

KINNEY®
Two-Stage, Rotary Piston Vacuum Pump

Manual 1807 Rev B p/n 001807 0000

WARNING: Do Not Operate Before Reading Manual

KC Series OPERATOR'S MANUAL

Models

KC-5 KC-15
KC-8



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Table of Contents

Introduction	1
Description.....	1
Pump Components	2
Operating Cycle	2
Sealing and Lubrication	3
Oil Types	3
Specifications.....	4
Safety	5
Graphic Conventions Used in this Manual.....	5
Safety Instruction Tags.....	5
Safety Precautions for Rotary Piston Pumps.....	6
Installation	7
Mounting	7
V-Belt.....	7
Discharge Piping	7
Vacuum Piping	7
Vacuum Gauges	9
Electrical Connections	9
General	9
Filling the Pump with Oil.....	10
KC-5 and KC-8	10
KC-15	10

Pre-Start Checks	10
Operation	11
Starting the Pump	12
Stopping the Pump	12
Gas Ballast.....	12
Special Refrigeration Service Pumps	13
Maintenance	14
Periodic Maintenance	14
Changing the Oil	14
Flooding	15
Oil Mist Eliminator	15
Stalling	17
Troubleshooting.....	18
Checking Pump Performance	19
Pump Leaks	20
Checking Process Equipment	20
Process Equipment Leaks	20
Leak Checking Techniques.....	21
Oil Contamination.....	21
Discharge Valve	21
Shaft Seal	22
Disassembly	24
Reassembly	26
Replacement Parts.....	29
Spare Parts	29
Ordering Parts	29
Exploded Views and Parts Lists.....	30
KC-5 and KC-8 Exploded View Drawing	30
KC-5 and KC-8 Parts List	31

KC-8C Exploded View Drawing..... 32
KC-8C Parts List..... 33
KC-15D Exploded View Drawing..... 34
KC-15D Parts List..... 35
KC-15L Exploded View Drawing 36
KC-15L Parts List 37

INTRODUCTION

CONGRATULATIONS on the purchase of a new KINNEY® KC™ Two-stage, Rotary Piston Vacuum Pump from Tuthill Vacuum & Blower Systems. Please examine the pump for shipping damage, and if any damage is found, report it immediately to the carrier. If the blower is to be installed at a later date, make sure it is stored in a clean, dry location and rotated regularly. Make sure covers are kept on all openings. If blower is stored outdoors, be sure to protect it from weather and corrosion.

KINNEY KC vacuum pumps are built to exacting standards and, if properly installed and maintained, will provide many years of reliable service. Read and follow every step of these instructions when installing and maintaining the blower.



WARNING

Serious injury can result from operating or repairing this machine without first reading the service manual and taking adequate safety precautions.

NOTE: Record the pump model and serial numbers in the **OPERATING DATA** form on the inside back cover of this manual. Use this identification on any replacement part orders, or if service or application assistance is required.

DESCRIPTION

The KC series of compound high vacuum pumps covered by this manual consists of two basic pump groups models:

- KC-5 and KC-8
- KC-15

The pumps within each of the first two groups are identical except for the motor and V-belt drive, which differ in order to produce different rotational speeds. Specifically, models KC-5 and KC-8 are the same except that the KC-8 is driven faster.

Each Kinney KC pump is an air-cooled rotary piston high vacuum pump consisting of two rotary piston pumping stages, which operate in series. These pumps attain low ultimate pressures of less than 2×10^{-4} Torr (McLeod gauge). The rugged, simple design ensures dependable service under the most severe applications without costly or complicated maintenance. All components are easily serviced, and no special tools are required. Reliable, leak-free shaft seals require no adjustments or maintenance.

Each pump is equipped with a gas ballast valve, which regulates the vapor handling capacity of the pump. Gas ballast helps increase the operation period between oil changes by preventing oil contamination by most condensable vapors. It can also be used to clean the oil once it has become contaminated. Use of gas ballast also reduces pump operating noise.

A combination oil separator and oil mist eliminator is used in place of a conventionally designed oil

separator. This combination oil separator and oil mist eliminator thoroughly filters the pump exhaust and results in a cleaner pump area, without expensive and space-consuming exhaust piping systems.

See Specifications on page 4 for pump specifications.

PUMP COMPONENTS

Each pump basically consists of two rotary piston pumping stages connected in series – a high vacuum stage and a backing stage. The two rotary pistons are driven by two eccentric cams keyed to a common shaft. Each rotary piston has a hollow extension (slide) that moves through a slide pin and leads to the inlet of the particular pumping stage. Ports are cast into the inlet side of each piston and these ports together with the slide pins form automatic inlet valves.

The two pumping stages are connected in series by an internal duct and are enclosed in a single cylinder. The ends of the cylinder are enclosed by an open head, through which the shaft extends, and a closed head. The open head contains a shaft seal to prevent leakage along the shaft.

A spring-loaded discharge valve is located at the discharge side of the backing stage (on the open head end of the pump). An oil mist eliminator is mounted above the backing stage.

A sight gauge is provided for checking the oil level in the pump. When the pump is operating at low inlet pressure, the level should be in the center of the sight gauge. The oil level will change with large changes in pump inlet pressure.

Operating Cycle

The operating cycle is shown in **Figure 1-1**. Gas from the system enters through the pump inlet. It passes through the hollow piston slide and out through the piston slide port into the space being created between the piston and cylinder wall. As the piston rotates, this space increases and more gas is drawn in. At the same time, the gas taken in and trapped on the previous revolution is on the compression side of the piston and slide where

it is compressed and discharged into the cored passageway that leads to the inlet of the backing stage.

The rotary piston pumping cycle is repeated in the backing stage. The gas is compressed and forced out through the discharge valves along with a small amount of oil and then into the oil mist eliminator where the oil is separated from the gas. The gas is discharged to atmosphere and the oil drains back to the reservoir.

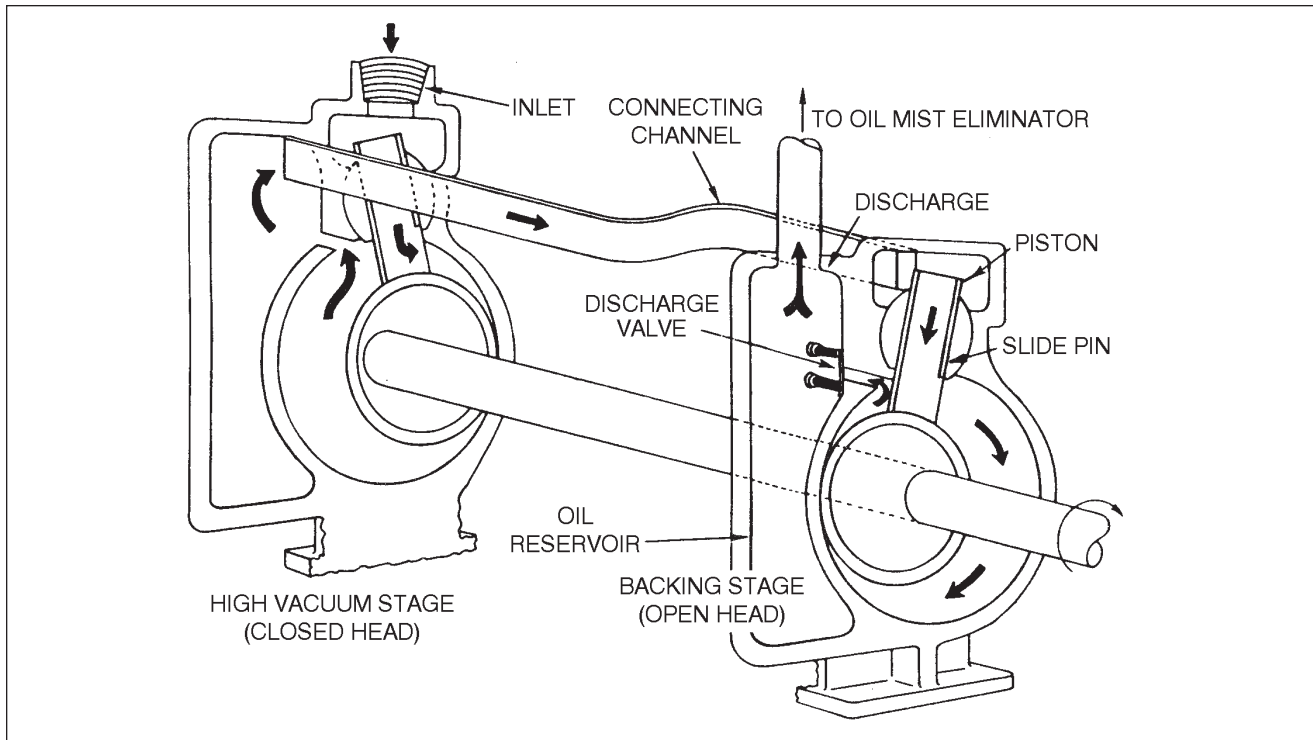


Figure 1-1 – Pump Operating Cycle

Sealing and Lubrication

The cylinder walls, pistons, and slide pins are lubricated and sealed against the backflow of gas by a film of oil, which fills the close running clearances. When operating, the cylindrical part of the piston almost touches the pump cylinder at a line along the length of the piston. At this moving line, an effective wave of oil is pushed ahead of the piston. The oil forms a vacuum tight seal between the piston and the cylinder, as well as between all other working components. The same oil also supplies all required lubrication. The oil flows through the pump by means of differential pressure. Because of high pressure at the discharge and low pressure at the inlet of each stage, the oil is forced from both oil reservoirs (one at the discharge of each stage), through internal cored passageways leading to each pumping stage. The oil from the backing stage reservoir lubricates and seals the backing stage, whereas the oil from the high vacuum stage reservoir lubricates and seals the high vacuum stage. At the end of the compression stroke, the oil is forced

out with the discharged gas and returns to the respective oil reservoir.

Oil Types

The ability of each KC pump to obtain and hold pressures in the low micron range depends partly on the use of the proper sealing and lubricating oil. The AX Vacuum Oil recommended for use with these pumps is a dry, low-vapor pressure fluid with suitable viscosity. Such oil is necessary for a high pumping speed at low pressure.

It may be necessary to use other fluids for special applications. If varnishing is a concern, high-detergent oils may be used. If low-temperature starting is required, other more suitable fluid may be used. Tuthill Vacuum & Blower Systems can recommend fluids to fit most special applications.

SPECIFICATIONS

MODEL	KC-5	KC-8	KC-15
Free air displacement	5 CFM (1.42 L/sec)	8 CFM (3.78 L/sec)	15 CFM (7.08 L/sec)
Pump speed	630 rpm	1,000 rpm	525 rpm
Motor	0.33 HP (0.25 kW)	0.5 HP (0.37 kW)	1.0 HP (0.75 kW)
Oil capacity	0.5 qt (0.47 L)	0.8 qt (0.76 L)	3 qt (2.84 L)
Inlet connection	1 in. FNPT	1 in. FNPT	2 in. FNPT
Discharge connection	3/4 in. FNPT	3/4 in. FNPT	1-1/4 in. FNPT
Pump shaft diameter	3/4 in. (19.1 mm)	3/4 in. (19.1 mm)	3/4 in. (19.1 mm)
Approximate length	19.13 in. (486 mm)	19.50 in. (495 mm)	22.50 (572 mm)
Approximate width	13.25 in. (337)	12.31 in. (313 mm)	18.06 (459 mm)
Approximate height	16.19 in. (411 mm)	16.19 in. (411 mm)	25.75 (654 mm)
Approximate weight (complete assembly)	115 lb (52 kg)	120 lb (54 kg)	210 lb (95 kg)

Table 1-1

SAFETY

GRAPHIC CONVENTIONS USED IN THIS MANUAL

The following hazard levels are referenced within this manual:

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

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

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation that can cause damage to the engine, personal property, and/or the environment or cause the equipment to operate improperly.

NOTE: Indicates a procedure, practice, or condition that should be followed in order for the equipment to function in the manner intended.

SAFETY INSTRUCTION TAGS

WARNING



Do not operate without belt guard.

CAUTION

Do not valve or restrict pump discharge opening.

Use oil mist eliminator when operating pump, ensure adequate ventilation when discharging indoors.

Refer to manual safety instructions.

NOTICE

The above safety instruction tags were permanently affixed to your pump prior to shipment. Do not remove, paint over or obscure in any manner.

Failure to heed these warnings could result in serious bodily injury to the personnel operating and maintaining this equipment.

SAFETY PRECAUTIONS FOR ROTARY PISTON PUMPS

Please read the following safety information before operating the vacuum pump.

- Do not operate the pump without the belt guard properly attached. Disconnect the pump motor from the electrical supply at the main disconnect before removing the belt guard. Replace the belt guard before reconnecting the power supply to the pump motor. Operating the pump without the belt guard properly installed exposes personnel in the vicinity of the pump to risk from rotating drive components.
- Do not operate the pump with oxygen-enriched gas (greater than 20% by volume) in the suction line, unless the pump has been prepared with an inert fluid suitable for the application.

WARNING

Pumping oxygen-enriched gases with mineral oil or other non-inert fluids can cause fire or explosion in the pump, resulting in damage or serious bodily injury.

- Take precautions to avoid prolonged or excessive exposure to oil mist or process materials emanating from the discharge of the pump.
- Do not allow the pump to discharge into a closed or inadequately ventilated room. Always use a discharge oil mist eliminator unless the pump discharge is discharged to outside atmosphere. Laws and ordinances may pertain to your local area regarding discharge of oil mist or vapor to atmosphere. Check local laws and ordinances prior to operation of the pump with discharge to outside atmosphere. Venting of the discharge of an oil mist eliminator to outside atmosphere is highly recommended.

- Do not restrict the pump discharge in any way or place valves in the discharge line. The vacuum pump is a compressor and will generate high pressures without stalling the motor when operated at low suction pressures. Excessive pressure could cause damage or serious bodily injury.
- Disconnect the pump motor from the electrical supply at the main disconnect before disassembling or servicing the pump. Make sure the pump is completely reassembled, the belt guard is properly installed, and all fill and drain valves are installed and closed before reconnecting the power supply. Accidental starting or operation of the pump while maintenance is in progress could cause damage or serious bodily injury.
- Lift pump only by the lifting lugs supplied with the pump. Never lift equipment attached to pump by the pump lifting lugs.
- Do not touch hot surfaces on the pump. In normal operation at low pressures, surface temperatures will not normally exceed 180°F (82°C). Prolonged operation at 200 Torr (267 mbar a) may cause surface temperatures as high as 220°F (104°C).

MOUNTING

If only a bare shaft pump has been supplied, mount it on a level, rigid base. Connect it to a motor and operate it at the rotational speed shown in **Specifications on page 4**. Wire the motor so that the direction of the shaft rotation is as shown by the arrow cast on the pump. On standard pumps, this is clockwise when facing the pump pulley.

V-BELT

When installing a V-belt drive, loosen the motor mounting screws and slide the motor toward the pump. Position the V-belt on the pulleys. Move the motor away from the pump to tighten the drive.

To check the tension of the V-belt drive, apply normal thumb pressure to the top of the V-belt midway between the two pulleys. The tightest belt should not depress more than its own thickness. Adjust the belt tension as required, but do not over-tighten or under-tighten the drive. A general rule for correct V-belt tension is to tighten the drive just enough to prevent slippage when operating at full load (that is, with the pump gas ballast valve fully opened). Recheck the tension of the V-belts after the first 48 hours of operation.

DISCHARGE PIPING

If desired, connect discharge piping to the discharge fitting on top of the oil mist eliminator to vent or reclaim the exhaust gases.

When connecting the discharge piping, use a dropout trap at the connection to the oil mist eliminator. Otherwise, condensate from the discharge piping will drip back into the oil separator and may contaminate the oil.

A simple dropout trap consists of a tee equipped with a drain cock for condensate removal. Place a flexible connection, such as rubber hose, at the discharge of the pump to eliminate a rigid connection and to provide a convenient disconnect point for servicing. Turn down the outside end of the discharge line to prevent rain entry.

VACUUM PIPING

The vacuum piping to the pump inlet should be as large and as short as possible. Use manifolding that is no smaller than the pump inlet. Tuthill recommends arranging the inlet manifolding to prevent oil migration back into the system. **See Figure 3-1** for recommended arrangements of vacuum manifolding with integral oil baffles.

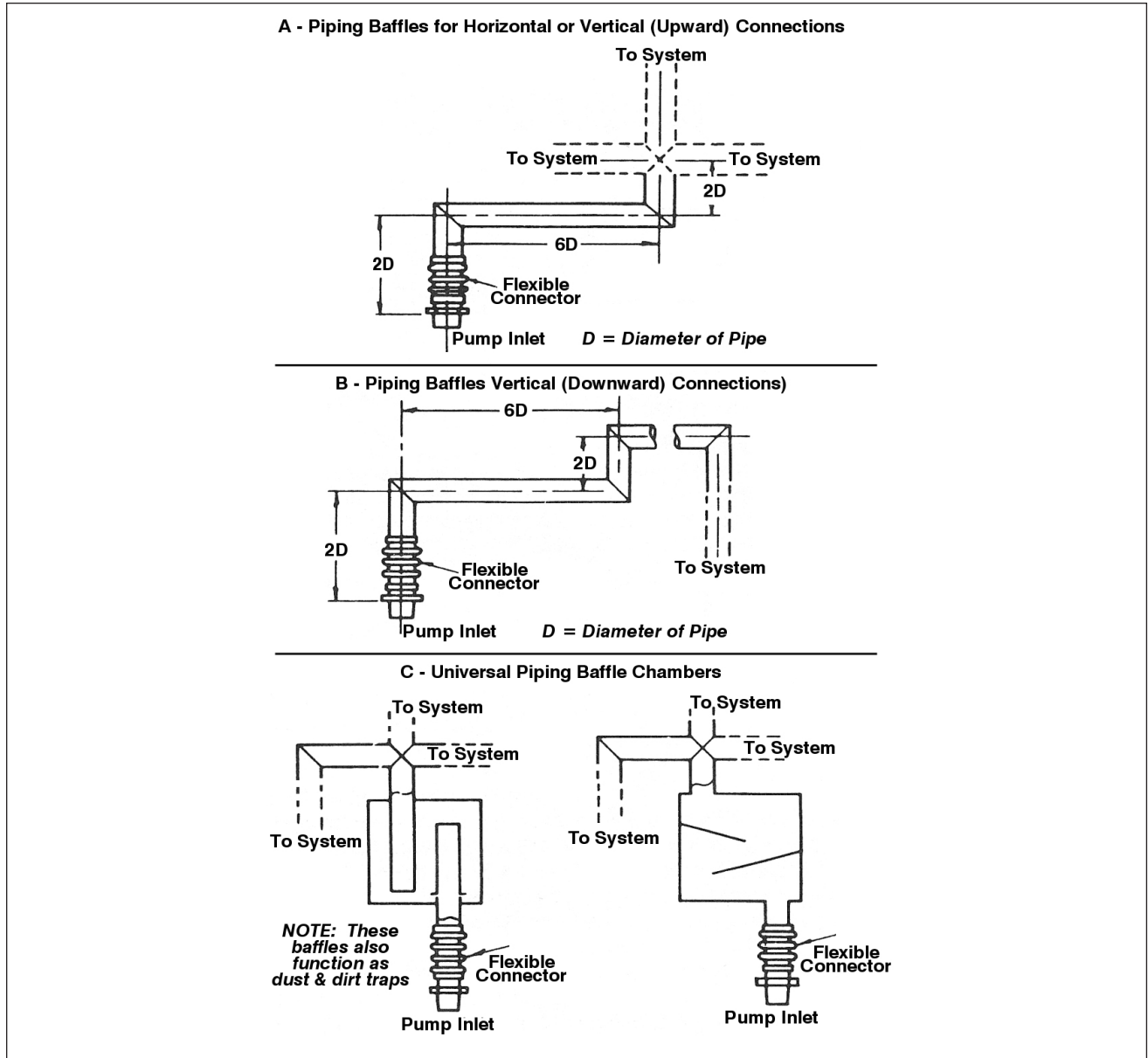


Figure 3-1 – Vacuum Manifolding with Integral Oil Baffles

As with all rotary mechanical pumps, it is best to install a flexible member in the suction manifold of the pump to avoid alignment problems and to reduce the possibility of transmitting vibration to and from other components. Self-supporting bellows-type flexible connectors are recommended and are available from Tuthill Vacuum & Blower Systems. Other types of connectors may be too hard and transmit vibration, or they may be too soft and may exert considerable force on the pump

and piping when collapsing under atmospheric pressure. To ensure proper lubrication at initial start-up, pour a small amount of oil into the pump suction before connecting the inlet piping.

Make all inlet connections vacuum-tight. Make sure that the pressure at the end of the connecting manifold is very close to the pressure obtained with the pump inlet blanked off. All demountable joints should be O-ring sealed.

If threaded connections are used, clean the threads and turn them together about two turns. Cover the remaining exposed threads with a sealing compound such as Loctite 567 or PTFE tape for piping up to 1 in. (25.4 mm) in diameter. Use Tite seal on large pipe sizes. Screw the joint together tightly.

Install a vacuum isolation valve between the system and the pump with a means for connecting a vacuum gauge on both sides of the valve and an air admittance valve on the pump side of the isolation valve. With such an arrangement, it is possible to check either the system or the pump for leaks without disconnecting the vacuum piping. This isolation valve will also allow the system to be kept under vacuum while the pump is not running, and it will allow the pump to remain operating while the system is open to atmospheric pressure.

VACUUM GAUGES

Two types of vacuum gauges are used for testing vacuum equipment:

- Total pressure reading types, such as thermistor or thermocouple gauges
- Partial pressure reading McLeod gauges

The McLeod gauge indicates the partial pressure of permanent gases. It does not indicate the component of pressure due to condensable gases such as water vapor. It is not greatly affected by vapor contamination unless the contamination pressure is quite high. It is most useful in confirming pump performance and for determining the absence or presence of real leaks. Thermistor or thermocouple gauges are preferable for leak checking and indicating the degree of contamination.

A high thermistor or thermocouple gauge reading may indicate that the pump is contaminated, that the pump leaks, or both. A high McLeod gauge reading means that a real leak is present.

ELECTRICAL CONNECTIONS

WARNING

Disconnect pump from electrical power source prior to making repairs or adjustments to any electric component of the unit.

Check the operating voltage of the motor by comparing the lead connections with the markings on the motor. Connect the motor to the proper power source through the necessary switching and safety equipment. After wiring is complete, momentarily start and stop the motor to check the direction of rotation against the arrow cast on the pump. If the rotation is in the wrong direction, switch any two wire leads to correct the direction. These are generally printed on the connections cover plate.

NOTE: Standard pumps rotate clockwise as viewed when facing the pump pulley.

WARNING

When operating the pump in an enclosed area it is necessary, for health reasons, to have the area well ventilated. If ventilation is not adequate, the pump discharge should be filtered or piped to open air.

Do not block or restrict the flow of gas from the pump discharge. Back pressure could cause severe damage.

The belt guard must be properly secured to the pump at all times while the pump is running.

GENERAL

Kinney KC pumps are designed for low-pressure operation. They are not generally suitable for prolonged periods of operation at high pressures. Each pump has been thoroughly tested and is ready for operation as soon as it is installed and filled with oil. If the vacuum system is tight, including the connections to the pump, the ultimate

system pressure should be close to that obtained with the pump inlet closed off.

FILLING THE PUMP WITH OIL

See **Specifications on page 4** for the quantity of oil required for each model. Upon initial start-up, pour a small quantity of oil into the pump inlet to ensure adequate lubrication on starting. Pour the remainder of the required oil quantity into the pump as follows:

KC-5 and KC-8

1. Unscrew the oil mist eliminator from the pump.
2. Remove the high vacuum stage oil fill plug.
3. Pour approximately 1/3 of the required quantity of oil into the high vacuum stage of the pump.
4. Pour the remaining quantity of oil through the threaded hole from which the oil mist eliminator was removed.
5. Check that the fill plug and gasket are clean and in good condition.
6. Replace the plug and gasket, making a vacuum-tight seal.
7. Replace the oil mist eliminator on the pump.

KC-15

1. Pour approximately 1/8 qt (0.15 L) of oil into the pump suction port.
2. Pour the remaining 7/8 qt (0.85 L) of oil into the high vacuum stage oil fill port.
3. Continue to pour the remaining oil into the discharge port of the pump until the oil level is approximately 1/8 in. (3.2 mm) below the top of the sight glass.

PRE-START CHECKS

1. Check that the suction lines are tight and completely free of all foreign matter.

2. Check that the pump has been filled with oil.
3. Check that the pump can be turned over by hand without mechanical interference. The inlet should be open to atmospheric pressure, and additional turning force is required when the pump discharges.
4. Check the V-belt tension by applying normal thumb pressure to the top of the tightest belt about midway between the two pulleys. The tightest belt should depress about its own thickness, indicating proper tension.

In general, V-belts should be tightened just enough to prevent slippage when operating the pump under load (that is, operating with a fully open gas ballast valve).

5. Check that all wiring is completed and correct. Momentarily start and stop the pump to check the direction of pump shaft rotation. On standard pumps, the rotation should be clockwise when facing the pump pulley.

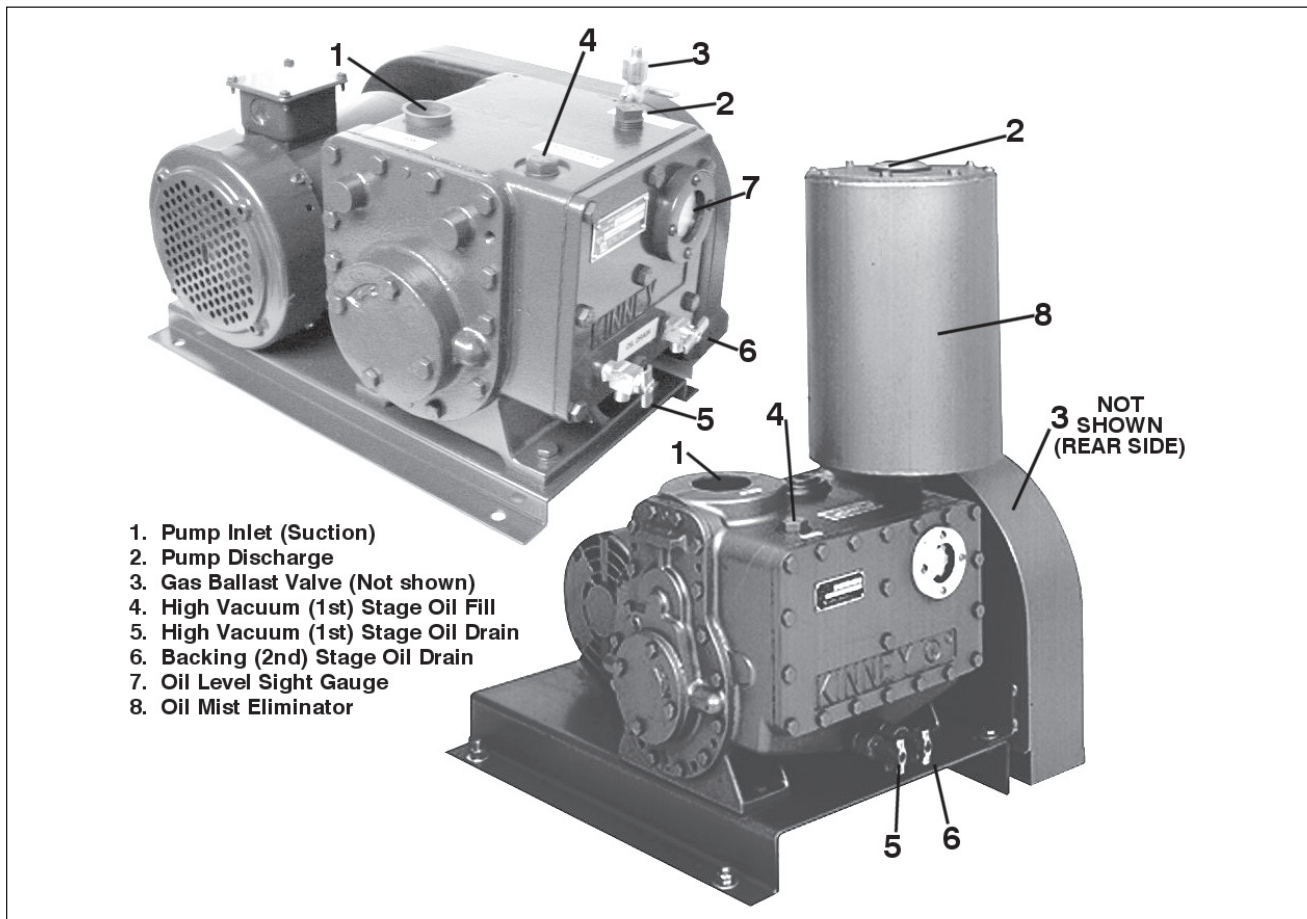


Figure 4-1 – Pump Components

STARTING THE PUMP

Perform the pre-start checks as described in **Pre-Start Checks on page 10**.

NOTE: The minimum starting temperature is 50°F (10°C).

1. Depress the motor start switch to start the pump. It is recommended that the pump be warmed up before starting process work. Warm-up requires about 10 minutes of operation with the pump isolated from the process equipment.
2. Open the pump isolation valve, if one is provided, allowing the pump to evacuate the process equipment.
3. To reduce the operating sound of the pump, slightly open the gas ballast valve. This is a preferred method of operation since it helps to keep the oil clean.
4. Note that the oil level should change when operating the pump at high and low inlet pressures. This indicates proper oil flow through the pump. When the pump is initially started, the oil level will rise in the backing stage. When the inlet pressure is reduced to the micron (10^{-3} Torr) range, the oil level will drop to about the center of the sight glass.
5. If the pump is used in an application where excessive amounts of water vapor are encountered, remove the mist eliminator element to prevent condensation. Periodically stop the pump and open the backing stage oil drain to drain water accumulation. Drain all water accumulation each time before starting the pump, as the pump may be damaged upon start-up if the water level rises above the oil inlet port.

STOPPING THE PUMP

1. If a vacuum valve is provided between the pump and the process equipment, put the vacuum valve in the closed position.

2. Vent the pump suction to atmospheric pressure by opening a vent valve. Turn off the power to the pump motor.

NOTE: If the system does not have a pump isolation valve, vent the system to atmospheric pressure to prevent oil from being drawn into the vacuum system. Oil flooding of the pump cylinder could make restarting difficult. Note that a solenoid-operated air inlet vent valve is offered as an accessory on the KC-15 model. This valve is wired across the motor so that it will automatically open to vent the pump inlet when the pump power is turned off. This valve is adequate for venting only a small volume. It is not large enough to vent an attached system.

GAS BALLAST

Gas ballast is an operating mechanism that is used to prevent the condensation of vapor in a vacuum pump. Vapor present in the gas being pumped can condense during the vacuum pump compression cycle and mix with the vacuum pump oil. Since this oil is recirculated through the pump, the condensate is carried with the oil and allowed to re-evaporate, causing poor pump performance and making frequent oil changes necessary. If gas ballast is used, most vapors can be passed through a vacuum pump without condensing and then discharged with the pump exhaust.

Gas ballast also reduces discharge valve noise to a low level. It is generally possible to eliminate valve noise with a small gas ballast flow, which does not seriously increase the ultimate pressure. If the ultimate pressure is tolerable, this is a preferred method of operating since it also helps to keep the oil clean.

The setting of the gas ballast valve is best determined by trial and error because the amount of condensable vapor, as well as the system operating conditions, vary with different processes. In addition, the motor power consumption and the ultimate pressure increase in proportion to the gas ballast airflow.

To use the gas ballast technique, proceed as follows:

- **Continuous gas ballast:** With the pump operating, open the gas ballast valve until the ultimate pressure is slightly below that needed for the process. Operate the pump in this manner continuously to aid in preventing oil contamination.
- **Intermittent gas ballast:** With the pump operating, fully open the gas ballast valve during periods when this will not affect the process (work preparation, recycling, etc.). This will aid in cleaning up oil contamination. If not convenient, operate the pump in this manner overnight to clean up severely contaminated oil.

If it is necessary to clean up the oil in the shortest period, use the following procedure as a rough guide to estimate the total time required to obtain the desired blank-off pressure.

1. Observe the pump's blank-off pressure with the gas ballast valve fully closed.
2. Open the gas ballast valve fully and operate the pump for about 15 – 20 minutes.
3. Close the gas ballast valve fully and observe the pressure change in that time period. The oil is clean when there is no further reduction in pressure.

SPECIAL REFRIGERATION SERVICE PUMPS

Kinney offers high vacuum pumps that are specifically engineered for servicing refrigeration equipment, which includes thorough vacuum drying, degassing, and fast leak detection.

When connecting a pump to a refrigeration unit, use 1/2 in., 5/8 in., or 3/4 in. copper tubing. Smaller tubing is not recommended because of the restriction to gas flow. If it is necessary to vent the pump exhaust outside, use ordinary hose of suitable diameter. Do not position the hose so that condensate can collect and cause blockage, such as in a loop or sag in the hose.

Before and after using a pump on refrigeration equipment, remove the cap in the drop-out trap to drain all liquid condensate. Drain the pump, flush, and recharge it with fresh oil after each use if it will not be used again for 2 or 3 days. This will protect the pump during storage from rust and contaminants, which are frequently encountered in refrigeration service.

05

MAINTENANCE

PERIODIC MAINTENANCE

Check the oil level daily for the first week of operation and weekly thereafter. The oil level should be about midway on the sight gauge when operating at low inlet pressures. However, the oil level will change with large changes in pump inlet pressure. If there are no changes in the oil level, check for obstructed oil passages.

Check the condition of the oil periodically by draining a small quantity of oil into a clean container and visually inspecting it for solid or liquid contaminants.

Change the oil when it is contaminated. There is no fixed interval for changing the pump oil, since applications vary widely. This interval can be determined only by experience or deterioration of pump performance. At minimum, change the pump oil after each 3-month operating (not storage or idle) period.

CHANGING THE OIL

All moisture, as well as other vapors present in the system, will be drawn into the pump. Some may be condensed and will collect in the backing stage oil reservoir, contaminating the pump oil and causing poor pump performance. Proper use of gas ballast will minimize the amount of condensate and reduce the frequency of oil changes.

Change the oil when it becomes contaminated with foreign matter or with chemicals. The period between changes is best determined by the user for his or her particular operation.

To drain the oil:

1. Remove both drain plugs on the side of the cylinder.
2. If drain valves are provided, open both drain valves.
3. To clear all the oil out of the cylinder, open the pump inlet (suction) to atmosphere. Turn the pump over a few revolutions to drive the oil out of the cylinder.
4. Replace the drain plugs.
5. Fill the pump with oil as described in ***Filling the Pump with Oil on page 10.***

NOTE: If the oil is severely contaminated, it may be necessary to flush the pump by changing the oil several times, with a short period of operation between each change, to check the pump's blank-off pressure.

FLOODING

If the pump is not vented to atmosphere when stopped under vacuum, it is possible for oil to flood the pump cylinder, causing a hydraulic lock that can make it difficult to start the pump.

To release this hydraulic lock, fully open the gas ballast valve and try to turn or rock the pump pulley by hand to force out the oil. Do not apply excessive force to turn the pump pulley, such as with a long pry bar.

OIL MIST ELIMINATOR

It may be necessary to clean out the oil separator or change the replaceable filter element after the pump has been in service for a long time. It may be necessary to do so quite frequently if mechanical contaminants are present or if oil sludging due to chemical attack takes place. To do this, remove the top cover of the oil separator and clean it as required.

Since pump applications vary greatly, operating experience is the best guide for determining the interval for replacing the oil mist eliminator element.

NOTE: Drain valves in the oil mist eliminator are application-specific.

Change the oil mist eliminator if:

- Visual inspection shows the oil mist eliminator element is blocked by foreign matter.
- Pump backpressure as read at the inlet to the oil mist eliminator (or the oil fill plug) reads higher than 4 – 6 psig (27.57 – 41.36 kPa). This indicates the element is contaminated.
- Motor current exceeds the manufacturer's recommendations shown on the motor nameplate. This indicates the element is contaminated.
- Mist is discharged from the oil mist eliminator. This indicates the element is ruptured or the gasket is not sealing.

The oil separator-mist eliminator assembly can flood if the pump is operated for prolonged periods higher than 5 Torr (6.7 mbar a). This oil buildup will cause oil droplets to be discharged when the pump is operating. To remove this trapped oil, decrease the pump operating pressure to less than 5 Torr (6.7 mbar a) until the trapped oil can return to the pump.

If it is not feasible to operate the pump at 5 Torr (6.7 mbar a) or below to prevent flooding the oil separator-mist eliminator assembly, install an oil return line (*see Figure 5-1*). If the pump operating range is 5 – 150 Torr (6.7 – 200 mbar a), the return line should connect to the gas ballast valve, in which case the valve must not be closed. If the operating range is above 150 Torr (200 mbar a), the oil return line should connect to the pump at the suction port area.

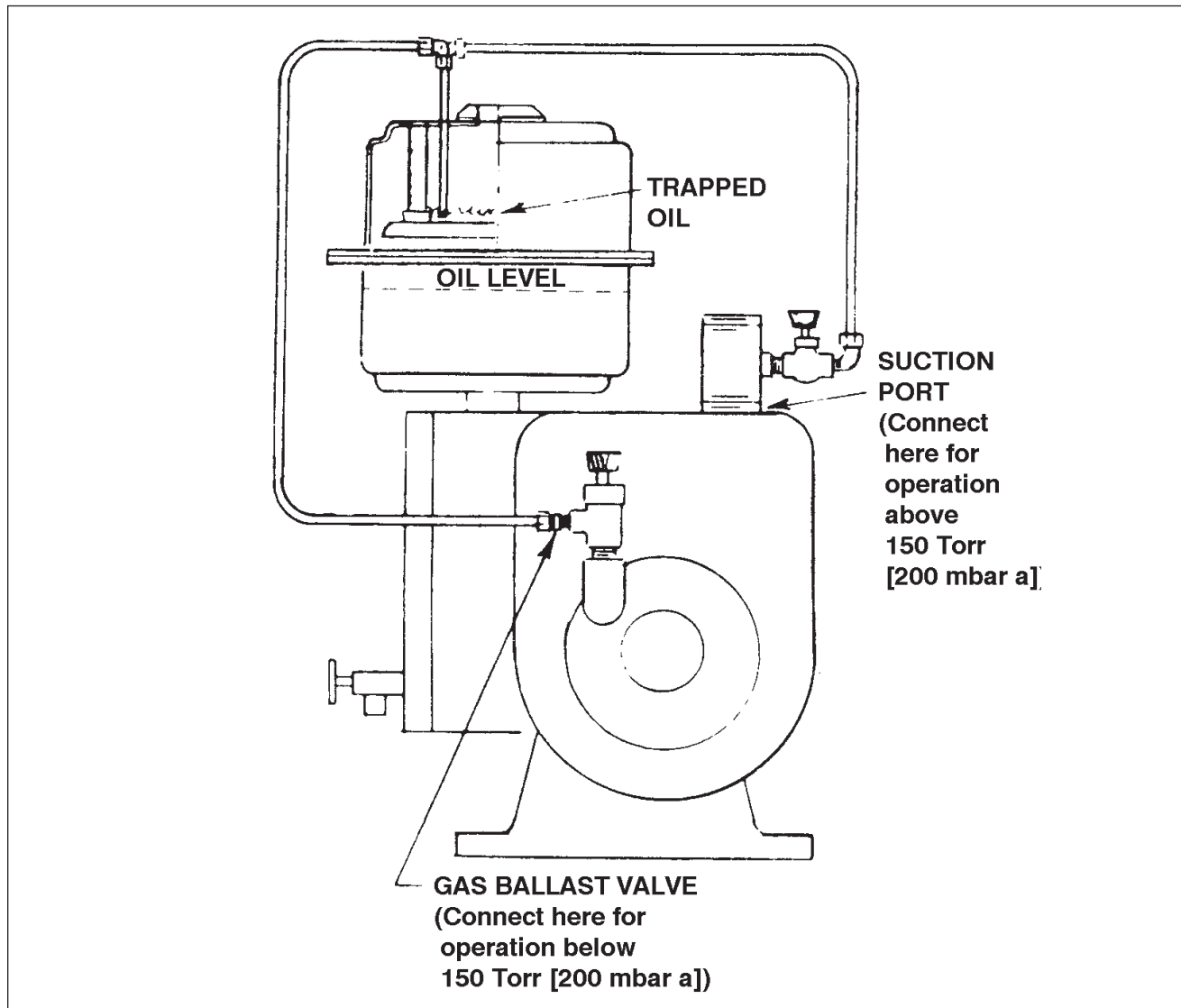


Figure 5-1 – Oil Return Line

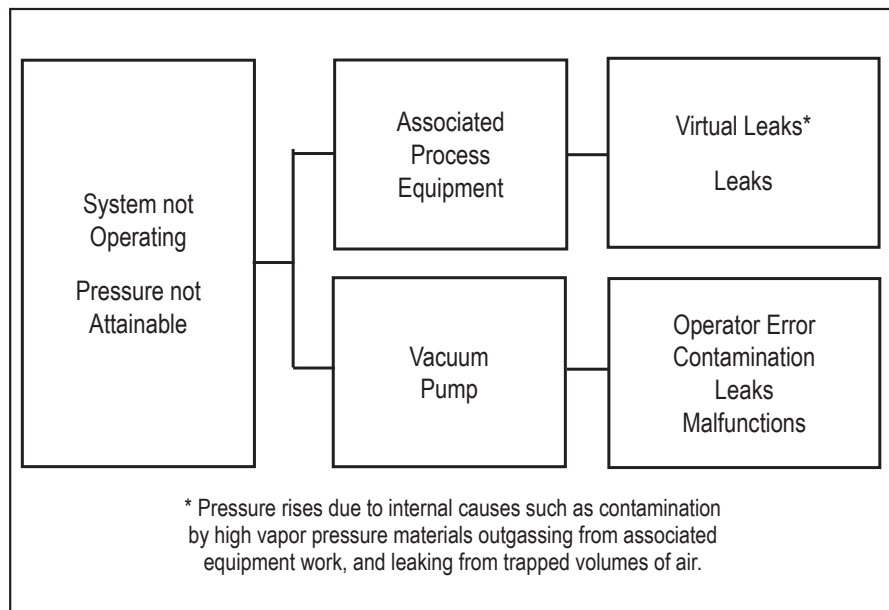


Figure 5-2 – Common Faults in Vacuum Systems

STALLING

If the pump stalls at any time, it may be due to a loose belt, lack of lubrication, or foreign matter in the pump. If the pump cannot be turned over by hand after it has cooled down, clean the pump.

See Disassembly on page 24 for pump cleaning and inspection.

06

TROUBLESHOOTING

Although KINNEY® KC™ rotary piston vacuum pumps are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The following chart lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Excessively high system ultimate pressure	Faulty process equipment	Check the pump performance. See <i>Checking Pump Performance on page 19.</i>
	Vacuum pump improperly operating or malfunctioning	
	Process equipment contaminated by high vapor pressure material	Clean the equipment with acetone, alcohol, or ether.
		Pump down with vacuum pump overnight.
	Process equipment leaks	Leak check the process equipment. See <i>Process Equipment Leaks on page 20.</i>
	Improper vacuum pump oil flow	Clean the oil ducts.
	Contaminated vacuum pump oil	Change the pump oil. See <i>Changing the Oil on page 14</i> and <i>Oil Contamination on page 21.</i>
	Discharge valves malfunctioning	Check the valves as described in <i>Discharge Valve on page 21.</i>
	Vacuum pump leaks	Leak check the pump as described in <i>Pump Leaks on page 20.</i>
	Vacuum pump shaft seal malfunctioning	Check the shaft seal as described in <i>Shaft Seal on page 22.</i>
Worn or damaged vacuum pump internal parts	Disassemble the pump and inspect the internal parts. See <i>Disassembly on page 24.</i>	
Excessive pump noise at low pressures	Hydraulic noise of pump discharge	Open the gas ballast valve.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Pump stalls	Electrical power loss	Check power at the pump.
	Pump malfunctioning	See Stalling on page 17. See V-Belt on page 7 and Changing the Oil on page 14.
	Contaminated pump oil or insufficient lubrication	
	Blocked pump discharge line	Clear the pump discharge line. Check the oil mist eliminator element for blockage.
Pump will not start	Electrical failure	Check for power at the pump. Check the motor start controls and motor.
	Pump flooded with oil	Clear oil from the pump by turning over by hand or disassembling the pump. See Flooding on page 15.
	Excessively low temperature	Heat the pump to minimum starting temperature of 50°F (10°C).
Oil discharged from oil mist eliminator	Excess oil on discharge side of oil mist eliminator	Unscrew the oil mist eliminator and pour oil through the discharge fitting back into the pump.
		Reduce pump inlet pressure below 10 Torr to allow collected oil to drain back through the integral check valve in the oil mist eliminator.

Table 6-1– Common Symptoms and Remedies

CHECKING PUMP PERFORMANCE

If the processing time increases or the ultimate pressure becomes poor with no recent changes in the process or in the system configuration, test the pump to determine whether the trouble is in the pump or the connected process equipment. To check the condition of the pump, use a McLeod gauge to measure the blank-off pressure as described in the following procedure.

NOTE: If possible, also read the blank-off pressure with a thermistor or thermocouple gauge. See *Figure 6-1* and *Table 6-1* for common faults in vacuum systems.

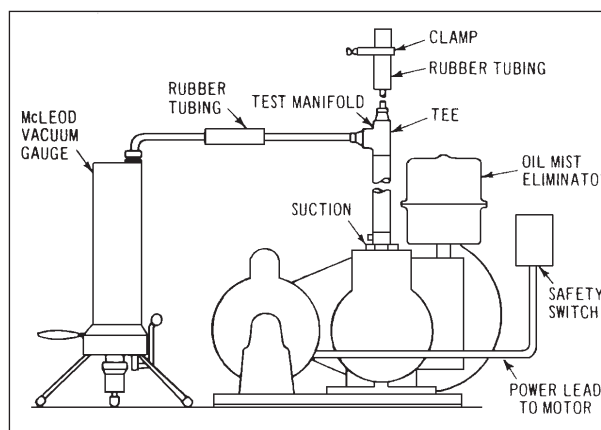


Figure 6-1 – Pump Test Manifolding

To read the pump blank-off pressure:

1. Close off the pump inlet by means of a vacuum valve or short segment of manifolding, as shown in *Figure 6-1*.
2. Connect a vacuum gauge to the pump side of the valve or manifolding. Position the gauge connection so that it will not become flooded or blocked by splashing pump oil.

- Operate the pump for about 15 minutes until the lowest pressure is reached. Note the reading obtained.

The reading obtained should be between the pump's specification blank-off pressure (low end) and the pressure needed for the process (high end). Average blank-off readings are 0.5 to 2.0 microns with a McLeod gauge.

NOTE: For practical consideration, pumps need not obtain pressures lower than 90% of the required operating pressure to be usable. If the McLeod gauge reading is low and the thermocouple gauge reading is high, the pump oil is contaminated. Change the oil and recheck the pump blank-off pressure. It may be necessary to change the oil several times to flush all traces of contamination from the pump. If a thermocouple gauge is not available and the pump oil has been in service for a significantly long period, it is best to change the pump oil several times to eliminate pump oil contamination as a possible cause of poor pump performance. After changing the oil, recheck the blank-off pressure.

If both the McLeod and thermocouple gauge readings are high, indicating that the oil is not contaminated, the pump is leaking. Proceed as described in **Pump Leaks on page 20**.

PUMP LEAKS

If the pump is suspected of leaking after oil contamination has been eliminated as the cause of poor performance (**see Checking Pump Performance on page 19**), use a plastic sealing compound, such as Apiezon Q, to seal over suspected areas, and check pump blank-off performance before making permanent repairs with Loctite 515. If gasketed connections are suspected, remake the connections with temporary gaskets of plastic sealing compound. Do not make these too thick since the material may be squeezed into the equipment.

Check carefully around the head-to-cylinder joints, securing bolts, plugs, shaft seal housing joints, and generally any penetration into the vacuum

pumping portion of the pump. Check the shaft seal for mechanical defects, such as a cracked carbon washer or hardened rubber components.

CHECKING PROCESS EQUIPMENT

If the blank-off test shows that the vacuum pump is functioning properly but that the process equipment is faulty, apply the following procedure to further isolate the trouble:

- Pump down each segment of the process equipment individually, starting at the segment closest to the vacuum pump.
- Check the lowest pressure attainable when each segment is added. If the pressure is close to that obtained previously, add the next segment. If the pressure is not close, leak test the last segment. When leak checking process chambers, start at the air and gas inlet valves, doors, sight ports, electrical and mechanical feedthroughs, gauge tube fittings, and any other penetrations, especially threaded, gasketed, and O-ring connections.

After a suspected leak has been found, cover it with plastic sealing compound, such as Apiezon® Q, and check the equipment performance before sealing the leak permanently. Continue leak testing if necessary, and make all permanent repairs at the same time.

PROCESS EQUIPMENT LEAKS

Attach a vacuum gauge to the connection on the system side of the vacuum valve. For this test, clear the system of any process work, which might give off vapors and change the reading. Run the pump to obtain the lowest possible pressure and close the valve. Observe the pressure rise. If the pressure rise is greater than desired, or if the ultimate pressure is too high, check and eliminate all leaks. Check the system carefully for loose joints and obvious leaks. Use a leak detector if available. If a leak detector is not available, proceed as described in **Leak Checking Techniques on page 21**.

LEAK CHECKING TECHNIQUES

If a leak detector is not available, cover suspected leaks with a low-vapor pressure sealing compound, such as Apiezon® Q, Duct Seal, or Plasticine®, while pumping on the equipment and monitoring the pressure. A sudden decrease in pressure indicates that a leak has been covered. Repair leaks permanently as necessary.

- If the leak is large, causing pressures in the Torr range, pressurize the process equipment with 1 psig (6.9 kPa) of clean compressed air and paint a soap solution on suspected leak areas. Bubbles indicate leaks. De-energize and isolate the pump during the leak checking. Repair leaks as required.
- If the leak is small, causing pressures in the sub Torr range, use a fast-acting thermocouple or thermistor gauge along with a probing medium such as helium. Position the vacuum gauge head downstream from the suspected leak area, between the leak and the pump. When the pressure has been reduced so that the gauge may be used, apply the probing medium to the suspected leak areas. If the probing fluid is directed at the leak or an area close to it, a sudden change in pressure will occur. Cover the suspected leaks with plastic sealing compound and continue leak checking until the desired pressure is obtained.

If leak checking fails, disassemble and remake all demountable joints and connections using new gaskets or vacuum sealing compound such as Loctite 515. Temporary gaskets may be fabricated from plastic sealing compound, but do not make them too thick since the material may be squeezed into the equipment.

OIL CONTAMINATION

If the pressure has been satisfactory for some time and then gradually increases, this indicates oil contamination. Clean up the oil by applying gas ballast, or change the oil as described in **Changing the Oil on page 14**.

A change in the color of the oil does not necessarily mean it is unsuitable for use. Conversely, the oil

may be contaminated by vapors yet not change color.

DISCHARGE VALVE

If the cause of poor pump performance was not due to leaks or oil contamination, then inspect the discharge valve.

The discharge valve is at the exhaust port of the backing stage. It should not cause trouble unless it has mechanical damage or is prevented from sealing properly due to foreign matter on the valve seat. When the pump is operating without gas ballast, a sharp valve noise (a “click”) indicates proper valve closure.

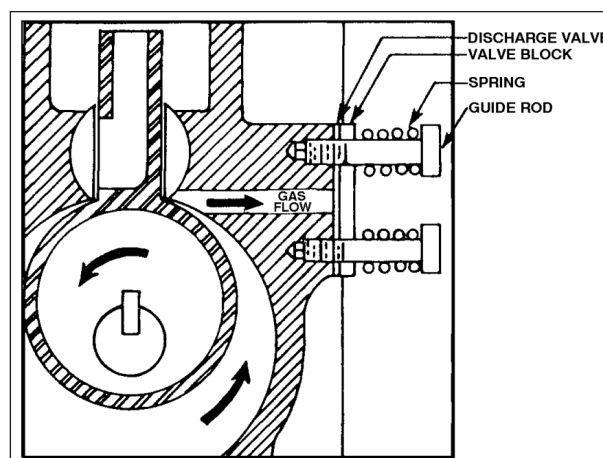


Figure 6-2 – Discharge Valve Assembly (Typical)

To inspect the discharge valve, proceed as follows:

1. Drain the pump oil by removing both drain plugs (or by opening the drain valves, if provided). Remove the cylinder cover to expose the discharge valve.
2. Remove both guide rods, discharge valve springs, the discharge valve block, and the discharge valve. Note how the components were removed so they can later be replaced correctly.
3. Check the discharge valve. It should be flat and not worn thin on the edges or kinked. The valve will normally show the outline of the cylinder

- discharge holes. Clean this from the valve and check that the holes are not worn into the valves.
4. Check the discharge valve block. It should not be worn out of round in the holes or damaged around the lower edge. Check for flatness with a straightedge.
 5. Check the discharge valve springs. They should show no signs of weakening such as unevenness or bulging of coils.
 6. Check the guide rods. They should be smooth and not worn in ridges, damaged, or worn in any way that would allow the block to bind as it slides up and down.
 7. Check the valve seat in the cylinder. It should be smooth and flush with the surrounding area.
 8. Replace any worn components as required.
 9. Replace the discharge valve, valve block, discharge valve springs, and guide rods in the same order and position in which they were removed. Replace the cylinder cover and secure it in place. Replace the oil drain plugs (or close the drain valves) and fill the pump with oil as described in ***Filling the Pump with Oil on page 10***. Test the pump as described in ***Checking Pump Performance on page 19***.

SHAFT SEAL

Although the shaft seal has a long, trouble-free life under normal conditions, it may become worn or scratched on the sealing faces by contaminated oil and it may be damaged by inadequate lubrication.

To inspect the shaft seal:

1. Position the pump so that it rests on the closed head to prevent oil from draining out of the shaft seal housing.
2. Remove the belt guard and belts. Remove the pump pulley and drive key from the pump shaft.
3. Remove the shaft seal retaining ring from the shaft.

4. Remove the rotating portion of the shaft seal from the shaft. This may require a heavy pull, especially if the unit has heat bonded to the shaft. In extreme cases, it may be necessary to remove the open head (or shaft seal housing) to remove the seal.
5. If necessary, remove the seal seat from the pump.
6. Check the mating seal faces on the stationary and rotating segments of the seal assembly. They should be smooth and shining with no scratches or indentations.
7. Check the rubber friction ring. It should have no scratches or grooves on the inside diameter that seals to the shaft. It should be flexible – not hardened.
8. Check the seal seat gasket. It should not be cut, nicked, or hardened. Cracks or hardening of rubber components indicate exposure to excessive temperatures, and the seal should be replaced.
9. If the components are defective or damaged, replace the entire seal assembly.
10. Coat the seat gasket and seal seat with AX Vacuum Oil and insert in position on the open head and shaft seal housing. Use caution so that the gasket does not roll or twist, since creases or cuts cause a vacuum leak.
11. Coat the rotating portion of the shaft seal with AX Vacuum Oil. Cover the keyway on the shaft with a plastic tape or by forming a thin piece of metal over the shaft. Coat the shaft and metal cover with oil.
12. Carefully push the rotating portion of the shaft seal (consisting of the seal face retainer shell, friction ring, spring, and spring holder) over the shaft by means of a pipe sleeve or a large washer against the outer spring holder.

Note that the friction ring fits tightly on the shaft to prevent slippage of the rotating portion of the shaft seal. Be careful not to damage the seal faces or cut the rubber. Check that the seal face is not tilted. Remove the cover from the shaft and install the retaining ring.

13. Replace the pump drive key and pulley.
Replace the V-belt drive and tension it as described in **Mounting on page 7**.
Replace the belt guard. Test the pump per **Checking Pump Performance on page 19**.

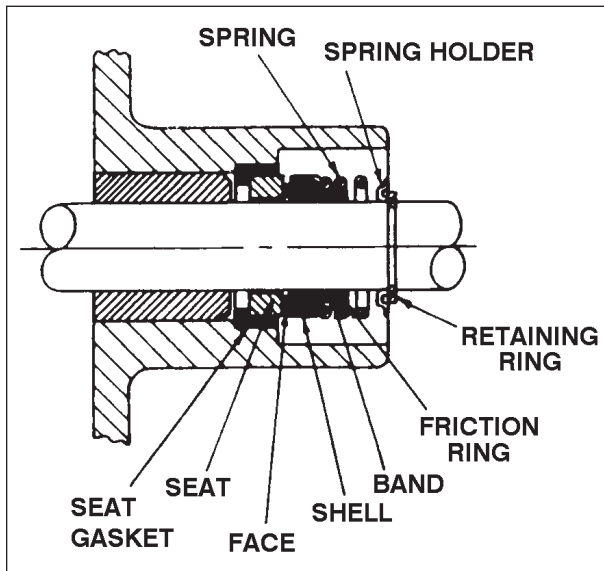


Figure 6-3 – Shaft Seal Assembly

07

DISASSEMBLY

Although these instructions describe complete disassembly, disassemble the pump only to the extent necessary to repair it.

These instructions make reference to the open head and closed head ends of the cylinder. Note that the open head is the end through which the shaft extends.

1. Drain the oil as described in **Changing the Oil on page 14**. Remove the belt guard (if supplied) and belts.
2. Disconnect the piping to the pump suction.
3. Remove the pump pulley and drive key.
4. Remove the pump assembly from the base and position it on a workbench.
5. If pump is equipped with an oil mist eliminator, unscrew the oil mist eliminator.
6. Remove the discharge valve assembly as follows:
 - a. Remove the cylinder cover and gasket.
 - b. Remove both guide rods, both discharge valve springs, the discharge valve block, and the discharge valve. Note how the components were removed so that they can later be replaced correctly.
7. Remove the shaft seal as follows:
 - a. Remove the shaft seal retaining ring from the shaft.
 - b. Remove the rotating portion of the shaft seal from the shaft. This may require a heavy pull, especially if the unit has heat bonded to the shaft. In extreme cases, it may be necessary to remove the open head or shaft seal housing to remove the seal.
- c. Remove the stationary portion of the shaft seal (seal seat) from the pump.
8. Remove the shaft seal housing by removing the securing cap screws and break the seal between the shaft seal housing and the head. Remove the shaft seal housing O-ring.
9. Remove the gas ballast valve and connecting fittings.
10. Remove the open head as follows:
 - a. Remove the open head cap screws and break the seal between the head and the cylinder.
 - b. If necessary, remove the open head bearing by pressing it out of the head.
11. Remove the open head piston and slide pin. Mark the piston and the slide pin so that they can be reassembled in the same position. Although parts are interchangeable between the high vacuum stage and the backing stage, it is advisable to replace piston and slide pin in the same stage once the parts are worn in.
12. Remove the cap screws securing the closed head cap to the closed head.
13. Remove the cap and sealing O-ring.

14. Remove the closed head by unscrewing the closed head securing cap screws and breaking the seal between the closed head and the cylinder.
15. Remove the closed head piston and slide pin. Note how they were removed so that they may be later reassembled in the same position.
16. Remove the closed head bearing if necessary, by pressing it out of the closed head.

NOTE: Do not mar the finished faces of the head.

17. Remove the shaft and cams as follows:
 - a. Remove the closed head cam, if necessary, by tapping the shaft through the cam using a lead mallet or hammer and wooden block.
 - b. Remove the shaft with the open head cam attached. Do not remove the open head cam unless replacement of the shaft or cam is necessary. If cam removal is necessary, press the cam from the shaft.
18. If seal removal is necessary, tap out the center wall seal with a wooden block and hammer.
19. Remove additional parts, such as elbows, drain plugs, and the sight glass, as required to complete pump disassembly.
20. Inspect all parts for wear and damage. Replace components as required.

08

REASSEMBLY

Before starting to reassemble the pump, inspect all parts to make sure that they are clean, smooth, and free of nicks and old sealing compound. Replace all worn or damaged parts. Do not use solvents such as kerosene or carbon tetrachloride for cleaning unless facilities are available to evaporate them by vapor degreasing or washing in acetone or alcohol. Tuthill Vacuum & Blower Systems recommends a general cleaning solvent with flash point exceeding 140°F (60°C), such as Solvent 140. Avoid leaving excessive solvent on the pump parts.

As the pump is reassembled, lightly coat the cylinder and internal moving parts with AX Vacuum Oil to facilitate assembly and to ensure that all parts are lubricated when the pump is first started.

1. If removed, replace the cam key and press the open head cam onto the shaft. Use a securing compound, such as Loctite®, if necessary. Insert the cam key and top the closed head cam onto the shaft. Rotate the shaft to check that the cams do not bind on the center wall.
2. On KC-5 and KC-8 models, position the piston so that the inlet ports in the piston slide are facing away from the discharge valve side of the pump. Place the closed head slide pin on the piston with the flat side down and the closed end of the slide pin toward the center wall. Insert the piston and slide the pin into the pump.

On KC-15 models, position the closed head piston with the inlet slots in the piston slide facing away from the discharge valve side of the pump. Place the closed head slide pin over the piston slide with the scalloped edges up

and the arrow cast into the slide pin pointing toward the discharge valve side of the pump. Insert the piston and slide pin into the pump.

3. Check that the sealing faces of the closed head and cylinder are clean and free of all sealant. Carefully apply a thin coat of Loctite 515 to the sealing faces of the cylinder and the head.

CAUTION

If too much or too thick an application of sealing compound is used, it will squeeze into the pump during assembly and will cause the moving parts to stick or clog the small oil ducts.

4. Position the closed head on the cylinder and install the securing cap screws. Tighten the closed head cap screws. Rotate the shaft to check that there is no binding. Replace the bearings into the head.
5. Check that the sealing faces of the closed head and closed head cap are clean. Place the sealing O-ring on the closed head cap. Position the cap on the closed head. Install and tighten the securing cap screws.
6. On KC-5 and KC-8 models, position the open head piston with the inlet port in the piston slide facing away from the discharge side of the pump. Position the slide pin on the piston slide with the flat side down and the closed end toward the center wall.

On KC-15 models, position the open head slide pin with the inlet ports in the piston slide facing away from the discharge side of the pump. Position the open head slide pin with the scalloped edge up and the arrow cast into the slide pin pointing toward the discharge side of the pump.

7. Install the open head piston and slide pin in the pump.
8. Check that the open head end of the cylinder and the cylinder mating surface are both free of all sealing compound. Apply a thin coat of Loctite 515 sealing compound to the sealing faces of the cylinder and head.

Position the open head on the cylinder and tighten the securing cap screws. Tighten the open head securing cap screws. Rotate the shaft to check that there is no binding. If it binds, gently tap on either end of the shaft a few times to free it. If tapping does not work, remove the heads, one at a time, and correct the problem. Replace the bearings into the head.

9. Install the shaft seal housing and shaft seal housing O-ring on the open head. Sealing compound is not required. Tighten the securing cap screws.
10. Assemble the shaft seal assembly as follows (*see Figure 6-3*):
 - a. Apply a light coat of AX Vacuum Oil to the seat of the shaft seal assembly. Place the seat gasket on the seat, and carefully slide the seat and gasket over the shaft into position on the pump. Press in both pieces until they are seated uniformly against the shoulder. Do not damage the gasket or mar the face of the seat.
 - b. Coat the rotating portion of the shaft seal (face, shell, bank, and friction ring) with AX Vacuum Oil. Cover the retaining ring groove and the keyway on the shaft with plastic tape or by forming a thin piece of metal over the shaft. Coat the shaft and the metal cover with oil. Carefully push the rotating portion of the shaft seal over the shaft by means of a pipe sleeve or a large

washer. Be careful not to damage the seal face or cut the rubber. Remove the cover from the shaft.

- c. Place the spring and the spring holder on the shaft and compress the spring beyond the retaining ring over the shaft until it snaps into its groove. Assemble the discharge valve, valve block, two valve springs, and the two valve guide rods on the cylinder, replacing them in the same position as they were removed.
11. Assemble the discharge valve, valve block, two valve springs, and the two guide rods on the cylinder, replacing them in the same position as they were removed.
12. Replace the cylinder cover and gasket, and tighten the securing cap screws.
13. Replace the gas ballast assembly on the pump. Tighten it securely.
14. Replace the oil mist eliminator on top of the pump.
15. Replace any plugs or fittings that were removed.
16. Replace the pump assembly on the base. Install the drive key and pump pulley.
17. Replace the V-belt on the pulleys. **See V-Belt on page 7** for more information if desired. Tighten the drive by moving the motor until the tightest belt will depress no more than its own thickness under normal thumb pressure. Replace the belt guard and secure it in position.
18. Check that the pump oil drain plugs or valves are in place, and fill the pump with oil as described in **Filling the Pump with Oil on page 10**. Test the pump according to **Checking Pump Performance on page 19**.
19. Reconnect the vacuum piping from the process equipment to the pump suction (inlet).

REPLACEMENT PARTS

The following drawings and parts lists cover all the parts in each model. Any of these parts may be ordered from Tuthill for replacement as necessary.

SPARE PARTS

Recommended spare parts are indicated on the parts lists by an asterisk preceding the description of the item. This includes all gaskets and O-rings, the shaft seal, and the discharge valve. It is recommended that these items be maintained in stock for use as necessary.

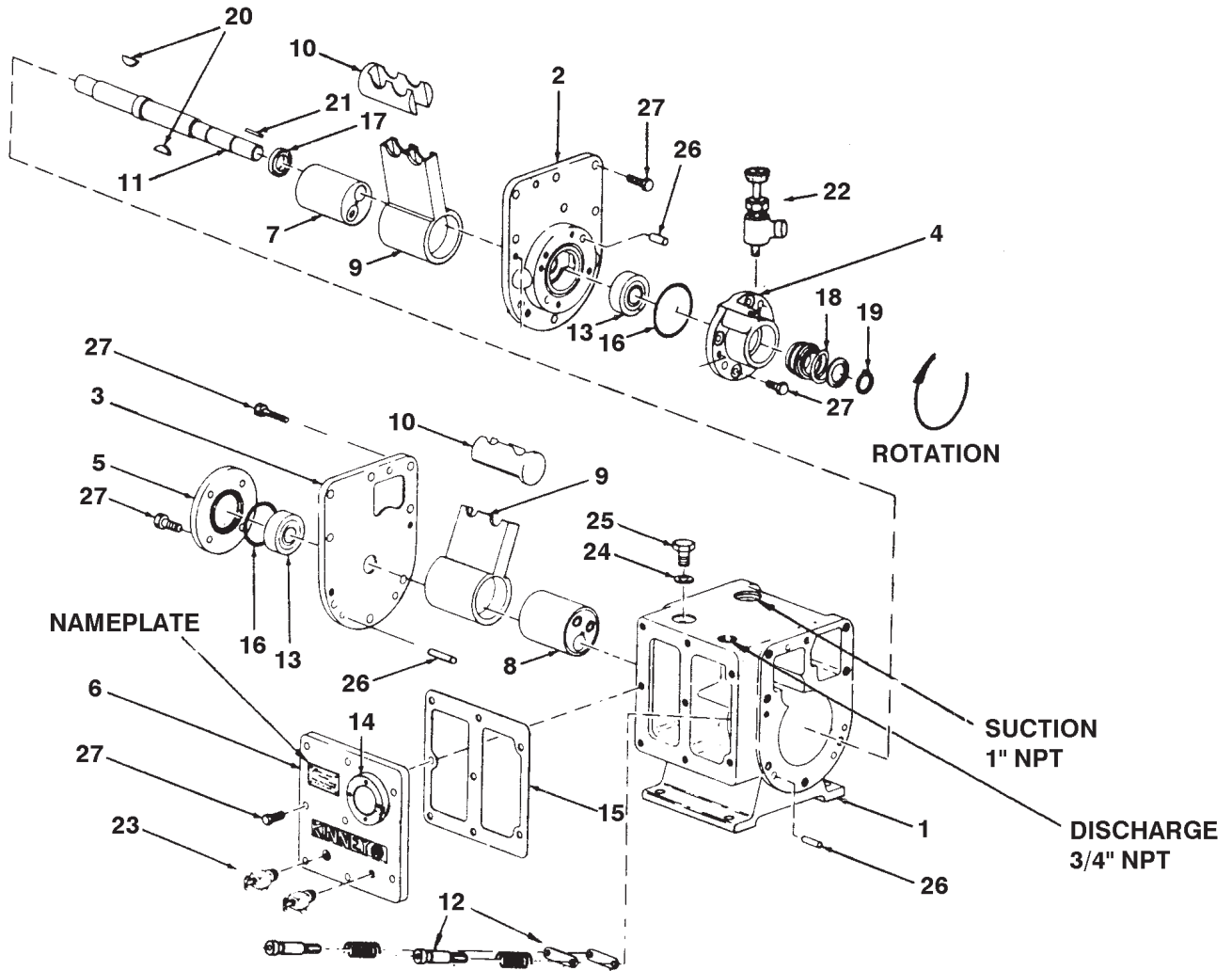
It is also recommended that sufficient AX Vacuum Pump Oil be kept on hand for at least one oil change as well as a can of Loctite 515 for sealing leaks. An accurate vacuum gauge, such as Kinney McLeod gauge Model TD, be obtained for checking pump performance.

ORDERING PARTS

When ordering parts, order them by item number and description, and specify the model and serial number stamped on the nameplate so that the pump may positively identified. Tuthill may substitute newer parts for previous ones if the particular pump can be identified.

EXPLODED VIEWS AND PARTS LISTS

KC-5 and KC-8 Exploded View Drawing



	KC-5	KC-8
Pump RPM	638	1022
Motor HP (kW)	0.33 (0.25)	0.50 (0.37)
Oil Capacity, qts. (liters)	0.8 (0.76)	
Forced Drain w/ open suction, qts. (liters)	0.85 (0.80)	
<p>Use Loctite 515 vacuum pump sealant for assembly. For best performance, use only AX vacuum pump oil.</p>		

KC-5 and KC-8 Parts List

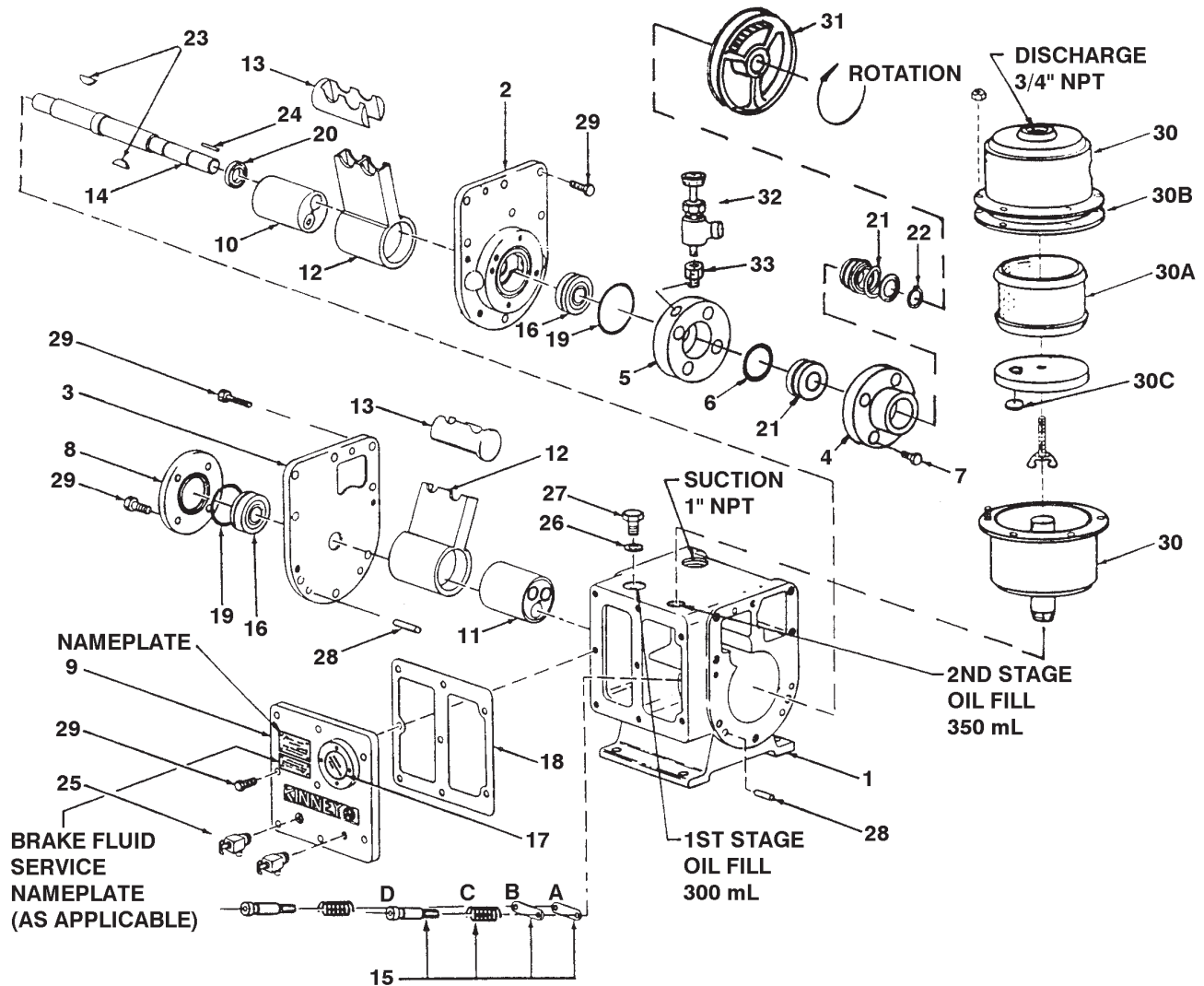
ITEM NO.	DESCRIPTION	QTY
1	CYLINDER	1
2	HEAD, OPEN END	1
3	HEAD, CLOSED END	1
4	HOUSING, SHAFT SEAL	1
5	CAP, CLOSED END	1
6	COVER, CYLINDER	1
7	CAM, OPEN END (HEAVY)	1
8	CAM, CLOSED END	1
9	PISTON	2
10	SLIDE PIN	2
11	SHAFT	1
12	DISCHARGE VALVE KIT	1
13	BEARING & SPACER KIT	2
14	SIGHT GLASS ASSEMBLY	1
15	GASKET	1
16	O-RING	2
17	SEAL, CENTER WALL	1

ITEM NO.	DESCRIPTION	QTY
18	SHAFT SEAL	1
19	RETAINING RING	1
20	KEY	2
21	KEY	1
22	GAS BALLAST VALVE	1
23	DRAIN COCK W/ SEAL	2
24	GASKET	1
25	CAP SCREW, HEX HEAD	1
26	DOWEL PIN	6
27	CAP SCREW, HEX HEAD	41

When ordering parts, use the item number shown, plus the model and serial number.

For earlier production models or special application pumps, consult factory for assistance.

KC-8C Exploded View Drawing



Free Air Displacement , CFM (L/sec)	8 (3.78)
Pump Rotative Speed, RPM	1022
Ultimate Pressure, Torr (mbar a)	.005 (.007)
Motor HP (kW)	0.75 (0.56)
Oil Capacity, qts. (liters)	0.8 (0.76)
Use Loctite 515 vacuum pump sealant for assembly. For best performance, use only AX vacuum pump oil.	

KC-8C Parts List

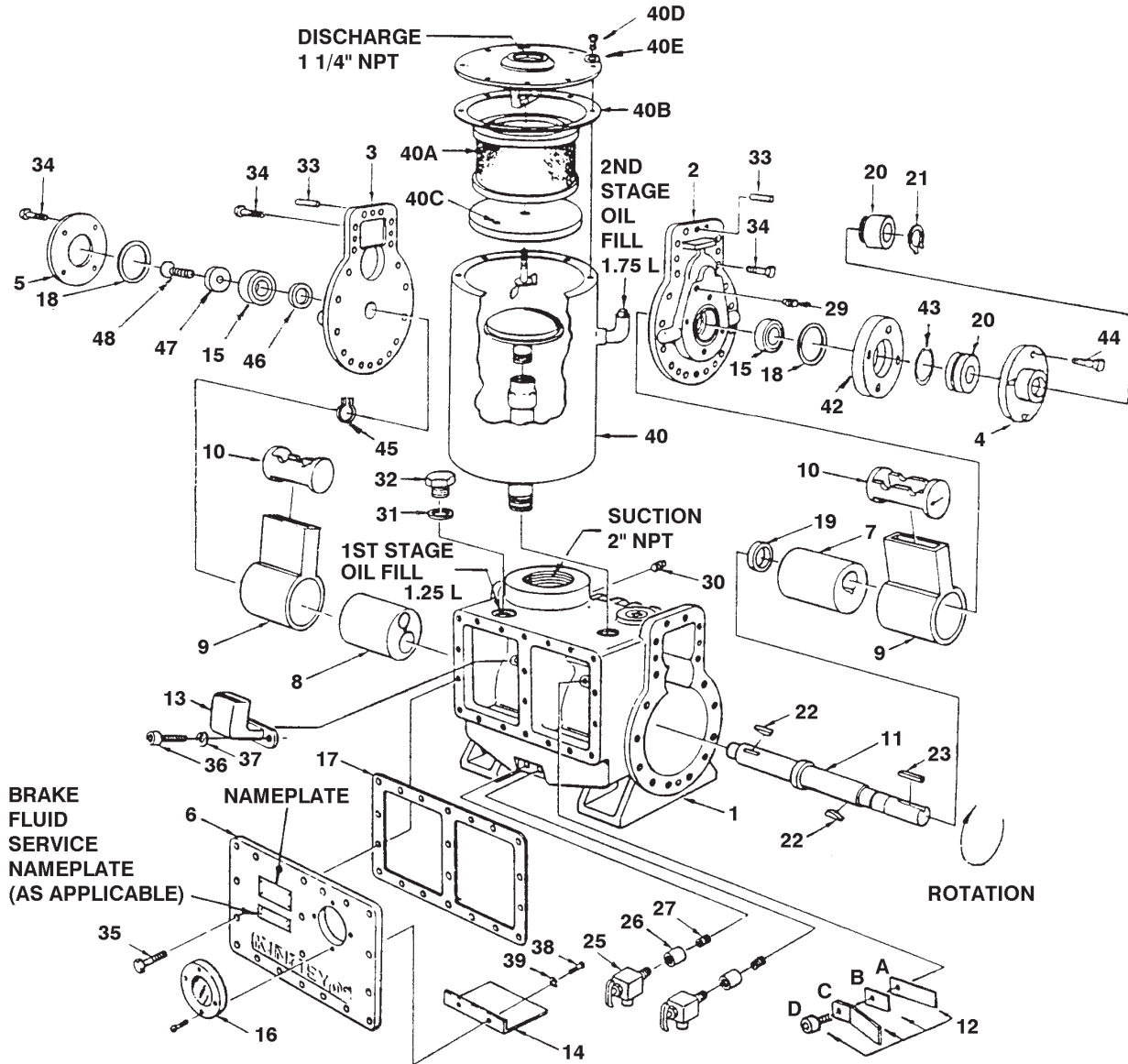
ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
1	CYLINDER	1	1
2	HEAD, OPEN END	1	1
3	HEAD, CLOSED END	1	1
4	HOUSING, SHAFT SEAL	1	1
5	FLANGE, SHAFT SEAL SEAT	1	1
6	O-RING	1	1
7	CAP SCREW, HEX HEAD	4	4
8	CAP, CLOSED END	1	1
9	COVER, CYLINDER	1	1
10	CAM, OPEN END (HEAVY)	1	1
11	CAM, CLOSED END	1	1
12	PISTON	2	2
13	SLIDE PIN	2	2
14	SHAFT	1	1
15	DISCHARGE VALVE KIT	1	1
16	BEARING & SPACER SET	2	2
17	SIGHT GLASS ASSEMBLY	1	1
18	GASKET	1	1
19	O-RING	2	2
20	SEAL, CENTER WALL	1	1

ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
21	SHAFT SEAL	1	1
22	RETAINING RING	1	1
23	KEY, CAM	2	2
24	KEY, DRIVE SHAFT	1	1
25	DRAIN COCK W/ SEAL	2	2
26	GASKET	1	1
27	CAP SCREW, HEX HEAD	1	1
28	DOWEL PIN	4	4
29	CAP SCREW, HEX HEAD	37	37
30	OIL MIST ELIMINATOR	1	1
30A	ELEMENT	1	1
30B	GASKET	1	1
30C	SHEAVE	1	1
31	PIPE PLUG	1	—
32	GAS BALLAST VALVE	—	1
33	ADAPTER		1

When ordering parts, use the item number shown, plus the model and serial number.

For earlier production models or special application pumps, consult factory for assistance.

KC-15D Exploded View Drawing



Free Air Displacement , CFM (L/sec)	15 (7.08)
Pump Rotative Speed, RPM	572
Ultimate Pressure, Torr (mbar a)	.005 (.007)
Motor HP (kW)	1 (0.75)
Oil Capacity, qts. (liters)	3.0 (2.84)
<p>After normal oil drain, start pump to force out residual oil. Then, refill both stages with quantities shown above. Use Loctite 515 vacuum pump sealant for assembly. For best performance, use only AX vacuum pump oil.</p>	

KC-15D Parts List

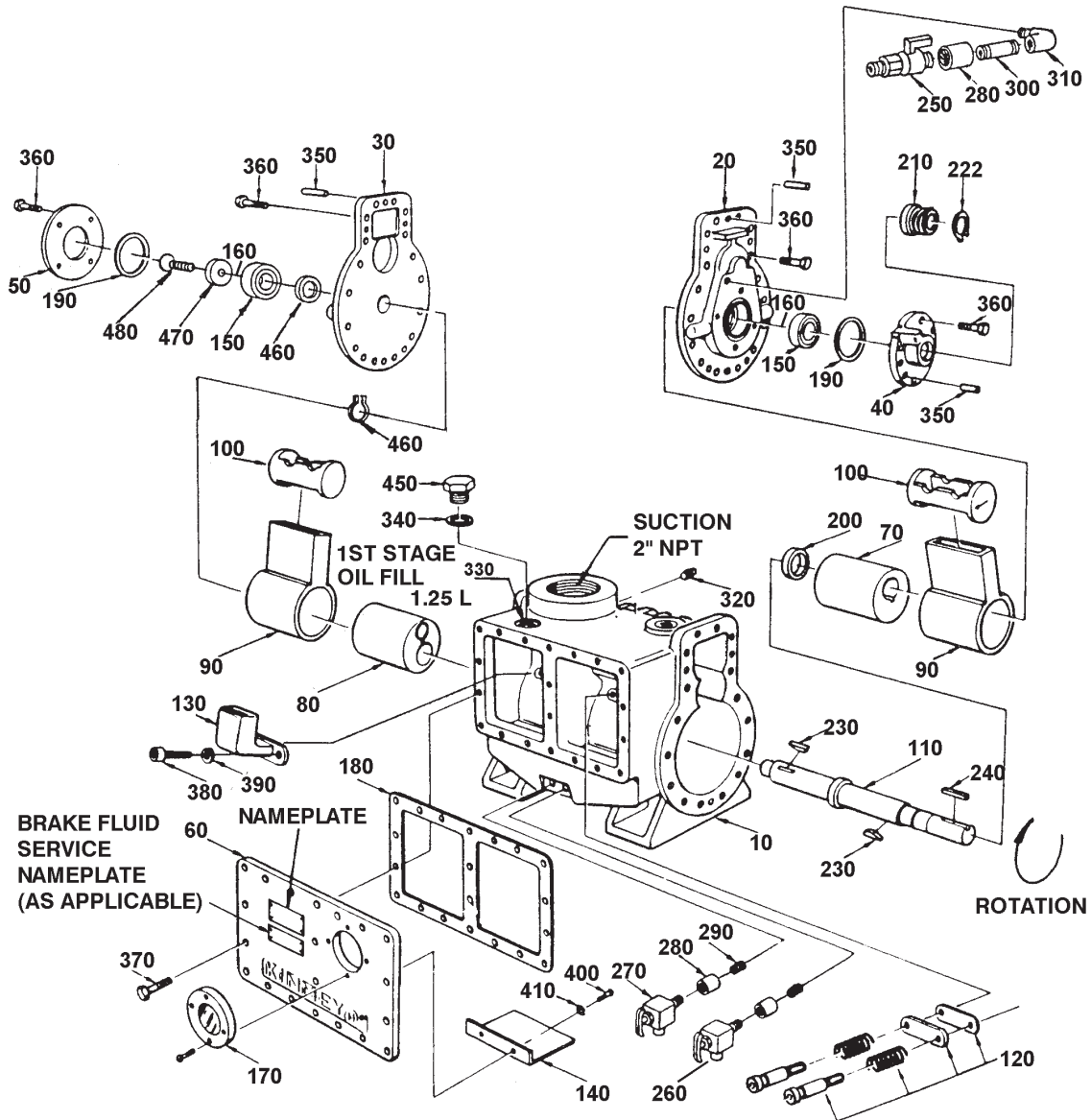
ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
1	CYLINDER	1	1
2	HEAD, OPEN END	1	1
3	HEAD, CLOSED END	1	1
4	HOUSING, SHAFT SEAL	1	1
5	CAP, CLOSED END	1	1
6	COVER, CYLINDER	1	1
7	CAM, OPEN END (HEAVY)	1	1
8	CAM, CLOSED END	1	1
9	PISTON	2	2
10	SLIDE PIN	2	2
11	SHAFT	1	1
12	DISCHARGE VALVE KIT	1	1
13	CHAMBER, NOISE ELIMINATION	1	1
14	BAFFLE, OIL	1	1
15A	BALL BEARING	2	2
15B	SPACER RING	2	2
16	SIGHT GLASS ASSEMBLY W/ SCREWS	1	1
17	GASKET	1	1
18	O-RING	2	2
19	SEAL, CENTER WALL	1	1
20	SHAFT SEAL ASSEMBLY	1	1
21	RETAINING RING	2	2
22	KEY	2	2
23	KEY	1	1
24	GAS BALLAST VALVE	—	—
265	DRAIN COCK (SPECIAL)	2	2
26	COUPLING	3	3
27	NIPPLE	2	2
28	NIPPLE	—	—
29	ELBOW	1	1

ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
30	PIPE PLUG	1	1
31	SEAL WASHER	1	1
32	CAP SCREW, HEX HEAD	1	1
33	DOWEL PIN	6	4
34	CAP SCREW, HEX HEAD	36	36
35	CAP SCREW, HEX HEAD	20	20
36	CAP SCREW, SOCKET HEAD	2	2
37	LOCK WASHER	2	2
38	MACHINE SCREW	2	2
39	LOCK WASHER	2	2
40	OIL MIST ELIMINATOR	1	1
40A	ELEMENT	1	1
40B	GASKET	1	1
40C	CHECK DISC	1	1
40D	CAP SCREW, HEX HEAD	8	8
40E	FLAT WASHER	8	8
41	SHEAVE	1	1
42	FLANGE, SHAFT SEAL SEAT	1	1
43	O-RING	1	1
44	CAP SCREW, HEX HEAD	4	4
45	RETAINING RING	1	1
46	BEARING BACKUP RING	1	1
47	BEARING CLAMPING DISC	1	1
48	CAP SCREW, SOCKET HEAD	1	1

When ordering parts, use the item number shown, plus the model and serial number.

For earlier production models or special application pumps, consult factory for assistance.

KC-15L Exploded View Drawing



Free Air Displacement , CFM (L/sec)	15 (7.08)
Pump Rotative Speed, RPM	572
Ultimate Pressure, Torr (mbar a)	.005 (.007)
Motor HP (kW)	1 (0.75)
Oil Capacity, qts. (liters)	3.0 (2.84)
<p>After normal oil drain, start pump to force out residual oil. Then, refill both stages with quantities shown above. Use Loctite 515 vacuum pump sealant for assembly. For best performance, use only AX vacuum pump oil.</p>	

KC-15L Parts List

ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
10	CYLINDER	1	1
20	HEAD, OPEN END	1	1
30	HEAD, CLOSED END	1	1
40	HOUSING, SHAFT SEAL	1	1
50	CAP, CLOSED END	1	1
60	COVER, CYLINDER	1	1
70	CAM, OPEN END (HEAVY)	1	1
80	CAM, CLOSED END	1	1
90	PISTON	2	2
100	SLIDE PIN	2	2
110	SHAFT	1	1
120	DISCHARGE VALVE KIT	1	1
130	CHAMBER, NOISE ELIMINATION	1	1
140	BAFFLE, OIL	1	1
150	BALL BEARING	2	2
160	SPACER RING	2	2
170	SIGHT GLASS ASSEMBLY W/	1	1
180	GASKET	1	1
190	O-RING	2	2
200	SEAL, CENTER WALL	1	1
210	SHAFT SEAL ASSEMBLY	1	1
220	RETAINING RING	2	2
230	KEY	2	2
240	KEY	1	1
250	GAS BALLAST VALVE	—	—
260	DRAIN COCK	1	1
270	DRAIN COCK W/ O-RING	1	1
280	COUPLING	3	3
290	NIPPLE	2	2
300	NIPPLE	1	1
310	ELBOW	1	1

ITEM NO.	DESCRIPTION	BRAKE FLUID SERVICE QTY	REFRIGERATION/ MINERAL OIL QTY
320	PIPE PLUG	1	1
330	SEAL WASHER	1	1
340	CAP SCREW, HEX HEAD	1	1
350	DOWEL PIN	6	4
360	CAP SCREW, HEX HEAD	36	36
370	CAP SCREW, HEX HEAD	20	20
380	CAP SCREW, SOCKET HEAD	2	2
390	LOCK WASHER	2	2
400	MACHINE SCREW	2	2
410	LOCK WASHER	2	2
40	OIL MIST ELIMINATOR	1	1
40A	ELEMENT	1	1
40B	GASKET	1	1
40C	CHECK DISC	1	1
40D	CAP SCREW, HEX HEAD	8	8
40E	FLAT WASHER	8	8
41	SHEAVE	1	1
420	FLANGE, SHAFT SEAL SEAT	1	1
430	O-RING	1	1
440	CAP SCREW, HEX HEAD	4	4
450	RETAINING RING	1	1
460	BEARING BACKUP RING	1	1
470	BEARING CLAMPING DISC	1	1
480	CAP SCREW, SOCKET HEAD	1	1

When ordering parts, use the item number shown, plus the model and serial number.

For earlier production models or special application pumps, consult factory for assistance.



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DECLARATION OF INCORPORATION

Herewith we declare that the items detailed below are in conformity with the provisions of the Machinery Directive 2006/42/EC.

Information on the items detailed are compiled per the Machinery Directive 2006/42/EC, Annex VII, part A and are the responsibility of the person listed below.

The items detailed below must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the relevant directive(s).

Other directives and standards that apply to this Declaration of Incorporation:

EN 1012-2:1996 - Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum Pumps

The scope of the Declaration of Incorporation is for bare shaft Two Stage Rotary Piston Pumps.

Models KC5, KC8, KC15, KTC-60, KTC-112

WHEN WE COME ALIVE



THE WORLD COMES ALONG

WARRANTY – VACUUM PRODUCTS

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Tuthill Vacuum & Blower Systems (the Seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period as stated in the table below. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation. (Non-standard materials are subject to a plus or minus 10% variation).

PRODUCT TYPE	TYPE OF APPLICATION
New	15 months after date of shipment or 12 months after initial startup date, whichever occurs first
Piston Pumps	30 months after date of shipment, on all units sold after June 1, 2014
Repair	6 months after date of shipment or remaining warranty period, whichever is greater
Remanufactured	9 months after date of shipment or 6 months after initial startup date, whichever occurs first

THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.

All accessories furnished by Seller but manufactured by others bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within one (1) year from date of completion thereof by Seller. Unless done with prior written consent of Seller, any repairs, alterations or disassembly of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's Ex-works point upon request.

THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.

After Buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by Seller, or any alteration or repair by others in such manner as in Seller's judgment affects the product materially and adversely shall void this warranty.

No employee or representative of Seller other than an Officer of the Company is authorized to change this warranty in any way or grant any other warranty. Any such change by an Officer of the Company must be in writing.

The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the General Terms of Sale in the sections on **CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE** and the **PATENTS Clause hereof, the foregoing is BUYER'S ONLY REMEDY HEREUNDER BY WAY OF BREACH OF CONTRACT, TORT OR OTHERWISE, WITHOUT REGARD TO WHETHER ANY DEFECT WAS DISCOVERED OR LATENT AT THE TIME OF DELIVERY OF THE PRODUCT OR WORK.** In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within one (1) year after the cause of action has occurred.

June 2014

OPERATING DATA FORM / PRODUCT REGISTRATION

It is to the user's advantage to have the requested data filled in below and available in the event a problem should develop in the blower or the system. This information is also helpful when ordering spare parts.

Model No.		V-Belt Size		Length	
Serial No.		Type of Lubrication			
Start-up Date					
Pump RPM		Operating Vacuum			
Pump Sheave Diameter		Any Other Special Accessories Supplied or in Use:			
Motor Sheave Diameter					
Motor RPM		HP			

NOTES:
