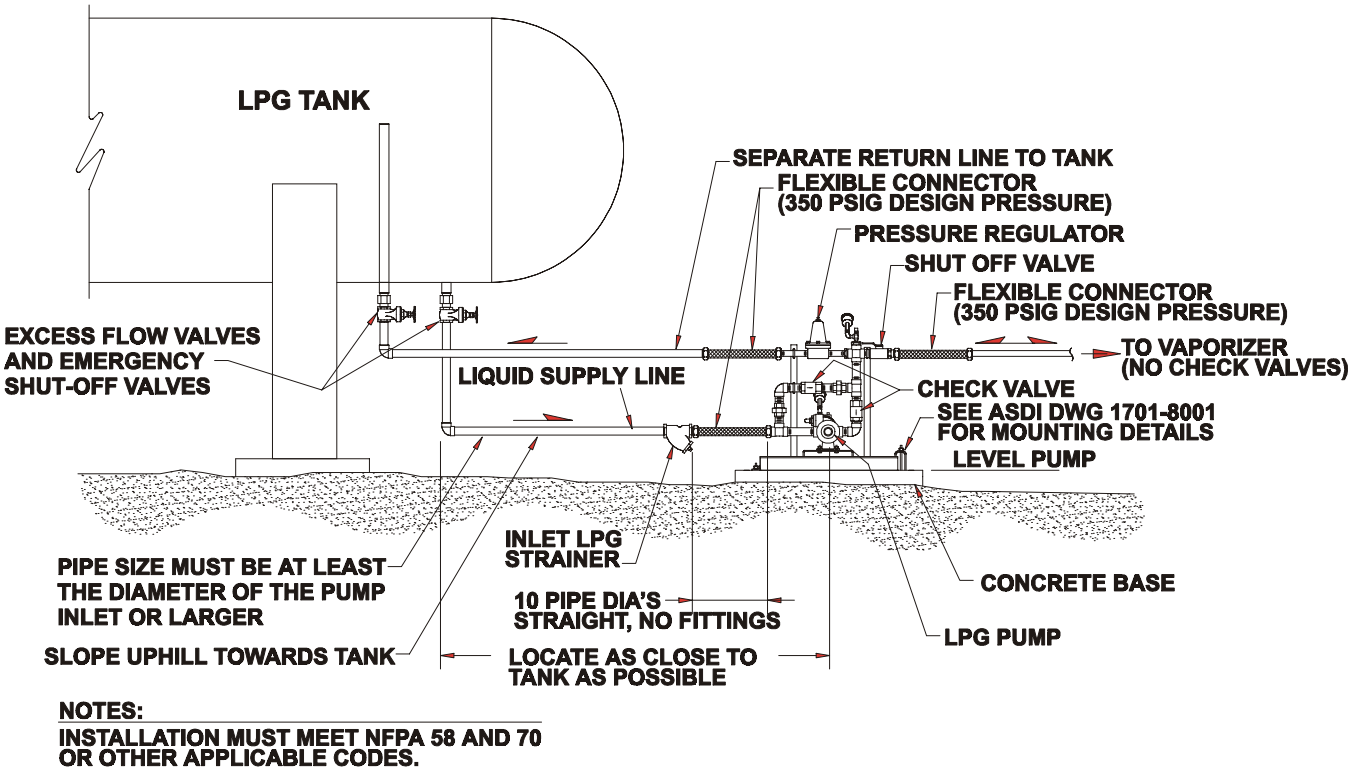
GENERAL INSTALLTION OF STABILAIRE PUMP SYSTEMS

See Figure 3. All local codes and regulations must be determined so the installation conforms to local requirements.

CAUTION

LPG is explosive and extremely flammable. Appropriate safety procedures must be observed when installing and operating the system.

Figure 3 – *Typical Installation Drawing*



Installation.wmf

PUMP BASE

The steel base of the pump unit must be installed on concrete. Pumps bolted to a concrete foundation will operate better with less vibration. The steel base must be level on the concrete. If necessary, drive metal shims under the steel base near the concrete anchor bolts to make the base level. Refer to drawing # 1701-8001 for mounting suggestions.

TYPES OF VALVES AND FITTINGS TO USE

Use gate or ball type valves, not globe valves for installation. The flow of the LPG should be as straight through as possible. *See Figure 3*.

Do not use fittings that reduce the LPG pressure. Vaporization may occur and cause cavitation.

LOCATION AND PIPING - GENERAL INFORMATION

If the LPG liquid boils in the intake line the system may fail. Boiling may be caused by heat from sunshine, heat from the earth on underground piping, heat from the atmosphere when the air is warmer than the liquid in the pipes, friction from the liquid in the pipe and restrictions in the pipe. Vapor in the pipe may reduce the flow of LPG liquid to the pump, causing damage to the pump.

Locate the pump within five feet (1.5 meters) of the LPG storage tanks to reduce the friction of the LPG through the pipe.

Whenever possible, locate the pump directly under the supply tank so the piping will be short to keep friction loss minimal and where vapors will rise into the tank.

Never locate the pump more than 50 piping feet (15 meters) from the LPG tanks.

Where the pipes are connected horizontally to the pump, slope the piping downward to the pump at least one inch per 10 feet (2.5 centimeters per 3 meters) so vapors will go back to the tanks. Whenever possible, the pipe should drop straight down from the manifold at least 12 inches (30 centimeters) to the pump.

The inlet pipe should have a length ten times that of its diameter between the pump inlet and the strainer.

Do not bury the intake lines underground. Do not route the intake piping upward at any point because vapor will accumulate. In cold weather when vaporizers are needed most, pump cavitation from vapors is much worse because bubbles from boiling are much larger because vapor pressure is low.

Flexible connectors are recommended for the intake and discharge piping because they will result in much quieter pump operation and help eliminate vaporization problems. The recommended flexible connectors should be rated at least 350 psi (24.5 KG/CM2) see NFPA 58.

When installing the system, check to make sure that the pipes are properly supported so there is no pipe strain on the pump. Always flush the piping before installing the pump to remove all debris and welding slag.

DETERMINING CORRECT PUMP CAPACITY

The delivery rate of LPG at the system operating pressure should be 2 to 3 times the maximum system consumption. For example, a 1,000 GPH system requires a pump with a capacity of 2,000 to 3,000 GPH at the desired pressure.

All vaporizers have a cycling type of operation and have changes in load during operation. In the cycling process, the flow rate of LPG liquid from the pump to the vaporizer is much larger than a calculated steady flow rate. For example, in the case of a vaporizer supplying LPG vapor to a blender that has only one venturi, the off period is zero flow and the on period is maximum flow.

When the system starts and the vaporizer begins operating, the liquid chamber is empty of LPG and must be filled rapidly to avoid a low pressure condition. This requires extra pump capacity.

Maximum flow rates are always used in determining the sizing of propane equipment. The piping from the pump to the vaporizer should be sized for the maximum capacity of the vaporizer. In determining the pump capacity, the pressure drop through the vaporizer output pressure must be determined by calculating the total pressure drop in the system.

The built-in relief valve on the pump is factory set to prevent re-circulation which would cause vapor binding. Never connect the back pressure control valve discharge pipe into the pump intake piping.

PUMP MOTORS

The lead wires to the motor starter should be run through rigid threaded metal conduit, explosion-proof joints and explosion proof condulets. Adequate size wire must be used from the power source to the motor starter.

Motor rotation should always be the same as the direction arrow on the pump body. If the motor rotation is incorrect, check the wiring with the wiring diagram on the motor.

NOTE

3 phase motors may be reversed in direction by changing the position of any two of the three lead wires.

CAUTION

Do not reverse the pump rotation to reverse the direction of the flow. This will not work! Reverse rotation would make the pump unsafe and work poorly.

An overload protector will cut off power to the motor if it overheats. The motor temperature depends on the load and the air temperature. Shading the motor from direct sunlight will help reduce its operating temperature.

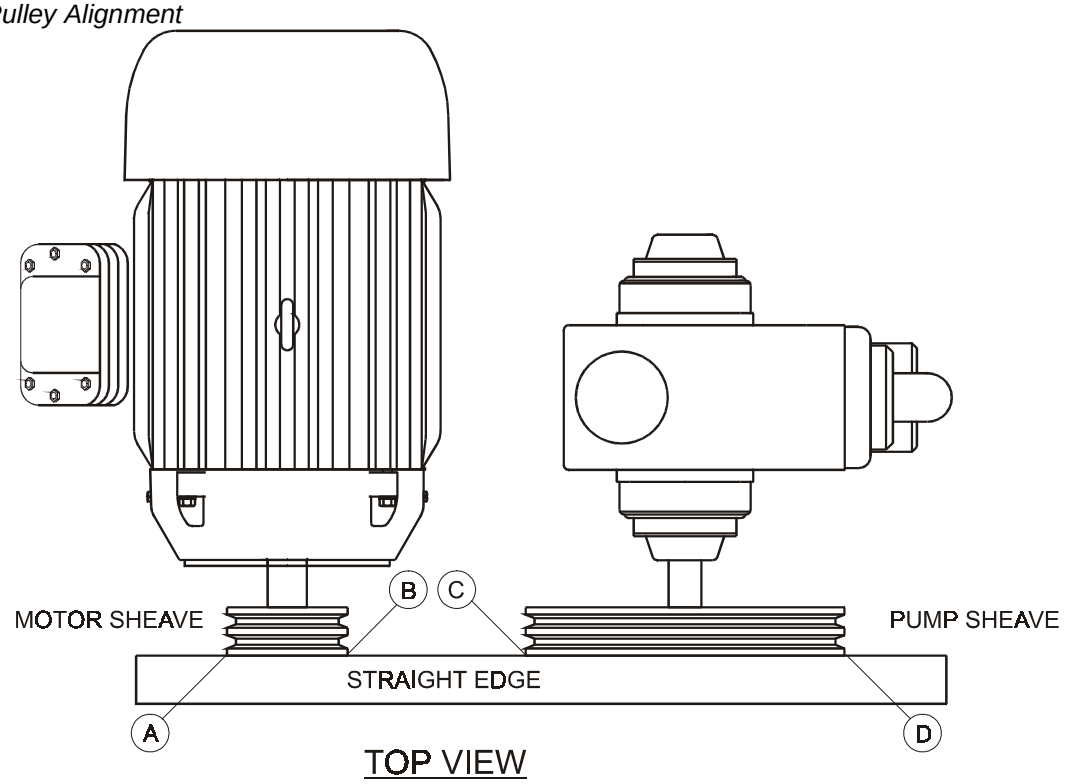
V-BELT DRIVE PUMPS

See Figure 2. Loose belts will cause noise and excessive wear. Follow these directions for installation or replacement of V-belts.

V-Belt Installation Guide

1. Remove V-Belt guard, Fig.2 Item 14, unscrew the bolts holding it down and lift it up and out of the way.
2. Check for proper rotation, by applying power to motor. Check pump rotation direction indicated on pump. Motor rotation **MUST** match that of pump.
3. After proper rotation has been verified, disconnect power to motor.
4. Loosen, but do not remove, the four mounting bolts, Fig. 2, Item 18.
5. Loosen motor position adjustment bolt(s), Fig. 2. Item 19, until approximately 1" to 1 ½" of the motor position bolt(s) are visible. This will allow the motor to be moved towards the pump for easier installation of the V-Belt(s) onto pulleys.
6. Install V-Belt(s) over both pulleys.
7. Check for proper installation of pulleys with a straight edge. Place the straight edge against the outside face of both pulleys. The straight edge **MUST** be able to lay up against both edges of both pulleys at the same time. The pulleys are aligned when the straight edge is flush at points A through D. *See Figure 4*.

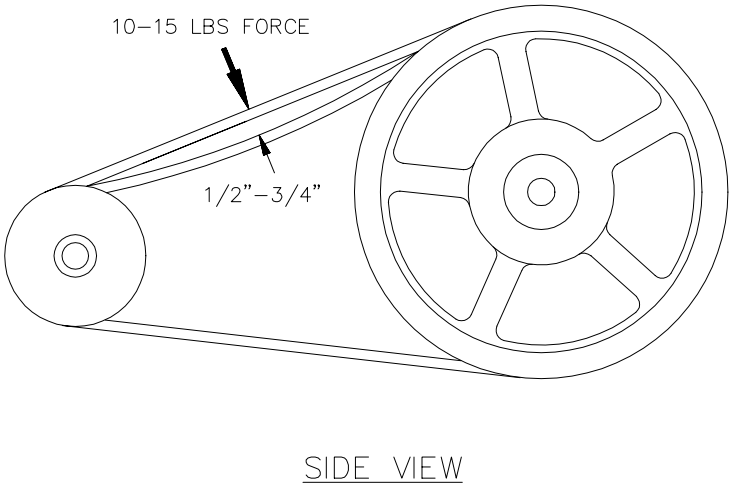
Figure 4 – *Pulley Alignment*



Pulley Alignment.dxf

8. Tighten motor position adjustment bolt(s) until proper belt tension is achieved. Proper belt tension is the lowest tension at which the belt(s) will not slip under peak load conditions. A general rule for ASDI's application of V-Belts: a 10 to 15 (4 to 7 kg) lb. pressure applied at the center point on the belt between the pump and motor pulleys should deflect the belt ½" to ¾" (1 cm to 2 cm). See Figure 5.

Figure 5 – *Proper Belt Tension*



Belt Tension.dxf

9. After proper tension has been achieved, re-check for proper pulley alignment with a straight edge. Place the straight edge against the outside face of both pulleys. The straight edge MUST be able to lay up against both edges of both pulleys, at the same time. The pulleys are aligned when the straight edge is flush at points A through D. See figure 4. If belt tension adjustment has mis-aligned the pulleys, the motor adjustment bolts must be loosened and the procedure repeated.

10. Tighten the four (4) motor mounting bolts (item 18) securely.

11. Before replacing the V-Belt guard (14), momentarily apply power to motor to double-check tension, alignment and rotation.

12. Replace the V-Belt guard and tighten all bolts securely.

DIRECT COUPLED PUMPS (REFER TO FIGURE 1)

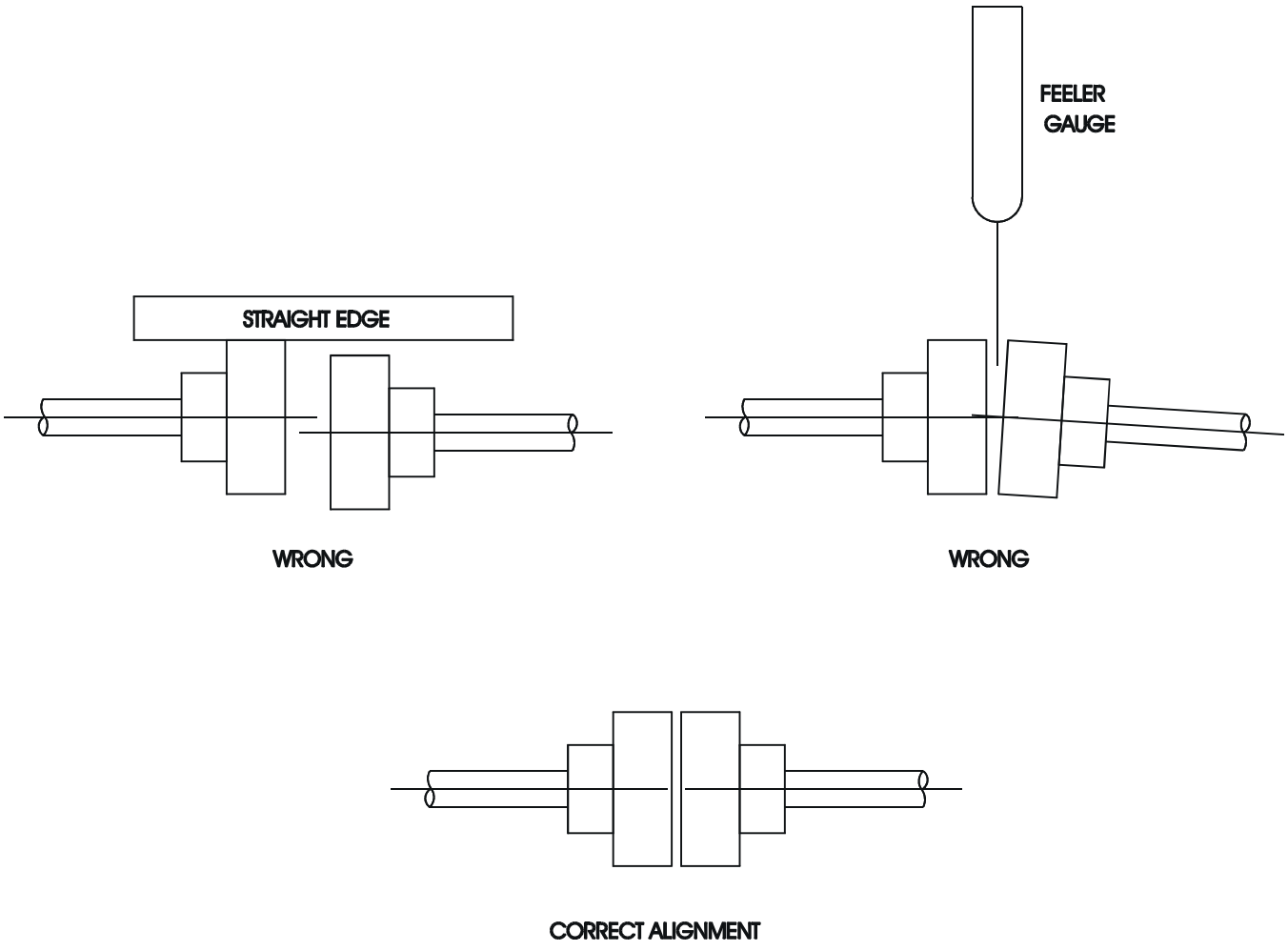
The coupling alignment must be near perfect to give quiet, long-life to the pump and driver. The pump and driver shafts are carefully aligned at the factory, but the alignment should always be checked after the pump is installed and before initial operation.

After the power to the pump motor is disconnected and the coupling guard is removed, use either of the methods on the following pages to align the pump coupling.

ALIGNMENT VERIFICATION GUIDELINES FOR DIRECT COUPLED PUMPS

1. Disconnect power to pump motor.
2. Remove coupling guard.
3. Inspect flexible coupling insert for wear.
4. Two methods can be used to check alignment of couplings. One requires the use of a small straight edge. The other requires the use of a feeler gauge.

Figure 6 – *Direct Coupled Pump Alignment*



Direct Coupled Pump Alignment.dxf

Startup 3

OPERATION CHECK

Thoroughly check the entire LPG facility for safe operation and function before starting up the process. The check must include the condition and operation of the storage tanks, pipes, electrical wiring, and appropriate valves all the way to the outlet and transfer pipes.

TAKE ALL SAFTEY PRECAUTIONS!

CAUTION

LPG is explosive and extremely dangerous. Take all necessary safety precautions in operation of the system. No open flames or sources of electrical sparks should be in the operating facility.

NOTE

All piping of the system, both incoming and outgoing, should be thoroughly cleaned and tested before starting.

WARNING

No smoking throughout the entire facility! Even smoking in an adjacent room next to the facility or close by outdoors is dangerous.

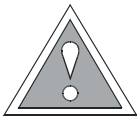
VERIFY THAT THE PUMP SYSTEM HAS BEEN INSTALLED CORRECTLY

1. Check the pump system for correct installation of all components. All bolts should be tight, secure, and the V-belts should be correctly adjusted. See the maintenance section for correct tightening of belts if necessary.
2. Check the wiring, make sure there are no broken or frayed wires and that all wiring is properly installed. Check all electrical conduit for correct installation and ensure that all fittings are tight.
3. Measure the incoming voltage with a voltmeter to check if it is the correct voltage for the system.
4. All piping should be clean, free of moisture and have no leaks. Even a small leak anywhere in the entire facility is unacceptable!

PUMP SETTINGS AND ADJUSTMENT PROCEDURES (REFER TO FIGURES 1 OR 2)

Perform these procedures on initial startup of the system, if the pump is restarted after being idle, or if the delivery pressure or tank pressure changes.

CAUTION



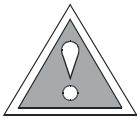
Before performing this procedure, follow all safety procedures for LPG. Make sure there are no open flames or electrical sparks, wear gloves and appropriate clothing.

ADJUSTING OUTPUT SETPOINT

1. Determine the required pump discharge pressure.
2. Slowly open shut-off valves in the storage tank for pump section line and return lines. Open all shut-off valves between storage tank and pump.
3. Verify tank pressure reading and gauge reading on LPG pump inlet. Both should correspond with each other. If not, refer to step #2.
4. Close shut-off valve at pump outlet.
5. Loosen lock nut on adjustment bolt for the control valve, Fig. 2, Item 4. Turn adjustment bolt out until it is loose. **DO NOT** remove completely.
6. Turn pump on. You may notice a slight pressure increase at the outlet pressure gauge.
7. Slowly start to turn adjustment bolt “in” on the control relief valve, Fig. 2, Item 4, until the desired outlet pressure is attained. Stop the adjustment when the pressure is obtained.
8. Tighten lock nut, making sure adjustment bolt does not turn while tightening.

INTERNAL PUMP RELIEF VALVE ADJUSTMENT

CAUTION



Only try this test briefly. If the relief valve doesn’t open during the test, open the outlet valve. The internal bypass valve of the pump is designed for emergency protection only. It may be damaged if this procedure is done for any length of time.

1. To test pump bypass valve (Fig. 2, Item 2) for proper operation, with pump outlet closed and pump on, momentarily close manual shut-off valve in the control relief valve return line to the tank. The pressure increase should be slightly higher than the normal discharge pressure.

   For example: if the outlet pressure is normally 80 psi, the outlet pressure should now be 90 to 100 psi.
2. Adjust the valve as required using a hex wrench and an open end wrench.
3. Open manual shut-off valve in the control relief valve return line to the tank.
4. Open pump outlet shut-off valve (Fig.2, Item 7). Pump is now ready for operation.

Operation 4

Startup

1. Check the system thoroughly before putting it into operation. Any problem with the system: leak, faulty valve, loose bolt or connection is unacceptable! Repairs must be made immediately.

   The wiring should be examined for correct connections, voltage and proper rotation.

2. Open all valves in the lines to the pump.

3. Turn on the power to the pump

4. Turn on the pump.

If it is in correct operating order, the motor should start quickly, the pressure will come up immediately, the pump will run at normal operating speed and the pressure gauge on the discharge side of the pump will indicate the correct operating pressure. Refer to the troubleshooting guides if there is pump noise, vibration, leakage, overheating, or low pressure.

To check pump operation separately, start it manually. (In systems with magnetic starters, put the Hand-Off-Auto Switch in the **HAND** position).

Normal Operation

OPERATING PRECAUTIONS

- Do not run the pump dry.
- Do not allow LPG liquid to cavitate in the pump as this will also damage it.
- Correct piping minimizes vaporization of the LPG liquid into the pump. Excessive vaporization in the intake line causes pump noise and excessive wear. Restrictive intake piping, globe valves, or some types of tank outlet valves can cause cavitation. Circulation of LPG liquid through the built-in relief valve causes cavitation inside the pump. The relief valve is an emergency protection device only.
- Check the inlet and outlet pressure at regular intervals.
- Check the bearing seal at the shaft end of the pump for leaks.
- Pump drives should operate satisfactorily with a minimum of vibration.
- If direct coupled pumps vibrate excessively they should be checked for alignment as noted in the maintenance section.

INLET PRESSURE

If the inlet pressure differs or fluctuates from the setpoint the system should be shut down, lines bled to zero pressure, purged and source of difficulty determined. (Changes in climate will also cause changes in inlet pressure.)

OUTLET PRESSURE

If the outlet pressure and all other parts of the pump system are functioning normally, the control valve must be reset. *See Adjusting the Output Setpoint procedure* in the initial startup section.

BACK PRESSURE RELIEF VALVE

The back pressure relief valve may need to be adjusted as climatic conditions change causing a change in the storage tank pressure.

To adjust the back pressure relief valve perform the following:

1. Turn off the pump.
2. Loosen the adjusting nut on the relief valve and screw out the pusher post all of the way.
3. Start the pump, make sure the pump is operating normally.
4. Slowly screw in the pusher post until the output pressure is the desired setting.
5. Tighten the adjusting nut.

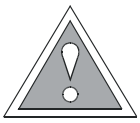
STRAINER

Inspect and clean the strainer periodically. A dirty strainer screen can cause vaporization, cavitation, lower the pump capacity and increase pump wear.

On new installations, inspect the strainer frequently until the initial accumulation of dirt and other material is flushed from the system.

To clean the strainer, shut down the system, remove the cap and remove the screen.

A plugged strainer basket or a very fine strainer may also cause cavitation and noise.



CAUTION

System pressure must be zero before the strainer basket can be removed and cleaned.

CAUTION

Strainer contents may be flammable. Observe all safety rules in handling flammable material.

LUBRICATION

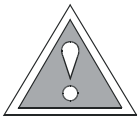
The pump bearings should be lubricated every six months with number 2 lithium-base type of grease. Apply the grease slowly with a grease gun to the grease fittings on each bearing cover until excess grease begins to come from the relief fitting. It is normal for some grease to escape from the tell-tale holes under the bearing covers for a short period after lubrication.

For operation in very low temperatures, lubricate the pump with a low temperature grease.

NOTE

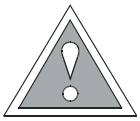
If excessive grease leaks from the holes under the bearing covers the mechanical seal may be damaged or liquified gas may be leaking past the seal and gradually washing grease out of the bearing chamber. Remove the bearing head and examine the mechanical seal for wear or damage. If gas is escaping from the tell-tale holes, the entire mechanical seal must be replaced.

Pump overhaul and repair



CAUTION

Before performing any work on the pump, follow all safety procedures for LPG gas. Make sure there are no open flames or electrical sparks, and wear appropriate clothing.



CAUTION

Do not open the pump until the pressure is bled off. On systems with meters, the differential valve will keep LPG under pressure in the pump, meter, and piping even when the hose is emptied.

TOOLS REQUIRED

Worn or defective parts can be replaced using the following tools:

1. small blade screwdriver
2. small hammer
3. two pairs of vise-grip pliers
4. long handle wrenches
5. one half of the drive coupling and key

DISASSEMBLY

Lock nuts are secured by a lock washer tang. This tang must be pried out of one slot, in the lock nut, with a small blade screwdriver. After removing both lock nuts and lock washers, remove the four (4) head cap screws. While holding the cylinder, tap the drive end of the rotor shaft and the pump will pop apart. Use caution to avoid getting dirt into the bearing grease and to not damage the mechanical seals. Remove the combination bypass and relief valve.

Observe all parts and check them for wear and physical damage. Replace all defective parts. A groove around the cylinder bore or back wall makes that part unusable. These same conditions apply to the head wall. Parts with such grooves should be replaced.

ASSEMBLY

NOTE

The rotor and shaft is used as an assembly pilot guide to get alignment between the cylinder and the head.

1. Apply a light coating of grease or oil to the “O” rings and insert the mechanical seal assembly into the cylinder. Insert ball bearings (shield side inboard).
2. Insert the drive end of the rotor shaft through the mechanical seal and bearing. Push the rotor into the cylinder and rotate to engage the seal drive tangs.
3. Install the tang lock washer and lock nut. Using vice-grip pliers, tighten the lock nut to pull the rotor down tight against the cylinder back wall.
4. Cover the shaft with cloth to protect it, then tighten the drive end of the rotor shaft in a vise. Insert the four (4) vanes.
5. Insert the head “O” ring, mechanical seal assembly, and bearing (shield side inboard) in the head. Place this assembly over the outboard end of the rotor shaft.
6. Press down and rotate the head to engage the seal drive tangs, then just start the four (4) head cap screws.
7. Install the tanged lock washer and start the lock nut. Grasp and clamp the lock nut in the vise-grip pliers. With the vice-grip pliers clamped on to the lock nut, pull the head down very tight. Wiggle the head while tightening the lock nut.
8. Tighten the four (4) head cap screws before loosening the outboard lock hut, then loosen both lock nuts three more turns.
9. Using a keyed coupling half, check that the rotor turns free, only the seal should cause any drag. It should turn easily by hand. If the rotor does not run free, tear down the pump and correct the problem.
10. Tighten the drive end lock nut with vise-grip pliers until a moderate rotor drag is felt when turning the rotor shaft with the coupling half.
11. Locate the closest lock washer tang and lock nut slot. Align that slot and tang and stake the tang into the slot.
12. Clamp the coupling half and the outboard lock nut firmly in vise-grip pliers. Tighten the outboard lock nut approximately one-eighth ( ) of a turn past the point where rotor drag disappears.
13. Remove both vise-grips, turn the rotor shaft with the coupling half and check for free turning (no metal-to-metal rotor drag). Align the closest slot and tang and stake the tang into the slot.
14. Install the bearing cover and bracket, then lubricate both inboard and outboard bearings.

15. Install the bypass/relief valve, making certain the valve slides freely and the disc is properly located in the valve. Insert the valve spring and install the valve cover.

NOTE

Vanes installed backwards will cause vibration and low pump pressure.

Improper adjustment of the bearing lock nuts will cause worn or scored disks and rotor ends. If the lock nuts are not drawn up evenly, the rotor and disk will wear.

Table 1 - *Pump Troubleshooting*

PROBLEM	CAUSE	SOLUTION
Electric motor will not run.	Power is not connected.	Connect power.
	Blown fuse.	Replace fuse.
	Switch on starter is not in correct position.	Reset switch.
	Switch in panel is not in correct position.	Reset switch.
	Pump switch not reset.	To restart pump, first turn off the pump switch, press the reset button, then turn on the pump switch.
	Burnt or defective electric motor.	Replace motor.
	Loose wires.	Reconnect wires.
Pump will run – low output pressure.	Restricted excess flow valve in tank.	Replace excess flow valve 1.
	Restricted valve in inlet pie line.	Open shut-off valves.
	Low tank pressure.	Check tank pressure.
	Worn pumps or vanes sticking.	Rebuild pump.
	Pump speed too low.	On pumps with V-belts, check the belt tension.
	Low voltage supply.	Supply correct voltage to motors.
	Bypass valve stuck or set too low.	Check capacity with bypass line closed with manual valve. Readjust, repair, or replace valve.
	Clogged strainer.	Clean strainer.
	Poor suction.	Increase intake and vapor pipe sizes.
Pump will run – high output pressure.	Restricted valve in pump return lines.	Check all valves.
	Relief control valve set to high.	Check setting.
	High tank pressure.	Check tank pressure.
	Failed control valve.	Repair or replace.
Pump runs for short time, then stops.	Load too high for motor.	Check pump and drive mechanism.
	Improper inlet power.	Check and restore incoming voltage.
	Overload heaters too small.	Check overload size.
Excessive vibration and/or noise when pump is running.	Loose mounting bolts.	Tighten all mounting bolts.
	Relief control valve line too small.	Check data sheet.
	Pump and motor out of alignment.	Re-align pump and motor.
	Worn belts.	Check V-belt installation guidelines.
	Restricted valve in pump piping.	Open all valves in pump piping.
	Cavitation from poor suction.	Increase size of intake and vapor pipes.
	Very high differential pressure.	Check for restriction in discharge line.

PROBLEM	CAUSE	SOLUTION
Pump runs but no LPG delivered.	Closed valve in line.	Open proper valve.
	Closed excess flow valve at tank outlet.	Open excess flow valve.
	Vapor binding or boiling LPG at intake line.	Check inlet pipes and valves for proper installation.
	Wrong type of valves installed.	Install correct valves.
	Restriction in suction line L.	Locate pump as close as possible to supply tank.
	Broken pump shaft.	Disassemble pump and repair.
Pump leaks.	Leakage at drain holes on the bottom of the pump cylinder and the head.	Replace mechanical seals.
	Leakage between pump cylinder and head.	Replace the head “O” ring (head must be removed).
Pump will not turn.	Foreign matter in pump.	Clean out the pump – check the strainer and clean it.
	Broken pump blades.	Disassemble pump and replace blades.
	Bearing seized.	Clean or replace pump bearings.
Unstable outlet pressure.	Damaged back pressure control valve.	Repair or replace back pressure control valve.
	Cavitation at pump.	Open all valves to pump.
		Poor installation – correct piping to pump.
		Clean strainer.
	Worn pump.	Rebuilt pump.

APPENDIX A

COMPONENT INFORMATION

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BLACKMER LIQUEFIED GAS PUMPS

FOR LP-GAS AND NH3 SERVICE

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

MODELS: LGF1D, LGB1D, LGF1PD, LGB1PD, LGF1C, LGB1C, LGF1PC, LGB1PC

Section	500
Effective	December 2000
Replaces	585/A April 80

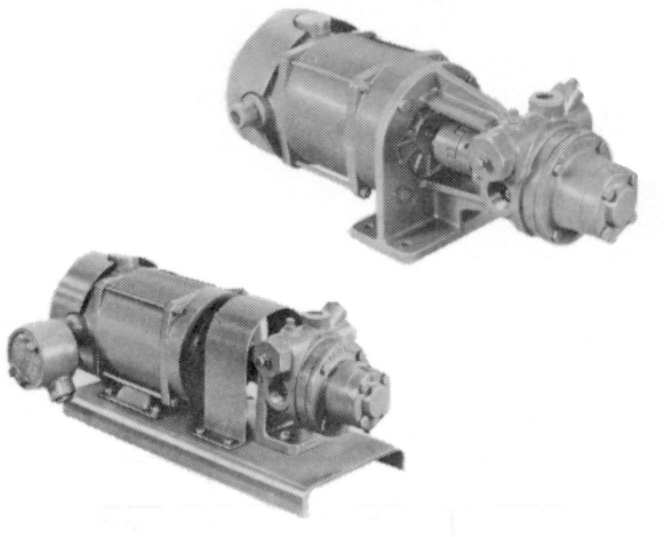


TABLE OF CONTENTS *Page*

NOTE: Numbers in parentheses following individual parts indicate reference numbers on the corresponding Blackmer Pump Parts List 501-A01.

SAFETY DATA

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

NOTICE:

Blackmer liquefied gas pumps MUST only be installed in systems which have been designed by qualified engineering personnel. The system MUST conform to all applicable local and national regulations and safety standards.

This manual is intended to assist in the installation and operation of the Blackmer liquefied gas pumps, and MUST be kept with the pump.

Blackmer liquefied gas pump service shall be performed by qualified technicians ONLY. Service shall conform to all applicable local and national regulations and safety standards.

Thoroughly review this manual, all instructions and hazard warnings, BEFORE performing any work on the Blackmer liquefied gas pumps.

Maintain ALL system and Blackmer liquefied gas pump operation and hazard warning decals.

SAFETY DATA

⚠WARNING

Hazardous voltage. Can shock, burn or cause death.

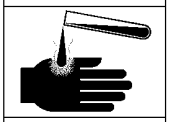
FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

⚠WARNING

Hazardous pressure can cause personal injury or property damage.

DISCONNECTING FLUID OR PRESSURE CONTAINMENT COMPONENTS DURING PUMP OPERATION CAN CAUSE SERIOUS PERSONAL INJURY, DEATH OR MAJOR PROPERTY DAMAGE.

⚠WARNING



Hazardous or toxic fluids can cause serious injury.

IF PUMPING HAZARDOUS OR TOXIC FLUIDS, SYSTEM MUST BE FLUSHED AND DECONTAMINATED, INSIDE AND OUT, PRIOR TO PERFORMING MAINTENANCE.

⚠WARNING

Hazardous machinery can cause serious personal injury.

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.

⚠WARNING

Hazardous pressure can cause personal injury or property damage.

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

⚠ CAUTION

Hazardous pressure can cause personal injury or property damage.

FAILURE TO RELIEVE SYSTEM PRESSURE PRIOR TO PERFORMING PUMP SERVICE OR MAINTENANCE CAN CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

PUMP DATA

TECHNICAL DATA

Maximum Pump Speed	1750 RPM
Maximum Temperature	240°F (115°C)
Maximum Differential Pressure	125 psi (8.6 bar)
Maximum Working Pressure (Inlet Pressure + Differential Pressure)	350 psi (24.1 bar)

NOTE: These pumps are listed by Underwriters' Laboratories for liquefied petroleum gas and NH3 service.

INITIAL START UP INFORMATION

Model No. _____

Serial No. _____

Date of Installation: _____

Pressure Gauge Reading: _____

Vacuum Gauge Reading: _____

Flow Rate: _____

INSTALLATION

NOTICE:

BLACKMER LP-GAS PUMPS MUST ONLY BE INSTALLED IN SYSTEMS DESIGNED BY QUALIFIED ENGINEERING PERSONNEL. SYSTEM DESIGN MUST CONFORM WITH ALL APPLICABLE REGULATIONS AND CODES AND PROVIDE WARNING OF ALL SYSTEM HAZARDS.

NOTICE:

THIS PUMP SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 58 AND ALL APPLICABLE LOCAL, STATE AND NATIONAL REGULATIONS.

⚠WARNING

Hazardous voltage. Can shock, burn or cause death.

- **⚠ Install, ground and wire to local and National Electrical Code requirements.**
- **⚠ Install an all-leg disconnect switch near the unit motor.**
- **⚠ Disconnect and lockout electrical power before installation or service.**
- **⚠ Electrical supply MUST match motor nameplate specifications.**
- **⚠ Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.**

INSTALLATION

PRE-INSTALLATION CLEANING

Foreign matter entering the pump WILL cause extensive damage. The supply tank and intake piping MUST be cleaned and flushed prior to pump installation and operation.

LOCATION AND PIPING

An improperly designed piping system or improper unit installation WILL significantly reduce pump performance and life. Blackmer recommends the following piping system layout and unit installation.

1. To minimize intake losses, locate the pump as close as possible to the source of supply.
2. Intake piping and fittings MUST be at least as large in diameter as the pump intake connection.
3. Minimize the number of intake line fittings (valves, elbows, etc.) and piping turns or bends. The nearest fitting on the intake line must be 6" from the pump to permit access to the pump relief valve (see Figure 2).
4. An intake strainer must be installed 5 - 10 pipe diameters from the pump intake. The strainer should have a net open area of at least four times the area of the intake pipe. Strainers must be cleaned regularly to avoid pump starvation aand cavitation.
5. Intake and discharge piping MUST be free of all leaks.
6. To facilitate piping expansion and contraction, expansion joints should be placed 3 feet (0.9m) from the pump intake and discharge.
7. ALL piping and fittings MUST be properly supported to prevent any piping loads from being placed on the pump.
8. Install pressure gauges in the NPT ports provided in the pump cylinder to check pump at start up.
9. The external bypass line should be $^1/_2$" (12.7 mm) diameter pipe and can be piped back to either the liquid or vapor section of the tank. See Figure 2.
10. Whenever possible, keep liquefied gas systems full of liquid, even when idle. This will keep the O-rings from changing shape, shrinking or super cooling. Evaporation of liquefied gas leaves an abrasive powder on the surface which can cause wear to the pump, meter, and seals.

PUMP MOUNTING

Permanently mounted the unit by securing the base plate with adequately sized anchor bolts to a level concrete floor following recommended industry standards. A solid foundation will reduce system noise and vibration, and will improve pump performance. Refer to ANSI/HI standards or a suitable pump handbook for information on typical pump mounting and foundations. Check coupling alignment after pump and base assembly is secured to the foundation.

COUPLING ALIGNMENT

The pump must be directly coupled to a gear and/or driver with a flexible coupling.

Both angular and parallel coupling alignment MUST be maintained between the pump, gear, motor, etc. in accordance with manufacturer's instructions. See Figure 1.

1. To check for parallel alignment, the use of a dial indicator is preferred. If a dial indicator is not available use a straight edge. Turn both shafts by hand, checking the reading through one complete revolution. Maximum offset should be less than .005" (125 microns).
2. To check for angular alignment, insert a feeler gauge between the coupling halves. Check the spacing in 90 degree increments around the coupling (four check points). Maximum variation should not exceed .005" (125 microns).

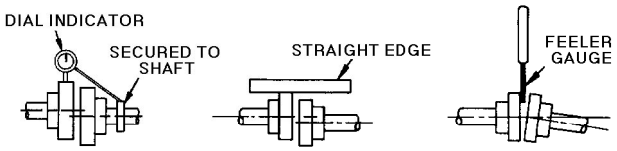


Figure 1 - Alignment Check

PUMP ROTATION

LG1 pump models are designed as LEFT HAND pumps ONLY, with COUNTERCLOCKWISE rotation. When viewing the pump from the non-drive end (pump end), the pump intake port and relief valve must always be on the left, and the discharge port on the right. See Figure 2.

NOTICE:

CONFIRM CORRECT PUMP ROTATION BY CHECKING THE PUMP ROTATION ARROWS RESPECTIVE TO PUMP DRIVER ROTATION. DO NOT OPERATE THE PUMP IN REVERSE ROTATION TO REVERSE THE DIRECTION OF FLOW.

COMBINATION PUMP RELIEF VALVE AND BACK-TO-TANK BYPASS VALVE

The built-in spring loaded pump relief valve on the LG1 pump models has a dual purpose. The valve provides an external bypass back to the tank to provide relief of excess pressure. The valve also will act as an internal safety relief valve recirculating fluid within the pump to provide relief of excess pressure if the separate back-to-tank line is closed. See Figure 2. Refer to "Relief Valve Setting and Adjustment" for proper valve setting and adjustment procedure.

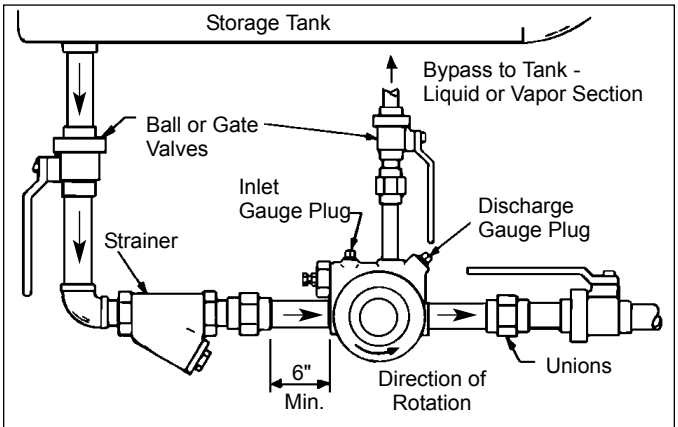


Figure 2 - Piping Configuration

OPERATION

⚠WARNING

Hazardous machinery can cause serious personal injury.

OPERATION WITHOUT GUARDS IN PLACE CAN CAUSE SERIOUS PERSONAL INJURY, MAJOR PROPERTY DAMAGE OR DEATH.

⚠ CAUTION

Hazardous pressure can cause personal injury or property damage.

PUMP OPERATING AGAINST A CLOSED VALVE CAN CAUSE SYSTEM COMPONENT FAILURE, PERSONAL INJURY AND PROPERTY DAMAGE.

PRE-START UP CHECK LIST

1. Inspect complete piping system and supports to ensure that no piping loads are being placed on the pump.
2. Ensure all valves and fittings in piping system are in the start-up or operating positions.
3. Check the wiring of the pump motor and jog the motor to verify proper pump rotation.

START UP PROCEDURES

NOTICE:

CONSULT THE "PUMP TROUBLESHOOTING" SECTION OF THIS MANUAL IF DIFFICULTIES DURING START UP ARE EXPERIENCED.

1. Start the motor. Priming should occur within one minute.
2. Check the pressure gauges to ensure the system is operating within expected parameters. Record the gauge readings in the "Initial Start Up Information" section of this manual for future reference.
3. Inspect piping, fittings, and associated system equipment for leaks, noise, vibration and overheating.
4. Check the flow rate to ensure the pump is operating within the expected parameters. Record flow rate in the “Initial Start Up Information” section.
5. With the manual valve in the bypass line OPEN, check the pressure setting of the relief valve by slowly closing a valve in the discharge line and reading the pressure gauge. As the valve in the discharge line is closed, the pump discharge pressure will rise to a maximum value, then drop back slightly. Use the maximum pressure to determine the valve setting. This pressure should be 10 - 20 psi (0.7 - 1.4 bar) higher than the maximum system operating pressure. If adjustments need to be made, refer to the "Relief Valve Setting and Adjustment" section of this manual.

   NOTE: If the pump is operated with both the discharge line and bypass line closed, the pump will recirculate fluid through the internal relief valve, causing cavitation and excessive wear on the pump. The pressure gauge may also read lower than with normal operation.

RELIEF VALVE SETTING AND ADJUSTMENT

The pump relief valve factory pressure setting is marked on a metal tag attached to the valve cover. The relief valve must be set at least 10 - 20 psi (0.7 - 1.4 bar) higher than the operating pressure or the system pressure control valve setting.

⚠ CAUTION

Hazardous Pressure

INCORRECT SETTINGS OF THE PRESSURE RELIEF VALVE CAN CAUSE SYSTEM COMPONENT FAILURE, PERSONAL INJURY AND PROPERTY DAMAGE.

Relief Valve Adjustment Procedure:

1. **To INCREASE the pressure setting**, Loosen the locknut (3), and turn the adjusting screw (2) inward, or CLOCKWISE.
2. **To DECREASE the pressure setting**, Loosen the locknut (3), and turn the adjusting screw (2) outward, or COUNTERCLOCKWISE.

MAINTENANCE

⚠WARNING

Hazardous machinery can cause serious personal injury.

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.

⚠WARNING

Hazardous pressure can cause personal injury or property damage.

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

⚠WARNING

Hazardous pressure can cause personal injury or property damage.

DISCONNECTING FLUID OR PRESSURE CONTAINMENT COMPONENTS DURING PUMP OPERATION CAN CAUSE SERIOUS PERSONAL INJURY, DEATH OR MAJOR PROPERTY DAMAGE.

⚠WARNING

Hazardous or toxic fluids can cause serious injury.

IF PUMPING HAZARDOUS FLUIDS, SYSTEM MUST BE FLUSHED AND DECONTAMINATED, INSIDE AND OUT, PRIOR TO PERFORMING SERVICE.

MAINTENANCE

NOTICE:

MAINTENANCE SHALL BE PERFORMED BY QUALIFIED TECHNICIANS ONLY, FOLLOWING THE APPROPRIATE PROCEDURES AND WARNINGS AS PRESENTED IN THIS MANUAL.

SCHEDULED MAINTENANCE

Strainers

Strainers must be cleaned regularly to avoid pump starvation. Schedule will depend upon the application and operating conditions.

Pump Lubrication

Ball bearings must be lubricated every three months at minimum. More frequent lubrication may be required, depending on the application and the operating conditions.

Recommended Grease:

Exxon® - RONNEX MP Grease;

Mobil® MOBILITH AW-2 (64353-6) Grease, or equivalent.

Greasing Procedure:

1. Remove the grease relief fittings (76A) from the bearing cover (27) and mounting bracket (108 or 108A).
2. SLOWLY apply grease with a hand gun until grease begins to escape from the grease relief fitting port. Discard excess grease in accordance with the proper codes and regulations.
3. Replace the grease relief fittings (76A).

DO NOT overgrease pump bearings. While it is normal for some grease to escape from the grease tell-tale hole after lubrication, excessive grease on pumps equipped with mechanical seals can cause seal failure. The tell-tale hole is located in the head between the bearing and the seal.

VANE REPLACEMENT

NOTICE:

FOLLOW ALL HAZARD WARNINGS AND INSTRUCTIONS PROVIDED IN THE "MAINTENANCE" SECTION OF THIS MANUAL.

1. Drain and relieve pressure from the pump and system as required.
2. Remove the bearing cover (27), locknut (24A) and lockwasher (24B) from the outboard (non-driven) side of the pump.
2. Remove the head assembly according to steps 6 - 8 in the "Pump Disassembly" section of this manual.
3. Turn the shaft by hand until a vane (14) comes to the top (12 o'clock) position of the rotor. Remove the vane and install a new one.
4. Repeat step 3 until all vanes have been replaced.
5. Reassemble the pump according to steps 10 - 17 of the "Pump Assembly" section of this manual.

PUMP DISASSEMBLY

NOTICE:

FOLLOW ALL HAZARD WARNINGS AND INSTRUCTIONS PROVIDED IN THE "MAINTENANCE" SECTION OF THIS MANUAL.

1. Drain and relieve pressure from the pump and system as required.
2. Loosen the coupling (34) and remove the shaft key (35).
3. Remove the four mounting screws (28A) and remove the entire pump assembly from the bracket mount (108 or 108A).
4. Remove the bearing cover capscrews (28), the bearing cover (27) and gasket (26) from the outboard pump end. Discard the bearing cover gasket.
5. Remove the locknuts and lockwashers (24A & 24B) from BOTH shaft ends:
   a. Bend up the engaged lockwasher tang and rotate the locknut counterclockwise to remove it from the shaft
   b. Slide the lockwasher off the shaft. Inspect the lockwasher for damage and replace as required.
   c. Repeat on opposite shaft end.
6. Clean the outboard pump shaft thoroughly, making sure the shaft is free of nicks and burrs. This will prevent damage to the mechanical seal when the outboard head assembly is removed.
7. Remove the head capscrews (21) and carefully pry the head (20) away from the cylinder.
8. Slide the head off the shaft. The head O-ring (72), bearing (24), and mechanical seal (153) will come off with the head assembly. Remove and discard the head O-ring.
   a. Pull the bearing (24) from the housing in the head.
   b. Place a cloth under the seal to prevent damage, and using a blunt instrument, gently push the backside of the seal assembly to remove it from the head. Be careful not to contact the seal faces during removal. Remove and discard the mechanical seal O-rings/seal rings.
9. Clean the inboard pump shaft thoroughly, making sure the shaft is free of nicks and burrs.
10. Gently pull the rotor and shaft (13) from the cylinder. While one hand is pulling the shaft, the other hand should be cupped underneath the rotor to prevent the vanes (14) from falling out. Carefully set the rotor and shaft aside for future vane replacement and reassembly.
11. Pull the bearing and mechanical seal from the pump cylinder. Be careful not to damage the seal components during removal. Remove and discard the mechanical seal O-rings/seal rings.

PUMP ASSEMBLY

Before reassembling the pump, inspect all component parts for wear or damage, and replace as required. Wash out the bearing/seal recess of the head and cylinder, and

remove any burrs or nicks from the rotor and shaft.

1. **Reassemble the INBOARD side of the pump first**, by positioning the pump cylinder (12) with the INTAKE port and relief valve to the **right**.
2. Apply a small amount of quality O-ring lubricant in the seal and bearing recess of the cylinder to facilitate mechanical seal installation (153).
   a. Insert the seal jacket assembly (153A) into the seal recess of the cylinder with the drive tangs of the jacket inward.
   b. With the polished face outward, align the notches of the rotating seal face with the jacket, and install the seal face and ring assembly (153F, 153G) into the jacket assembly. After installation, clean the seal face with a clean tissue and alcohol.
   c. Install the seal backup ring (153N) into the seal recess.
   d. Clean the polished face of the stationary seat (153B) with a clean tissue and alcohol. Align the stationary seat and O-ring assembly (153B, 153D,) and insert it into the seal recess with the polished face inward to mate with the rotating face.
3. Hand pack the ball bearing (24) with grease. Refer to "Lubrication" in the Pump Maintenance Section for the recommended grease.
4. Install the bearing (24) into the cylinder recess. The bearing balls should face outward, with the grease shield inward. Ensure that the bearing (24) is fully and squarely seated against the mechanical seal (153).
5. Turn the pump cylinder (12) around and begin assembly on the opposite, outboard end.
6. Remove the vanes (14) from the rotor and shaft assembly (13). Inspect for wear and damage, and replace as follows:
   a. Apply a light coating of quality O-ring lubricant on the inboard shaft (driven end) to facilitate installation.
   b. Insert the inboard shaft end into the pump cylinder. Carefully slide the shaft through the installed mechanical seal (153) and bearing (24).
   c. Rotate the shaft to engage the drive tangs of the mechanical seal (153) in the rotor.
   d. Insert the four vanes (14) into the slots in the rotor.
7. Install the lockwasher with the tangs outward, and the locknut with the tapered end inward, on the inboard shaft end. Ensure the inner tang “A” of the lockwasher is engaged in the slot in shaft threads. Bend it slightly, if necessary. (See Figure 4.)
8. Using a spanner wrench, tighten the locknut (24A) to pull the rotor flat against the back wall of the cylinder. **DO NOT overtighten the locknut and bend or shear the inner tang.** Adjustment to the locknuts will be made after the head is installed.
9. Follow the procedures in steps 2 - 4 above to install the mechanical seal (153) and bearing (24) into the head. Apply a small amount of quality O-ring lubricant in the head recess to facilitate installation.

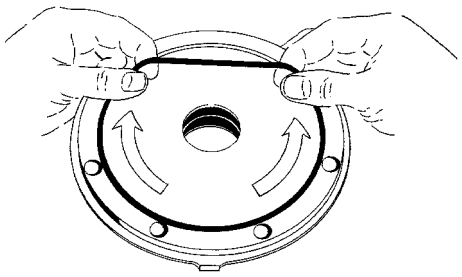


Figure 3 - Head O-Ring Installation

10. Apply a small amount of quality O-ring lubricant to the O-ring groove on the inside face of the head and install a new head O-ring (72) in the groove by laying the O-ring flat and starting in on one side of the groove, stretching ahead with the fingers, as shown in Figure 3.
11. Apply a light coating of quality O-ring lubricant on the outboard shaft to facilitate head installation.
12. With the tell-tale hole towards the bottom of the pump, carefully install the head assembly (20) over the shaft and against the cylinder (12). Use care not to damage the mechanical seal components.
13. Rotate the head (20) to engage the drive tangs of the seal jacket with the slots in the rotor.
14. Install and snug up the head capscrews (21). The head capscrews will be fully tightened after the second locknut is installed.
15. Install the locknut (24A) and lockwasher (24B) on the outboard shaft end as instructed in step 7.
16. Using a keyed coupling half, hold the inboard shaft end and tighten the outboard locknut with a spanner wrench to pull the head against the cylinder. **DO NOT overtighten and shear the inner tang of the lockwasher**.
17. Rotate the shaft to test for binding or tight spots. If the rotor does not turn freely, tap the rim of the head with a soft faced mallet until the correct position is found. Uniformly tighten the head capscrews, torquing to 25 lbs ft (34 Nm).
18. **LOCKNUT ADJUSTMENT**

    It is important the bearing locknuts (24A) and lockwashers (24B) be adjusted properly. Overtightening locknuts can cause bearing failure or a broken lockwasher tang. Loose locknuts will allow the rotor to shift against the head or cylinder wall, causing wear. See Figure 4.

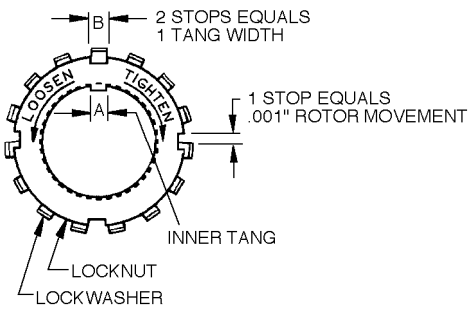


Figure 4 - Locknut Adjustment

a. Using a spanner wrench, tighten both locknuts (24A) to ensure that the bearings (24) are bottomed in the head (20) or cylinder recess. **DO NOT overtighten and bend or shear the lockwasher inner tang.**

b. Loosen both locknuts (24A) one complete turn.

c. Turn the shaft by hand to verify free movement. If it binds, readjust the head (20).

d. Tighten one locknut (24A) until a slight rotor drag is felt when turning the shaft by hand.

e. Back off the nut the width of one lockwasher tang "B". Secure the locknut (24A) by bending the closest aligned lockwasher tang into the slot in the locknut (24A). The pump should turn freely when rotated by hand.

f. Tighten the opposite locknut (24A) the width of one lockwasher tang. Tighten just past the desired tang, then back off the nut to align the tang with the slot in the nut. Secure the nut by bending the aligned lockwasher tang into the slot in the locknut. The pump should continue to turn freely when rotated by hand.

g. To check adjustment, grasp the nut and washer with fingers and rotate back and forth. If this cannot be done, one or both locknuts are too tight and should be alternately loosened one stop at a time (.001") (25 microns). Begin by loosening the locknut adjusted last.

19. Attach the new bearing cover gasket (26) and the bearing cover (27) to the head with the grease fitting (76) upward. Install and tighten the bearing cover capscrews (28), torquing to 15 lbs ft (20 Nm).

20. Inspect the grease seal (104) in the foot bracket for wear or damage and replace as required. Grease the outside diameter of the grease seal (104) and push it into the bracket (108 or 108A) with the lip inward.

21. Mount the assembled pump on the foot bracket (108 or 108A) with the four mounting screws (28A).

22. Reinstall coupling, shaft key, and coupling guards.

23. Refer to “Pre-Start Up Check List” and “Start Up Procedures” sections of this manual prior to restarting pump operation.

PUMP TROUBLESHOOTING

NOTICE:

MAINTENANCE SHALL BE PERFORMED BY QUALIFIED TECHNICIANS ONLY, FOLLOWING THE APPROPRIATE PROCEDURES AND WARNINGS AS PRESENTED IN THIS MANUAL.

SYMPTOM	PROBABLE CAUSE
Pump Not Priming	1. Pump not wetted. 2. Worn vanes 3. Suction valve closed. 4. Leaks in the suction line. 5. Strainer clogged. 6. Suction line or valves clogged or too restrictive. 7. Pump vapor-locked. 8. Pump speed too low for priming. 9. Relief valve partially open, worn or not seating properly.
Reduced Capacity	1. Pump speed too low. 2. Suction valves not fully open. 3. Leaks in the suction line. 4. Excessive restriction in the suction line (i.e.: undersized piping, too many elbows & fittings, clogged strainer, etc.). 5. Damaged or worn parts. 6. Excessive restriction in discharge line causing partial flow through the relief valve. 7. Relief Valve worn, set too low, or not seating properly.

continued on following page

PUMP TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE
Noise	1. Excessive pressure drop in pump inlet pipe due to: a. Undersized or restricted fittings in the suction line. b. Pump speed too fast. c. Pump too far from fluid source. 2. Running the pump with a closed discharge line and closed bypass return line. 3. Pump not securely mounted. 4. Bearings worn or damaged. 5. Vibration from improperly anchored piping. 6. Bent shaft, or drive coupling misaligned. 7. Excessively worn rotor. 8. Malfunctioning valve in the system. 9. Relief valve setting too low. 10. Damaged vanes (see following category).
Damaged Vanes	1. Foreign objects entering the pump. 2. Running the pump dry for extended periods of time. 3. Cavitation. 4. Incompatibility with the liquids pumped. 5. Excessive heat. 6. Settled or solidified material in the pump at start-up. 7. Hydraulic hammer - pressure spikes.
Broken Shaft	1. Foreign objects entering the pump. 2. Relief valve not opening. 3. Hydraulic hammer - pressure spikes. 4. Pump/driver misalignment. 5. Excessively worn vanes or vane slots.
Mechanical Seal Leakage	1. O-rings not compatible with the liquids pumped. 2. O-rings nicked, cut or twisted 3. Shaft at seal area damaged, worn or dirty. 4. Ball bearings overgreased. 5. Excessive cavitation. 6. Mechanical seal faces cracked, scratched, pitted or dirty.
Overload on Motor	1. Horsepower of motor not sufficient for application. 2. Improper wiring and/or low voltage to motor. 3. Misalignment. 4. Excessive pressure or speed. 5. Bearing locknuts adjusted improperly. 6. Faulty or worn bearings. 7. Rotor rubbing against head or cylinder. 8. Dirty mechanical seal faces.

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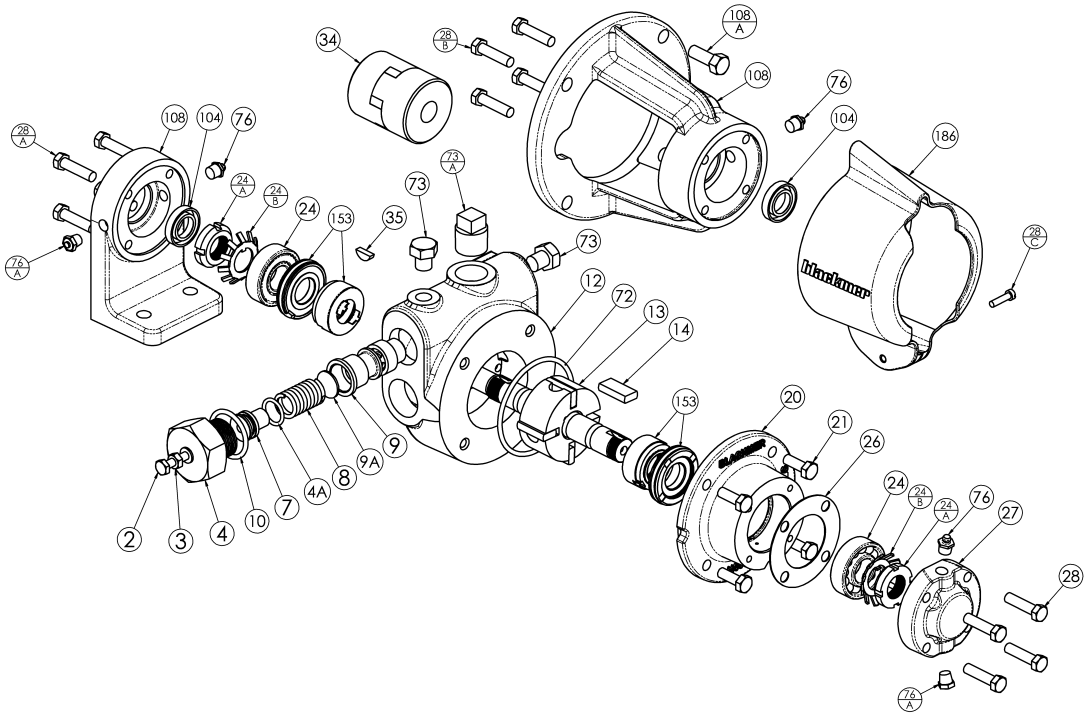
BLACKMER PARTS LIST

PUMP MODELS: LGF1D, LGB1D, LGF1PD, LGB1PD

and discontinued models LGF1C, LGB1C, LGF1PC, LGB1PC

(See Instructions 501-A00 or 585/A for Installation, Operation and Maintenance)

Section	500
Effective	Feb. 2001
Replaces	Oct. 2000 & 585/A1 Aug. 00



Ref. No.	Description	Parts per Pump		Ref. No.	Description	Parts per Pump	
2	Adjusting Screw – Relief Valve (R/V)	1		28 [2]	Capscrews – Bearing Cover	4	
3	Locknut – Adjusting Screw	1		28A [2]	Bracket Mounting Screws	4	
4	Cover – R/V	1		28B [2]	Bracket Mounting Screws	4	
4A [1]	O-Ring – Spring Guide	1		28C	Guard Screw	1	
7	Spring Guide – R/V	1		34	Coupling Half – Pump	1	
8 [1]	Spring – R/V	1			Coupling Half – Motor (56C)		
9 [1]	Valve – R/V	1			Couplng. Half – Motor (143-145TC/184C)		
9A [1]	Disc – R/V	1			Coupling Spider		
10 [1]	O-Ring – R/V Cover	1		35 [1]	Key – Shaft	1	
12 [2]	Cylinder – LGF1, LGB1	1		72 [1]	O-Ring – Head	1	
	Cylinder – LGF1P, LGB1P			73	Gage Plug (1/4")	2	
13	Rotor & Shaft Assembly	1		73A [2]	Gage Plug (3/4")	1	
	(Includes Ref. Nos. 24A & 24B)			76	Grease Fitting	2	
14 [1]	Vane – Duravane (Std.)	4		76A	Grease Relief Fitting	2	
20 [2]	Head	1		104 [1]	Grease Seal	1	
21	Capscrews – Head	4		108	Bracket – (base mount) - LGB1(P)D	1	
24 [1]	Ball Bearing	2			Bracket (C-faced footless) – LGF1(P)D		
24A	Locknut – Bearing	2		108A	Capscrews – Bracket	4	
24B [1]	Lockwasher – Bearing	2		108B	Bracket (C-faced footed) - **see page 2**	-	-
26 [1,2]	Gasket – Bearing Cover	1		186	Guard	1	
27 [2]	Bearing Cover	1			Pump Repair Kit (not shown)	1	

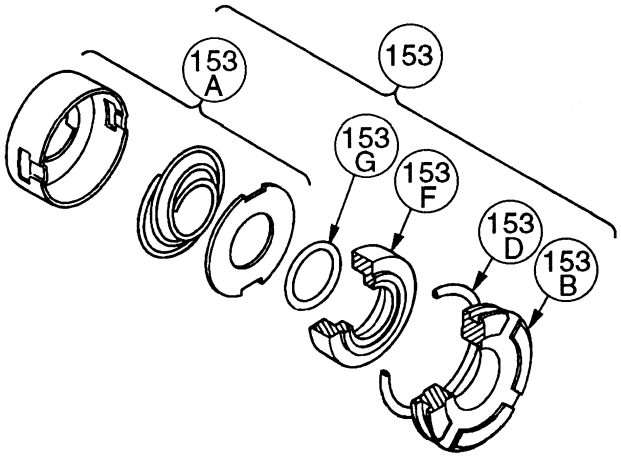
1 = Parts included in Pump Repair Kit. 2 = To fit the LGB1 (P) C, LGF1 (P) C use: Ref. No. 12-022902/022911 respectively, Ref. No. 20-032902, Ref. No. 26-382901, Ref. No. 27-042901, Ref. No. 28-920203, Ref. No. 28A & B-920230, Ref. No. 73A-908198, and Ref. No.108-832901/832905 respectively. Keep this parts list with Installation, Operation and Maintenance Instructions 501-A00 or 585/A.

MECHANICAL SEAL

Ref. No.	Part Name	Parts Per Pump	
153*	Mechanical Seal Assembly	2	
153A	Jacket Assembly – Seal	2	
153B	Stationary Seat (Steel)	2	
153D	O-Ring – Stationary Seat (Buna-N)	2	
153F	Seal Face (Carbon)	2	
153G	O-ring – Rotating (Buna-N)	2	

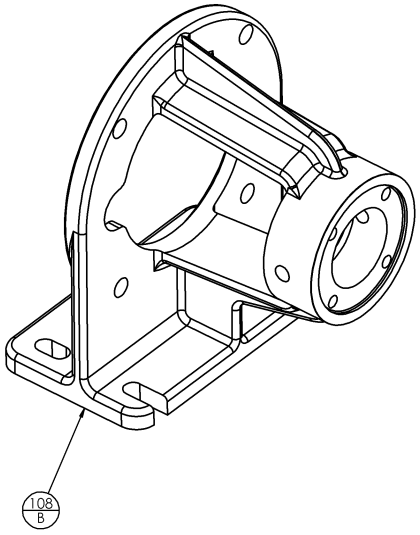
* Included in Pump Repair Kit.

* * Ref. Nos. 153A, 153B & 153 are not available as separate repair parts.



MOUNTING BRACKET

Ref. No.	Part Name	Parts Per Pump	
108B	Bracket (C-faced footed) – LGF1(P)D	1	



BLACKMER LIQUEFIED GAS PUMPS FOR LP-GAS AND NH3 SERVICE

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

MODELS: LGRL(F)1¼, LGL(F)1¼, LGL1½

960409
INSTRUCTIONS NO. 585/C

Section	500
Effective	November 1988
Replaces	June 1984

GENERAL INFORMATION

SAFETY RULES

It is recommended that NFPA Pamphlet 58 be consulted for Safety Rules. Consult local and state regulations also.

WARNING

THIS PRODUCT MUST ONLY BE INSTALLED IN SYSTEMS WHICH HAVE BEEN DESIGNED BY THOSE QUALIFIED TO ENGINEER SUCH SYSTEMS. THE SYSTEM MUST BE IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS AND SAFETY CODES AND WARN OF ANY HAZARDS UNIQUE TO THE PARTICULAR SYSTEM.

WARNING DANGER

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

PUMP DATA

	LGRL(F)1¼	LGL(F)1¼	LGL1½
Nominal Capacity (GPM)			
(1800 RPM - 50 psi)			
(1800 RPM - 345 kPa)			
at Ambient Temperature of:			
80°F (27°C)	16	21	33
32°F (0°C)	13	17	26
(1200 RPM - 50 psi)			
(1200 RPM - 345 kPa)			
at Ambient Temperature of:			
80°F (27°C)	—	13	20
32°F (0°C)	—	10	16

Maximum Differential Pressure.....150 psi (1034 kPa)

Maximum Temperature.....240°F (115°C)

Maximum Pump Speed.....1800 RPM

These pumps are listed by Underwriters' Laboratories, Inc. for liquefied-petroleum gas and NH_3.

INSTALLATION AND OPERATION

LOCATION

Locate the pump as near the source of supply as possible to reduce pipe friction. A good foundation reduces vibration and noise and improves the pump performance. On permanent installations, it is recommended that the pumping units be securely bolted to a concrete foundation. When new pump foundations are to be cast in concrete, it is suggested that anchor bolts of the type shown in Fig. 1 be set into the concrete.

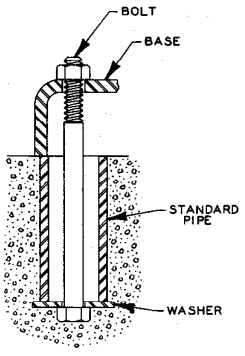


Fig. 1

This type of bolt allows for slight shifting of position to better line up with the mounting holes in the base plate. When pumps are to be located on existing concrete floors, holes should be drilled into the concrete and foundation bolts anchored therein.

RELIEF VALVE & BYPASS VALVE

The built-in spring loaded relief valve is to prevent damage to the pump or pumping system from excess pressure, and should not be used for recirculation. A separate bypass valve, such as the Blackmer Model BV3/4 or BV1, is required by Underwriters' Laboratories, Inc. to be piped from the pump discharge system back to the supply tank (see Figure 2). The setting on the separate by-pass valve should be at least 25 psi (172 kPa) less than the relief valve setting. Do not pipe the bypass valve back to the intake line. The valve and piping should be of adequate size to accommodate the full flow from the pump when the discharge line is closed and the pump is running at its normal maximum speed.

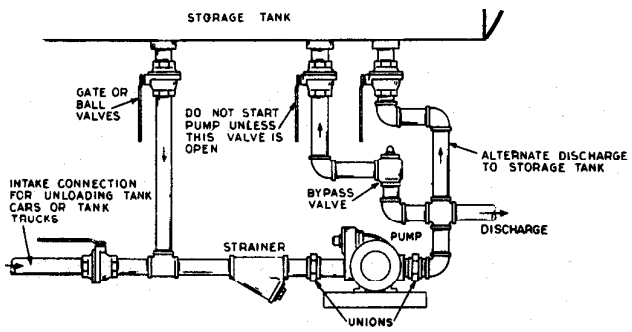


Fig. 2

STRAINER

A strainer is recommended to protect the pump from damage by foreign particles. Generally, the strainer should be installed in the inlet line close to the pump, and should have a net open area of at least four times the area of the pump intake pipe. For more specific applications, refer to the manufacturer's recommendation for proper installation and sizing of the strainer. The strainer should be inspected and cleaned at regular intervals.

PIPING

Many pump systems deliver at a rate below the designated capacity of the pump because the system was improperly piped. Restrictions in the pipe line such as elbows, sharp bends, globe valves, certain restrictive-type plug valves and undersized strainers, should be avoided. Use gate or ball valves, not globe valves. The inlet line should slope downward to the pump, never upward or with upstanding loops. Use pipe of adequate size and strength that has been thoroughly flushed before connecting to the pump. Flexible connectors used near the pump will compensate for expansion contraction and will provide a more vibration-free operation.

On the intake side, locate the nearest fitting at least six inches from the pump to permit the removal of the relief valve cover.

Whenever possible, keep liquefied gas systems full of liquid, even when idle. This will keep the O-rings from changing shape, shrinking or super-cooling. Evaporation of liquefied gas leaves an abrasive powder on the surface which can cause wear to the pump, seals, meter, etc.

Use a vapor return line if possible. This will speed up delivery since a vapor line prevents back-pressure from building up at the receiving tank and a vacuum from forming in the supply tank. In laying out the system, read the section on "Pump Troubles and Their Cures" for suggested ways to eliminate difficulties before they develop.

ALIGNMENT

Coupling alignment on stationary units should be checked after anchor bolts are tightened.

Where flexible couplings are used, the coupling cover should be removed and a straight edge laid across the two hubs of the coupling as shown in Fig. 3. The maximum offset should be less than .015 " (.381mm).

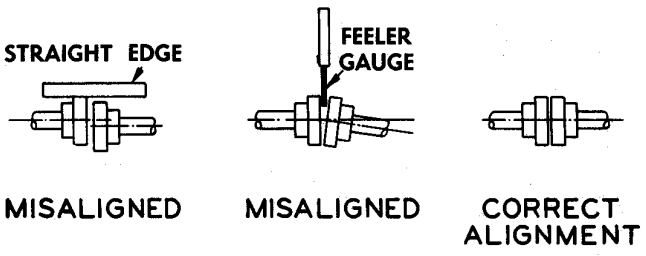


Fig. 3

With a feeler gage or piece of flat steel of proper thickness, check the space between the two coupling valves. Insert a gage at a point on the coupling and at 90° increments about the coupling. The space should not vary more than .020" (.508mm). Misalignment is not desirable. If it does exist, it must not exceed the above limits.

Check the alignment of the pipes to the pump to avoid strains which might later cause misalignment. To check, break union joints; pipes should not spring away or drop down.

OPERATIONAL CHECK

The installation should be checked before being put into operation. Install a pressure gage in the gage hole nearest the discharge port provided on the pump casing before starting. Check all valves. The valve in the bypass return line must be open. After the pump is started, check the direction of shaft rotation to be sure it matches the direction of the arrow on the pump.

With the pump in operation, slowly close the valve in the pump discharge line. This forces the pump output to go through the separate bypass valve. Subtract the inlet pressure from the pump discharge pressure gage reading, to obtain the system differential pressure that is determined by the adjustment on the separate bypass valve. Adjust the separate bypass valve to obtain a system differential pressure that is at least 15 psi (103 kPa) higher than the maximum required differential pressure. The pinned locknut, on the separate bypass valve adjustment screw, sets the maximum differential pressure adjustment permitted. Close the discharge line from the separate bypass valve back to the tank, and adjust the internal pump relief valve to a differential pressure that is 25 psi (172 kPa) greater than the separate bypass valve differential.

To increase the pressure setting on the pump relief valve, remove the relief valve cap from the adjusting screw, loosen the locknut, and turn the adjusting screw clockwise or inward. To reduce the pressure setting, turn the screw counterclockwise, or outward.

Check the general performance of the unit: gallons per minute delivered, noise level (if any), signs of overheating, vibration, leakage, etc. If there is any malfunction, refer to "Pump Troubles and Their Cures."

TO REVERSE PUMP ROTATION

Remove the bearing covers from both heads, the bearing lockwashers and locknuts from the shaft, and the head from the shaft side. Reverse the rotor and shaft so that the shaft protrudes through the head still on the casing. The vanes must be reversed in the slots so that the pressure relief grooves face in the direction of rotation. The rounded or wearing edge of the vanes must be outward to contact the liner. See "Maintenance" for removal and replacement of heads and rotors.

MAINTENANCE

MAINTENANCE AND TROUBLE SHOOTING MUST BE DONE BY AN INDIVIDUAL EXPERIENCED WITH PUMP MAINTENANCE AND THE TYPE OF SYSTEM INVOLVED.

LUBRICATION

Pump bearings should be lubricated every three months.

Recommended Grease: *Amoco® - Amolith All Weather Grease*, or equivalent (must be paraffinic base).

CAUTION: Excessive greasing pressure can cause grease to be pushed between the mechanical seal faces causing seal failure.

It is recommended that you remove the grease relief fitting, and with a hand gun apply grease slowly to the grease fittings on both bearing covers until excess grease begins to come from the grease relief fitting port. Replace the grease relief fittings before putting the pump into operation. It is normal for some grease to escape from the tell-tale holes under the bearing housing for a short time after lubrication.

DISASSEMBLY

Before work is started on a pump, be sure the liquid is drained and the gas pressure relieved.

Remove the bearing cover capscrews and slide the bearing cover off the shaft. These pumps are protected from "end thrust" by a lockwasher and locknut installed outside the bearing on each end of the shaft. Remove the bearing locknut after bending up the engaged lockwasher tang and rotating the nut counterclockwise.

Check for burrs or roughness on the shaft that could damage the mechanical seal O-ring when the head is removed. Remove the head capscrews. Each head is located by two (2) tapered pins, and has a threaded jackscrew hole to facilitate removal. Insert a bearing cover capscrew in the jackscrew hole to pull the locating taper pins out of the housing.

When the head is removed, the stationary seat of the mechanical seal will come off with the head. The rest of the mechanical seal, including the jacket assembly and the rotating seal face and O-ring, can then be slid from the shaft as a complete unit. It is important to keep all parts of the seal clean, and to keep the seals matched as a set.

If the mechanical seal has been leaking, it is advisable to replace the entire seal, including the stationary seat and its O-ring.

Slide the disc and head O-ring off the shaft. Inspect the vanes for damage. If the outer edges of the vanes are torn or chipped the vanes should be replaced. If the vanes are found to be damaged, it is advisable to pull the rotor and shaft and check the liner for damage also. A badly worn or damaged liner should be replaced. Using a brass or hard wood drift, with a hammer, tap the liner around its outside diameter to drive it out of the casing.

Some scoring of the rotor O.D. may occur due to weld splatter or other abrasives in the fluid. If this condition has occurred, remove any burrs from the vane slots and check the push rods (four-vane rotor only) for free movement in the push rod holes. Binding push rods will require replacement of the rotor and shaft assembly.

REPLACING VANES ONLY

When replacing only the vanes, it is advisable to remove the head opposite the drive end for this purpose. Turn the rotor by hand until the vanes appear at the 11 and 1 o'clock positions. Remove these two vanes and install new ones. The rounded or wearing edge of the vane must be outward to contact the liner, and the relief grooves must face in the direction of rotation. Repeat this operation until all new vanes are in place.

NOTE: For replacement of other pump parts, refer to the following "Assembly" Section.

ASSEMBLY

Before reassembling the pump, clean each part thoroughly. Wash out bearing and seal recesses.

Start the liner into the casing. Make sure the embossed word "INTAKE" on the liner, is positioned towards the intake port on the pump casing. The liner keyway must be aligned with the pin that extends down into the bore of the casing. Lightly tap the outer edge of the liner with a plastic or lead hammer to fully insert the liner into the casing.

Install the disc, cavity side out, with the disc relief hole located on the discharge side of the pump, approximately 45° from the base of the pump (see Figure 4).

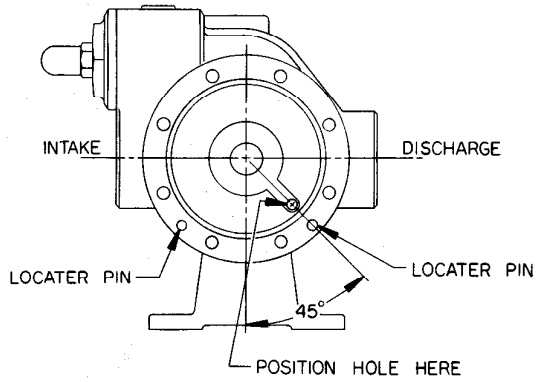


Fig. 4 — Disc Hole Location

The head O-ring should be replaced if it is swollen, nicked or cut. Install the head O-ring in the groove between the disc and the pump casing.

To install the mechanical seal, place the seal jacket assembly in the disc cavity with the drive tang in the center hole. Align and install the carbon rotating seal face and its O-ring in the seal jacket assembly with the polished, or mating face outward. With the pump head resting flat and its seal recess facing up, install the stationary seat and its O-ring into the recess of the head. The pin of the stationary seat must be engaged in either slot in the bottom of the recess. The polished or mating face of the stationary seat should face outward. It is important to keep both seal faces free of all traces of dirt, grease, or oil. A clean tissue paper and alcohol should be used to clean the seal faces.

Place the bearing into the bearing bore of the head with the grease shield towards the inside, so that the balls are visible after installation.

Attach the head assembly to the casing. Use the taper pins to locate and center the head. Note: The heads are not interchangeable, and must be attached on the same ends from which they were removed. Install and tighten the head capscrews.

Before the rotor and shaft can be installed, the direction of pump rotation must be determined. If the pump is to be right-hand (clockwise rotation), the intake port and relief valve must be on the right, with the drive end of the pump's shaft pointing towards the observer. If the pump is to be left-hand (counterclockwise rotation), the pump must have the intake port and relief valve on the left, with the drive end of the pump's shaft pointing towards the observer.

Thoroughly clean the shaft and remove all burrs or roughness with emery. Put a light coating of clean, light oil on the shaft, between the threads and the rotor on both sides of the rotor.

On pumps equipped with a four-vane rotor and shaft, to prevent the push rods from dropping into the intake or discharge ports and jamming the rotor, hold the two bottom vanes in place and install the push rods (see Figure 5). Carefully insert the correct

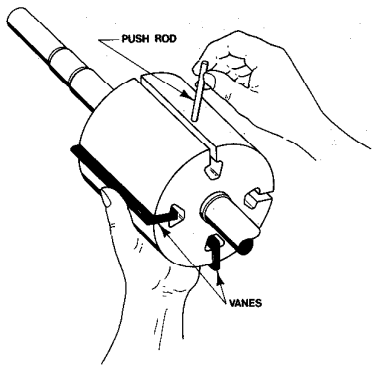


Fig. 5 — Push Rod Installation

end of the shaft through the seal assembly in the installed head (refer to pump rotation in preceding paragraph). To install the two remaining vanes, turn the shaft by hand until an empty slot comes to the 12 o'clock (top) position, insert a vane and rotate to the next empty slot. Be careful not to rotate an empty vane slot towards the bottom of the pump or the push rods will drop and jam the rotor.

On pumps equipped with an eight-vane rotor and shaft, no push rods are used. Insert the correct end of the rotor and shaft through the seal assembly in the installed head. Install the vanes by rotating the shaft by hand until an empty slot comes to the 12 o'clock (top) position, insert a vane and rotate to the next empty slot. Continue this process until all eight (8) vanes are in place.

On both the four-vane, and the eight-vane rotor and shaft, the vanes must be installed with the rounded or wearing edge outward to contact the surface of the liner. The relief grooves must face in the direction of rotation.

After the rotor and shaft and vanes have been installed, slowly rotate the shaft by hand to engage in the seal drive tang.

Install the second disc, head O-ring, ball bearing, and seal jacket assembly in the same manner as previously instructed. Press down while rotating the seal jacket assembly to engage the seal drive tang.

Install the stationary seat of the mechanical seal in the head recess. Attach the head assembly to the casing using the taper pins to locate and center it. Be careful not to contaminate the mechanical seal faces. Install and tighten the head capscrews.

Before installing the bearing lockwashers and locknuts tap the outer race of the bearing to ensure that it is properly seated in its cavity. Install a lockwasher and locknut on both ends of the shaft. Tighten the locknuts with the use of a spanner wrench and tap the bearings again for proper seating. Loosen both locknuts and rotate the shaft. The shaft must turn, with a light uniform seal drag, in both directions.

To adjust the locknuts, first tighten the locknut on the driver end until a slight drag increase is noted. Next, tighten the bearing locknut on the outboard end until the increase drag is eliminated. Find, align, and stake the closest lockwasher tang into the slot on the locknut. Repeat this operation for the locknut on the opposite end of the shaft.

Apply a small amount of grease to the lip of the grease seal and insert it in the inboard bearing cover with the lip outward. Attach a bearing cover gasket and bearing cover on each end.

PUMP TROUBLES AND THEIR CURES

LOSS OF DELIVERY

Probable causes:

1. Cavitation caused by circulation of liquid through the relief valve. This might happen if the separate bypass valve is too small, or if the piping to the valve is too small.
2. Lack of a vapor return will cause high discharge pressure, a vacuum in the supply tank, and resulting cavitation. If a vapor line is being used, it should be sized to allow minimal restriction of vapor flow. Where such a line is not permitted, vapor space filling (spray) valves should be used to keep pressure down to a reasonable level. When no vapor return line is used, the maximum delivery rate is limited to approximately 2½ percent of the tanks capacity per minute. This will vary somewhat with temperatures of the liquid and atmosphere, and resistance in the intake line.
3. Reversed pump rotation. Check the rotation of the pump with the arrow on the casing. The arrow must point in the direction of pump rotation.
4. Restriction in the suction line, caused by closed valves or too long of a suction line. Locate the pump as close to the supply as possible. It is easier for a pump to push liquid through a discharge pipe than to pull it through a suction pipe because of the tendency of these liquids to vaporize when the pressure drops.
5. Resistance in the discharge line.
6. Excessively worn vanes, discs, and rotor ends will increase pump slippage. One or more vanes installed backwards may reduce capacity.
7. Cold weather will increase the size of vapor bubbles in the inlet line thereby displacing a larger amount of liquid in the system, reducing flow.

LEAKAGE

Mechanical seals can be damaged and will begin leaking due to the following: greasing with a high pressure gun, using the wrong grease, dirt or abrasive particles between the seal faces, cut or otherwised damaged O-rings. Leakage will appear at the telltale holes under the bearing housing on the pump head. If leakage becomes excessive, the entire mechanical seal assembly should be replaced.

If leakage appears from between the pump casing and the head, the head should be removed and its O-ring inspected for cuts and nicks. If the O-ring is damaged, it should be replaced.

EXCESSIVE WEAR OR DAMAGED PARTS

Excessive wear and damaged pump parts are most often the result of the following:

Excessive vane wear is usually caused by:

a. Running dry
b. Overspeeding
c. Dirt "abrasives" in the line

Push rod penetration (four-vane rotor and shaft only) is usually caused by:

a. Overspeeding
b. Cavitation
c. Worn vane slots
d. Corrosion in push rod hole area

Corrosion of pump parts can be caused by water or carry-over from dehydrators. Corrosion may damage internal parts and weaken the entire system. Corrective action should be taken, immediately, to eliminate the cause.

Worn or scored discs and rotor ends are usually caused by improper adjustment of the bearing locknuts. Unless the locknuts are drawn up evenly as previously instructed in "Assembly," end-play will permit rotor and disc contact, causing wear.

NOISE AND VIBRATION

Noise and vibration are usually the result of cavitation (see causes above). Noise and vibration may also be caused by: vanes installed backwards (see Replacing Vanes), liner installed backwards, a broken vane, or by an improperly designed drive line which may impart a surging vibration to the pumping system.

Recirculation through the pump relief valve can also cause noise. Check the setting of the separate bypass valve.

blackmer / A DOVER RESOURCES COMPANY
1809 Century Avenue, Grand Rapids, Michigan 49509, U.S.A. • (616) 241-1611 • Fax: (616) 241-3752

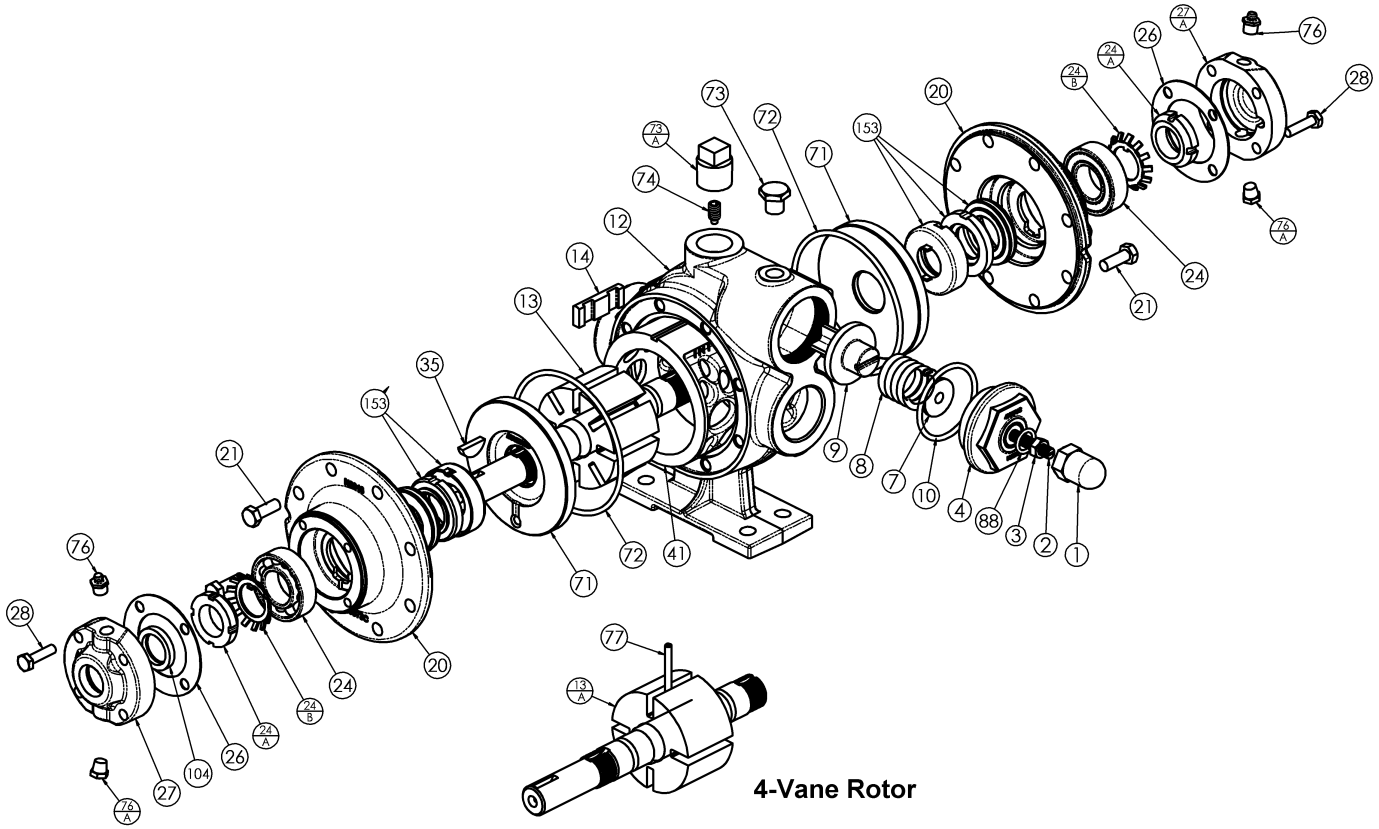
BLACKMER PARTS LIST

PUMP MODELS: LGRLF1.25A, LGL1.25, LGLF1.25A, LGL1.5, LGLF1.5A

and discontinued models: LGRL1.25, LGRLF1.25, LGLF1.25

(See Instructions 501-B00 or 585/C for Installation, Operation and Maintenance)

Section	500
Effective	Oct. 2000
Replaces	585/C1 Aug 00



Ref. No.	Description	Parts per Pump		Ref. No.	Description	Parts per Pump	
1	Cap – Relief Valve (R/V)	1		26	Gasket – Bearing Cover	2	
2	Adjusting Screw – R/V	1		27	Bearing Cover – Inboard	0-1	
3	Locknut – Adjusting Screw	1		27A	Bearing Cover – Outboard	1	
				28	Capscrews – Bearing Cover	4 - 8	
4	Cover – R/V	1		41	Liner – LGRL(F)1.25	1	
7	Spring Guide – R/V	1			Liner – LGL(F)1.25		
8*	Spring – R/V (81 – 125 psi)	1			Liner – LGL(F)1.5		
9	Valve – R/V	1		71*	Disc	2	
	Valve – R/V (Nickel Plated)			72*	O-Ring – Head	2	
10*	O-Ring – R/V Cover	1		73	Gage Plug (1/4")	1	
12	Casing (1.25)	1		73A* *	Gage Plug (3/4")	1	
	Casing (1.5)			74	Setscrew – Liner	1	
13	Rotor & Shaft Assembly, Eight Vane (Includes Ref. Nos. 24A & 24B)	1		76	Grease Fitting	2	
				76A	Grease Relief Fitting	2	
13A	Rotor & Shaft Assembly, Four Vane (Includes Ref. Nos. 24A & 24B)	1		77*	Push Rod – LGRL(F)1.25	0-2	
					Push Rod – LGL(F)1.25		
14*	Vane – Duravane	4-8			Push Rod LGL(F)1.5		
20	Head	2		88*	O-Ring – R/V Cap	1	
21	Capscrews – Head	16		104*	Grease Seal	1	
24*	Ball Bearing	2			Pump Repair Kit – LGRL(F)1.25		
24A	Locknut – Bearing	2			Pump Repair Kit – LGL(F)1.25		
24B*	Lockwasher – Bearing	2			Pump Repair Kit – LGL(F)1.5		

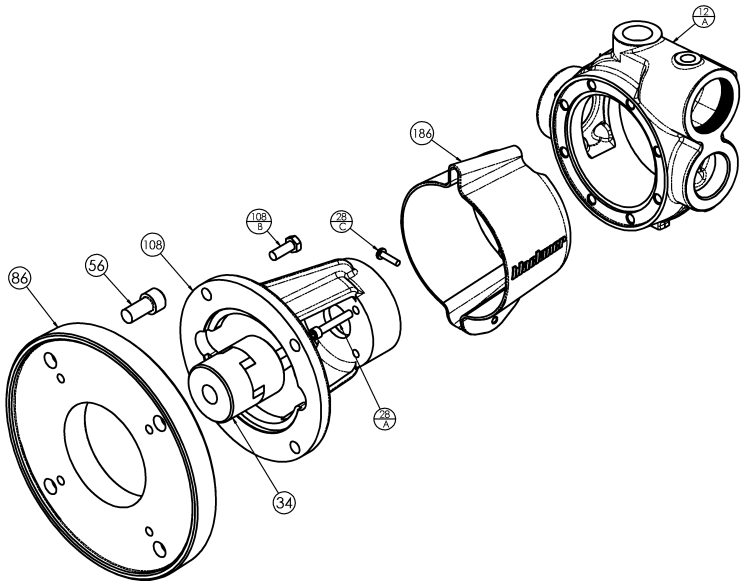
***** Included in Spare Parts Kits, *** ***Ref. No. 73A: Earlier versions of these pumps may use a 1/4" plug (P/N 908198) or 1/2" plug (P/N 908215). **Note:** earlier versions of these pumps used taper pins, which are no longer required.

Keep this parts list with Installation, Operation and Maintenance Instructions 501-B00 or 585/C.

FLANGE ‘ F’ MOUNTING

Ref. No.	Description	Parts per Pump	
12A	Casing w/o Feet – LG(R)LF1.25	1	
	Casing w/o Feet – LGLF1.5	1	
28A	Bracket Mounting Screws	4	
28C	Guard Screw	1	
34	Coupling Half – Pump	1	
	Coupling Spider (56C/143TC-184C)		
	Coupling Half – Motor (56C)		
	Coupling Half – Motor (143TC-184C)		
	Cplg. Half – Motor (182TC-184TC/215C)		
56	Capscrews – Adapter Ring Mounting	4	
86	Motor Adapter Ring (182TC Frame)	1	
108 [1]	Mounting Bracket	1	
108B	Capscrews - Bracket	4	
186	Guard	1	

1 = Use (P/N 833000– Mounting Bracket w/ feet) on discontinued models LG(R)LF1.25 and LGLF1.5

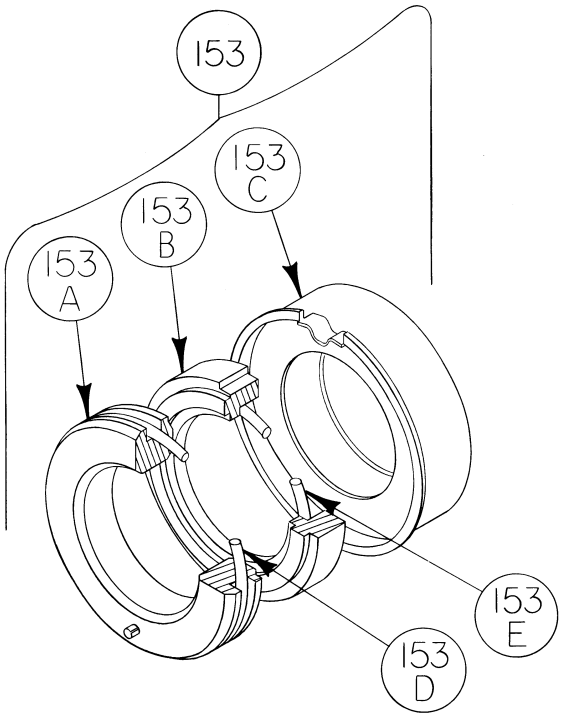


Mechanical Seal

Ref. No.	Part Name	Parts Per Pump	
153*	Mechanical Seal Assembly	2	
153A* *	Stationary Seat (Hardened Steel)	2	
153B* *	Seal Face (Carbon)	2	
153C* *	Jacket Assembly	2	
153D	O-Ring – Stationary (Buna-N)	2	
153E	O-Ring – Rotating (Buna-N)	2	

* Included in Spare Parts Kits

* * Ref. Nos. 153A, 153B, 153C are not available as separate replacement parts.



BLACKMER LIQUEFIED GAS PUMPS FOR LP-GAS AND NH3 SERVICE

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

960417
INSTRUCTIONS NO. 585/E

Section	500
Effective	June 1995
Replaces	April 1989

MODELS: LGL2E, TLGLD2E, LGL3E, TLGLD3E

GENERAL INFORMATION

SAFETY RULES

It is recommended that NFPA Pamphlet 58 be consulted for Safety Rules. Consult local and State regulations also.

WARNING

THIS PRODUCT MUST ONLY BE INSTALLED IN SYSTEMS WHICH HAVE BEEN DESIGNED BY THOSE QUALIFIED TO ENGINEER SUCH SYSTEMS. THE SYSTEM MUST BE IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS AND SAFETY CODES AND WARN OF ANY HAZARDS UNIQUE TO THE PARTICULAR SYSTEM.

WARNING DANGER

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

PUMP DATA

	Size 2	Size 3
Nominal Capacity (GPM) (640 RPM—50 PSI) at Ambient Temperature of:		
80° F.	64	137
32° F.	51	107
Maximum Differential Pressure (PSI) (330 RPM to 640 RPM)	150	150
Maximum Pump Speed (RPM)	980	980
Maximum Differential Pressure (PSI) (at 980 RPM)	60	60
Pump Weight (LBS.)	85	160
Maximum Temperature (° F.)	240	240
Torque Required (FT-LB.) (at 100 PSI)	48	89
Model Designations:		
For Motor Drive	LGL2E	LGL3E
For Truck Mounting	TLGLD2E	TLGLD3E

These pumps are listed by Underwriters' Laboratories, Inc. for liquefied-petroleum gas and NH_3.

INSTALLATION AND OPERATION—MOTOR DRIVEN PUMPS

LOCATION

Locate the pump as near the source of supply as possible to reduce pipe friction. A good foundation reduces vibration and noise and improves the pump performance. On permanent installations, it is recommended that the pumping units be securely bolted to a concrete foundation.

When new pump foundations are to be cast in concrete, it is suggested that anchor bolts of the type shown in Fig. 1 be set into the concrete.

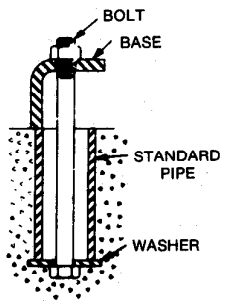


Fig. 1

RELIEF VALVE & BYPASS VALVE

The built-in spring loaded relief valve is to prevent damage to the pump or pumping system from excess pressure and should not be used for recirculation. A separate bypass valve is required by Underwriters' Laboratories, Inc. piped from the pump discharge system back to the supply tank. The setting on the separate bypass valve should be at least 25 psi less than the relief valve setting. Do not pipe the bypass valve back to the intake line. The valve and piping should be of adequate size to accommodate the full flow from the pump when the discharge line is closed.

The Blackmer Model BV2 separate bypass valve can be mounted as shown in Fig. 2 for bulk plant installation.

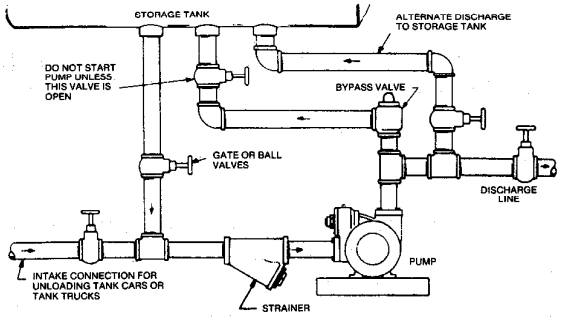


Fig. 2

STRAINER

The pump should be protected from foreign matter by the installation of a strainer in the intake line. A 40 mesh screen is recommended. It will prevent .010″ and larger pieces of weld splatter, slag, etc. from entering the pump.

PIPING

Many pump systems deliver at a rate below the designated capacity of the pump because the system was improperly piped. Restrictions in the pipe line should be avoided, such as elbows, sharp bends, globe valves, certain restricted type plug valves and undersize strainers. Use pipe of adequate size and strength that has been thoroughly flushed before connecting to the pump. Less restrictive gate or ball valves should also be used. Flexible connectors used near the pump will compensate for expansion, contraction and will provide a more vibration free operation.

Unions and valves in the piping near the pump will facilitate maintenance. On the intake side, locate the nearest fitting at least six inches from the pump to permit the removal of the relief valve cover.

CAUTION

PUMP WITH WELDED CONNECTIONS

THE PUMP CONTAINS THREE NON-METALLIC "O" RING SEALS THAT WILL BE DAMAGED IF WELDING IS DONE WITH THESE "O" RINGS INSTALLED.

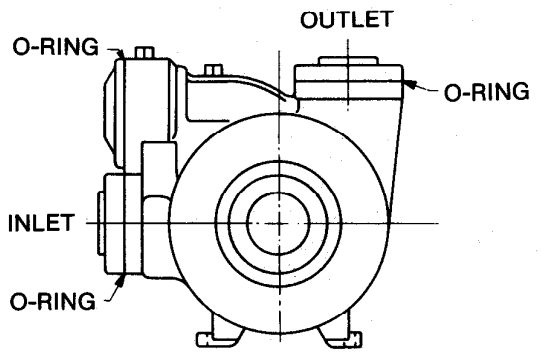


Fig. 3

Remove the "O" rings under the inlet flange, outlet flange and the relief valve cover then reinstall the inlet and outlet flanges.

Weld piping to inlet and outlet flanges and reinstall the three "O" rings.

When the unit is first started, rotation should be checked with the direction arrow on the pump. The discharge pressure should be compared to the supply pressure with a closed discharge. If the differential is over 100 psi, the separate bypass valve setting should be reduced.

Whenever possible, keep liquefied gas systems full of liquid, even when idle. This will keep the "O" rings from changing shape, shrinking or super cooling. Evaporation of liquefied gas leaves an abrasive powder on the surface which can cause wear to the pump, seals, meter, etc. If the system does not function properly, refer to the section on "Pump Troubles and Their Cures."

Use a vapor return line if possible. This will speed up delivery since a vapor line prevents back pressure from building up at the receiving tank, and a vacuum from forming in the supply tank. In laying out the system, read the section on "Pump Troubles" for suggested ways to eliminate difficulties before they develop.

ALIGNMENT

Where flexible couplings are used, the coupling cover should be removed and a straight edge laid across the two hubs of the coupling as shown in Fig. 4. The maximum offset should be less than .015″.

With a feeler gage or piece of flat steel of proper thickness, check the space between the two coupling halves. Insert a gage at a point on the coupling, and at 90° increments about the coupling. The space should not vary more than .020″. Misalignment is not desirable. If it does exist, it must not exceed the above limits.

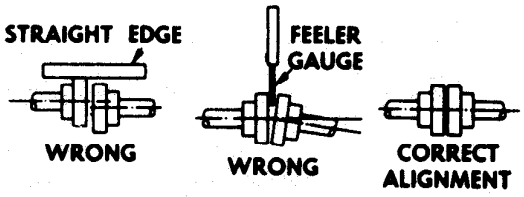


Fig. 4

The installation should be checked before being put into operation. Install a pressure gage in the gage hole nearest the discharge port provided on the pump casing before starting. Check all valves. The valves in the bypass return line must be open. After the pump is started, check the direction of the arrow on the pump head.

OPERATIONAL CHECK

The relief valve and separate bypass valve setting should be checked as described under Steps 8, 9 and 10 of Truck pump "Operation Check." The separate bypass valve on motor driven units is frequently set to protect the motor. If the pump is not delivering the expected flow rate, the separate bypass valve may be set too low and thus remain partially open. Remember that relief valves normally begin to bypass about 5 to 15 psi below their setting.

INSTALLATION AND OPERATION—TRUCK PUMPS

LOCATION

When locating the pump on the tank, safety should be the first consideration.

Locate the pump so that the suction line will be as short and straight as possible. Long suction lines lessen the capacity of a pump.

A large vapor return line should be used in all transport loading and unloading. Without such a line, the back pressure built up in the receiving tank, along with the vacuum in the supply tank, would noticeably reduce the flow rate and could cause constant bypassing. A 1½" or 2" (depending on length) vapor return hose and piping is recommended.

The outlet valve selected for the tank must give the desired flow rate without starving the pump.

PUMP ROTATION

An engine-wise rotation of the power take-off requires a right-hand pump for direct drive; anti-engine-wise a left-hand pump. When viewed from the shaft end, a right-hand pump turns clockwise, a left-hand pump counter-clockwise. Be sure your pump rotates in the same direction as the power take-off. The pump rotation is indicated by an arrow on the pump head. It should never be run in the reverse direction.

DRIVE

The pump may be driven by a power take-off from the transmission through universal joints. Additional pump shaft support is not necessary.

It is extremely important to install a proper drive line to avoid excessive wear, vibration and noise.

A few general rules to follow:

1. Use the least practical number of jackshafts (intermediate shafts).
2. Use an even number of universal joints.
3. The pump shaft and every other (alternate) jackshaft must be parallel to power take-off in both vertical and horizontal planes. The other shafts do not have to be parallel with anything.
4. Do not exceed 15° at any joint.
5. When unloading—align tractor with trailer.
6. An improperly designed drive line can result in a gallop or uneven turning of pump rotor which will impart a surging vibration to the liquid stream and piping system.

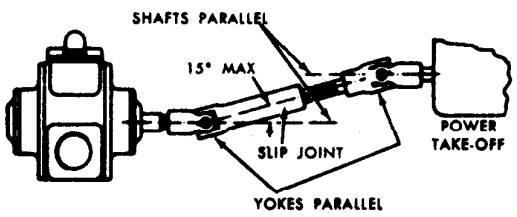


Fig. 5

PUMP SPEED

The higher the operating speed of the pump, the shorter the life of wearing parts. High pump speed may also cause continuous partial recirculation through the internal relief valve which will further shorten vane life. The operator should acquaint himself with these factors and, when making a delivery, set the engine to operate the pump at proper speed. The use of a tachometer is recommended. If the differential pressure on the pump is then over 100 psi the speed should be lowered, since part of the product will be recirculating through the bypass or relief valve.

OPERATIONAL CHECK

The following steps should be taken to check out a new system when it is placed in operation:

1. Install a pressure gage on the discharge side of the pump. (The difference between pump discharge pressure and the supply tank pressure is called the "Differential Pressure" in the following instructions.)
2. Connect the hose to the receiving tank.
3. Open the shut-off valve in the bypass return line.
4. If the tank outlet valve is:
   (a) Lever Operated - Pull control knob all the way out. Manually check the lever under the truck to see that it is in a completely open position.
   (b) Discharge Pressure Operated - Keep discharge line valve closed. When pump is started it will build up enough pressure to open the tank outlet valve. NOTE: This type of valve usually requires about 20 PSI differential pressure to open and about 15 PSI differential pressure to keep it open. If the piping is quite large it may be necessary to restrict the discharge line shut-off valve in order to maintain sufficient pressure to keep tank outlet valve open.
5. Start the pump.
6. Check pump rotation with the arrow on the pump.
7. Check pump speed (it should never exceed recommended maximum).
8. With discharge valve closed, check the differential pressure across the pump. It should not exceed the pressure setting of the separate bypass valve.
9. With discharge valve still closed, momentarily close the manual shut-off valve in the bypass return line to check the pump relief valve. The differential pressure should be between 150 psi and 170 psi.
10. The separate bypass valve must always be set lower than the relief valve. If the valves work properly, the pump should now be ready to operate.
    Note that the normal operating pressure should be at least 5-15 psi less than the separate bypass setting. Pump speeds which result in higher pressures (nearing the valve setting) mean that liquid is being recirculated uselessly. Slow the engine down, thereby eliminating needless wear on the equipment.

Whenever possible, keep liquefied gas systems full of liquid, even when idle. This will keep the "O" rings from changing shape, shrinking or super-cooling.

MAINTENANCE

MAINTENANCE AND TROUBLE SHOOTING MUST BE DONE BY AN INDIVIDUAL EXPERIENCED WITH PUMP MAINTENANCE AND THE TYPE OF SYSTEM INVOLVED.

LUBRICATION

Pump bearings should be lubricated every three months.

Recommended Grease: *Amoco® - Amolith All Weather Grease*, or equivalent (must be paraffinic base).

Apply grease with a hand pressure gun until it appears at the grease relief fitting.

It is normal for some grease to escape from the tell-tale holes under the bearing covers for a short period after lubrication. If this condition persists, the head must be removed and the mechanical seal replaced.

On motor-driven units using a gear reducer, the oil in the gear case should be maintained to the oil level plug hole, and changed every 6 months.

DISASSEMBLY

Before work is started on a pump it must be drained and the gas pressure relieved.

The size 2 pumps have dirt shields on the shafts; the double-end shaft models have one on each shaft. These shields will slide off the shaft with the bearing cover after removing the bearing cover capscrews.

Bearings are located by collars and serve as thrust bearings to position the rotor in the casing. It is necessary to remove the locknut and lockwasher, from each end of the rotor shaft, before each head can be removed. Remove the bearing cover, wipe off the excess grease, and locate the lockwasher tang that is staked into one of the locknut slots. Using a small blade screwdriver, pry up the staked lockwasher tang and remove the locknut. Remove the head capscrews and use two (2) large screwdrivers to pry the head loose from the casing around the head O.D. Slide the head assembly off the rotor shaft and use care not to drop the bearing.

The stationary seat, of the seal and its "O" ring, will come off the shaft as part of the head assembly. To remove the stationary seat, remove the bearing and use a screwdriver to push the stationary seat out of its cavity. The seal face and seal jacket may require a light pry to be slid off the shaft. Wipe the shaft and inspect for pits under the seal face "O" ring. If the seal has been leaking, it is advisable to replace the entire seal, including the stationary seat and its "O" ring. It is important to keep all parts of the seal clean.

With a pick or small screwdriver, slide out the three (3) uppermost vanes noting which side the slots are on. Inspect the edges of these vanes, that contact the liner, for gouges, ridges and tears. Replace these vanes and rotate the rotor shaft 180 degrees. Remove and inspect the top three (3) vanes. If vanes are damaged, it is advisable to remove the rotor and inspect the liner.

Remove the remaining head and hold the bottom vanes in the vane slot to prevent the push rods from jamming the rotor while it is being removed. Using a hard wood or brass drift and hammer, tap the liner around its outer edge to drive it out of the casing.

ASSEMBLY

Before assembling the pump, clean each part thoroughly. Wash out the bearing and seal cavities, and the recessed areas of the casing. Remove any burrs from the liner with a file.

On 2-inch pump models, apply grease to the liner key groove inside the pump casing to hold the key in place for liner insertion. Install the key in the groove before starting liner into casing. On 3-inch models, install the key in the keyway on the top of the liner. Align the liner keyway with the casing keyway and start the liner into the pump casing with the slots in the liner towards the casing intake port and with the hole pattern towards the discharge port. Use a rubber mallet to uniformly tap around the edge of the liner to fully install in the casing. If the liner is installed backwards it will restrict the port openings, causing noise and loss of capacity.

TLGL pump models are equipped with a double-ended rotor and shaft which allows the pump to be driven from either end.

LGL pump models are equipped with a single-ended rotor and shaft which can be assembled for either left-hand (LH) or right-hand (RH) rotation. To determine rotation:

If the intake port is on the right, with the drive end of the shaft pointing towards the observer, the pump is right-hand, clockwise rotation.

If the intake port is on the left, with the drive end of the shaft pointing towards the observer, the pump is left-hand, counter-clockwise rotation.

Install three (3) of the vanes in the bottom slots of the rotor with the rounded edges out and the relief grooves facing in the direction of rotation (see Figure 6). Hold the vanes in place and install the three push rods. With the hand cupped under the rotor, slide the rotor and shaft into the liner. Install the remaining three vanes into the top slots of the rotor with the rounded edges out and the relief grooves facing in the direction of rotation. Put a light coating of oil on both ends of the shaft between the threads and the rotor.

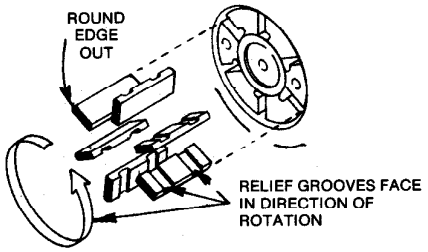


Fig. 6

Install a disc, against the liner, with the seal cavity outward and the disc hole radially positioned as shown in Fig. 7. Slide the seal jacket assembly over the shaft, with the drive tangs towards the rotor. Rotate the seal jacket assembly to get its tangs through the disc and engaged in the two (2) drive holes in the rotor. Insert the rotating "O" ring into the seal face and slide this subassembly, with polished mating face outward, over the shaft to the seal jacket assembly. Rotate the seal face to align the drive notches. Wipe any dirt, oil or grease off the mating surface of the seal face with a clean tissue (not a shop cloth).

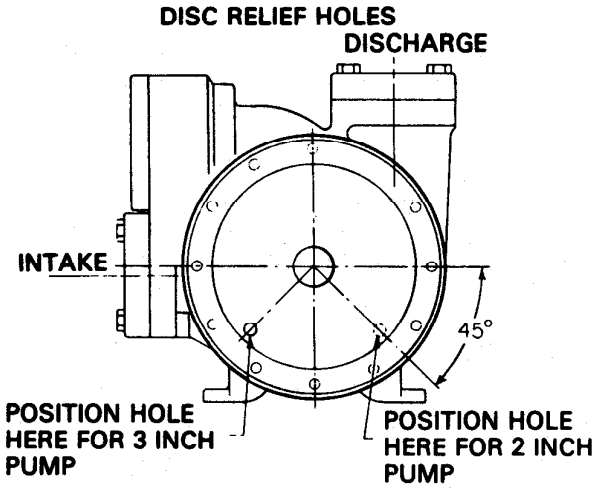


Fig. 7

With the head resting on its bearing boss, put a light coating of oil on the stationary seat cavity. Install the "O" ring in the groove around O.D. of the stationary seat. A pin, projecting from the back surface of the stationary seat, must be radially positioned to align with a notch at the bottom of the stationary seat cavity. Push the stationary seat into the cavity and make certain it is down. Wipe the mating face, of the stationary seat with tissue to remove any dirt, oil or grease.

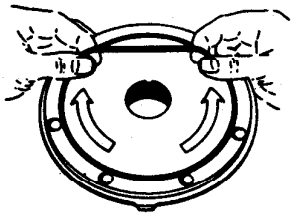


Fig. 8

The head "O" ring should be replaced if it is swollen, nicked, or cut. It is normally smaller in diameter than the "O" ring groove. To install, lay the ring flat on the head and start on one side of the groove. Slide thumbs over the "O" ring in opposite directions, stretching ahead with the fingers as shown in Fig. 8. If the "O" ring is rolled into the groove, it will roll right out.

Install the head assembly over the rotor shaft being careful to avoid any contact between the end of the rotor shaft and the mating face of the stationary seat. Rotate the head so that the drain hole, at the rear of the bearing cavity, is down when the pump is mounted for operation. Hold the head against the casing and install four (4) head capscrews, 90° apart. Snug up the four (4) capscrews but do not tighten. Install the bearing with the seal side in and the balls visible. Carefully tap the bearing outer race to seat the bearing in its cavity. Use the same procedure to install the second disc, seal assembly, head and bearing.

Install lockwashers and locknuts on both ends of the rotor shaft and tighten both locknuts very tight. Tighten the four (4) head capscrews holding each head, and loosen both bearing locknuts. Rotate the rotor shaft, by hand, to determine if any binding or tight spots exist. Any of these conditions may be corrected by loosening the four (4) capscrews, on one head, approximately one-half turn and tapping that head up or down, with a lead hammer. When the correct position is found, tighten the four (4) loosened capscrews and recheck for binding. Install and tighten all of the remaining head capscrews.

Tighten one bearing locknut until increased drag is noted, while turning the rotor shaft. Then tighten the other locknut until the increased drag disappears. Locate the closest lockwasher tang to a locknut slot, align these two and stake the tang into the slot. Repeat this operation with the second locknut then install gaskets and bearing covers on both ends. The bearing covers should be installed with the grease fittings up on stationary installations and down on mobile installations.

TO REVERSE PUMP ROTATION

Pump rotation, of LGL pumps, may be reversed by changing the side that the drive end of the shaft projects from the pump. Bearing covers, locknuts and one head must be removed to reverse the shaft. Previously covered "Disassembly and Assembly" Instructions apply.

PUMP TROUBLES AND THEIR CURES

VANE WEAR

Vane wear and push rod penetration are usually caused by excessive vapors entering the pump (called cavitation) or by abrasives in the liquid. Cavitation causes the vanes to "bounce" violently and sometimes is accompanied by noise and vibration.

Intake piping should be at least 2" on the LGL2 and TLGLD2 and at least 3" on the LGL3 and TLGLD3. For longer runs the next size larger piping should be used. Cavitation can be caused by circulation of liquid through the built-in relief valve on the pump, or through the separate bypass valve improperly piped back into the intake pipe. This can also happen if the pump valve operates at a lower differential pressure than the separate bypass valve, even though the separate bypass valve discharges into the supply tank. Check the setting of the separate bypass valve. Cavitation is also caused by restricted intake piping, small or defective excess flow valve, plugged or too fine a strainer basket, and the use of globe valves instead of ball-type or gate-type valves.

All the above conditions are aggravated if the pump is running too fast and is trying to deliver liquid faster than the piping can handle it.

One or more vanes installed backwards will cause noise and loss of capacity.

DAMAGED PUMP PARTS

Worn or scored discs can be caused by improper adjustment of the locknuts.

Corrosion of pump parts can be caused by calcium chloride brine carried over from dehydrators. Corrosion may damage internal parts and weaken the entire system. Corrective action should be taken immediately to eliminate the cause of corrosion.

LEAKAGE

Mechanical seals can be damaged and begin leaking from using the wrong grease, greasing with a high pressure gun, dirt or abrasive particles entering between the seal faces, cut or otherwise damaged "O" rings.

Leakage may appear at the drain holes under the bearing housing on the pump head. If leakage becomes excessive the entire mechanical seal assembly should be replaced. Leakage between the heads and pump casing is caused by a cut, nicked or damaged head "O" ring and the "O" ring must be replaced.

ROTOR AND DISC WEAR

Worn universal joints or a slip-joint that does not slip under load are the two most common causes for excessive end thrust on the pump shaft. This will cause the rotor to wear into the pump discs.

The most effective slip-joint is a well lubricated close fitting splined slip-joint. These commercially manufactured slip-joints will move axially under a high torque (rotating load). Worn, dry or dirty slip-joints especially the square "home-made" type will slip axially when the pump running, but when under load with the pump running the slip-joint becomes rigid. This can result in severe end thrust and wear to the pump.

NOISE AND VIBRATION

The most frequent cause is recirculation through the pump relief valve, caused by malfunction of the separate bypass or high bypass setting.

Another cause is excessive cavitation from a restricted intake, dirty strainer, small excess flow valve, too long or too small intake pipe.

Other possible causes—one or more vanes installed backwards, universal joints out of phase.

LOSS OF CAPACITY

The most probable causes are: restricted valve in pipe line; restricted excess-flow valve at tank outlet; cavitation; pump rotating backward; worn vane, disc, liner or rotor; pump located too far from storage tank (see paragraph on Location under "Motor Driven Pumps").

Cavitation and vapor binding may be caused by circulation of liquid through the relief valve. This will happen if the separate relief valve is set too high, is too small, or if the piping on the valve is too small. It can also be caused by overheating the pump or piping from hot sunshine or being located near a hot exhaust pipe.

If the excess-flow valve closes, it is an indication of trying to deliver too fast. The pump speed should be reduced.

Capacity without a vapor return line will be less than when a vapor return line is used.

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BLACKMER PARTS LIST

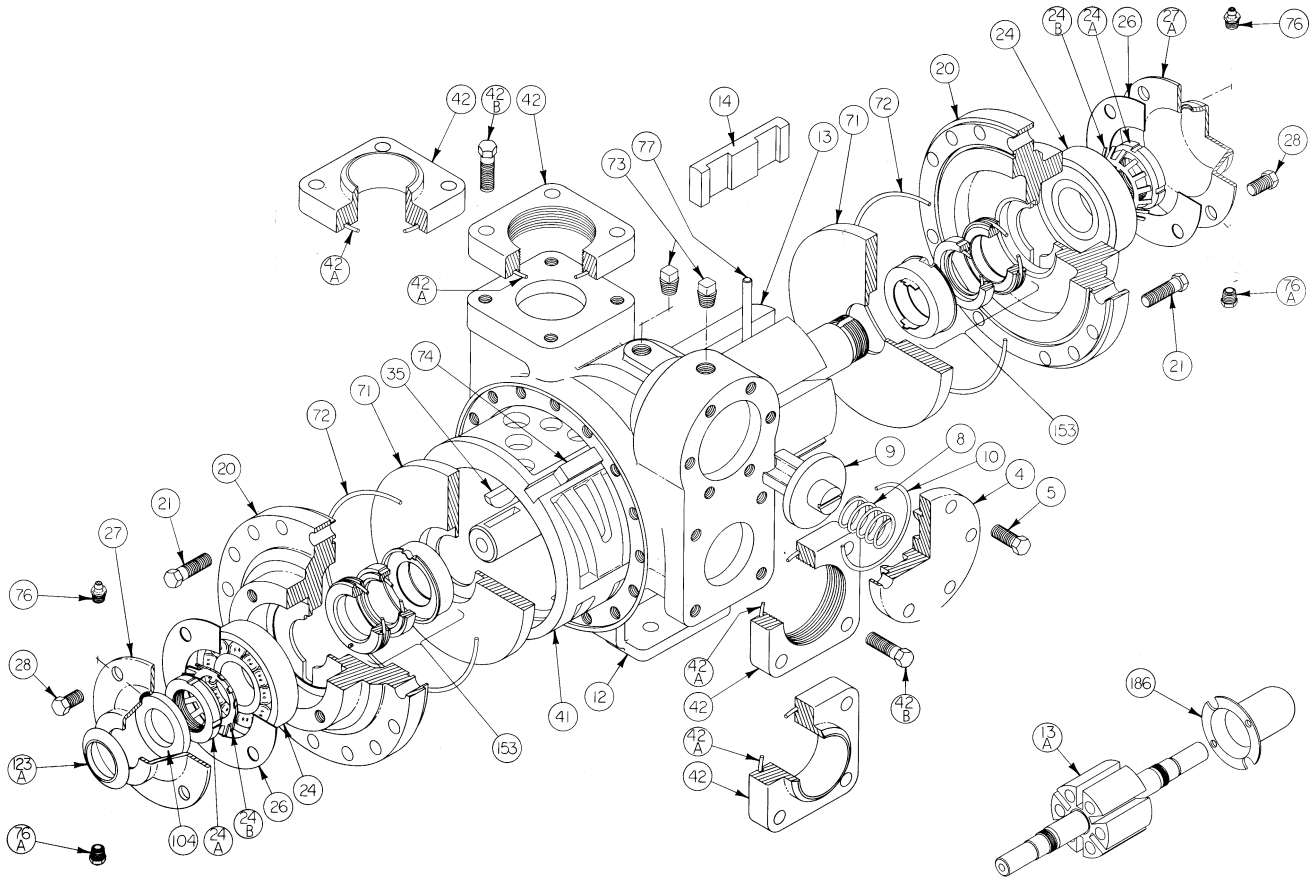
PUMP MODELS:
LGLD2E, LGLD3E

(See Instructions 501-C00 for Installation, Operation and Maintenance)

PARTS LIST
501-C01

Section	500
Effective	Dec 1999
Replaces	585/E1 Apr 90

DISCONTINUED MODELS: LGL2E, TLGLD2E, LGL3E, TLGLD3E



Ref. No.	Description	Parts Per Pump			Ref. No.	Description	Parts Per Pump	Size 2 Part No.	Size 3 Part No.
4	Cover - Relief Valve (R/V)	1			28	Cascrews - Bearing Cover (Size 2)	8		
5	Capscrews - R/V Cover	6				Capscrews - Bearing Cover (Size 3)	12		
8	Spring - R/V	1			35	Key - Shaft	1		
9	Valve - R/V (Std.)	1			41	Liner	1		
	Valve - R/V (Nickel Plated)				42	Flange - NPT	2		
10	O-RIng - R/V Cover	1				Flange - Weld			
12	Casing	1			42A	O-Ring - Flange	2		
13	Rotor & Shaft Asy. - LGL (Includes Ref. Nos. 24A & 24B)	1			42B	Capscrew - NPT Flange	8		
						Capscrew - Weld Flange			
13A	Rotor & Shaft Asy. – LGLD & TLGLD** (Includes Ref. Nos. 24A & 24B)	1			71	Disc	2		
					72	O-Ring - Head	2		
14	Vane - Duravane (Std.)	6			73	Gage Plug	2		
20	Head	2			74	+ Key - Liner	1		
21	Capscrews - Head (Size 2)	32			76	Grease Fitting	2		
	Capscrews - Head (Size 3)	40			76A	Grease Relief Fitting	2		
24	Ball Bearing	2			77	Push Rod	3		
24A	Locknut - Bearing	2			104	Grease Seal	1 (2)		
24B	Lockwasher - Bearing	2			123A	Dirt Shield	1 (2)		
26	Gasket - Bearing Cover	2			186	Shaft Protector (TLGLD Models Only)	1		
27	Bearing Cover (Inboard)	1 (2)							
27A	Bearing Cover (Outboard)	1 (3)				Pump Repair Kit			

* Parts Included in Pump Repair Kits.

** Double-Ended Rotor & Shaft.

The Following applies to double end shaft pump models LGLD2E, TLGLD2E, LGLD3E & TLGLD3E: (1) Use One (2) Use Two (3) Use None

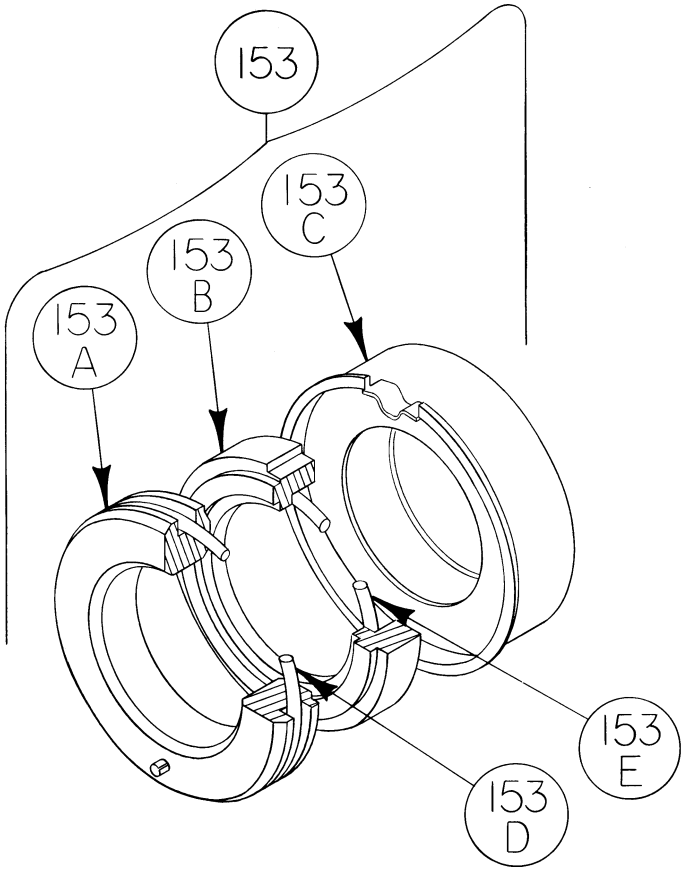
Keep this parts list with Installation, Operation and Maintenance Instructions 501-C00.

\+ Pump Models Before 1995 Require Key 184407.

MECHANICAL SEAL - STANDARD

Ref. No.	Part Name	Parts Per Pump		
153	Mechanical Seal Assembly	2		
153A	Stationary Seat (Steel)	2		
153B	Seal Face (Carbon)	2		
153C	Jacket Assembly	2		
153D	O-Ring - Stationary (Buna-N)	2		
153E	O-Ring Rotating (Buna-N)	2		

* Included in Pump Repair Kit.
** NOTE: Mechanical Seal Ref. No. 153 is only sold as a complete assembly. Ref. Nos. 153A, 153B & 153C are not available as separate replacement parts.



Fisher Controls

Instruction Manual

Type 98L and Type 98H Back Pressure and Relief Valves

FISHER

August 1993 *Form 1570*

WARNING

Fisher relief valves must be installed, operated and maintained in accordance with federal, state, and local codes, rules and regulations, and Fisher instructions.

If the spring case develops a leak or if the outlet continually vents gas, service to the unit may be required. Failure to correct trouble could result in a hazardous condition. Only a qualified person must install or service the unit.

Introduction

Type 98L and Type 98H (see figure 1) are self-operated, spring-loaded back pressure or relief valves. Typical applications include use in wash tanks, small heaters, fuel and oil lines, air supply systems, test fixtures, and sterilizers. Relief pressure ranges are 2 to 38 psig (0.14 to 2.6 bar), in four ranges, for the Type 98L and 15 to 200 psig (1.03 to 13.8 bar), in eight ranges, for the Type 98H. Type 98L body sizes are 1/4, 1/2, 3/4 and 1-inch. Type 98H body sizes are 1/4, 1/2, 3/4, 1, 1-1/2 and 2-inch.

Specifications

Specifications for the Type 98L and 98H backpressure and relief valves are given in table 1.

W6155

TYPE 98H

W6156

TYPE 98L

Figure 1. Type 98L & 98H Back Pressure and Relief Valves

D100258X012

Table 1. Specifications

Available Constructions

Type 98L: Self-operated with standard adjusting screw. Relief pressure ranges are 2 to 38 psig (0.14 to 2.6 bar).

Type 98H: Self-operated with standard adjusting screw. Relief pressure ranges are 15 to 200 psig (1.03 to 13.8 bar).

End Connection Style

NPT screwed, socket weld, or ANSI flanged-14 inches face to face (DIN flanged-356mm face to face)

Body Sizes

■ 1/4, ■ 1/2, ■ 3/4, ■ 1, ■ 1-1/2, ■ 2

Maximum Inlet Pressures, Psig[1,5] (Set Pressure Plus Buildup)

TYPE NUMBER	STEEL (WCB) OR STAINLESS STEEL BODY/ ALL TRIMS TO 150°F[2] (66°C)	CAST IRON BODY		
		All Trims to 150°F[3] (66°C)	Metal Trims [4]	
			To 315°F (66°C)	To 406°F (208°C)
98L	125 (52)	60 (16)	60 (16)	60 (16)
98H	300 (149)	300 (149)	300 (149)	250 (121)

Relief Pressure Ranges

See table 2

1. Relief pressure setting plus maximum allowable buildup over setting.
2. Or fluoroelastomer trims to 300°F (149°C) or metal trims to 450°F (232°C).
3. Or fluoroelastomer trims to 300°F (149°C).

Allowable Temperature Ranges[5]

Nitrile Parts: -20 to 200°F (-29 to 93°C)
Neoprene Parts: -40 to 150°F (-40 to 66°C)
Fluoroelastomer Parts: 0 to 300°F (-18 to 149°C)
Metal Diaphragm and Seat
Cast Iron Body and Spring Case:
-40 to 406°F (-40 to 208°C)
Steel Body and Spring Case:
-20 to 450°F (-29 to 232°C)
Stainless Steel Body and Spring Case:
-40 to 450°F (-40 to 232°C)

Approximate Weight, lb (kg)

Type 98H
1/4-inch Body: 7 (3.18)
1/2-inch Body: 7 (3.18)
3/4-inch Body: 16 (7.26)
1-inch Body: 16 (7.26)
1-1/2-inch Body: 55 (25)
2-inch Body: 55 (25)
Type 98L
1/4-inch Body: 6 (2.80)
1/2-inch Body: 13 (5.90)
3/4-inch Body: 30 (13.6)
1-inch Body: 30 (13.6)

4. Interpolate for intermediate pressure ratings.
5. The pressure/temperature limits in this bulletin and any applicable standard limitation should not be exceeded.

Table 2. Relief Pressure Ranges

BODY SIZE, INCHES	98L RANGE		98H RANGE		COLOR| CODE	PART NUMBER
	Psi	Bar	Psi	Bar		
1/4	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E392527022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1E392627012
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1E392727142
	29 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L346127142
1/2	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E395627022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1D745527142
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1D395727192
	29 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L380027142
3/4 & 1	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E398927022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1E399027142
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1D399127162
	29 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L380127232
1-1/2 & 2	- - -	- - -	5 to 35	0.3 to 2.4	Dark Gray	1E792327092
	- - -	- - -	20 to 65	1.4 to 4.5	Light Blue	1E795327082
	- - -	- - -	50 to 100	3.4 to 6.9	Light Gray	1E795427082
	- - -	- - -	80 to 170	5.6 to 11.7	Black	1P788827082

1. All springs may be backed off to 0 psig (bar). However, highest capacities and best performances are obtained by using these springs in their recommended ranges. Psi (bar) rather than psig (bar) are used for differential relief constructions.

Installation

Unbox and inspect the valve. Remove pipe scale and other foreign material from the connecting pipeline. Apply a suitable pipe compound to the male threads. The relief valve can be installed in any position as long as the flow is in the direction indicated by the arrow cast on the body.

Maximum operating temperatures for the Type 98L and 98H relief valves are as follows:

Elastomer diaphragm or seat: 150°F (66°C)

Metal diaphragm and seat: 406°F (208°C) with cast iron body and spring case or 450°F (232°C) with steel or stainless steel body and spring case

Vents

WARNING

If the process fluid is hazardous, install remote vent lines to carry fluid to a safe area.

If remote venting is necessary, an optional tapped vent in the spring case is available. Install remote vent lines in the spring case and outlet openings. The vent lines must have the largest practical diameter and be as short as possible with a minimum number of bends or elbows.

Overpressure

WARNING

Overpressuring any portion of this equipment may result in equipment damage, leaks in the relief valve, or personal injury due to bursting of pressure-containing parts. The system should be inspected after any overpressure condition.

Relief or back pressure ranges are from 2 to 200 psig (0.14 to 13.8 bar). The individual spring range of your relief valve is stamped on the nameplate.

Maximum inlet pressures depend upon body materials and temperatures. See table 1 for the maximum inlet pressure of the valve. The valve should be inspected for damage after any overpressure condition.

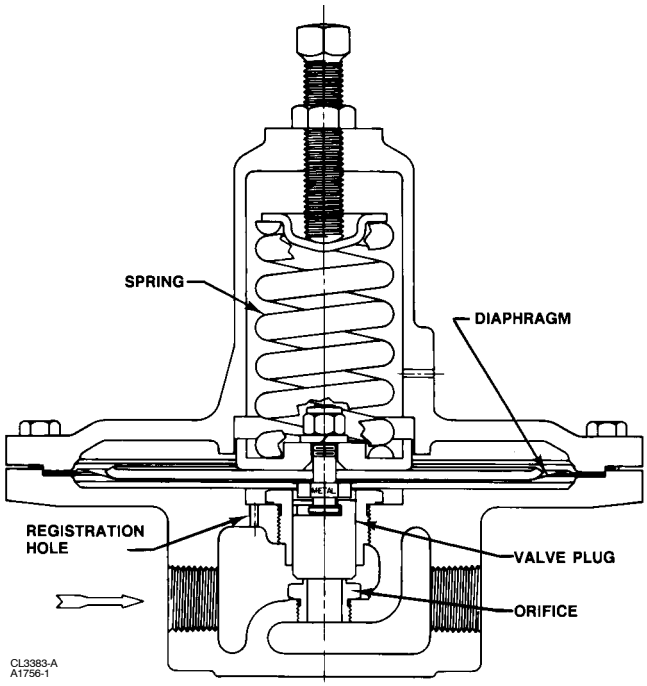


Figure 2. Type 98L Relief Valve Operational Schematic

Adjustment

Each unit is factory set for the pressure specified on your order. The allowable spring range is stamped on the nameplate. If a pressure setting beyond the indicated range is required, substitute the appropriate spring. Be sure to label the valve to indicate the new pressure range.

Always use a pressure gauge to monitor pressure when making adjustments.

Loosen the locknut (key 17). To increase the setting, turn the adjusting screw (key 15) clockwise. Turn the adjusting screw counterclockwise to decrease the setting. Tighten the locknut.

Principle Of Operation

Relief or back pressure valves respond to changes in upstream pressure. Pressure changes register under the diaphragm (see figure 2) through a registration hole in the valve body. When the pressure increases beyond the spring setting, the diaphragm pressure overcomes the spring compression. This causes the valve plug to move away from the orifice. The flow line through the valve is open and excess pressure is vented. When upstream pressure drops back to normal, the valve resumes its closed position.

Maintenance

WARNING

To avoid personal injury and equipment damage, isolate the valve from all pressure. Cautiously release pressure from the valve before attempting disassembly.

Due to normal wear and damage that may occur from external sources, relief valve parts such as the O-rings, gaskets, diaphragm, orifice, and valve plug should be inspected periodically and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions or the requirements of state and federal laws.

Instructions are given below for disassembly of the Type 98L and 98H back pressure relief valves. These valves do not have to be removed from the pipeline to inspect internal parts. Suitable lubricants are indicated on the assembly drawings. Apply the lubricants as the relief valve is being reassembled. Refer to figures 3 and 4 while servicing the relief valve.

1. Relieve the spring tension by loosening the locknut (key 17) and turning the adjusting screw (key 15) counterclockwise. Remove the cap screws (key 16). Lift off the spring case (key 2), spring (key 11), and upper spring seat (key 9).

2. Lift out the diaphragm unit which includes the pusher post (key 6), lower spring seat (key 8), diaphragm head (key 25, Type 98L), diaphragm (key 12), washer (key 7), and valve plug (key 4). (There will be two diaphragms if the diaphragm material is metal or fluoroelastomer.)

3. Check the orifice (key 3). If it needs replacing or repairing, unscrew the valve plug guide (key 5) and then the orifice. The valve plug can be removed by sliding it off of the pusher post.

Note

If damage to elastomer or metal seating surfaces is severe, replace the orifice and valve plug O-ring with new parts. However, by following the lapping procedure below, it is possible to repair metal seating surfaces if they are only slightly worn or scratched.

4. Lapping procedure:

a. Place a small amount of 500-grit silicon carbide or aluminum oxide lapping compound on a flat surface such as a piece of heavy plate glass.

Table 3. Torque Specifications

Body Size, Inches	Spring Case Ft-Lbs	Orifice Ft-Lbs
1/4	4.5 - 5.0	8 - 12
1/2	10 - 13	29 - 35
3/4 - 1	24 - 30	33 - 42
1-1/2 - 2	40 - 50	140 - 170

b. Take the valve plug or orifice and move it in a figure 8 motion on the lapping compound. Do not allow the part to tip or rock since this would round the corners.

c. Repeat step b for each part, using an 800-grit or 1000-grit silicon carbide or aluminum oxide lapping compound.

d. Wash away all traces of the lapping compound. To help prevent scratching the seating surfaces, a light coat of oil may be applied before returning the valve plug and orifice to the body. See table 3 for torque specifications.

5. Return the orifice and valve plug guide to the body.

6. To replace the valve plug O-ring (key 22), remove the screw (key 24) and O-ring retainer (key 21) from the plug. Remove and replace the O-ring.

7. Separate the remainder of the diaphragm unit parts. Take the locknut (key 26) off of the pusher post. Slide off the washer (key 23), lower spring seat, diaphragm head (Type 98L), diaphragm, washer (key 7), and gasket (key 10).

8. Slip the plug onto the pusher post.

Note

If a metal diaphragm is to be replaced by a elastomer diaphragm or a elastomer diaphragm by a metal diaphragm, a new pusher post is required. Each diaphragm material requires a different length pusher post.

9. Replace the diaphragm gasket (key 19) if necessary.

10. Slip gasket, washer, diaphragm, diaphragm head, lower spring seat, and washer back onto the pusher post. Screw on the locknut and return the unit to the body.

11. Set the spring in the lower spring seat and place the upper spring seat on the spring.

12. Put the spring case over the spring and onto the body. Tighten the cap screws finger tight only.

13. To ensure proper slack in the diaphragm, apply some spring compression by turning the adjusting screw clockwise. Finish tightening the cap screws.

Parts Ordering

When corresponding with your Fisher sales office or sales representative about this equipment, be sure to include the type number and other information stamped on the nameplate.

When ordering replacement parts, reference the key number of each needed part and specify the eleven-character part number as found in the following parts list.

Parts List

Key	Description	Part Number
	Note	
	In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the National Association of Corrosion Engineers (NACE) standard MR0175-92.	
	Parts kit (included are keys 3, 4, 10, 12, 19, 21, 22 and 24). Also included for 98H only is key 14.	
	Elastomer Trim	
	1/4-inch body	R98H X000012
	1/2-inch body	R98H X000022
	3/4 and 1-inch body	R98H X000032
	1-1/2 and 2-inch body	
	Type 98H only	R98H X000072
	Metal Trim	
	1/4-inch body	R98H X000042
	1/2-inch body	R98H X000052
	3/4 and 1-inch body	R98H X000062
	1-1/2 and 2-inch body	
	Type 98H only	R98H X000082
1	Body	See following table
2	Spring Case	
	Type 98H	
	Cast iron	
	1/4-inch body	2E3912 19012
	1/2-inch-body	2J4962 19012
	3/4 and 1□inch bodies	3E3978 19012
	1-1/2 and 2-inch bodies	4P7840 19012
	Steel	
	1/4-inch body	2J1275 22012
	1/2-inch body	2L4163 22012
	3/4 and 1-inch bodies	3E4087 22012
	1-1/2 and 2-inch bodies	3P7904 22012
2	Spring Case (Continued)	
	Type 98L	
	Cast iron	
	1/4-inch body	2E3913 19012
	1/2-inch body	3J4963 19012
	3/4 and 1-inch bodies	4E3979 19012
	Steel	
	1/4-inch body	2J1279 22012
	1/2-inch body	3L4161 22012
	3/4 and 1-inch bodies	4E5929 22012
3*	Orifice	See following table
4*	Valve Plug	See following table
5	Valve Plug Guide	
	416 stainless steel	
	1/4-inch body	1L3458 35132
	1/2-inch bodies	1L3416 35132
	3/4 and 1-inch bodies	1L3429 35132
	1-1/2 and 2-inch bodies	1P7885 35132
	316 stainless steel	
	1/4-inch body (NACE)	1L3458 35072
	1/2-inch body (NACE)	1L3416 35072
	3/4 and 1-inch bodies (NACE)	1L3429 35072
	1-1/2 and 2-inch bodies (NACE)	
	Type 98H only	1P7885 35072
6	Pusher Post	See following table
7	Washer (elastomer diaphragm only)	
	416 stainless steel trim	
	1/4-inch body	1L3447 36012
	1/2-inch body	1L3398 36012
	3/4 and 1-inch bodies	1L3428 36012
	316 stainless steel trim	
	1/4-inch body, std	1L3447 36142
	(NACE)	1L3447 X0012
	1/2-inch body, std	1L3398 35072
	(NACE)	1L3398 40032
	3/4 and 1-inch bodies, std	1L3428 36142
	(NACE)	1L3428 X0022
8	Lower Spring Seat	
	1/4-inch body, aluminum	1L3446 09012
	1/2-inch body, aluminum	1L3397 08012
	3/4 and 1-inch bodies, aluminum	1L3427 08012
	1-1/2 and 2-inch bodies	
	Type 98H only, steel zinc plated	1P7877 24152
9	Upper Spring Seat, steel pl	
	1/4-inch body	1B7985 25062
	1/2-inch body	1D6671 25072
	3/4 and 1-inch bodies	1E3987 25072
	1-1/2 and 2-inch bodies	
	Type 98H only	1P7876 24092
10*	Gasket, composition	
	(2 req d for metal diaphragm)	
	1/4-inch body	1L3448 04022
	1/2-inch body	1L3411 04022
	3/4 and 1-inch bodies	1L3434 04022
	1-1/2 and 2-inch bodies (metal diaphragm only) (2 req d)	
	Type 98H only	1P7880 04022
11	Relief Valve Spring	See following table
12*	Diaphragm	See following table
13	Nameplate, aluminum	
	(not shown)	11A5494 X0A2
14*	O-Ring, Type 98H only	
	1-1/2 and 2-inch bodies,	
	elastomer seat only	
	Nitrile	1C7822 06992
	Fluoroelastomer	1K7561 06382
	Fluoroelastomer (NACE)	1K7561 35072

*Recommended spare part.

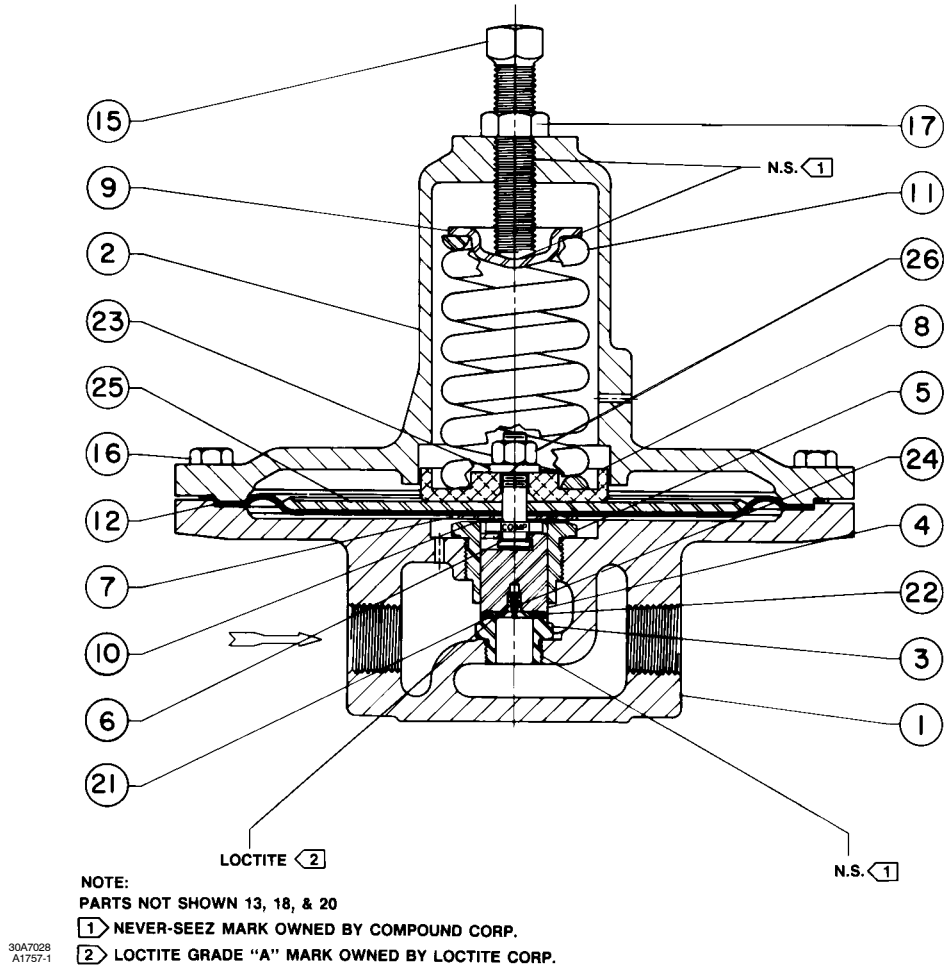


Figure 3. Type 98L Relief Valve Assembly Drawing

Key	Description	Part Number
15	Adjusting Screw, steel pl	
	1/4-inch body	
	Standard	1E6399 28992
	1/2-inch body	
	Standard	1D9954 48702
	For handwheel	1J4964 28982
	3/4 and 1-inch bodies	
	Standard	1A3308 28982
	1-1/2 and 2-inch bodies	
	Standard, Type 98H only	1A6801 28992
16	Cap Screw, steel pl	
	Type 98L	
	1/4-inch body (10 req d)	1A4078 24052
	1/2-inch body (10 req d)	1A3816 24052
	3/4 and 1-inch bodies (12 req d)	1A3369 24052
	Type 98H	
	1/4-inch body (6 req d)	1A3917 24052
	1/2-inch body (8 req d)	1A3526 24052
	3/4 and 1-inch bodies (8 req d)	1A3418 24052
	1-1/2 and 2-inch bodies (8 req d)	1K5684 28982
17	Jam Nut, steel zinc plated	
	1/4-inch body	1A3522 24122
	1/2-inch body	1A3537 24122
	3/4 and 1-inch bodies	1A3192 24122
	1-1/2 and 2-inch bodies	
	Type 98H only	1A3681 24112
18	Drive Screw (not shown)	
	Stainless steel (2 req d)	1A3682 28982
19*	Diaphragm Gasket, elastomer	
	Use w/302 stainless steel diaphragm	
	Type 98H	
	1/4-inch body	1E3931 04022
	1/2-inch body	1E3961 04022
	3/4 and 1-inch bodies	1E3993 04022
	1-1/2 and 2-inch bodies	1P7879 04022
	Type 98L	
	1/4-inch body	1E3940 04022
	1/2-inch body	1E3970 04022
	3/4 and 1-inch bodies	1E3904 04022

*Recommended spare part.

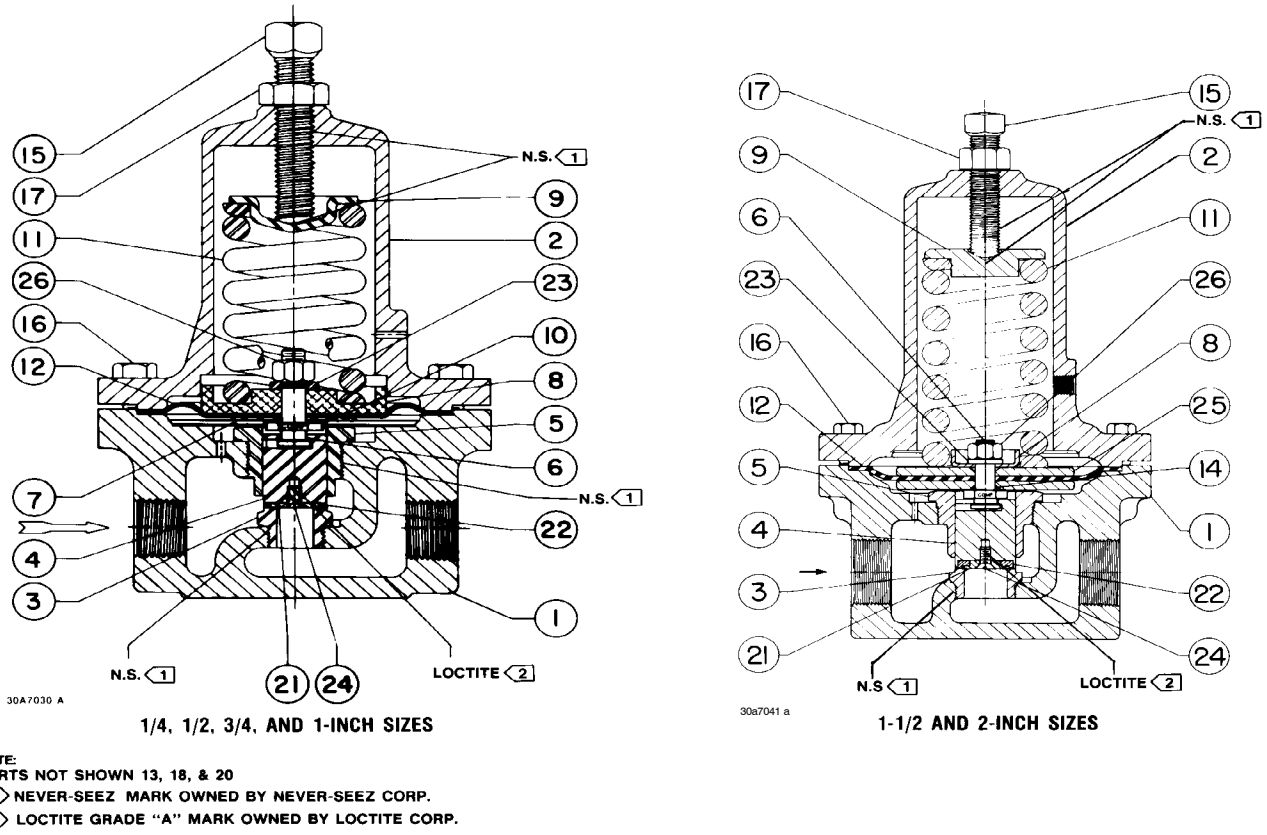


Figure 4. Type 98H Relief Valve Assembly Drawing

Key	Description	Part Number
21	O-Ring Retainer (elastomer seat only)	
	1/4-inch body	
	416 stainless steel	1L3460 35132
	316 stainless steel (NACE)	1L3460 35072
	1/2-inch body	
	416 stainless steel	1L3415 35232
	316 stainless steel (NACE)	1L3415 35072
	3/4 and 1-inch bodies	
	416 stainless steel	1L3430 35132
	316 stainless steel (NACE)	1L3430 35072
	1-1/2 and 2-inch bodies, Type 98H only	
	416 stainless steel	1P7875 35132
	316 stainless steel (NACE)	1P7875 35072
22*	O-Ring (elastomer seat only)	
	1/4-inch body	
	Nitrile	1C8538 06992
	Fluoroelastomer	1C8538 X0052
	1/2-inch body	
	Nitrile	1D2888 06992
	Fluoroelastomer	1N5301 06382
	3/4 and 1-inch bodies	
	Nitrile	1C7821 06992
	Fluoroelastomer	1N1632 06382

Key	Description	Part Number
22	L-Ring, Type 98H only	
	Elastomer seat only	
	1-1/2 and 2-inch bodies	
	Nitrile	1P7874 03202
	Fluoroelastomer	1P7874 06382
23	Lockwasher, steel	
	1/4 and 1/2-inch bodies	1C2256 28982
	3/4 and 1-inch bodies	1H6243 28992
	1-1/2 and 2-inch bodies, Type 98H only	1A4878 28992
24	Machine Screw, stainless steel	
	Elastomer seat only	
	1/4-inch body (NACE)	1L3462 38992
	1/2-inch body (NACE)	1L3444 38992
	3/4 and 1-inch bodies (NACE)	1L3435 38992
	1-1/2 and 2-inch bodies (NACE)	
	Type 98H only	1P7886 38992

*Recommended spare part.

Key	Description	Part Number
25	Diaphragm Head	
	Type 98L, steel zinc plated	
	1/4-inch body	1L3455 25072
	1/2-inch body	1L3396 25072
	3/4 and 1-inch bodies	1L3421 25072
	Type 98H, steel	
	1-1/2 and 2-inch bodies (2 req d)	
	Standard	1P7882 25012
	(NACE)	1P7882 35072
26	Locknut, steel zinc plated	
	1/4 and 1/2-inch bodies	1L8723 24122
	3/4 and 1-inch bodies	1L8722 24122
	1-1/2 and 2-inch bodies, Type 98H only	1P7887 24122
28	Handwheel, zinc	
	1/2-inch body only	1J4961 44012
29	Machine Screw, steel pl	
	1/2-inch body	
	With handwheel only	1A8517 28982
30	Lockwasher, steel	
	1/2-inch body	
	With handwheel only	1A3523 32992
51	NACE Tag, not shown	19A6034 X012
52	Tag Wire, not shown (NACE)	1U7581 X0022

Key 1 Regulator Body, NPT

BODY SIZE, INCHES	TYPE 98H				98L			
	NACE	For Other Than Sour Gas Corrosion Resistance Applications			NACE	For Other Than Sour Gas Corrosion Resistance Applications		
		Cast Iron	Steel	316 SST		Cast Iron	Steel	316 SST
1/4	1L3721X0052	1L346419012	1L372122012	1L372133092	1L3723X0022	1L346519012	1L372322012	1L372333092
1/2	2L3687X0022	2L339519012	2L368722012	2L368733092	2L3689X0032	2L339219012	2L368922012	2L368933092
3/4	2L3734X0062	2L342519012	2L373422012	2L373433092	2L3182X0022	2L341919012	2L318222012	2L318233092
1	2L3735X0032	2L342619012	2L373522012	2L1373533092	2L3183X0042	2L342019012	2L318322012	2L318333092
1-1/2	3P7868X0022	3P786819012	3P786822012	3P786833092	- - -	- - -	- - -	- - -
2	3P7867X0042	3P786719012	3P786722012	3P786733092	- - -	- - -	- - -	- - -

Key 1 Regulator Body, ANSI Class 150 & 300 Flanges

BODY SIZE, INCHES	TYPE 98H BODY MATERIAL				TYPE 98L BODY MATERIAL			
	Steel		Stainless Steel		Steel		Stainless Steel	
	ANSI Class				ANSI Class			
	150	300	150	300	150	300	150	300
1/2	1V5178X0012	- - -	1V5178X0022	- - -	- - -	- - -	- - -	- - -
3/4	- - -	- - -	- - -	- - -	2V4264X0022	- - -	- - -	- - -
1	2V3805X0012	2U8048X0012	2V3805X00B2	2U8048X0022	2V3641X0022	2U8047X0012	2V3641X0012	- - -
1-1/2	21B0804X012	1V4541X0012	21B0804X0022	1V4541X0022	- - -	- - -	- - -	- - -
2	10A0192X012	10A4986X012	10A0192X022	1V4541X0022	- - -	- - -	- - -	- - -

Key 1 Regulator Body, Socket Weld

BODY SIZE, INCHES	TYPE 98H BODY MATERIAL		TYPE 98L BODY MATERIAL	
	Steel	Stainless Steel	Steel	Stainless Steel
1/2	2L9673X0022	2L9673X0012	- - -	- - -
3/4	- - -	- - -	2N4463X0012	- - -
1	2N414422012	2N4144X0012	2N445222012	2N4452X0012
1-1/2	3V4542X0012	3V4542X0022	- - -	- - -
2	30A0191X012	30A0191X032	- - -	- - -

Key 3 Orifice

BODY SIZE, INCHES	METAL TO METAL SEAT		ELASTOMER SEAT		
			NACE	For Other Than Sour Gas Corrosion Resistance Applications	
	416 SST	316 SST		416 SST	316 SST
1/4	1E391646172	1E391635072	1L345935072	1L345935132	1L345935072
1/2	1E395046172	1E395035072	1L341735072	1L341735132	1L341735072
3/4, 1	1E398046172	1E398035072	1L343135072	1L343135132	1L343135072
Type 98H only 1-1/2, 2	2P787046172	2P787035072	1P787135072	1P787135132	1P787135072

Key 4* Valve Plug

BODY SIZE, INCHES	METAL TO METAL SEAT		ELASTOMER SEAT		
			NACE	For Other Than Sour Gas Corrosion Resistance Applications	
	416 SST	316 SST		416 SST	316 SST
1/4	1L345246172	1L345235072	1L345135072	1L345135132	1L345135072
1/2	1L344146172	1L344135162	1L344335072	1L344335132	1L344335072
3/4, 1	1L343746172	1L343735162	1L343635072	1L343635132	1L343635072
Type 98H only 1-1/2, 2	1P787246172	1P787235072	1P787335072	1P787346172	1P787335072

Key 6 Pusher Post

BODY SIZE, INCHES	METAL TO METAL SEAT		ELASTOMER SEAT		
			NACE	For Other Than Sour Gas Corrosion Resistance Applications	
	416 SST	316 SST		416 SST	316 SST
1/4	1L345735132	1L345735072	1L345635072	1L345635132	1L345635072
1/2	1E344535132	1L344535072	1L344235072	1L344235132	1L344235072
3/4, 1	1L343935132	1L343935072	1L343835072	1L343835132	1L343835072
Type 98H only 1-1/2, 2	1P788335132	1P788335072	1P788435072	1P788435132	1P788435072

*Recommended spare part.

Key 11 Relief Valve Spring

BODY SIZE, INCHES	98L RANGE		98H RANGE		COLOR CODE	PART NUMBER
	Psi	Bar	Psi	Bar		
1/4	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E392527022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1E392627012
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1E392727142
	20 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L346127142
1/2	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E395627022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1D745527142
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1D395727192
	20 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L380027142
3/4 & 1	2 to 17	0.1 to 1.2	15 to 35	1.0 to 2.4	Yellow	1E398927022
	6 to 14	0.4 to 1.0	25 to 75	1.7 to 5.2	Green	1E399027142
	12 to 25	0.8 to 1.7	70 to 140	4.8 to 9.7	Red	1D399127162
	20 to 38	1.4 to 2.6	130 to 200	9.0 to 13.8	Blue	1L380127232
1-1/2 & 2	- - -	- - -	5 to 35	0.3 to 2.4	Dark Gray	1E792327092
	- - -	- - -	20 to 65	1.4 to 4.5	Light Blue	1E795327082
	- - -	- - -	50 to 100	3.4 to 6.9	Light Gray	1E795427082
	- - -	- - -	80 to 170	5.6 to 11.7	Black	1P788827082

Key 12* Diaphragm

TYPE NUMBER	BODY SIZE, INCHES	DIAPHRAGM MATERIAL		
		Neoprene	Fluoroelastomer (2 req d)	302 SST (2 req d)
98L	1/4	1L345302112	1L345302402	1L345436012
	1/2	1L341302112	1L341302402	1L341436012
	3/4, 1	1L342302112	1L342302402	1L342236012
98H	1/4	1L344902112	1L344902402	1L345036012
	1/2	1L341202112	1L341202402	1L339936012
	3/4, 1	1L343302112	1L3433X0032	1L343236012
	1-1/2, 2	1P788102192	11A1347X012	1P787836012

*Recommended spare part.

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APPENDIX B

TECHNICAL INFORMATION

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Figure 7 – *Electrical schematic for pump with on/off switch*

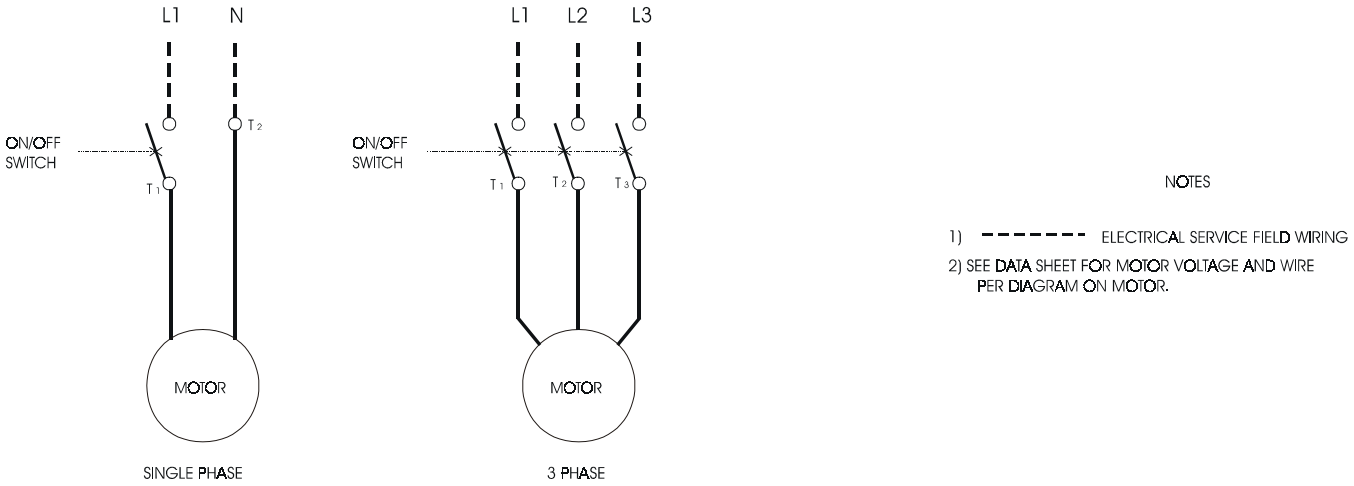
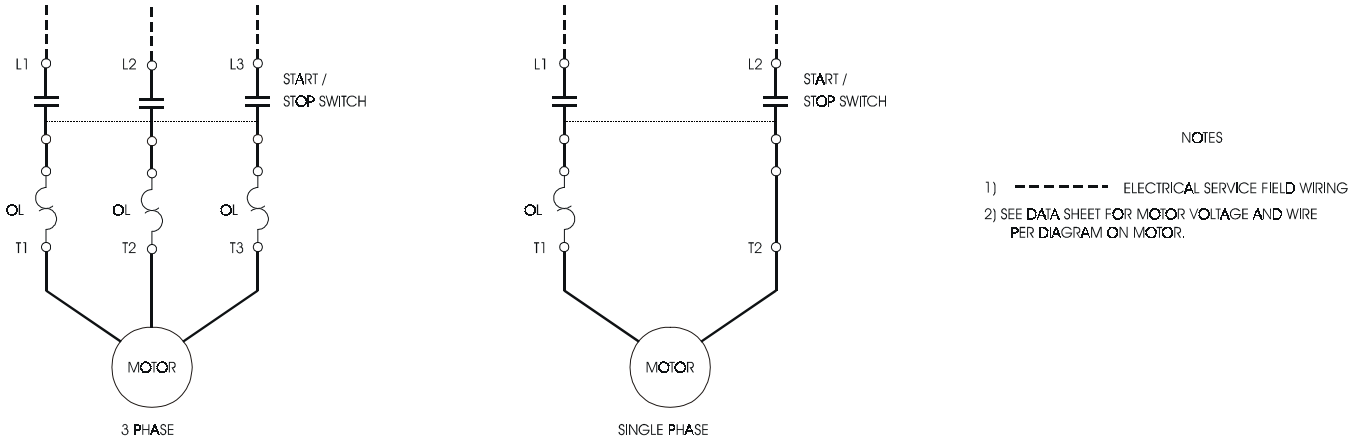


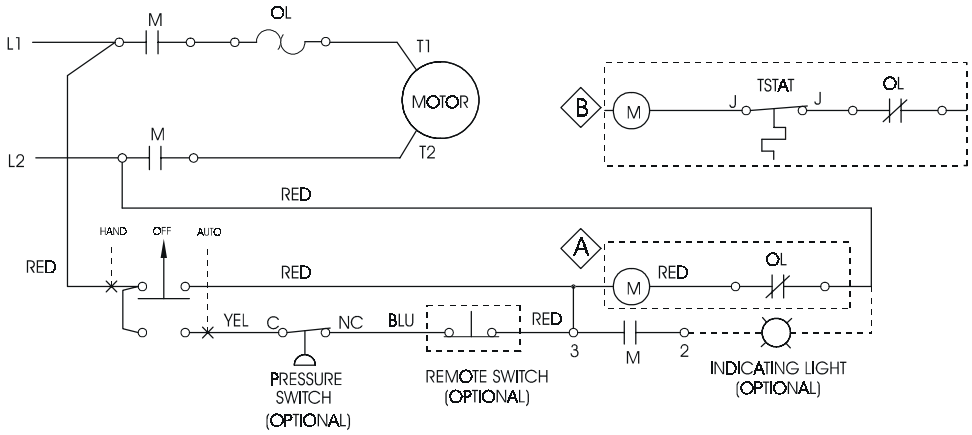
Figure 8 – *Electrical schematic for pump with manual starter.*



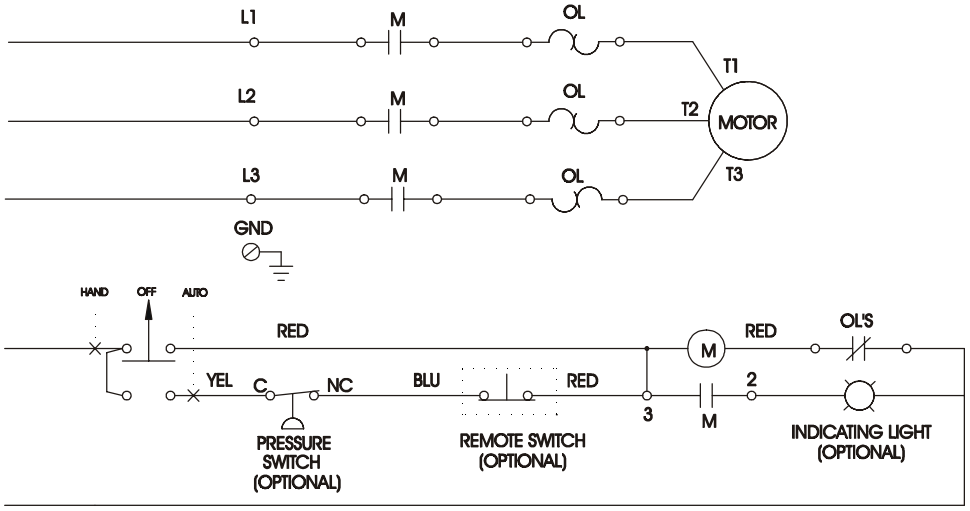
NOTE

For all Pumps see Data Sheet for voltage and wire per diagram on motor.

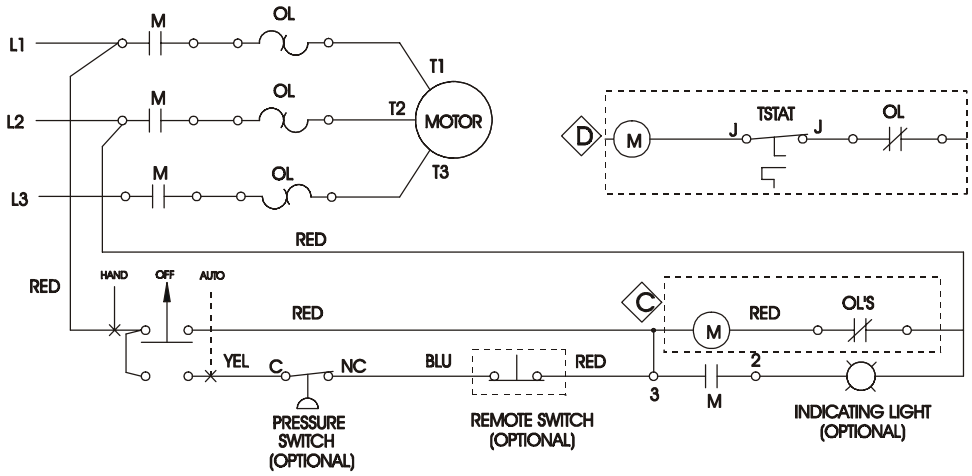
Figure 9 *– Electrical schematic for pumps with magnetic starters.*



SINGLE PHASE SCHEMATIC



THREE SCHEMATIC DIAGRAM W/SEPARATE CONTROL VOLTAGE



THREE PHASE SCHEMATIC

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