

**KINNEY®**  
**Two-Stage, Triplex Rotary Piston Pump**

Manual 1845 Rev B p/n 001845 0000

**WARNING: Do Not Operate Before Reading Manual**

# KTC™ SERIES OPERATOR'S MANUAL

Models

KTC-60    KTC-112



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# INTRODUCTION

**CONGRATULATIONS** on the purchase of a new **KINNEY® KTC™** Two-Stage, Triplex 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 pump 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 pump is stored outdoors, be sure to protect it from weather and corrosion.

This manual applies to Kinney Vacuum models KTC-60 and KTC-112. You should be thoroughly familiar with these instructions before attempting to install, operate or repair this unit. Consult Kinney when problems arise that cannot be resolved after reading this manual. Always include pump nameplate information when ordering parts or components.

**KINNEY KTC** 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 pump.

## **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.

## APPLICABLE DOCUMENTATION

The applicable documents associated with this manual are:

- EN 1012-1:1996 - Compressors and vacuum pumps - Safety Requirements - Part 2: Vacuum Pumps

## SCOPE OF MANUAL

The scope of this manual includes the KTC Series rotary piston pumps.

# 02

## CONVENTIONS AND DATA PLATE

### GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in **Applicable Documentation on page 1**. The following are hazard levels 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.

#### **CAUTION**



Read manual before operation or bodily harm may result. Attention should be given to the safety related sections of this manual.



## DATA PLATE






MODEL NUMBER	SERIAL NUMBER	MAWP	YEAR
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Tuthill Vacuum & Blower Systems 4840 West Kearney Street Springfield, Missouri USA 65803		MAX RPM	
		<input type="text"/>	
<b>READ INSTRUCTION MANUAL BEFORE OPERATION OR BODILY HARM MAY RESULT</b>			
<b>! WARNING</b>	<b>! WARNING</b>	<b>! CAUTION</b>	<b>! CAUTION</b>
			
Keep body & clothing away from machine openings.	Do not operate without guards in place.	Hearing protection required.	Do not touch hot surfaces.
<a href="http://www.tuthill.com">http://www.tuthill.com</a>	(800) 825-6937		Made in the USA

Figure 2-1 – General Operation and Symbols on Data Plate

The following information is contained on the data plate:

**! WARNING**



Keep body and clothing away from machine.


During operation, keep body and clothing away from inlet and outlet of the pump.

**! WARNING**




Do not operate without guards in place. Assure that the guards are in place and secure prior to operation.

**! CAUTION**



Hearing protection is required while the pump is in operation. At ultimate pressure noise levels are 75 dBA, however due to process or installation conditions noise levels may be higher.

**! CAUTION**



Do not touch hot surfaces. Do not touch the vacuum pump while it is in operation and assure that the pump is cool before touching, when not in operation.

<b>MODEL NUMBER:</b>	The specific model of the pump
<b>SERIAL NUMBER:</b>	Unique to each pump. Use with any service issues and with any contact with the manufacturer.
<b>YEAR:</b>	Year of manufacture
<b>MAX RPM:</b>	Maximum RPM at which the pump can be operated

This manual describes instructions and precautions to be observed in the handling and maintenance of Tuthill Vacuum & Blower Systems Kinney® KTC™ Two-Stage, Triplex Rotary Piston Vacuum Pumps. It is strongly recommended that those who operate or maintain the pump read this manual carefully prior to pump operation, to ensure personal safety and pump life.

### **WARNING**

The vacuum pump must be handled using an appropriate device such as a fork truck or appropriate lifting device. See *Table 4-1 on page 7* for approximate weights. Care should be taken to assure pump does not over-turn during handling and installation.

### **CAUTION**

**DO NOT LIFT THE VACUUM PUMP BY THE MOTOR.**

### **NOTICE**

*Lift the vacuum pump using both eyebolts directly attached to the top of the pump separator housing, or with both fork truck forks underneath the pump.*

# 04

## DESCRIPTION

The Kinney KTC oil-sealed, compound rotary piston pumps produce the lowest pressures achievable with mechanical pumps. Two pumping chambers in parallel are backed by a third pumping chamber in series and produce an ultimate pressure 0.2 microns as indicated by a McLeod Gauge ( $2 \times 10^{-4}$  Torr). The pumps are simple to operate and require straightforward maintenance without special tools.

The moving parts in the triplex pumps are inherently dynamically balanced so the pumps run smoothly and quietly. The standard vibramounts virtually eliminate vibration transmitted to the floor.

Adjustable gas ballast valves can reduce or prevent contamination of the oil, and can be used to clean oil that has become contaminated with vapors. The gas ballast can also be cracked open to quiet the pump when operating at blank-off.

The KTC-60 is air-cooled and oil is circulated by vacuum generated by the pump itself. Two solenoid valves control the oil flow.

In the KTC-112, an oil pump circulates oil through a water-cooled heat exchanger. Solenoid valves and a pressure switch control the oil flow.

## SPECIFICATIONS

	UNIT	KTC-60	KTC-112
Free Air Displacement	cfm (m <sup>3</sup> /h)	60 (102)	107 (182)
Pump Speed	RPM	972	1055
Motor Speed	RPM	1725	1725
Motor Power	HP	3	7.5
Total Oil Capacity	U.S. gal (L)	2 (7.6)	4 (15.1)
Cooling Water at 60°F (16°C)	gpm (L/min)	Not req'd	1.5 (6)
Cooling Water Connections	NPT	-	1/4 in.
Suction Connection	150 lb ASA Flanged	3 in.	3 in.
Discharge	NPT	1.5 in.	2 in.
Height	Inches (mm)	37 (940)	43 (1092)
Floor Space Required	Inches (mm)	24 × 19 (609 × 483)	26 × 21 (660 × 533)
Weight	lb (kg)	515 (234)	765 (347)
Ultimate Pressure	Torr	2 × 10 <sup>-4</sup>	2 × 10 <sup>-4</sup>

Table 4-1 – Specifications

## PUMP COMPONENTS

The pumps have three cylinders with rotary pistons, two of which operate in parallel as a single high-vacuum stage and have a common inlet and discharge. The discharge of this stage is connected in series to the inlet of the backing stage cylinder, which discharges into the oil-gas separator.

A check valve is provided between the inter-stage connection (high-vacuum stage discharge) and the oil reservoir. When the pump is operating at pressures above 200 Torr (267 mbar), some air is discharged from the inter-stage through the check valve(s) and into the separator housing.

The cylinder has an end cover called a head at each end. The end through which the drive shaft extends is called the open head and the non-drive end is called the closed head. The heads contain the main sleeve bearings and external piping or oil flow. The open head also contains a vacuum-tight rotary shaft seal to prevent leakage along the shaft.

KTC pumps have two oil reservoirs, one for the high-vacuum stage and one for the backing stage. The sight glass on the side of the separator housing indicates the oil level in the backing stage. The oil level should be near the mid-point of the sight glass when operating at low inlet pressures and will rise and fall with changes in the inlet pressure. The separator housing contains a discharge baffle to separate oil from the exhaust gas. There is a discharge valve on the backing stage below the baffle. There are no discharge valves on the high-vacuum stage.

## OPERATING CYCLE

Gas from the system enters the pump suction and passes through the hollow piston slide and out into the space being created between the piston and cylinder wall. This space increases and more gas is drawn in as the piston rotates. At the same time, the gas taken in and trapped on the previous revolution is discharged into the inlet of the backing stage.

The high-vacuum 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 separator where oil is separated from the gas. This gas is discharged into the atmosphere and the oil drains back to the oil reservoir. Oil from the reservoir does not normally enter the pump when stopped under vacuum; however, stopping the pump under vacuum is not recommended. **See Figure 4-1 on page 8.**

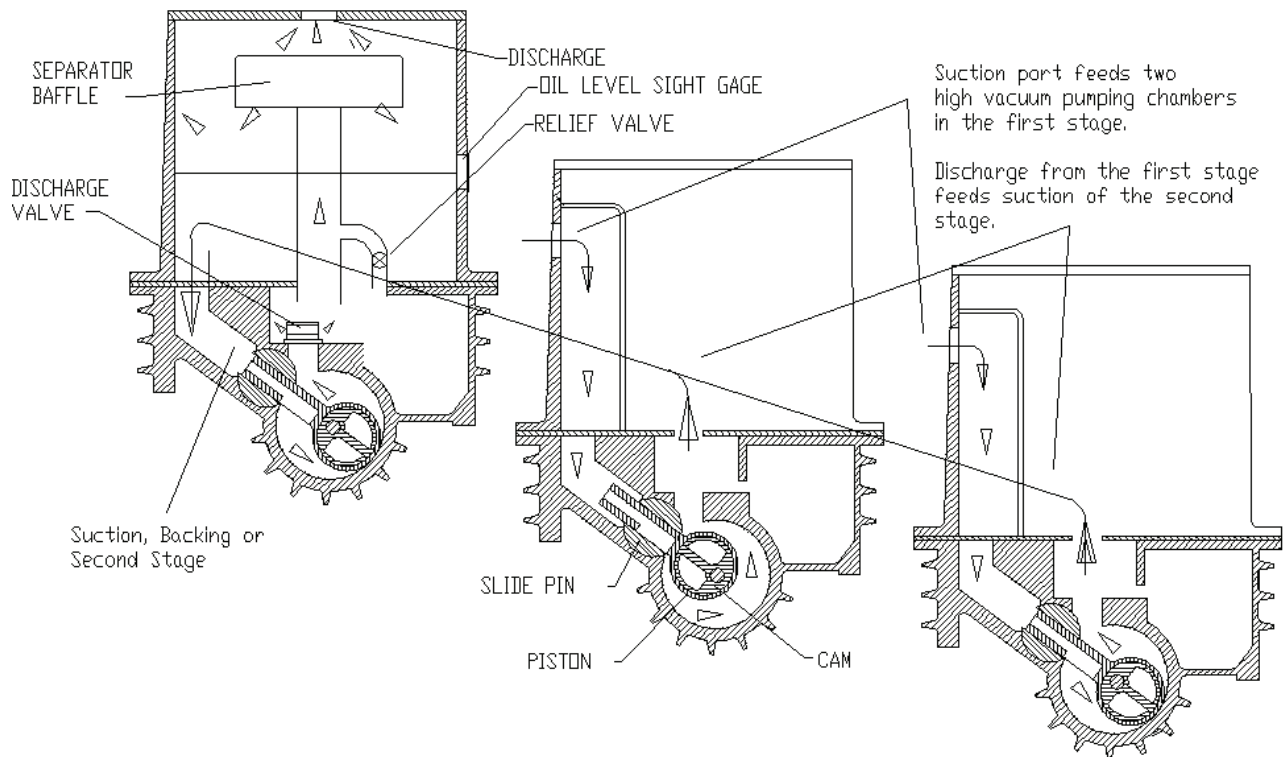


Figure 4-1 – Operating Cycle

## SEALING AND LUBRICATION

The pump components are lubricated and sealed against backflow of gas by a film of oil, which fills the running clearances. When the pump is in operation, the cylindrical part of the piston almost touches the pump cylinder at a line along the length of the piston. An effective wave of oil is pushed ahead of this moving line. Oil is also being squeezed through the clearances of the other working parts. The seal and bearings are lubricated and washed by the flow of intake oil. There are two oil reservoirs, one for each stage. At the end of the compression stroke, the oil is forced out with the discharged gas and returned to the respective reservoirs.

**Figure 4-2** shows the oil flow for KTC-112 pumps. The pump circulates oil from the backing (second) stage reservoir through a water-cooled heat exchanger and back to the reservoir. When the pump is at a pressure above 100 Torr (133 mbar), some of the oil leaving the heat exchanger is admitted through solenoid valve (A) into the high-vacuum (first) stage via the bearing located on the non-drive side of the pump. Below 50 Torr (67 mbar), the pressure switch closes solenoid valve (A) and opens solenoid valve (B), and the high-vacuum (first) stage is then supplied with degassed oil from the first stage reservoir. The oil supply pressure is provided by interstate pressure and the reservoir oil head. A solenoid valve located on the drive side of the pump, which is open when the pump is running, controls oil to the backing (second) stage. Oil is delivered into the backing stage by differential pressure.

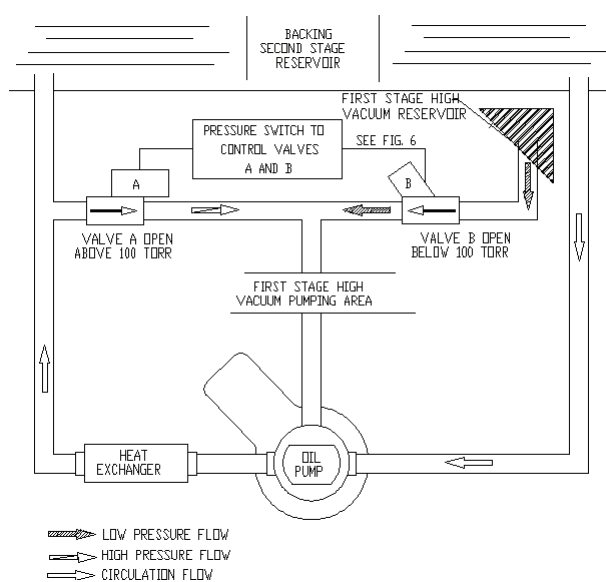


Figure 4-2 – Oil Flow - KTC-112

On the KTC-60, there is no oil pump, heat exchanger or pressure switch. Oil is fed from the backing stage reservoir to the drive end of the pump, and from the high-vacuum reservoir to the non-drive end of the pump. Solenoid valves close both lines when the pump is stopped.

# 05

## INSTALLATION

### VIBRAMOUNTS

KTC pumps are supplied with vibramounts, which enable them to run quietly and vibration-free. The pump can be operated on any floor that will support its weight. The pump must be installed on the vibramounts and flexible connectors fitted in suction, discharge, water and electrical connections. It is not necessary to bolt the pump to the floor.

Bolt the vibramounts to the four holes in the feet. On the KTC-112, all four vibramounts are the same. On the KTC-60, install two green vibramounts at the belt guard end and two red vibramounts at the other end.

Carefully set the pump down squarely on the mounts when installing the pump in operating position.

### PIPING CONNECTIONS

#### Suction Manifolding

Inlet manifolding should be sized and designed with three objectives in mind:

- To avoid gas flow restrictions.
- To prevent pump fluids from entering the process chamber.
- To protect the pump from the ingestion of particulate matter.

Under normal conditions, the diameter of the manifolding should not be less than the diameter of the pump connection, and the pipe length should be kept to a minimum.

Oil may splash from inside the pump through the suction port, so the suction line must be designed to prevent oil from collecting there and draining back to the system or process.

A flexible connection should be installed in the suction manifold to provide freedom for vibramounts. The vacuum piping must be well-aligned with the pump connections so as not to place a strain on the piping.

Provisions for gauge installation and any other drilling in the piping must be made prior to piping installation; otherwise, drilling particles entering the piping could be entrained into the pump.

A vacuum isolation valve should be installed adjacent to the suction port to be used for leak-checking, shutting down the system, or blanking-off the pump.

Before connecting the suction manifolding, distribute 4 quarts of oil over the two high-vacuum slide pins by reaching through the suction port with a container and pouring oil directly onto the slide pins. Then rotate the pump by hand a minimum of two revolutions to distribute the oil throughout the pump interior.



## Discharge Manifolding

During the initial operation and as long thereafter as necessary, install a fine mesh screen across the inlet connection to prevent abrasive or solid particles left in the line from being sucked into the pump. This screen can be removed when particles no longer accumulate. If particles continue to accumulate, install a filter in the line.

Discharge manifolding should be sized and designed to prevent the following:

- Return of oil mist condensate to the pump
- Oil loss
- Oil mist in the discharged gas

Under normal conditions, the diameter of the manifolding should not be less than the diameter of the pump connection, and pipe length should be kept to a minimum.

The installation of a Kinney oil mist eliminator on the discharge is recommended for all applications. Oil that collects in the eliminator should be returned to the pump. The optional oil return kit will drain oil back into the separator housing when the pump is operating at low pressure or when the pump is stopped. If the pump is to operate continuously, or normal operating pressure is 10 Torr (13 mbar) or higher, consult Kinney for special recommendations on oil return.

It may be necessary to pipe the pump exhaust fumes away from the pump area, such as outdoors. If this is done, the piping must be arranged to prevent line condensation from returning to the pump. A flexible connector should be fitted in the discharge line to provide freedom for the vibramounts.

## Cooling Water

The KTC-60 is air-cooled and does not require cooling water. On the KTC-112, the lubricating oil is cooled by a shell-and-tube heat exchanger mounted adjacent to the oil pump.

### WARNING

**Do not allow the cooling water to freeze in the heat exchanger.**

Connect a water supply line with “on-off” valve to the water inlet and an open drain to air the water outlet. The inlet line should have a flow-regulating valve. If the water supply is unreliable, install a flow switch to stop the pump or signal when the flow is interrupted. Normally the cooling water will be off when the pump is not running.

Standard cooling water rates are for up to 80°F (26°C) supply temperature and operation within the design of continuous operating pressure range below 10 Torr (13 mbar). For sustained operation above 10 Torr (13 mbar), consult Kinney for recommendations.

## LUBRICATION

### Filling the Pump with Oil

Use oil recommended by Kinney and see the specifications for the quantity of oil required to fill the pump. There are two oil reservoirs in Kinney KTC pumps. The main reservoir is at atmospheric pressure and feeds oil to the high-pressure stage, and the other is between the two stages and feeds oil to the low-pressure stage. Both must be filled before starting the pump. An oil sight glass is provided in the atmospheric reservoir only. Oil level in the interstage reservoir is maintained automatically by normal operation of the pump.

To fill the main reservoir, remove the filler cap from the fill elbow on the separator housing and add oil until the level reaches the top of the sight gauge. The level will drop to below mid-center of the gauge once the pump is operated at blank-off and the oil is distributed. Add or drain oil as necessary to keep the oil level (at blank-off) 3/8 in. (1 cm) up from the bottom of the glass. The oil level changes with operating pressure, reaching the lowest level at blank-off.

To fill the interstage, remove the filler cap from the fill elbow mounted on the pump cylinder and add the following quantity of oil:

**Interstage**

KTC-60	2 quarts
KTC-112	1 gallon

Replace the interstage filler cap and make sure the cap seals. The interstage reservoir is under vacuum when the pump is in operation. Any leakage will cause loss of performance.

**CAUTION**

**Do not overfill the pump, as excess oil will be blown out during the high-pressure operation of the pump.**

## VACUUM GAUGES

The vacuum gauge(s) to be installed on the pump must be selected to meet the requirements of the particular pump application. Two general types of vacuum gauges are used for the testing of vacuum equipment: total pressure reading, such as thermocouple gauges, and 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 vapor 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 leaks. A high thermocouple gauge reading may indicate that the pump is contaminated or that it leaks, or both. A high McLeod gauge reading means that a leak is present.

## GENERAL

 **WARNING**

Do not operate without guards in place.

Assure that the guard is in place and secure prior to operation.

 **CAUTION**

Do not operate the pump in an enclosed area unless the pump discharge is filtered or piped to open air. Prolonged inhalation of oil mist or vapors is a health hazard.

**NOTICE**

*Do not block or restrict the flow of gas from the pump discharge. Back pressure within the pump could cause severe damage. The belt guard must be properly secured to the pump at all times while the pump is running.*

## Electrical Connections

 **WARNING**

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

Wire the motor in accordance with the wiring diagram located on the motor. **See Figure 6-1 on page 14.** Oil control solenoid valves and switches are factory-wired. If the pump has been disassembled, rewire the solenoid according to the diagram located on the solenoid valve.

When wiring is complete, turn the pump by hand to ensure that the pump is free to turn and then momentarily jog the motor to check that the pump rotation direction is clockwise when facing the drive end. If the pump rotates in the wrong direction, reverse any two of the three motor leads. If a flow switch is provided, it should be wired into the motor circuit with a relay so as to stop the motor in the event the cooling water flow is interrupted.

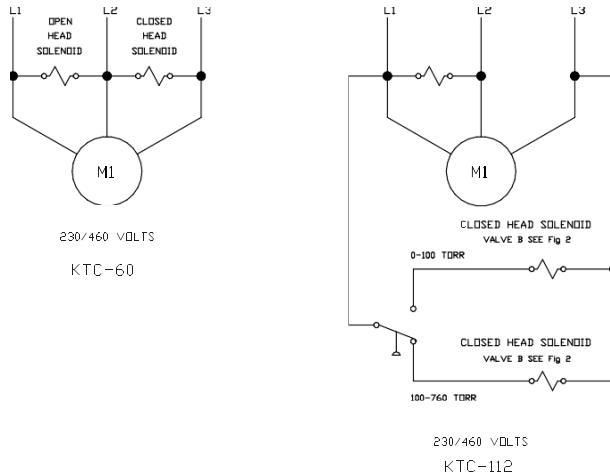


Figure 6-1 – Wiring Diagram

## PRE-START CHECKS

Before starting the pump, check the following items:

1. The installation has been made in accordance with **Installation on page 10**.
2. The pump has been filled with oil in accordance with **Installation on page 10**.
3. If the pump has been idle for a month or more: turn the pump, by hand, two or more revolutions to distribute oil internally through the pump.
4. The temperature of the pump oil is 60°F (16°C) or above. Special heaters may be required for starting at lower temperatures. Consult Kinney for recommendations.
5. Cooling water is available (for KTC-112 only). Do not start the cooling water flow until the pump has operated a few minutes.
6. Drive belts are correctly tensioned. **See V-Belt Drive on page 21**.
7. Direction of rotation is correct.

### WARNING

Correct rotation is clockwise when viewed from the drive end (counterclockwise when viewed from the motor fan). Operating the pump with the incorrect rotation will cause FAILURE.

### WARNING

Physical harm may occur if human body parts are in contact or exposed to the process vacuum. Assure that all connections are protected from human contact.

### CAUTION



Do not touch hot surfaces. Discharge gas based on operating conditions can be elevated.

## STARTING THE PUMP

1. Close the inlet isolation valve.
2. Close the vent valve if one is used.
3. Start the pump.
4. Open and adjust the cooling water flow as shown in the specifications.
5. Adjust the gas ballast. **See Gas Ballast on page 15**.
6. Maintain oil level 3/8 in. up from bottom of the sight glass when running at blank-off.
7. Run the pump at blank-off for 5-10 minutes and then with full gas ballast for 10-15 minutes before opening the suction of the pump to a higher air pressure.

## STOPPING THE PUMP

### NOTICE

*Rapid reversal will result in premature failure.*

### NOTICE

*KTC-series pumps must be properly vented during shut down to ensure normal startup conditions.*

1. Close the inlet isolation valve.
2. Vent the pump to the atmosphere through the vent (air admittance) valve.
3. Close the gas ballast valve.
4. Stop the pump.
5. Shut off cooling water.
6. Close the vent valve.

## HANDLING LARGE QUANTITIES OF WATER

Use of the gas ballast valve enables Kinney pumps to handle small to moderate amounts of water and other vapors in the suction gas stream. **See Gas Ballast on page 15.**

For applications where large quantities of water vapor are encountered, water will condense in the backing stage oil reservoir. If it is not drained, water will enter the lubrication system instead of oil and the pump may be seriously damaged.

KTC Series pumps can accumulate some water in the reservoir before the water level reaches the oil line pickup where it could circulate through the pump. If water or other condensate collects in the oil reservoir, it should be drained before the level reaches the oil line pickup. To drain water from the pump, crack the oil drain valve and leave it open until any water accumulation has drained out. Drain the water as often as necessary.

## GAS BALLAST

Gas ballast is used while the pump is running to prevent internal condensation of oil-insoluble vapors such as water, alcohol, or acetone, and to quiet the hydraulic noise when running pump at blank-off conditions.

The setting of the gas ballast valve is not critical on compound pumps, as full gas ballast does not seriously affect the base pressure. Compound pumps are eminently suitable for handling vapors at low pressure.

Continuous use of gas ballast is recommended where the process pressure requirements can be met with the gas ballast valve open; otherwise, intermittent use of gas ballast between process cycles is suggested. If use of gas ballast at neither of these times is tolerable, it is advisable to run the pump using gas ballast when process work is not being done, such as overnight.

Use the gas ballast valve as follows:

1. **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.
2. **INTERMITTENT GAS BALLAST DURING PROCESSING** — 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 the oil.
3. **CONTINUOUS GAS BALLAST WHEN NOT PROCESSING** — With the pump operating but isolated from the process, fully open the gas ballast valve. If convenient, operate the pump overnight in this manner to clean badly contaminated oil. Gas ballast will remove vapor contamination but will not remove solids such as varnish. If it is necessary to clean the oil using gas ballast in the short period, the time needed can be estimated as follows: Open the gas ballast valve fully and operate the pump for a short period (15 to 20 minutes).

Close the gas ballast valve and observe the pressure change after 1 to 2 minutes of running. Use the “pressure change versus time” as a rough guide to estimate the total time required to obtain the desired blank-off pressure.

## STALLING

If the pump stalls at any time, it may be due to loose belts, lack of lubrication caused by failure of the oil circulating pump, badly contaminated oil, coating build-up, or foreign matter in the pump. If the pump cannot be turned over freely by hand after cooling, there is foreign matter in the pump and the inside of the pump must be cleaned.

Sometimes a process-related coating build-up can be removed by soaking the pump with the proper solvent (while turning by hand). Check with Kinney Service Department. Inspecting the inside of the pump is covered under **Disassembly on page 21**.

## PUMP LEAKS

If the pump is suspected of having an air leak, after eliminating oil contamination as the cause of poor performance, use a plastic sealing compound to seal over suspected areas, such as joints, connections plugs, and any penetrations into the vacuum area. Check pump blank-off performance before making permanent repairs with Kinseal. If gasketed connections are suspected, remake the connections. Plastic sealing compound may be used to make temporary gaskets; these should not be made too thick since the material may be squeezed into the pump.

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

For checking leaks, a fast-acting total pressure gauge used with acetone or a sensitive freon leak detector can be used. A helium leak detector is the most convenient to use, if available.

## Checking Pump Performance

If the processing time or the ultimate pressure becomes poor with no recent changes in the process or in system configuration, test the pump to determine if the trouble is in the pump or the connected process equipment. To check the condition of the pump, measure the blank-off pressure as directed below using a McLeod gauge. If possible, also read the blank-off pressure with a thermocouple gauge. To read the blank-off pressure, close the pump inlet by means of a vacuum valve or blank-off plate.

Connect a vacuum gauge to the suction side and position the gauge tube, facing downward in the higher area of the manifolding so that the tube will not become flooded and blocked by splashing pump oil. If the pump is disconnected from the process equipment, connect a 90-degree elbow, extending upward, to the inlet flange and bolt the blank-off plate, with gauge connection to the open elbow flange.

Operate the pump for a minimum of 15 minutes and record the lowest pressure reached. Average blank-off readings are 0.0001 to 0.0005 microns with a McLeod gauge, and 1 to 10 microns with a thermocouple gauge. The specification pressure is 0.2 microns, McLeod gauge reading. If the McLeod gauge reading is low and the thermocouple gauge reading is high, the pump oil is contaminated. **See Oil Contamination on page 18**. A high reading of both the McLeod and thermocouple gauges indicates that an air leak is present.

## Checking Process Equipment

Attach a vacuum gauge to the connection on the system side of the isolation valve. **See Vacuum Gauges on page 12**. For this test, the system should be clear of any process work, which might give off vapors and change the reading. Run the pump to obtain the best vacuum possible with the valve open, and then close the valve and observe the pressure rise. If the pressure rise is greater than desired, the leaks should be eliminated. Check the system carefully for loose joints and obvious leaks. Use a leak detector if available. The trouble can be isolated further by applying the following procedures:

Isolate each segment by valves or blank-off plate at convenient locations. 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 to the previous reading, leak-test the last segment added.

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 gasketed penetrations 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. Thus, all permanent repairs can be made at the same time.

If a leak detector is not available, use the following methods to locate leaks:

1. Cover suspected leaks with a low vapor pressure sealing compound such as Apiezon Q, James Biddle Company or Shell Company, or Duxseal. Do this 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.
2. If the leak is large, causing pressures greater than 1 Torr (1.3 mbar), pressurize the process equipment with 1 PSIG (70 mbar) of clean compressed air and paint a soap solution on suspected leak areas. Bubbles will indicate leaks.
3. If the leak is small, causing pressures less than 1 Torr (1.3 mbar), use a fast-acting medium such as acetone, alcohol, freon or helium. Position the vacuum gauge head downstream from the suspected leak area, between the leak and pump. When the pressure has been reduced so the gauge may be used, apply probing medium to suspected leak areas using a squirt gun or brush. If the probing fluid is directed at the leak or an area close to it, a sudden change in pressure will occur. Cover suspected leaks with plastic sealing compound and continue leak-checking until desired pressure is obtained.
4. If leak-checking fails, disassemble and remake all demountable joints and connections using new gaskets and vacuum sealing compound such as Kinseal. Temporary gaskets may be fabricated from sealing compound, but these should not be made too thick, since the material may be squeezed into the equipment.



# 07

## MAINTENANCE

### GENERAL

Pump repair services are available at Tuthill Vacuum & Blower Systems Authorized Service Centers and at our Springfield, MO factory. Call Tuthill Vacuum & Blower Systems at 800-825-6937 or your nearest sales office for the location nearest you.



#### DANGER



**The pump and parts may contain hazardous media as determined by the process. Assure that pump and parts are evacuated of hazardous media prior to servicing.**



#### CAUTION

**The electrical service must be isolated and de-energized prior to maintenance. Apply appropriate procedures to assure electrical supply is de-energized and cannot be inadvertently energized during maintenance.**

**Assure piping and product are isolated prior to maintenance of pump. Apply appropriate procedures to assure piping and product is isolated and that inadvertent opening of valves cannot occur during maintenance.**

### PERIODIC MAINTENANCE

There is no fixed interval for changing pump oil, since applications vary widely. This can be determined only by experience and/or by deterioration of pump performance. As a minimum, the pump oil should be changed after each six-month logged period of operating.

At high pressures, or with a gas ballast flow, the oil level should be higher than it is when operating at low pressures near blank-off. 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.

#### Oil Contamination

When the pump has operated satisfactorily for some time followed by gradually declining vacuum performance, clean the oil by applying gas ballast, or change the oil as directed in ***Changing the Oil on page 19***. A change in the color of the oil does not necessarily mean that it is not satisfactory for use. On the other hand, vapors may contaminate the oil and not show any color change.

The following factors may cause the pump oil to deteriorate:

- Water and solvents will lower viscosity
- Solid accumulation will increase viscosity and “feel gritty”
- Polymerization and chemical attack on oil will increase viscosity and odor



As a “Rule of Thumb,” the oil should be changed if:

- The oil “feels gritty”
- Viscosity changes more than 100 SSU @ 100°F (38°C)
- Oil color becomes opaque
- A burnt or acrid smell occurs
- Total Acid Number increases to 0.3

If oil contamination is suspected, change the oil and operate the pump for 15 to 30 minutes. Repeat this procedure as required to flush out all contaminants from the pump or operate the pump with gas ballast as explained under **Gas Ballast on page 15**. See gas ballast and water handling instructions under **Operation on page 13**.

Oil filtration systems are available for filtering solids, water, and acids continuously or periodically.

## Changing the Oil

Run the pump until the oil reaches normal operating temperature 145 to 165°F (63 to 75°C) and pressure below 100 Torr (133 mbar). Stop the pump to drain the two oil reservoirs. Place a container under each oil drain valve and open the valves until the oil is removed from the pump. Close the valves.

If the oil is being drained because it has been contaminated, drain the oil from the discharge valve well. The well is located between the pump cylinder and separator housing. Oil trapped there can be drained by removing the pipe plug from the cylinder located above the open head.

When the oil has drained from the pump, close all drains and fill the pump with the quantity and type of oil shown in the specifications. The oil level will show above the center of the sight gauge until the pump is started and the oil is distributed through the pump.

## Lubricating the Pump

An oil pump is installed on the KTC-112 to circulate oil through the heat exchanger. It is mounted on the closed head and is driven directly by the vacuum pump shaft. Failure of the gear pump may be detected by high oil temperature and, consequently, deteriorating performance and noise. The tubing attached to the pump should be nearly the same as the oil temperature or 145 to 165°F (63 to 75°C). **See Sealing and Lubrication on page 9.**

## REPLACEMENT PARTS

Various parts, particularly internal components for earlier versions of KTC Series pumps, are different and cannot be interchanged. Many pumps are ordered and equipped with special modifications and accessories, or adaptations for special fluids. Therefore, when ordering spare parts the pump model and nameplate serial number must always be provided to ensure verification and shipment of the correct parts.

## Recommended Oil

KINNEY AX Oil is recommended for the KTC pumps. It is available from the factory and distributors under the following item numbers:

55 Gallons	203082 0000
5 Gallons	203080 0000
1 Gallon	203079 0000

# 08

## REPAIR INSTRUCTIONS

### DISCHARGE VALVES

If the cause of poor pump vacuum is not due to leaks or oil contamination, the next step is to inspect the discharge valves. The discharge valves are located at the exhaust port of the backing stage chamber. They should not cause trouble unless they are mechanically damaged or are prevented from sealing properly due to foreign matter on the valve seat. Under normal pump usage, the valves should be replaced annually. When the pump is operating at blank-off without gas ballast, a sharp hydraulic noise (click) indicates proper valve operation.

The poppet-type valve has six flat, washer-like springs, which press against a sealing disk. The disk fits against a seat, forming a tight seal. The springs are maintained in place by a lift stop and the entire valve is held together by a capscrew. The valves are attached to the cylinder by means of screws and a hold-down plate.

To inspect the discharge valves, remove the valve as described in **Disassembly on page 21**. Inspect the valves by snapping the valve disk or lower valve spring away from the valve seat to check for spring tension and mechanical defects. Inspect the sealing surfaces for dirt or other foreign material. Check that the disk or lower valve spring has not warped (dish shape), as they must be flat for full contact. If a more careful inspection is required, remove the cap screw(s) holding the valve together. When reassembling the valve, replace valve components in exactly the same position as before. Reassemble the valves as described in **Assembly on page 23**.

### SHAFT SEAL ASSEMBLY

Under normal conditions, the shaft seal (**see Figure 8-1**) has a long, trouble-free life. It may become worn or scratched on the sealing face by dirty sealing oil, which also lubricates the shaft seal, or it may be damaged by excessive heat due to poor lubrication.

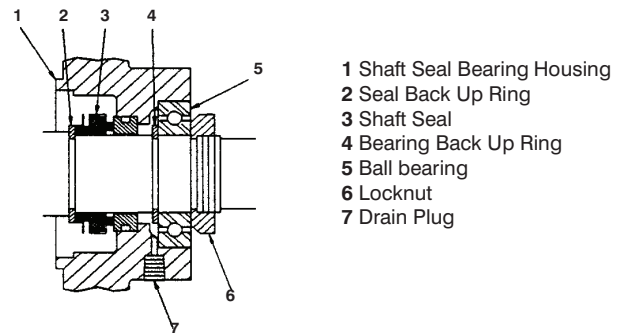


Figure 8-1 – Shaft Seal Assembly

If oil drips from the shaft seal and bearing housing, inspect the shaft seal and replace it as necessary. The drain plug of the shaft seal and bearing housing should be removed if oil is leaking past the shaft seal. If oil that has leaked from the shaft seal is allowed to drain through the bearing, it will wash the grease from the bearing and cause it to fail.

To inspect the seal:

1. Remove the belt guard and belts.
2. Remove the pump pulley and drive key from the shaft.
3. Remove the shaft bearing and housing:
  - a. Remove the outboard bearing retainer nut from the shaft.
  - b. Remove the capscrews holding the bearing housing and remove the housing.
4. Inspect the face of the running surface for dirt, scratches, or grooves that might cause leaks into the pump. A smooth shining carbon face indicates a good seal. A crease across the sealing ring, a dent, or a scratch in the running face marks a direct leak through the seal. Cracks or hardening of the rubber parts indicate that the shaft seal was exposed to excessive operating temperatures and needs to be replaced.

## V-BELT DRIVE

Before attempting to tension the V-belt drive, it is imperative that the sheaves be properly aligned. V-belts should be replaced in sets and the sheaves should be positioned so as to allow the belts to be placed in the grooves without rolling them onto the sheaves.

The following tensioning steps can be safely followed for all belt types, cross sections, number of belts per drive, or type of construction:

1. With the belts properly in their grooves, adjust the sheaves until all slack has been taken up.
2. Start the drive and continue to tension the V-belt(s) until only a slight bow on the slack side of the drive appears while operating under load conditions as shown in **Figure 8-2**.

- 1 Pump Sheave (pulley)
- 2 Motor Sheave (pulley)
- 3 Belt Too Tight
- 4 Belt Too Loose
- 5 Correct Tension

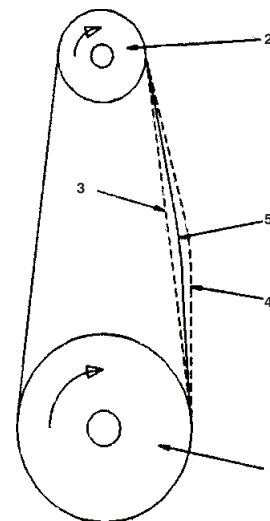


Figure 8-2 – V-Belt Drive

3. After 24 to 48 hours of operation, the belts will seat themselves in the sheave grooves. Further tensioning is then necessary as described in Step 2.
4. The belts should not slip if they are correctly adjusted and the correct starting procedure is used. A screeching noise at start-up may indicate the belts are too loose. Belt dressing should not be used on V-belts. Sheaves and V-belts should remain free of oil and grease. Tension should be removed from belts if the drive is to be inactive for an extended period of time.

## DISASSEMBLY

The following steps are for complete disassembly of the pump; however, the pump should be disassembled only to the extent necessary for servicing. Refer to assembly drawing and parts list as needed. Note that the open head is the head through which the shaft extends, and the closed head is the head on which the oil pump is mounted.

1. Disconnect the pump from the power supply.
2. Drain the oil as described in **Changing the Oil on page 19**.

3. Remove the belt guard.
4. Disconnect all leads from solenoid valves, pressure switch and motor junction box.
5. Loosen the jam nuts, release the belt tension and remove the V-belts.
6. Remove the pump sheave and key, spacer and locknut.
7. Remove the oil piping to the shaft seal housing.
8. Remove all the screws securing the shaft seal/bearing housing and use two screws to jack the housing and bearing off the shaft. Remove the O-ring.
9. Pull the seal head assembly (the rotating part of the shaft seal) off the shaft. This may require a heavy pull if the unit has heat-bonded to the shaft. In extreme cases, it may be necessary to break the bond by removing the open head from the cylinder. Remove the shaft seal backup ring. If necessary, press the seal seat (the stationary part of the shaft seal) from the bearing housing.
10. Disconnect the oil piping between the separator housing and the oil pump, the closed head and the heat exchanger. Remove the piping between the cylinder and the closed head.
11. Remove the separator housing cover. On the KTC-112, remove the valve deck cover complete with umbrella. On the KTC-60, remove the umbrella from the top of the separator housing, the nipple from the valve deck cover and then the valve deck cover itself. Remove the relief valve(s), and then drain the discharge valve chamber (if not already done). Remove the discharge valve retainers and discharge valves.
12. Remove all the screws from the open head. Using three or four screws in threaded holes in the head to break the seal, jack the head off the cylinder. Remove the open head.
13. Pull the open head slide pin and piston from the cylinder. Mark the parts to ensure that they can be replaced in the same location.
14. Pull the open head cam off the shaft.
15. Replace the open head and dowel pins using four screws to hold the head. This will support the shaft while the closed end of the pump is dismantled.
16. Remove four screws securing the oil pump housing and pull off the housing complete with the pump.
17. Remove the closed head in the same way as the open head was removed, by jacking the head off the cylinder.
18. Pull the closed head slide pin and piston from the cylinder and mark them so that they can be replaced in the same location.
19. Remove the closed head cam from the shaft.
20. Loosen the socket head self-locking screws in the floating wall to release the pins securing the wall to the cylinder. Withdraw the wall from the cylinder, taking care not to tilt the wall. Two 3/8 in.-16 tapped holes in the face of the wall can be used in conjunction with a bar (two 1/2 in. holes on 3-1/2 in. center) placed across the face of the cylinder and two draw bolts to aid in the wall removal.
21. Pull out the center slide pin and piston.
22. The shaft and cam can now be removed from the closed head end. Disassembly of the center cam and shaft is not recommended unless either part has to be replaced. The cam is a press fit onto the shaft and a press is required to remove it.
23. Remove the oil seal from the fixed wall and replace it.
24. If the bearings are to be replaced, press them out of the heads.
25. If disassembly has proceeded this far, perform a complete cleaning of the oil reservoirs as follows:
  - a. Remove separator housing from the cylinder complete with motor attached. Remove gaskets and compound plate.

- b. Remove discharge pipes and relief valves. Flush and clean both oil reservoirs with solvent and remove all solid particles.

## ASSEMBLY

Thoroughly clean all parts and remove harmful rough or sharp areas before assembling. Do not use solvents such as kerosene or carbon tetrachloride for cleaning unless facilities are available to evaporate them by vapor de-greasing or by washing with acetone or alcohol. When reassembling, all parts must be coated with vacuum oil.

1. Replace the Woodruff keys in the closed head end of the shaft. If the center cam has been removed from the shaft, press the cam onto the shaft. Do not install keys in the open head end of the shaft, as they may damage the center wall seal during assembly.
2. Install a new center-wall shaft seal in the cylinder, with the lip toward the open head of the cylinder.
3. If new bearings are to be installed, press them into the heads.
4. Attach the open head to the cylinder with dowels. Place and secure it with four screws.
5. Insert the shaft with the center cam attached into the cylinder from the open head side.
6. Place the center slide pin over the center cam with the flat edges of the slide pin facing the flats along the side of the piston tang. If the slide pin is assembled upside down, the pump will not be able to rotate correctly. Make sure the inlet port in the piston is facing down and slide the cam and piston into the cylinder and over the center cam. If the piston is installed upside down, the pump will rotate but will not pump.
7. Renew the locking screws in the removable wall. Insert the rounded ends of the locking pins into the holes on the outside edge of the wall and turn the locking screws until the head of the locking pin is just below the surface of the wall. Put a dab of grease on the top of the locking pin to prevent it from falling out. Carefully clean all foreign matter from the floating wall seating shoulder. Slide the wall into the cylinder from the closed head side and press it tightly against the shoulder in the bore of the cylinder. Place two pieces of 0.005 in. (0.127 mm) shim stock 2 inches apart, between the center slide pin O.D. and the floating wall cut-out, to ensure adequate clearance.
8. Tighten the socket-head screws to drive the locking pins out against the cylinder to secure the wall in place. The tightening torque for these screws is 80 in.-lb (9 N-m). This is as much torque that can be applied with one hand, as over-tightening may result in the wall becoming cocked and may cause the pump to bind. To ensure that the wall is correctly seated, check dimensions from cylinder face to wall face with a depth micrometer. Correct dimensions should be as follows:
 

KTC-60	2.500 to 2.504
KTC-112	2.9995 to 3.0035
9. When the floating wall is secured, remove the two pieces of shim stock from the pump and install the retaining ring to the shaft.
10. Install the closed head cam, and slide the closed head slide pin and piston into place, making sure the slide pin and piston are correctly positioned as described for the center piston.
11. Install the closed head and dowel pins, securing the head with four screws. Although the head could be sealed at this point, it is best to check that the pump does not bind before sealing the head.
12. Remove the open head by jacking it off the dowel pins, and install the open head slide pin and piston. Make sure the slide pin and piston are correctly positioned as described for the center piston.
13. The open head could now be sealed, but it is best to check that the pump does not bind before sealing the head. Install the open head with dowel pins and four screws.

## Repair Instructions

14. Turn the pump to ensure there is no binding. If binding occurs, dismantle the pump and correct the cause.
15. Remove the closed head and make sure the sealing surfaces on the head and cylinder are clean. Apply a thin coat of Kinseal to these surfaces. Allow the surfaces to become tacky before joining them.

### CAUTION

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

16. Install the closed head on the cylinder, tap the dowel pins home and tighten the screws securing the head. Rotate the head to ensure there is no binding.
17. Repeat this process for the open head.
18. Install the oil pump housing and O-ring to the closed head. Install oil pump and O-ring to housing. Apply vacuum oil or grease to O-rings before installing.
19. Install the shaft seal as follows:
  - a. Remove sharp edges and burrs from the shaft seal to prevent damage to the shaft seal.
  - b. Lubricate the shaft and seal head assembly with vacuum grease.
  - c. Replace the seal backup ring and slide the rotating portion of the seal against the ring with the carbon face outward. Be extremely careful not to damage or cut the rubber.
  - d. Coat the seal seat with vacuum grease and press it by hand into the shaft seal bearing housing. Assemble the bearing housing and seat to the open head.
- e. Insert the bearing backup ring against the shaft shoulder and tap the outer race of the bearing into its housing. Tighten the bearing locknut and rotate the shaft to check for binding.
- f. Reconnect all external lines except to the separator housing.
20. Install the discharge valve(s).
  - a. Place the compound plate with its top and bottom gaskets in position, and install the interstage relief valve. Install the valve deck cover and fasten it in place. Install the discharge baffle assembly. (On the KTC-60, the umbrella is fastened to the separator housing.)
  - b. Lower the separator housing into place and tighten the retaining screws inside. Then tighten the outside screws. Go back and re-tighten the inside screws.
21. Connect the oil line to the separator housing.
22. Reconnect the wiring.
23. Install the sheaves and belts. The V-belts should be adjusted as described in **Maintenance on page 18**.
24. Install the belt guard.
25. Fill the pump with oil as described in **Operation on page 13**.



## TROUBLESHOOTING

Although Tuthill Vacuum & Blower Systems blowers 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
System ultimate pressure excessively high	Process equipment contaminated by high vapor pressure material	Clean equipment with acetone, alcohol, or other. Pump down with vacuum pump overnight.
	Process equipment or pump leaks	Leak-check process equipment. Repair leaks as necessary.
	Oil flow restricted (oil level should change with pump pressure)	Drain oil, remove and clean external oil piping, clean y-strainer (KT500/850), and replace external oil filter, if so equipped.
	Vacuum pump oil contaminated	Change pump oil. <b><i>Changing the Oil on page 19</i></b> and <b><i>Oil Contamination on page 18</i></b> .
	Discharge valve malfunctioning	Check valves per <b><i>Discharge Valves on page 20</i></b> .
	Vacuum pump shaft seal malfunctioning	Check shaft seal per <b><i>Shaft Seal Assembly on page 20</i></b> .
	Vacuum pump internal parts worn or damaged	Dismantle pump and inspect internal parts. <b><i>See Disassembly on page 21</i></b> .
Excessive pump noise at low pressure	Clacking noise of pump discharge	Open the gas ballast valve. If noise disappears with air bleed, the noise is from the discharge valves and not a concern. Open small bleed at gas ballast valve if it cannot be tolerated due to loss of vacuum.
	Knocking noise	If the noise is still present with air bleed, the noise may be mechanical due to knocking of rotary internals because of excess wear. Change out rotary internals such as piston, cam, and slide pin.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Pump stalls	Electric loss of power	Check power at motor.
	Belts slipping; pump malfunctioning; pump oil contaminated or pump not sufficiently lubricated	<b>See <i>Installation on page 10</i>. Also, see <i>V-Belt Drive on page 21</i> and <i>Changing the Oil on page 19</i>.</b>
	Pump too cold	Install water jacket heaters.
	Foreign particles in pump	Disassemble pump and clean.
Pump vibrates	Inlet or outlet connectors not flexible	Use Kinney® flexible connectors.
	Vibration mounts incorrect or not positioned properly	Check to ensure that vibration mounts are installed correctly.
Oil in pump inlet piping	Piping at incorrect level	Add inlet elbow.
	Gas ballast valve left open when stopping pump	Add automatic valve.
	No isolation valve and vent valve	Add valves.



# 10

## TORQUE CHART

Data shown represents “wet” torque values.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	3 ft-lb (4 N-m)
CAP SCREW 1/4"-20UNC GR5	6 ft-lb (8 N-m)
CAP SCREW 5/16"-18UNC GR5	13 ft-lb (17 N-m)
CAP SCREW 3/8"-16UNC GR5	23 ft-lb (31 N-m)
CAP SCREW 1/2"-13UNC GR5	57 ft-lb (77 N-m)
CAP SCREW 5/8"-14UNC GR5	113 ft-lb (153 N-m)
CAP SCREW 3/4"-10UNC GR5	200 ft-lb (271 N-m)

# 11

## RECOMMENDED LUBRICANTS

### RECOMMENDED LUBRICANTS FOR ROTARY BLOWERS AND VACUUM BOOSTERS

RECOMMENDED MINERAL BASED LUBRICANTS				
AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON	EXXONMOBIL
0° to 32°F (-18° to 0°C)	TELLUS® S2 M 68 (ISO 68)	A/W 68 (ISO 68)	RANDO HD 68 (ISO 68)	DTE HEAVY MEDIUM (ISO 68)
32° to 90°F (0° to 32°C)	TELLUS® S2 M 100 (ISO 100)	A/W 100 (ISO 100)	RANDO HD 100 (ISO 100)	DTE HEAVY (ISO 100)
90° to 120°F* (32° to 50°C)	—	A/W 150 (ISO 150)	RANDO HD 150 (ISO 150)	DTE EXTRA HEAVY (ISO 150)

RECOMMENDED SYNTHETIC BASED LUBRICANTS**			
AMBIENT TEMPERATURE	TUTHILL	EXXONMOBIL	SHELL
0° to 32°F (-18° to 0°C)	PneuLube™ (ISO 100)	SHC 626 (ISO 68)	MORLINA® S4 B 68 (ISO 68)
32° to 90°F (0° to 32°C)		SHC 627 (ISO 100)	MORLINA® S4 B 100 (ISO 100)
90° to 120°F* (32° to 50°C)		SHC 629 (ISO 150)	MORLINA® S4 B 150 (ISO 150)

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	LUBRICANT MEETING U.S. FDA REGULATION 21 CFR 178.3570 GOVERNING PETROLEUM PRODUCTS WHICH MAY HAVE INCIDENTAL CONTACT WITH FOOD, AND USDA H1 REQUIREMENTS	LUBRICANT MEETING U.S. FDA REGULATIONS 21 CFR 172.878 AND 178.3620(A) FOR DIRECT AND INDIRECT FOOD CONTACT
0° to 32°F (-18° to 0°C)	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° to 90°F (0° to 32°C)	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° to 120°F* (32° to 50°C)	CONSULT FACTORY	CONSULT FACTORY

RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	LUBRICANT MEETING U.S. FDA REGULATION 21 CFR 178.3570 GOVERNING PETROLEUM PRODUCTS WHICH MAY HAVE INCIDENTAL CONTACT WITH FOOD, AND USDA H1 REQUIREMENTS	LUBRICANT MEETING U.S. FDA REGULATIONS 21 CFR 172.878 AND 178.3620(A) FOR DIRECT AND INDIRECT FOOD CONTACT
0° to 32°F (-18° to 0°C)	PneuLube™ FG (ISO 100)	CONSULT FACTORY
32° to 90°F (0° to 32°C)		
90° to 120°F* (32° to 50°C)		

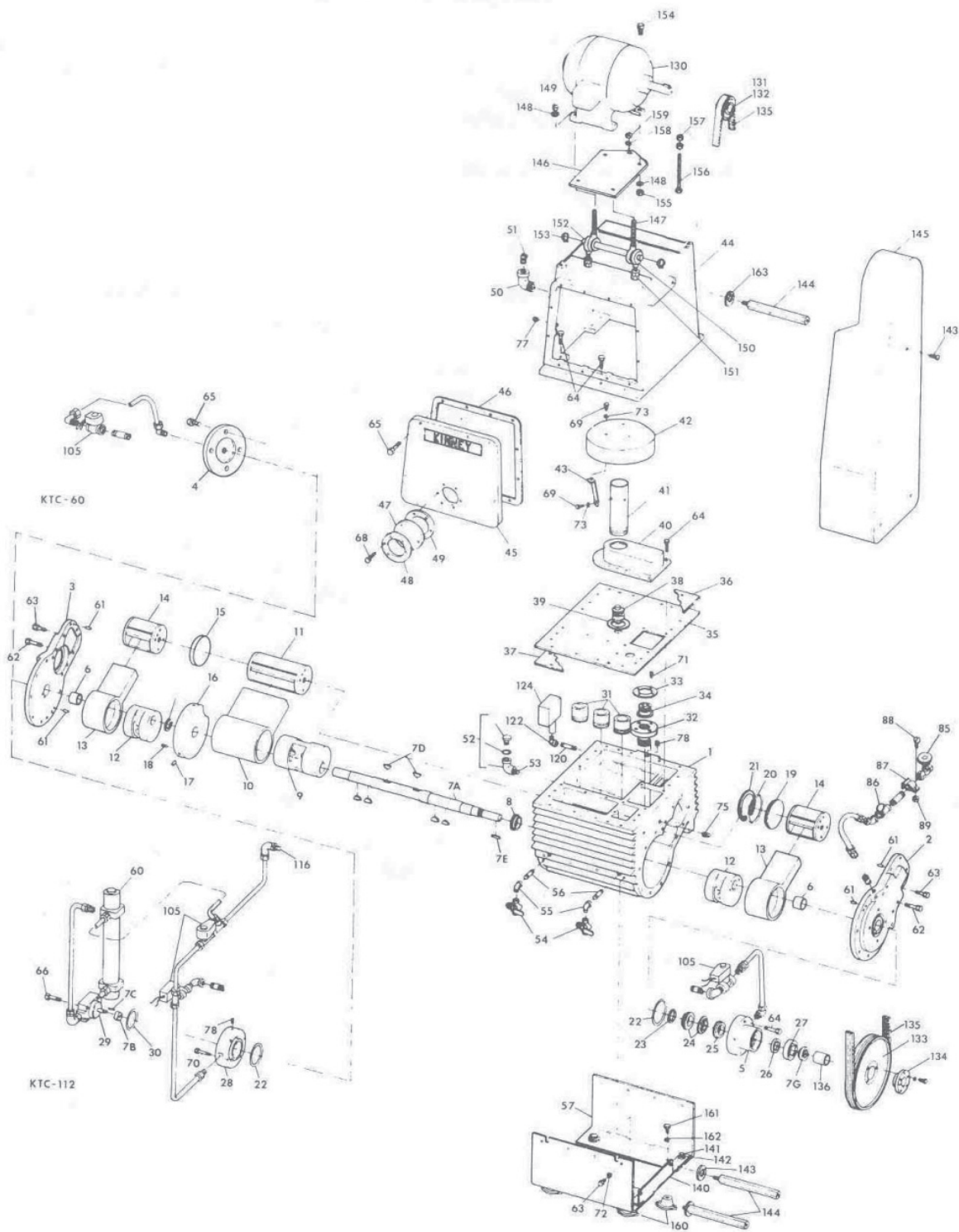
RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS
REQUIREMENTS
<ul style="list-style-type: none"> <li>• Suitable for high vacuum service</li> <li>• 100 cSt @ 40°C</li> <li>• Vapor pressure of 1 micron or less @ 70°F (21°C)</li> <li>• Straight mineral (no additives) or PAO synthetic oil</li> </ul>

RECOMMENDED GREASE FOR COMPETITOR® PLUS BLOWERS:	
TUTHILL	CITGO
Tuthill PneuLube™ NLGI #2 premium grade, petroleum base lithium grease.	<b>For food grade requirements:</b> Use Citgo Clarion® Food Grade HTEP grease, NLGI No. 2 grade. It meets all requirements of FDA Regulation 21 CFR 178.3570 (the former USDA H-1 approval requirements) for lubricants having incidental contact with food.

\* For higher ambient temperatures, please consult the factory.

\*\* Blowers used in oxygen-enriched service should use only Castrol Brayco 1726 Plus non-flammable, PFPE synthetic lubricant. Blowers used in hydrogen service should use only PneuLube synthetic oil. Tuthill Vacuum & Blower Systems cannot accept responsibility for damage to seals, O-rings and gaskets caused by use of synthetic lubricants not recommended by Tuthill Vacuum and Blower Systems.

# PUMP ASSEMBLY – KTC-60 AND KTC-112



## PUMP PARTS LIST – KTC-60 AND KTC-112

ITEM NO.	PART DESCRIPTION	KTC-60 QTY	KTC-112 QTY
1	Cylinder	1	1
2	Head, Open End	1	1
3	Head, Closed End	1	1
4	Cap, Closed End	1	
5	Housing, Shaft Seal and Bearing	1	1
6	Sleeve Bearing, Heads	2	2
7	Shaft and Coupling Assembly		1
A	Shaft	1	1
B	Drive Coupling		1
C	Roll Pin		2
D	Key Woodruff	4	6
E	Key, Drive	1	1
F	Retaining Ring, Cam	3	1
G	Bearing Locknut	1	1
8	Oil Seal	1	1
9	Cam, Center	1	1
10	Piston, Center	1	1
11	Slide Pin, Center	1	1
12	Cam, Outer	2	2
13	Piston, Outer	2	2
14	Slide Pin, Outer	2	2
15	Spacer, Slide Pin	1	1
16	Removable Wall	1	1
17	Pin, Wall Locking	3	3
18	Setscrew, Wall Locking	3	3
19	Separator, Slide Pin	1	1
20	O-Ring, Slide Pin Separator	1	1
21	Retaining Ring		1
22	O-Ring, SS Housing and OP Housing	1	2
23	Ring, Shaft Seal Backup	1	1
24	Shaft Seal Head Assembly	1	1
25	Shaft Seal Seat	1	1
26	Ring, Bearing Backup	1	1
27	Ball Bearing	1	1
28	Housing, Oil Pump		1
29	Oil Pump		1
30	O-Ring, Oil Pump		1
31	Pipe, Discharge	2	3
32	Valve Adapter	1	1
33	Hold-Down Plate	1	1
34	Discharge Valve Assembly	1	1
35	Compound Plate Assembly	1	1
36	Gasket, Top Plate	1	1
37	Gasket, Bottom Plate	1	1
38	Relief Valve	1	1
39	Gasket, Relief Valve	1	1
40	Valve Deck Cover	1	1

ITEM NO.	PART DESCRIPTION	KTC-60 QTY	KTC-112 QTY
41	Nipple, Baffle	1	1
42	Baffle	1	1
43	Baffle Support	1	1
44	Separator Housing	1	1
45	Cover, Separator Housing	1	1
46	Gasket, Separator Housing Cover	1	1
47	Sight Glass	1	1
48	Ring, Sight Glass	1	1
49	Gasket, Sight Glass	1	1
50	Street Elbow, 90-Degree	1	1
51	Pipe Plug, Square Head	1	1
52	Oil Fill Assembly	1	1
A	Elbow	1	1
B	Cap	1	1
	* O-Ring	1	1
53	Nipple, 3/4 in. x 1-3/8 in.	1	1
54	Ball Valve	2	2
55	Street Elbow	2	2
56	Nipple	2	2
57	Base	2	2
58	Air Diverter	1	-
59	Coupling, 1/8 in.	-	1
60	Heat Exchanger	-	1
61	Dowel Pin	4	4
62	Hex Head Capscrew, Heads	12	18
63	Hex Head Capscrew, Heads	38	51
64	Hex Head Capscrew, Separator Housing	20	16
65	Hex Head Capscrew, Separator Housing Cover	10	-
66	Hex Head Capscrew, Oil Pump	-	4
67	Hex Head Capscrew, Separator Housing	-	4
68	Hex Head Capscrew, SG	6	6
69	Hex Head Capscrew, Baffle	3	6
70	Socket Head Capscrew, OP Housing	-	4
71	Socket Head Capscrew, Discharge Valve	4	4
72	Lock Washer, Reg. Spring, 5/16 in.	26	8
73	Lock Washer, Reg. Spring, 1/4 in.	3	6
74	Face Bushing, 3/4 in. x 3/8 in.	2	-
75	Pipe Plug, Square Head, 1/4 in.	2	1
76	Pipe Plug, Square Head, 1/8 in.	1	1

## Parts Lists and Assembly Drawings

ITEM NO.	PART DESCRIPTION	KTC-60 QTY	KTC-112 QTY
77	Pipe Plug, Socket Head, 1/2 in.	-	2
78	Pipe Plug, Hexs, 1/4 in.	-	3
79	Mach. Screw, 10-32 x 3/4 in.	4	-
80	HMSN, 10-32 x 3/8 in.	4	-
85	Needle Valve, Gas Ballast	1	1
86	Check Valve, Swing	1	1
87	Hanger, 1/2 in. Conduit	1	1
88	Mach. Screw, 1/4-20 x 3/4 in.	1	1
89	Nut, 1/4-20	1	1
90	Mach. Screw, 1/4-20 x 1/2 in.	1	1
91	Lock Washer, Reg. Spring, 1/4 in.	2	2
94	Male Elbow, 3/8 in. x 1/4 in.	2	-
95	Female Connector, 3/8 in. x 1/8 in.	-	1
96	Nipple, 1/8 in. x 1-1/2 in.	-	1
97	Nipple	1	1
98	Nipple, 1/4 in. Close	-	1
99	Elbow, 1/4 in. x 45 Degrees	-	1
105	Solenoid Valve	2	3
106	Tubing, 3/8 in. O.D. x 0.035 W	2 ft	3 ft
107	Tubing, 1/2 in. O.D. x 0.035 W		1 ft
108	Male Connector, 3/8 in. x 1/8 in.	1	2
109	Male Connector, 3/8 in. x 1/4 in.	2	4
110	Male Connector, 1/2 in. x 3/8 in.	-	1
111	Male Elbow, 1/2 in. x 1/2 in.	-	1
112	Male Connector, 3/8 in. x 3/8 in.	-	1
113	Male Connector, 3/8 in. x 1/4 in.	-	1
114	Male Br Tee, 3/8 in. x 1/4 in.	-	1
115	Female Elbow, 3/8 in. x 1/4 in.	1	1
116	Orifice Nipple	-	1
117	Nipple, 1/2 in. x 1-1/2 in.	-	1
118	Hex Head Bushing, 1/2 in. x 3/8 in.	-	1
119	Hex Head Bushing, 1 in. x 1/4 in.	-	2
120	Nipple, 1/4 in. x 1-1/2 in.	3	3
121	Street Elbow, 90 Degrees x 1/8 in.	1	1
122	Street Elbow, 90 Degrees x 1/4 in.	1	3
123	Nipple, 1/4 in. x 1-3/4 in.	1	-
124	Pressure Switch	-	1
130	Motor	1	1
131	Motor Sheave	1	1

ITEM NO.	PART DESCRIPTION	KTC-60 QTY	KTC-112 QTY
132	QD Bushing	1	1
133	Pump Sheave	1	1
134	QD Bushing	1	1
135	V-Belt	1	1
136	Spacer Sheave	1	1
137	Fan Assembly	1	-
138	Socket Head Capscrew, 10-24 x 1/2 in.	3	-
139	Lock Washer, #10 Reg. Spring	3	-
140	Belt Guard Bracket	1	1
141	Hex Head Capscrew	4	2
142	Lock Washer, Reg. Spring, 5/16 in.	4	2
143	THMS, 3/8-16 x 3/4 in.	1	3
144	Standoff, Belt Guard	-	3
145	Belt Guard	1	1
146	Motor Plate	1	1
147	Rod End, Motor	2	2
148	Lock Washer, Reg. Spring, 3/8 in.	4	4
149	Hex Nut, 3/8-24	2	2
150	Rod End, Separator Housing	2	2
151	Jam Nut	4	4
152	Hinge Pin	1	1
153	Retaining Ring	2	2
154	Hex Head Capscrew	2	2
155	Hex Nut, 3/8-16	2	2
156	Jacking Screw	1	1
157	Jam Nut, 5/8-11	2	2
158	Lock Washer, Reg. Spring, 5/8 in.	1	1
159	Hex Nut, 5/8-11	1	1
160	Vibration Mounts	2	4
161	Hex Head Capscrew	4	4
162	Plain Washer	4	4
163	Lock Washer, 1/2 in.	-	3

**NOTES**

## 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	WARRANTY DURATION
New (Non-Piston Pumps)	15 months after date of shipment or 12 months after initial startup date, whichever occurs first
New (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:** \_\_\_\_\_

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