

WARNING: Do Not Operate Before Reading Manual

KT™ SERIES OPERATOR'S MANUAL

Models

KT150

KT300

KT500

KT850



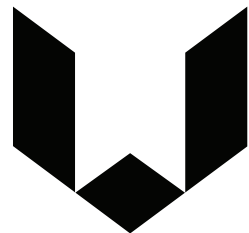
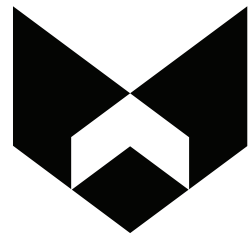
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Tuthill Springfield proudly manufactures Kinney® vacuum pumps and M-D Pneumatics™ blowers and vacuum boosters in Springfield, Missouri, USA. We bring 100+ years of engineering experience and solid, hands-on care to help customers keep their processes running. Your satisfaction is important to us so please take time to provide your Tuthill sales representative with performance feedback. We love to hear from our customers!

Tuthill is a family owned business that was started by James B. Tuthill in 1892. At that time, Tuthill manufactured common brick to Chicago construction companies who were fueling the city's rapid expansion. Fast forward to today and Tuthill now serves sustaining, global markets like agriculture, chemical, construction, energy, food and beverage, pharmaceuticals and medical, transportation, and utilities. While the company has changed in what it manufactures, one thing remains throughout every Tuthill line of business – we are a company with HEART. Our slogan is “Pump Your Heart Into It” and everyday our employees do just that as they represent the Tuthill brand and dare to make better.

Thank you for making Tuthill Springfield part of your company's process!

A company with heart
right from the start.



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INTRODUCTION

CONGRATULATIONS on the purchase of a new **KINNEY® KT™** Single-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 KT-150, KT-300, KT-500 and KT-850. Become thoroughly familiar with these instructions before attempting to install, operate or repair this unit. Consult Tuthill Vacuum & Blower Systems when problems arise that cannot be resolved after reading this manual. Always include pump nameplate information when ordering parts or components.

KINNEY KT 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.

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 KT Series rotary piston pumps.



WARNING

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

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
		Tuthill Vacuum & Blower Systems 4840 West Kearney Street Springfield, Missouri USA 65803	
MAX RPM 			
READ INSTRUCTION MANUAL BEFORE OPERATION OR BODILY HARM MAY RESULT			
 Keep body & clothing away from machine openings.	 Do not operate without guards in place.	 Hearing protection required.	 Do not touch hot surfaces.
http://www.tuthill.com		(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 & 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.

MODEL NUMBER: The specific model of the pump

SERIAL NUMBER: Unique to each pump. Use with any service issues and with any contact with the manufacturer.

YEAR: Year of manufacture

MAX RPM: 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® KT™ Single-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.

03

LIFTING



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 KT Series pumps covered by this manual have an oil circulating pump to provide adequate lubrication at all pressures, including atmosphere. The vacuum pump has three cams and pistons pumping in parallel, driven by a common shaft. The cams are positioned on the shaft so they dynamically balance moving parts. This balancing technique applied to the Rotary Piston Principle, developed by Tuthill Vacuum & Blower Systems, virtually eliminates vibration.

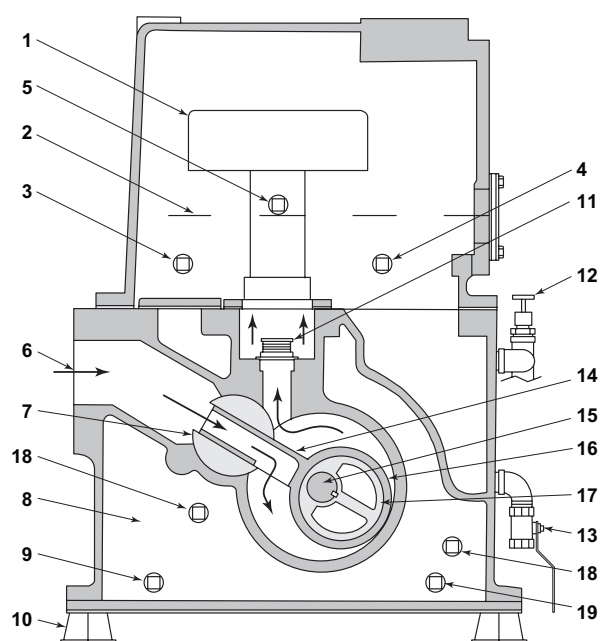
Figure 4-1 – General Operation Principle shows a cross section of the pump with the pistons being driven by the cams and revolving within the cylinder.

PRINCIPLE OF OPERATION

Gas is drawn into the pump through a common inlet, channeled to the three piston slides and into the space behind the pistons as they rotate. The gas ahead of the pistons is compressed and forced out of the discharge valves. As the gas is forced through the pump, sealing oil is mixed with the discharged gas and the discharged mixture is channeled into the separator, which is located in the reservoir. There the gas is separated from the oil. Sealing and lubricating oil is provided by the oil pump, which is mounted on the non-drive head and driven by direct coupling to the vacuum pump drive shaft. The oil pump provides forced feed oil circulation at all operating pressures, including atmosphere.

All models have a channeled drive shaft with an opening at each cam to distribute oil through the pump.

Oil is taken from the reservoir at a point some distance above the reservoir bottom. This provides an area for impurities to collect for draining.



KEY

1. AIR/OIL SEPARATOR
2. OIL LEVEL
3. CONNECTION FOR OPTIONAL TEMPERATURE SWITCH
4. CONNECTION FOR TEMPERATURE GAUGE
5. CONNECTION FOR "SCUM" TAKE-OFF
6. PUMP INLET
7. SLIDE PIN
8. WATER COOLING JACKET
9. (FAR SIDE) COOLING JACKET DRAIN (1 OF 2)
10. VIBRAMOUNTS
11. DISCHARGE VALVE
12. GAS BALLAST VALVE
13. OIL DRAIN
14. PISTON SLIDE
15. SHAFT
16. PISTON
17. CAM
18. CONNECTION FOR OPTIONAL HEATER
19. COOLING JACKET DRAIN (2 OF 2)

Figure 4-1 – General Operation Principle

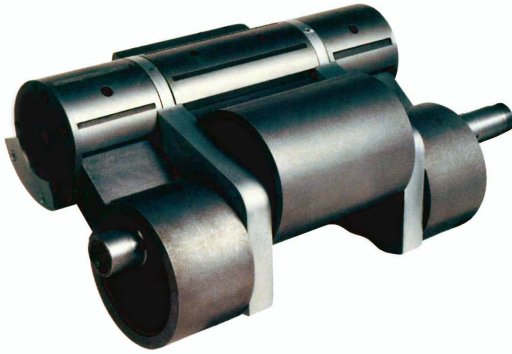


Figure 4-2 – Triplex Arrangement

SPECIFICATIONS

	UNIT	KT-150	KT-300	KT-500	KT-850
Nominal Displacement	cfm (m ³ /h)	150 (255)	300 (510)	490 (840)	780 (1325)
Motor Power	HP	7.5	15	30	40
Rotation Speed	RPM	1055	870	721	581
Oil Capacity (Total/Refill)	U.S. gal (L)	6/5 (23/19)	10/8.5 (38/32)	15/12.5 (57/47)	28/25 (106/95)
Cooling Water at 60°F (16°C)	gpm (L/min)	1 (4)	1.5 (6)	2.5 (9)	3.5 (13)
Cooling Water Inlet Connection	NPT	1/4 in.	3/8 in.	3/8 in.	3/8 in.
Suction Connection	150 lb ANSI Flanged	3 in.	4 in.	6 in.	8 in.
Discharge Connection	150 lb ANSI Flanged	2 in.	3 in.	4 in.	5 in.
Height Without Oil Mist Eliminator	Inches (mm)	43 (1092)	51 (1295)	63 (1600)	71 (1803)
Floor Space Required	Inches (mm)	24 × 26 (609 × 660)	27 × 34 (686 × 864)	34 × 38 (864 × 965)	38 × 49 (965 × 1245)
Weight	lb (kg)	800 (363)	1,525 (692)	2,625 (1,191)	4,175 (1,894)
Ultimate Pressure	microns	10	10	10	10
Noise Level (Typical at .1 Torr)*	dBA	71	72	73	75

* Noise level may vary based upon motor selection.

Table 4-1 – Specifications

WARNING

Do not exceed maximum rotation speed (RPM) as stated in Table 4-1.

MATERIALS OF CONSTRUCTION

HOUSINGS AND CYLINDER:	Cast iron
PISTONS, CAMS, SLIDE PINS:	Cast iron
SHAFT:	AISI 1144 Stress-proof
SHAFT SEALS:	Cast iron/Carbon/Viton®
BALLAST/CHECK VALVE:	Brass/bronze

INSTALLATION

GENERAL

KT pumps should always be operated with the pump in a vertical and level position. KT pumps should never be installed in a horizontal or angled position. Pump assembly should be placed on a foundation and should be supported evenly. Pump assembly should be leveled to within 0.02 in. (0.5 mm) in any 3.28 ft (1 m).

Any time the vacuum pump will be stored for an extended period of time (longer than 6 months), make sure it is protected from corrosion by preparing it for long-term storage.

1. Fill the separator housing to halfway in the sight glass with the Tuthill-recommended oil for the pump.
2. Close off the pump suction and discharge connections using blind flanges with gaskets. The oil fill connection should be plugged tightly, and the oil drain valve should also be plugged, to avoid accidental loss of oil.
3. Drain the water jacket and any other heat exchangers containing water.
4. Leave the water inlet and outlet connections unplugged and remove the drain plug from the bottom of the cooling jacket.
5. Reduce the tension on the drive belts by lowering the motor mounting plate.
6. Rotate the shaft of both pump and motor several revolutions by hand at least every 3 to 6 months to keep the lubrication and shaft load distributed in the bearings and seals.
7. For pumps that have been in service, contact the factory for complete instructions.

Safety

DANGER



Internal and external rotating parts of the pump and driving equipment can produce serious physical injuries. The pump should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the pump or to change the belt, be absolutely sure that all power to the motor controls has been shut off, the motor controls are locked out, and properly tagged before proceeding.

WARNING



Vacuum pump housing and associated piping or accessories may become hot enough to cause major skin burns on contact as a result of process conditions.

 WARNING

Use lockout / tagout procedures to disable the electrical energy source before any service or work is done on the vacuum pumps.

 CAUTION


Avoid extended exposure in close proximity to machinery with high intensity noise levels. Wear adequate ear protection.

 CAUTION

Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.

NOTICE

Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.

LUBRICATION

The KINNEY KT Pump is lubricated by a pressurized oil system. A positive displacement pump generates oil pressure. KT vacuum pumps use Tuthill KV100 oil. KV100 is used for factory testing and the initial charge is shipped along with the pump. It is necessary to use this oil to maximize pump life, achieve design intents and maintain full warranty. Contact the factory for review of a desired substitute or inert oils.

The lubricating gear pump is mounted on the closed head and is driven directly by the vacuum pump shaft. Failure of the gear pump may be detected by reduced oil pressure, deteriorating performance, noise, unusually high discharge or oil reservoir temperature and lower temperature

of oil line tubing. The tubing should be nearly the same as the oil temperature, or 145 to 190°F (63 to 87°C). If using the high oil temperature switch (water miser) option, it should be set at 190°F (88°C) when used with standard KV100 oil. Consult factory if higher discharge temperatures are required to avoid contamination of oil.

KT pumps are equipped with an oil pressure gauge that should indicate at least 20 PSIG (1.4 bar) (KT500 and KT850) or 25 PSIG (1.7 bar) (KT150 and KT300).

KT pumps may include an optional oil filtration system. With this system, the filter indicator gauge (red/green) may be in the red until the oil warms to 140°F - this is normal. If gauge needle is in the red after the oil warms to 140°F, replace the filter.

 WARNING

Never attempt to change or add lubrication while the pump is running. Failure to heed this warning could result in damage to the equipment or personal injury.

 WARNING

Properly dispose of spent lubricants. Refer to the manufacturer of the lubricant and any applicable regulations to ensure proper and safe disposal.

NOTICE

These pumps do not have a bypass valve on the oil pump and pressure may exceed 150 PSIG (10 bar) on cold start up.

NOTICE

If the oil level is too low, bearings and seals will be damaged as a result of improper lubrication.

Hazards Associated With Breakdown or Ignition of Lubrication

DANGER



There is a risk associated with the lubrication media breaking down and resulting in a hazardous fluid or vapor. There may also be a hazard associated with the ignition of the lubrication media. Refer to the lubrication manufacture's applicable instruction for safety precautions.

Filling the Pump With Oil

For initial oil filling and the first filling after the pump has been disassembled, the quantity of oil to be placed in the reservoir is one gallon less than shown in the specifications. One gallon is required in the suction port as outlined in **Suction Manifolding on page 12**.

Use oil recommended by Tuthill Vacuum & Blower Systems and see the specifications for the quantity of oil required to fill the pump. Remove the oil fill plug at the top of 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. With the pump shut off, 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.

CAUTION

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

LOCATION

The pump should be mounted on a flat, level surface. If installing outdoors, please ensure the motor, painting, peripheral equipment, parts, etc. are suitable for outdoor operation. There should be enough space around the pump to allow for safe maintenance work and periodic inspections. This includes, at a minimum, the ability to access oil fill and drain locations, view the oil level glass and the oil temperature and pressure gauges.

Foundation

The foundation for the pump assembly should be flat and level, and have adequate load-bearing capacity. The pump and its base frame, peripheral equipment and piping should be installed after the foundation concrete has been cured. Systematized pumps and frames should be leveled and secured prior to operation.

Installing the Vibramounts

KT 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.

If the studs are not already installed into the vibramounts, thread the short end into the top of the mount (smaller diameter) up to the spacer portion of the stud.

The vibramount attachment holes are the four open threaded holes in the flanged edges of the cylinder, in line with the bottom plate/cylinder bolts, just in from each corner of the pump.



WARNING

Do not use the four unthreaded holes, these are used for shipment only.

With the pump lifted off the ground, thread the vibramounts with studs into the vibramount attachment holes until contact is made between the top of the vibramount and the cylinder bottom plate, and the foot location is parallel to the pump shaft. **See Pump Assembly – KT-150, KT-300, KT-500, KT-850 on page 36** for KT850 vibramount locations, as the vibramounts are not interchangeable on this model.

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

If the KT pump was supplied as a part of a system, with the vibramounts pre-installed, ensure that any shipping retention bolts or spacer tubes are removed before startup. To avoid damage to the pump, it should be solely supported by the vibramounts when in operation.

PIPING CONNECTIONS

Manifolding should be no smaller than the pump connections in order to minimize restrictions to gas flow. Accurately align the mating flanges to the inlet and discharge manifolding to prevent distortion of the pump housing.



WARNING

Pipe loading on the pump should be negligible as pipe loading can cause distortion of the pump. Use proper supports and pipe hangers to assure that there is no loading.

Main Piping

Suction Manifolding

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

- To avoid gas flow restrictions.
- To prevent pump fluids from entering the process chamber.
- To protect the pump from ingesting particulate matter.
- To allow proper venting of the pump and suction manifold.

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. **See Figure 5-1** for recommended arrangement as a guide for fabricating inlet manifolding.

Proper standard inlet manifolding is available from Tuthill as a factory-installed or aftermarket accessory.

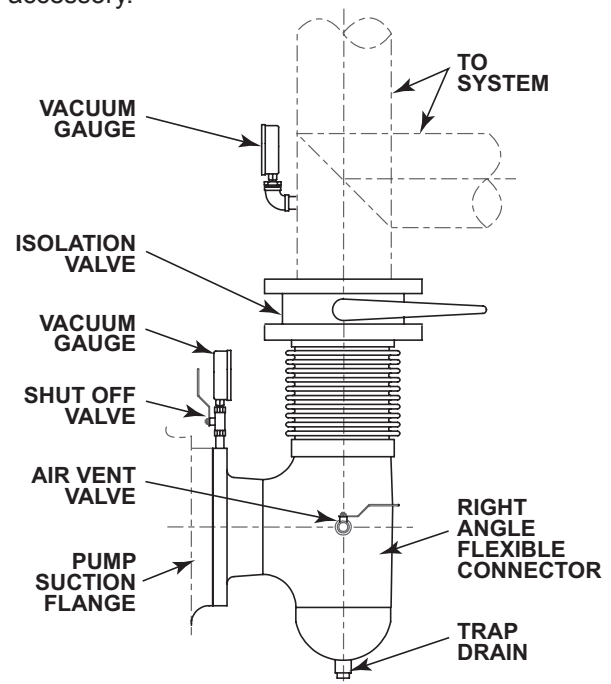


Figure 5-1 – Detailed Manifold Arrangement

In all cases, the inlet manifolding should include a 90° flanged elbow vertically oriented upward to retain pump oil at low pressures, an isolation valve, a flex connector, and a vent valve.

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.

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. This will also allow the system to be kept under vacuum while the pump is not running, or to keep the pump operating while the system is at atmospheric pressure.

Gauge connections should be provided on both sides of the isolation valve. With this arrangement, it is possible to check the system or the pump for leaks or ultimate vacuum level performance without disconnecting the vacuum 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.

Before connecting the suction manifolding, distribute 4 quarts of oil over the three 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.

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 upstream of the pump.

Proper Venting

The vacuum pump must be properly vented to ensure all oil is removed from the pumping chamber before the pump is turned off. Also, the suction line must be properly vented to ensure oil does not migrate into the process chamber.

Recommended vent valve sizes:

KT-150 = 0.75 inch	KT-300 = 1.0 inch
KT-500 = 1.5 inches	KT-850 = 2.0 inches

The vent valve must be open for at least 10 seconds before the pump is turned off to remove all oil from the pumping chamber.

Discharge Manifolding

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 to avoid increased back pressure.

The installation of an oil mist eliminator on the discharge is recommended for all applications (as shown in **Figure 5-3**). Oil that collects in the eliminator should be returned to the pump. The 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 between 10 Torr (13 mbar) and 150 Torr (200 mbar), the oil return should be connected to the gas ballast as shown in **Figure 5-2**. If over 150 Torr (200 mbar), the oil return should be connected to the pump inlet.

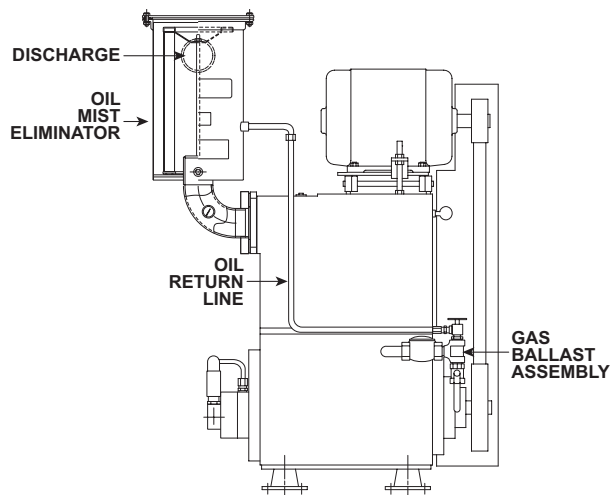


Figure 5-2 – Oil Return to the Gas Ballast Valve

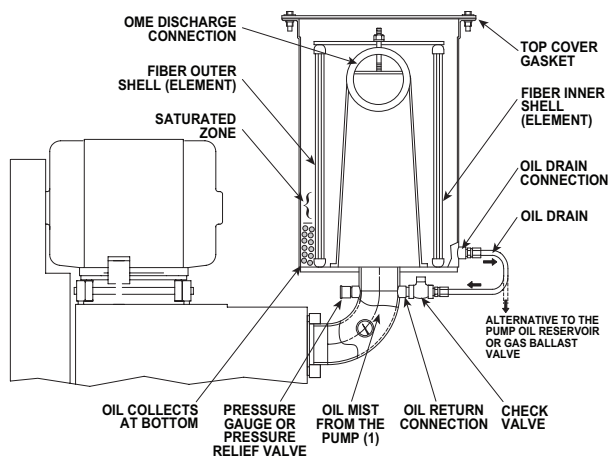


Figure 5-3 – Oil Mist Eliminator

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 vibrations.

Hazards Associated With Hazardous Process Fluids

DANGER



It shall be the responsibility of the installer to ensure that piping is adequate, sealing between pipe joints is adequate for the process fluids and proper process and pressure protection devices are in place. It is also the responsibility of the installer to assure that process gasses are not vented in a manner that would be hazardous. Refer to the manufacturer of the process media to assure that proper safety precautions are in place.

Cooling Water

The cylinder cooling water jacket is shipped dry. Fill the water jacket before starting the pump.

If an optional water flow modulating valve (water miser) is fitted, the cylinder may take 20 minutes or more to fill. The delay can be avoided by manually lifting the spring to open the valve. For installation of the valve, **see Figure 5-4**.

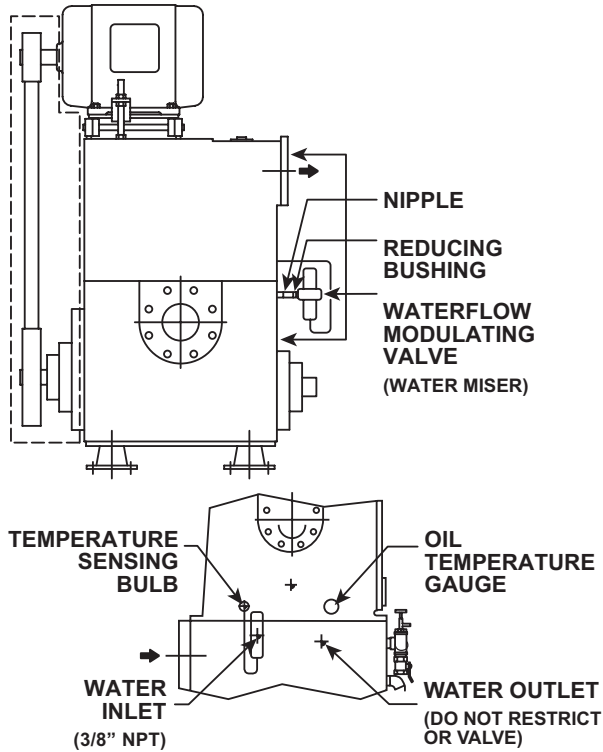


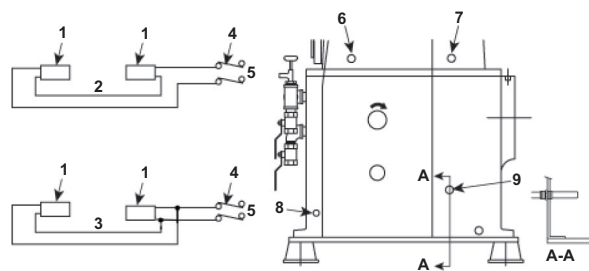
Figure 5-4 – Water Miser Installation

NOTE: Water inlet and outlet are on the opposite side on the KT-150.

Failure to ensure that the cooling water jacket is filled before starting the pump will result in localized over-heating of the pump and cause extensive damage.

For installations requiring starting at ambient temperatures lower than 60°F (16°C), electric heaters should be installed in the water jacket with an optional temperature switch installed in the separator housing. **See Figure 5-5.**

Model	Water Miser	Orifice Size	Nipple	Reducing Bushing
KT-150	808009 A000	0.032 in.	057222 00ST	055003 00ST
KT-300	808009 A000	0.032 in.	05719 00ST	
KT-500	808247 A000	0.062 in.	057603 00ST	055053 00MI
KT-850	808247 A000	0.062 in.	057603 00ST	055053 00MI

**KEY**

1. HEATERS
2. FOR 460 VOLTS
3. FOR 230 VOLTS
4. SWITCH
5. INPUT (FUSE PROTECTED)
6. TEMPERATURE GAUGE
7. OPTIONAL TEMPERATURE SWITCH
INSTALLED IN SEPARATOR HOUSING
8. INSTALL (1) HEATER INTO ¼ NPT TAP
FAR SIDE (½ NPT ON KT150, 300)
9. INSTALL (1) HEATER INTO ¼ NPT TAP
THIS SIDE (½ NPT ON KT150, 300)

BEFORE ENERGIZING HEATERS

1. BE SURE WATER JACKET IS FILLED.
2. TURN OFF COOLING WATER SUPPLY.
3. DO NOT RESTRICT COOLING WATER
OUTLET.

MODEL	HEATER	PART NO.	QTY
KT-150	300 W	074501-0000	2
KT-300	500 W	074502-0000	2
KT-500	750 W	074503-0000	2
KT-850	1000 W	074504-0000	2

Figure 5-5 – Water Jacket Heater Installation

**WARNING**

Do not allow the cooling water to freeze in the pump.

Freezing of the cooling water jacket usually results in extensive damage to the pump cylinder, which cannot be repaired.

Connect a water supply line with “on-off” valve to the water inlet and an open drain to 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.

A water pressure relief valve is fitted in the water jacket. This relief valve is set to open at 50 PSIG (3.5 bar).

Standard cooling water rates are for up to 80°F (26°C) supply temperature and operation within the design of continuous operating pressure range of 0.1 to 100 Torr (0.13-130 mbar).

Sustained operation above 100 Torr (130 mbar) and/or long pump-downs generally require larger cooling water flow rate and/or external oil heat exchanger. Larger cooling water rates increase cooling efficiency by reducing heat dissipation to the room and keeping oil cooler (longer oil life and reduced oil loss through the oil mist eliminator).

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 Pirani or 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 reading on a thermistor or thermocouple gauge may indicate that the pump is contaminated or that it leaks, or both. A high reading on a McLeod gauge means that a leak is present. Total pressure gauge readings will always be slightly higher than McLeod gauge readings because they include the partial pressure due to oil vapor at the localized temperatures. The most accurate total pressure gauges are capacitance manometers and piezo gauges that are independent of the physical properties of the gas or vapor.

OPERATION

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.

Electrical Connections

WARNING

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

If the pump is not wired when received, wire the motor as per the schematic/label on the motor. Also, wire any optional controls prior to start-up. Connect the motor and all applicable electrical accessories to a motor controller equipped with both overcurrent running protection and short-circuit protection.

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 that the cooling water flow is interrupted.

Optional custom control panels and electrical accessory components, along with schematic wiring diagrams and wiring instructions, are available separately from Tuthill Vacuum & Blower Systems.

PRE-START CHECKS

Before starting the pump, check the following items:

1. The installation has been made in accordance with **Installation on page 9**.
2. The pump has been filled with oil and the cylinder has been filled with water, in accordance with **Installation on page 9**.
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. Optional pump heaters are available for installation in the cylinder water jacket. **See Cooling Water on page 14**.
5. Cooling water is available. 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 28**.
7. Direction of rotation is correct. It should be clockwise when facing the pump pulley (in accordance with arrow cast into the pump).



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.

PUMP WARM-UP

With the inlet closed, pump warm-up and thermal stabilization is achieved in 20-30 minutes. Warm-up can be expedited by operation in the 20-40 Torr (27-53 mbar) range after an initial 5-minute operation with the inlet closed. This can be accomplished with an inlet start purge or, if allowable, a controlled air bleed near the inlet.

1. Check that the inlet isolation valve is closed.
2. Check that the vent valve is closed. Please note that if the pump was not vented (**see Proper Venting on page 13**) when the pump was stopped, the following procedure must be used:
 - a. Remove power source from the pump.
 - b. Remove belt guard from the pump.
 - c. Rotate pump, in proper rotation, by hand using drive belts.
 - d. Rotate at least 3 full rotations.
 - e. Replace belt guard.
 - f. Reconnect the power source to the pump, and ensure that motor rotation is in the correct direction.
3. Start the pump.
4. Open and adjust the cooling water flow as shown in the specifications.
5. Maintain oil level 3/8 in. up from bottom of the sight glass when running at blank-off conditions (no gas ballast). Once the circulating pump (gear pump) increases the oil pressure to 20 PSIG (1.4 bar), the check valve will open and oil will be forced into the pump through the main line.

6. KT pumps may include an optional oil filtration system. With this system, the filter indicator gauge (red/green) may be in the red until the oil warms to 140°F – this is normal. If gauge needle is in the red after the oil warms to 140°F, replace the filter.
7. Adjust the gas ballast. **See Gas Ballast on page 19.** *The small gas ballast valve can be set to quiet the pump during blank-off conditions and left open if an ultimate vacuum of 0.05 - 0.10 Torr (0.7 – 0.13 mbar) is acceptable.
8. 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 the process by opening the inlet isolation valve.

PUMP SHUTDOWN

NOTICE

Rapid reversal will result in premature failure.

NOTICE

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

1. Close the inlet isolation valve.
2. Open the vent (air admittance) valve while the pump is still operating. If the vent valve is not available, use the large gas ballast ball valve. Please note that the vent valve must be opened for at least 10 seconds before removing power from the pump. This will allow the majority of the oil in the pumping chamber to be transferred into the oil separator housing so it will not cause resistance to the internals on the next start-up.
3. Close the large 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 19.**

For applications where the vapor load exceeds that which can be handled by the gas ballast valve, consult Tuthill Vacuum & Blower Systems about vapor handling systems, which can usually be retrofitted to existing pumps.

In the KT500 and KT850 pumps, the coalescing mesh pad (item 96), located in the oil separator tank, can cause water build-up in applications where large amounts of water are being handled. Removing the mesh pad may allow water to more easily pass from the oil. Access the mesh pad by removing the separator housing cover.

KT Series pumps can accumulate 0.75 - 2.5 gal (2.8 - 9.5 L) of water (depending on the model) 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 free water accumulation has drained out. Drain the water as often as necessary. Never shut down the KT pump if oil is wet with water since it can separate out and cause damage on startup. Always clean up the oil by blanking-off the inlet of the pump and using full-open gas ballast to remove water vapor and condensates before shutting down.

GAS BALLAST

The gas ballast valve is shown in **Figure 4-1 on page 6** of this manual. 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 pump when running at blank-off conditions.

When gas ballast is used, the ultimate pump pressure increases, more oil mist is created in the pump discharge and power consumption increases slightly (within the standard motor rating). Pump noise can be generally eliminated by using a small flow of gas ballast with only a slight increase in ultimate pump 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 full 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 and to minimize noise.
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: With the pump inlet blanked-off, 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 foreign contamination, loose belts, or lack of lubrication caused by failure of the oil circulating pump, badly contaminated oil, coating build-up, or foreign matter in the pump or oil line strainer (KT-500 and KT-850). 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). **See Disassembly on page 29** for information on inspecting the inside of the pump. Tuthill Vacuum and Blower Systems is able to clean and recondition KT pumps through its factory repair department and network of Authorized Service Centers.

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 (check carefully around housing joints, pipe connections, plugs, oil lines, and any other penetrations into the vacuum area) and check pump blank-off performance before making permanent repairs with Loctite 515. 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 helium 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 thermistor or 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 inlet and position the gauge tube, facing downward in the higher area of the manifold 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° 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 5 to 25 microns with a McLeod gauge, and 10 to 100 microns with a thermocouple gauge. The specification pressure is 10 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 24.** 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 (upstream) of the isolation valve. **See Vacuum Gauges on page 16.** 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 pressure, 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 or Duxseal, 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 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 internally 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 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 spray bottle 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 Loctite 515. Temporary gaskets may be fabricated from plastic sealing compound, but these should not be made too thick, since the material may be squeezed into the equipment.

GENERAL

During normal operation, the temperature in the pump will increase in homogeneous manner as a result of compression work done on the process gas or vapor. It is abnormal if the temperature rise is localized in the pump and/or the external paint becomes scorched. Localized hot spots are typically due to an inadequate cooling liquid supply or cooling liquid cut-off, interference of the piston with cams, slide pins, or cylinder, process material build-up, or because the pump has ingested foreign material, such as solid particulates, metal chips, etc. If a localized hot spot is observed, the pump must be shut down immediately for inspection.

Most pump abnormalities can be noted by routine checks of temperature, vibration and noise, etc. Daily inspection of the pump is highly recommended as preventative maintenance. Whenever the pump is stopped, completely drain the cooling liquid if the pump is located in a cold region, or in the winter to prevent freezing of the cooling liquid.



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 operation.

An oil filtration system (available factory-installed or as a retrofit kit), will help decrease the frequency of oil changes and extend the life of seals, bearings, and internal rotating parts.

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. Clean y-strainer after oil pump (KT-500 and KT-850) at least at every oil and filter (if so equipped) change.

Changing the Oil

Run the pump until the oil reaches a normal operating temperature of 145 to 165°F (63 to 75°C) and pressure below 100 Torr (130 mbar). Stop the pump, place a container under the oil drain valve and open the valve until the oil is removed from the pump. Close the valve.

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

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.

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 24**. 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 change 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
- Smells burnt or acrid
- Total Acid Number increases to 0.3

In a new application, it is recommended that the oil be changed at intervals of 500 hours of operation and that the oil change interval be reduced or increased, depending on the condition of the oil after that period of operation, according to the previous guidelines.

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 19** and **Handling Large Quantities of Water on page 19**.

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

REPLACEMENT PARTS

Replacement parts for the KT-150 C Series and KT-300, KT-500, and KT-850 D Series pumps used with standard hydrocarbon vacuum pump oil are shown in **Pump Parts List – KT-150C, KT-300D, KT-500D, KT-850D on page 39**. Two levels of maintenance kits are available for the KT line of pumps. Contact the factory with serial number information for kit part numbers. Delivery can be provided at that time.

Various parts, particularly internal components for earlier versions of KT-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

The oil recommended for KT pumps in most applications is KV-100 oil. KV-100 is specially formulated to provide peak lubrication even in arduous conditions and provide high pumping capacity at low pressures. They are also formulated to resist rust and oxidation. These properties further enhance the performance and durability of Kinney KT pumps.

See Table 7-1 for a list of recommended oils by service type. LT oil may be required where low temperature starting or process contamination is encountered. Kinlube 220 may be recommended where a fire retardant fluid is required. Halocarbon 125 is an inert fluid recommended for oxygen service and for highly corrosive applications. S500 is a synthetic vacuum oil, and may be used when the pump is run at elevated temperatures to avoid contamination, or in other applications where a petroleum-based oil is undesirable.

SERVICE TYPE	RECOMMENDED OIL	ISO GRADE
Standard	KV100	100
Refrigeration	POE	68
Brake Fluid	UCON	68
Ammonia	POE	68
Oxygen	Fomblin or other PFPE	100
Radiator Fill	KV100	100
High Temp	S500	100

Table 7-1 – Recommended Oils by Service Type

FACTORY SERVICE AND REPAIR

With proper care, Tuthill Vacuum & Blower Systems vacuum pumps and systems will provide years of reliable service. Should adjustments or parts replacement eventually be needed, these can often be performed locally as described in this book after obtaining required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with the procedures outlined in this manual.

For major repairs not covered in this manual, contact the nearest Tuthill Vacuum & Blower Systems Authorized Service Center. Pump repair services are also available at our factory in Springfield, MO, or through our international network of Authorized Service Centers. Call (800) 825-6937 for the location nearest you for more information. Units that are still under warranty must be returned to the factory, freight prepaid, for service. Please visit our website, www.tuthillvacuumblower.com, for additional instructions on how to receive a Return Authorization number.

NOTICE

Current regulations require Material Safety Data Sheet to be completed and forwarded to Tuthill Corporation on any unit being returned for any reason which has been handling or involved with hazardous gases or materials. This is for the protection of the employees of Tuthill Vacuum & Blower Systems who are required to perform service on this equipment. Failure to do so will result in service delays.

08

REPAIR INSTRUCTIONS

GENERAL



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.



WARNING

Machine should be powered off and secured with proper lockout / tagout procedures prior to removal of any guards or panels and to ensure there are no accidental starts.



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.

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 (*see Figure 8-1*). The discharge valves are located at the exhaust port of each 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 valve 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.

ASSEMBLY PROCEDURE

NOTE: Individual components are not sold separately; discharge valves are sold as an assembly only.

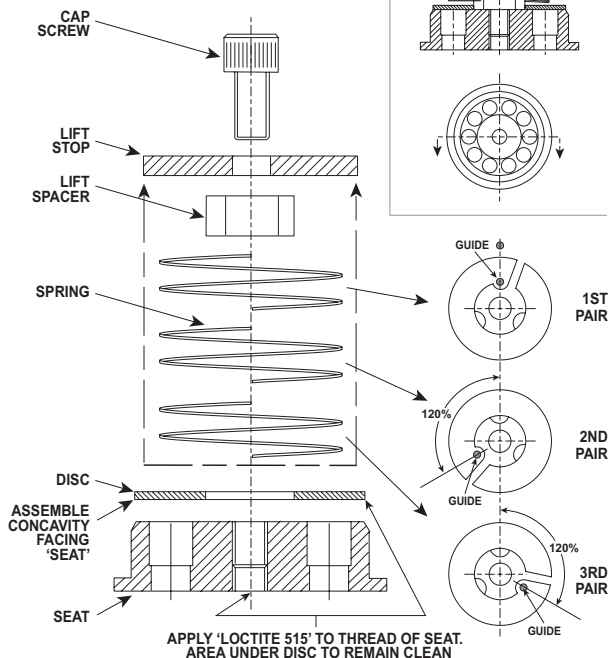


Figure 8-1 – Discharge Valve

To inspect the discharge valves, proceed as follows:

1. Drain oil from the pump and remove the separator housing cover.
2. Unscrew the air/oil separator from the top of the valve deck cover.
3. Remove the capscrews from the valve deck cover and remove the cover.
4. The valve chamber will contain a quantity of oil. Drain the chamber by removing the pipe plug on the closed head end of the cylinder. As an alternative, scoop the oil out of the valve cavity with a small container. Remove capscrews in valve hold-down plates and lift out valve plates with valves.
5. 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 capscrew(s) holding the valve together. When reassembling the valve, replace valve components in exactly the same position as before. **See Figure 8-1** for assembly instructions.

6. Reinstall the valves in the pump.

NOTICE

Caution must be used to ensure no screws or objects enter the piston chamber. It is recommended to replace the locking screws with new lock screws when re-installing the valves and plates.

SHAFT SEAL ASSEMBLY

Under normal conditions, the shaft seal (**see Figure 8-2** and **Figure 8-3**) 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.

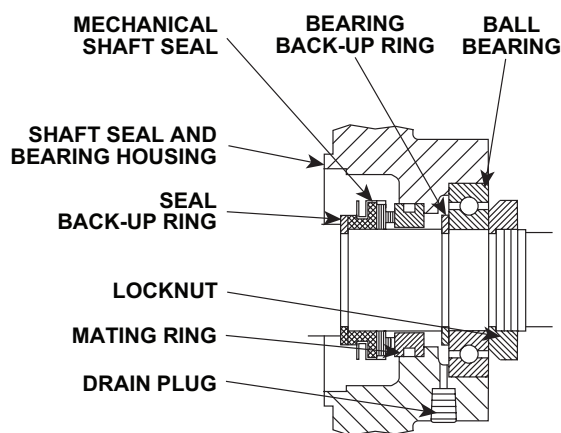


Figure 8-2 – KT-150 Shaft Seal and Bearing Housing

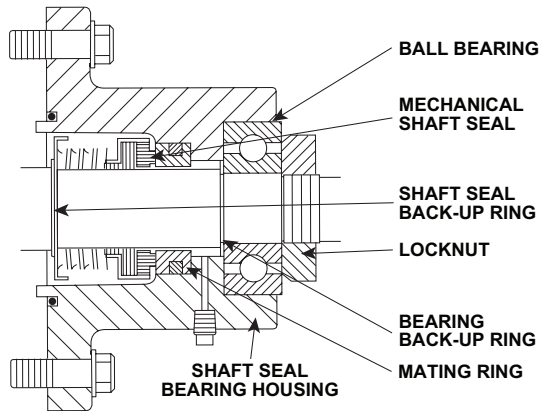


Figure 8-3 – KT-300, KT-500, KT-850 Shaft Seal and Bearing Housing

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 they were exposed to excessive operating temperatures and need replacement.

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 and the sheaves should be positioned so as to allow the belt 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 belts properly in their grooves, adjust the sheaves until all slack has been taken up by means of the motor support assembly.
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 8-4**.

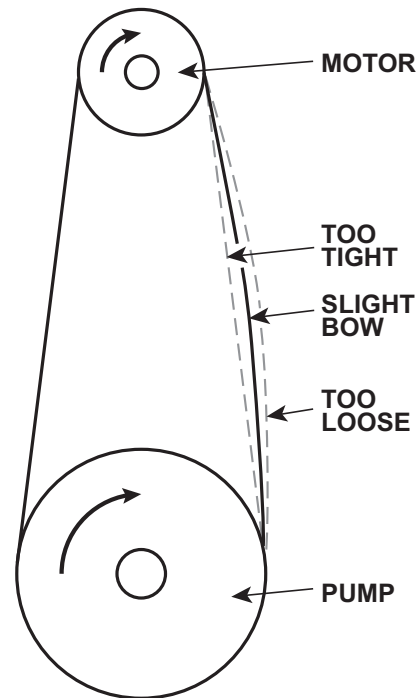


Figure 8-4 – V-Belt Tensioning

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 drawings and parts lists as needed. Note that the open head is the head through which the shaft extends, and closed head is the head on which the oil pump is mounted.

1. Disconnect all manifolding, water lines, and electrical connections, and drain the oil.
2. Remove the belt guard and belts.
3. Remove the oil lines from both ends.
4. Remove the motor from the top of the pump.
5. Remove the pump sheave and drive key.
6. Remove the oil sight gauge from the separator cover. Remove the inspection cover from the separator.
7. Remove the separator housing and gasket from the cylinder.

NOTICE

The separator housing has threaded holes to receive eye bolts for lifting the pump. When the separator housing is removed, do not attempt to lift the pump cylinder by using the gas ballast or oil drain piping to attach or support rigging for hoisting the cylinder.

8. Unscrew the air/oil separator assembly. Remove the valve cover from the cylinder.

9. Remove the discharge valves. If valves are disassembled, be sure to understand the procedure for proper reassembly.
10. Remove bearing retaining plate.
11. Unscrew the retainer nut from the shaft.
12. Remove the cap screws from the housing.
13. Remove the bearing, housing and stationary parts of the shaft seal.
14. Remove the rotating part of the shaft seal.
15. Remove the oil pump and housing from the closed head. Remove the closed head using two securing bolts as jackscrews to break the seal between head and cylinder after all securing screws are removed. Press the sleeve bearing from the head.
16. Withdraw the slide pin, piston, cam and slide-pin spacer.
17. Remove the retaining ring from the shaft. Loosen the socket head self-locking screws in the removable wall to release the pins securing the wall to the cylinder. Remove the wall, being careful not to cock it as it is removed.
18. Withdraw the slide pin, piston and slide-pin spacer.
19. Remove the open head following the same procedure as removing the closed head and press the bearing from the head.
20. Withdraw the piston, slide pin and cam.
21. The shaft and center cam can be taken out of the closed head end of the pump. Press the center cam from the shaft.

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 degreasing or by washing with acetone or alcohol. When reassembling, all parts must be coated with vacuum oil.

1. Place keys in the shaft grooves and press center cam on shaft until it is against the shaft shoulder. It may be desirable to heat the cam in vacuum oil to approximately 300°F (150°C) for easier assembly.
2. Temporarily mount the open head (with sleeve bearing pressed in) using two dowel pins for alignment and secure with three cap-screws. This will support the shaft when assembling the closed head end of pump.
3. From the closed head side, move the shaft through the hole in the stationary wall until the center cam is against the wall.
4. Place the slide pin over the slide on the center piston with the flat edges of the slide pin toward the piston and with the cap end to the left when facing the inlet ports.
5. With the piston port facing downward, insert the piston and slide pin into the cylinder.
6. Carefully clean the removable wall seating shoulder. Insert the beveled ends of the dowel pins into the outside edge of the floating wall. If necessary, use vacuum grease to hold the pins in the holes. Slide the removable wall into the cylinder from the closed head side with the crescent shaped cutout in the wall oriented to fit around the slide pin. Place two pieces of 0.005 in. (0.127 mm) shim stock at the ends of the cutout between the slide pin and removable wall. Screw new lock screws into the removable wall and with the wall firmly against the cylinder shoulder, tighten the socket head set screws to drive the dowel pins out against the cylinder to secure the wall in place. When tightening the center wall set screws, do not exceed a torque of 90 in.-lb

(10 N-m), as damage to the cylinder may result. Remove the two pieces of shim stock.

NOTICE

Lock screws in the removable wall should not be reused.

7. Install slide-pin spacer.
8. Place the retaining ring on the shaft. Insert the cam keys in the shaft grooves and tap the outer cam onto the shaft with the threaded holes of the cam outward.
9. Place the closed head slide pin on the piston slide with the flat edge toward the piston. With the inlet ports facing down, insert the piston and pin into the cylinder.
10. Press the sleeve bearing into the closed head. Apply a thin coat of Loctite 515, or equal sealing compound, to the sealing surfaces of the head and cylinder. Insert the two dowel pins into the cylinder and install the closed head. Tighten capscrews evenly.

NOTICE

Sealing compound must be used sparingly to prevent squeezing it into the pump when tightening heads. Allow compound to become tacky before installing heads.

11. Remove open head.
12. Install slide-pin spacer.
13. Place the cam keys in the shaft grooves and tap the outer cam onto the shaft with the threaded holes of the cam outward.
14. Place the open head slide pin on the piston slide with the flat edge toward the piston, and insert the piston and slide pin into the cylinder with the inlet ports of the piston facing down.
15. Install the open head using the procedure for installing the closed head.
16. Slip the backup ring on the shaft and install the rotating part of the shaft seal.

17. Press the stationary part of the shaft seal in the bearing housing. Install the bearing on the shaft and into the housing, and replace the lock nut on the shaft.
18. Install the discharge valves. Replace the valve deck cover and air/oil baffle assembly.
19. Install the separator housing and gasket.
20. Replace the oil sight gauge and replace the separator housing cover and gasket.
21. Replace the housing and oil circulating pump. Replace all oil lines and components.
22. Replace the motor and sheaves.
23. Replace and tension the V-belts and install the belt guard.
24. Reach through the suction port and pour 4 qt (2 L) of oil on the slide pins and finish filling the pump with oil.
25. Connect the electrical, water and manifold connections to the pump.
26. Run the pump and test that the pump can obtain satisfactory ultimate pressure.

09

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. See <i>Changing the Oil on page 24</i> and <i>Oil Contamination on page 24</i>.
	Discharge valve malfunctioning	Check valves per <i>Discharge Valves on page 26</i> .
	Vacuum pump shaft seal malfunctioning	Check shaft seal per <i>Shaft Seal Assembly on page 27</i> .
	Vacuum pump internal parts worn or damaged	Dismantle pump and inspect internal parts. See <i>Disassembly on page 29</i>.
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	See Installation on page 9. Also, see V-Belt Drive on page 28 and Changing the Oil on page 24.
	Pump too cold	See General on page 17. 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 as shown in Figure 5-1 on page 12.
	Gas ballast valve left open when stopping pump	Add automatic valve.
	No isolation valve and vent valve	Add valves as shown in Figure 5-1 on page 12.

KT SERIES PART NUMBER DESIGNATIONS

EXAMPLE: MODEL KT300D-M4A0

POSITION #:	1	2	3	4	5	6	7	8	9	10	11
	K	T	3	0	0	D	-	M	4	A	0

POSITIONS 1–5:

PUMP MODEL NUMBER

POSITION 6:

PUMP REVISION LEVEL

POSITION 8:

SCOPE OF SUPPLY

- L = Pump Complete Less Motor
- M = Pump Complete

POSITION 9:

ENCLOSURE RATING

- 4 = NEMA 4
- 7 = NEMA 7

POSITION 10:

POWER SUPPLY OPTIONS

VOLTAGE	TEFC	XP
3/60/200	9	G
3/60/230-460	A	H
3/50/190-380	D	L
3/60/575	E	M

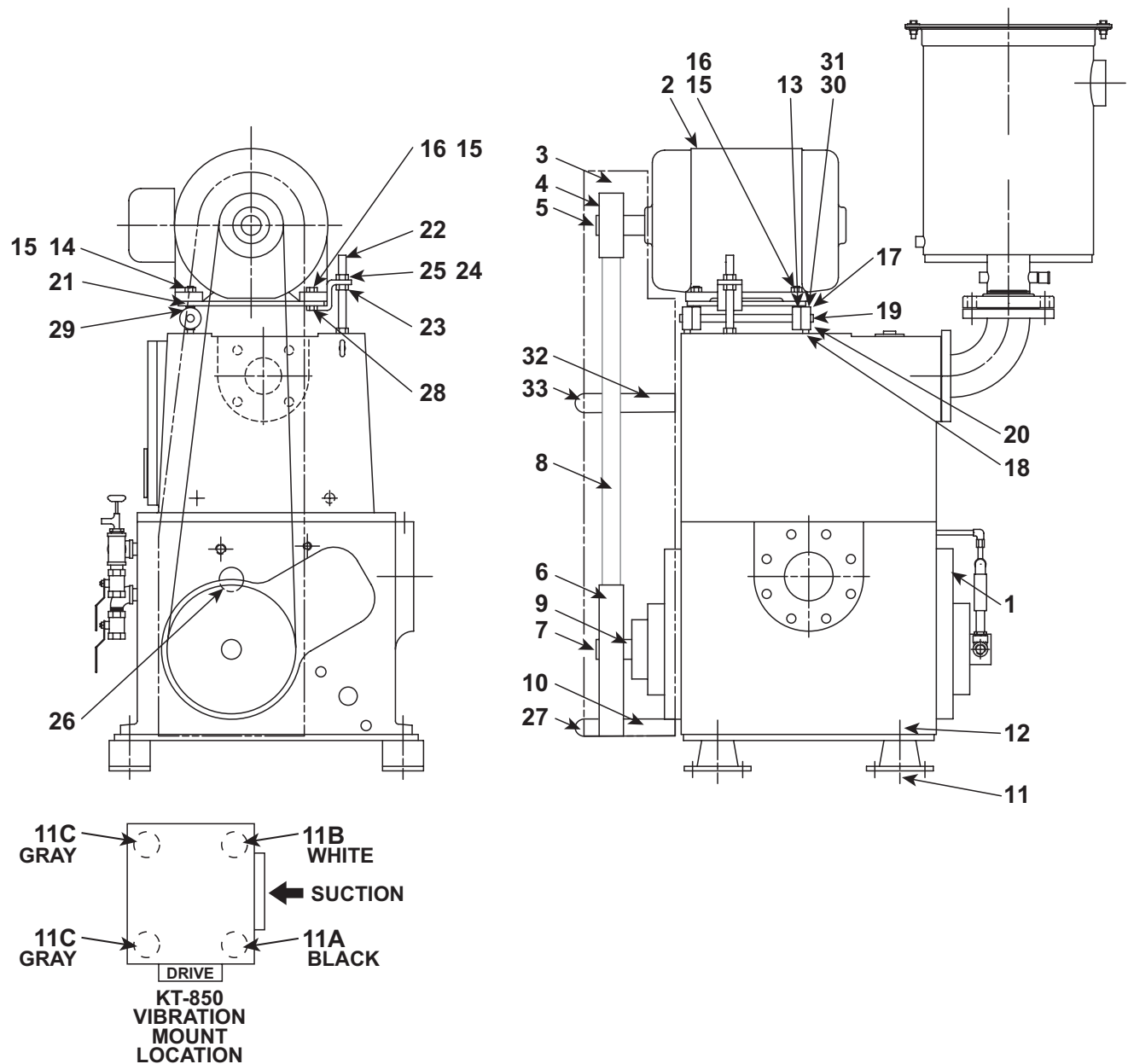
POSITION 11:

SERVICE OPTIONS

0	Standard Construction	Viton
2	Phosphate (TAP)	Viton
3	Refrigeration (POE)	Buna
4	Mineral Oil	Buna
5	Hardened Internals (QPQ)	
6	Brake Fluid (UCON)	EPR/EPDM
7	Ammonia Service (POE)	EPR; no Cu/Bronze
8	Customer Supplied Oil (O2)	
9	Radiator Filled	Buna

NOTES

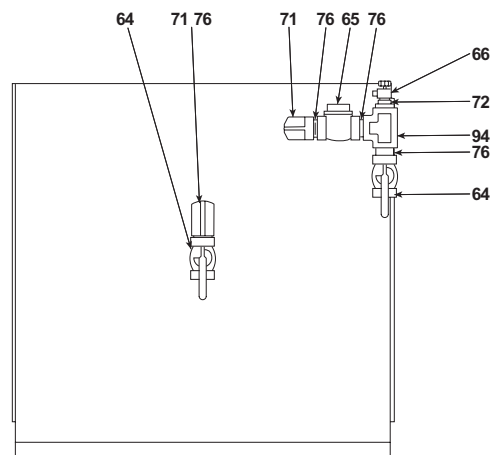
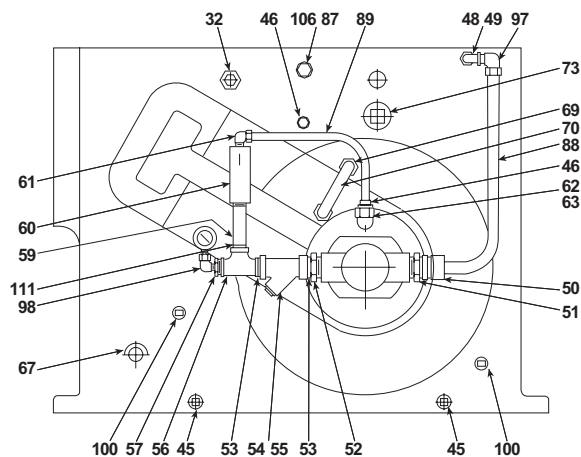
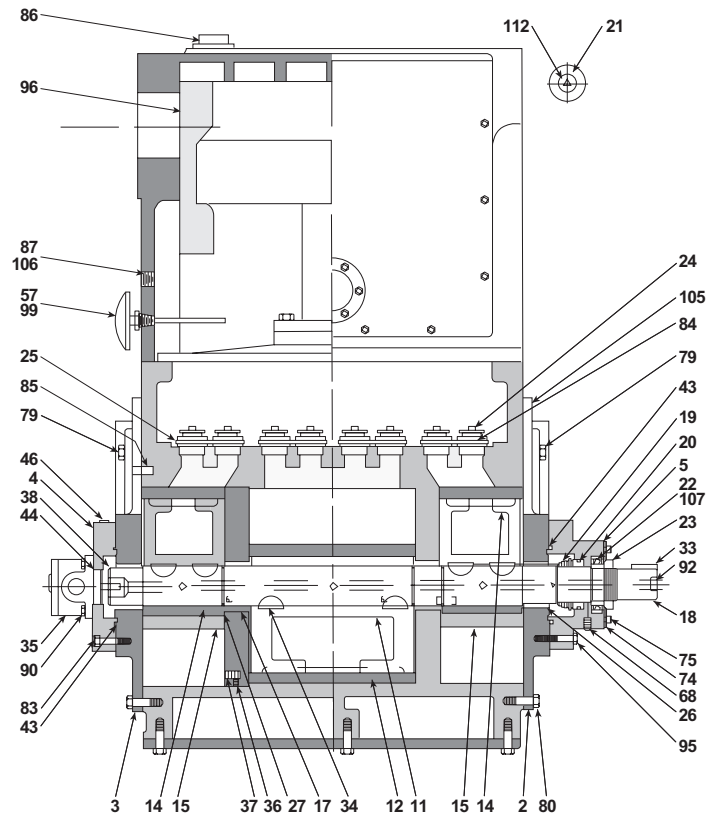
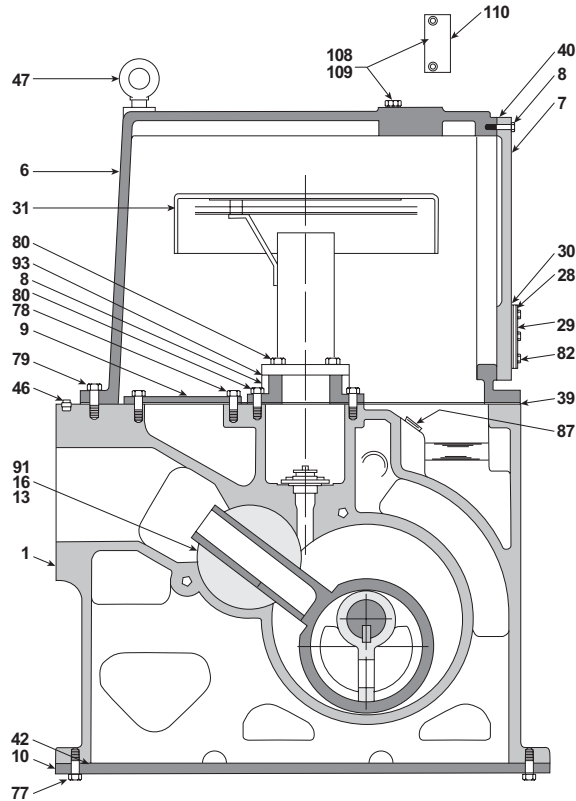
PUMP ASSEMBLY – KT-150, KT-300, KT-500, KT-850



PUMP PARTS LIST – KT-150, KT-300, KT-500, KT-850

ITEM NO.	PART DESCRIPTION	QTY			
		KT-150	KT-300	KT-500	KT-850
1	Pump	1	1	1	1
2	Motor	1	1	1	1
3	Belt Guard	1	1	1	1
4	Motor Sheave	1	1	1	1
5	QD Bushing	1	1	1	1
6	Pump Sheave	1	1	1	1
7	QD Bushing	1	1	1	1
8	V-Belt	1	1	1	1
9	Spacer	1	—	1	1
10	Belt Guard Standoff	3	4	4	5
11A	Vibration Mounts	4	4	4	1
11B	Vibration Mounts	—	—	—	1
11C	Vibration Mounts	—	—	—	2
12	Stud for Vibration Mount	4	4	4	4
13	Motor Rod End	2	2	2	2
14	Hex Nut	2	2	2	2
15	Washer	6	6	4	4
16	Hex Head Cap Screw	2	2	2	2
17	Rod End, S. Housing/Block	2	2	2	—
18	Jam Nut/Screw	2	2	4	—
19	Hinge Pin	1	1	1	1
20	Retaining Ring	2	2	2	2
21	Plate	1	1	1	0
22	Jack Screw	1	1	1	1
23	Jam Nut/Screw	2	2	2	2
24	Lock Washer Reg. Spring	1	1	1	1
25	Hex Nut	1	1	1	1
26	Snap Plug, Rotation View	1	1	1	1
27	Truss HD Screw	3	4	4	5
28	Hex Nut	2	2	2	—
29	Spacer	—	—	—	2
30	Pillow Block	—	—	—	2
31	SHCS 1/2-13-2	—	—	—	4
32	Belt Guard Standoff	—	4	—	—
33	Truss HD Screw	—	4	4	—

PUMP ASSEMBLY – KT-150C, KT-300D, KT-500D, KT-850D



PUMP PARTS LIST – KT-150C, KT-300D, KT-500D, KT-850D

ITEM NO.	PART DESCRIPTION	QTY			
		KT-150C	KT-300D	KT-500D	KT-850D
1	Cylinder Head	1	1	1	1
2	Head, Open End	1	1	1	1
3	Head, Closed End	1	1	1	1
4	Housing, Oil Pump	1	1	1	1
5	Housing, Bearing and Shaft Seal	1	1	1	1
6	Separator Housing	1	1	1	1
7	Cover, Separator Housing	1	1	1	1
8	Valve Deck Cover	1	1	1	1
9	Top Plate	1	1	1	1
10	Bottom Plate	1	1	1	1
11	Cam, Center	1	1	1	1
12	Piston, Center	1	1	1	1
13	Slide Pin, Center	1	1	1	1
14	Cam, Outer	2	2	2	2
15	Piston, Outer	2	2	2	2
16	Slide Pin, Outer	2	2	2	2
17	Removable Wall	1	1	1	1
18	Shaft Replacement Assembly	1	1	1	1
19	Shaft Seal Head Assembly	1	1	1	1
20	Shaft Seal Seat	1	1	1	1
21	Drive Coupling	—	1	1	1
22	Ball Bearing	1	1	1	1
23	Bearing Locknut	1	1	1	1
24	Discharge Valve Assembly	4	7	8	12
25	Valve Hold-down Plate	4	2	4	4
26	Sleeve Bearing, Heads	2	2	2	2
27	Retaining Ring, Cam	1	1	1	1
28	Sight Glass	1	1	1	1
29	Clamping Ring, Sight Glass	1	1	1	1
30	Gasket, Sight Glass	1	1	1	1
31	Discharge Baffle Assembly	1	1	1	1
32	Bushing	1	1	1	1
33	Key, Drive	1	1	1	1
34	Key, Woodruff	6	6	6	6
35	Oil Pump	1	1	1	1
36	Pin, Wall Locking	3	3	5	5
37	Setscrew, Wall Locking	3	3	5	5
38	Setscrew	—	1	1	1

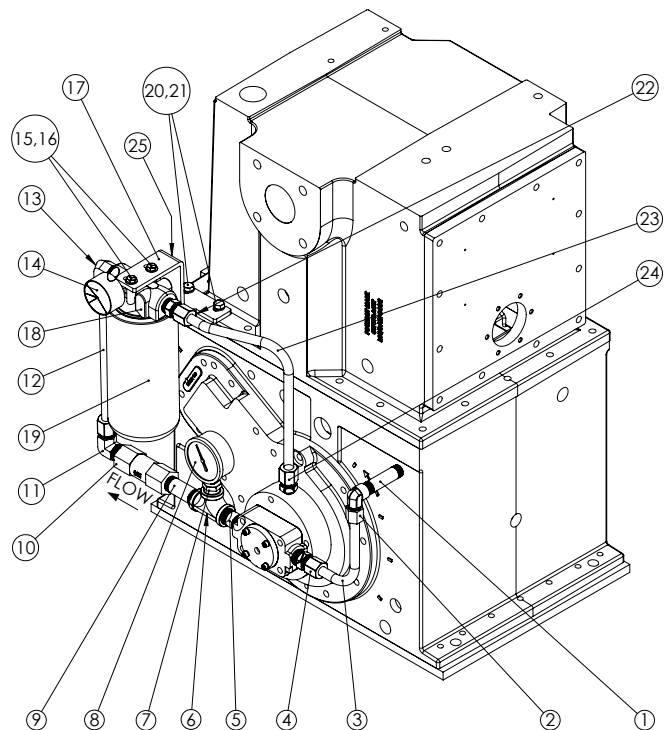
ITEM NO.	PART DESCRIPTION	QTY			
		KT-150C	KT-300D	KT-500D	KT-850D
39	Gasket, Cylinder/Separator Housing	1	1	1	1
40	Gasket, Separator Housing Cover	1	1	1	1
41	Gasket, Top Plate*	1	1	1	1
42	Gasket, Bottom Plate	—	1	1	2
43	O-Ring, Housing	2	2	2	1
44	O-Ring, Oil Pump	1	1	1	—
45	Pipe Plug, Square Head	2	1	2	2
46	Pipe Plug, Hex Socket	2	3	3	2
47	Eyebolt	2	2	2	1
48	Nipple	1	1	1	1
49	Elbow	—	—	1	—
50	Male Connector	1	—	1	1
51	Bushing	1	—	1	1
52	Bushing	—	1	1	1
53	Pipe Plug, Hex Socket	4	1	2	2
54	Strainer	—	—	1	1
55	Discharge Valve Assembly	—	—	1	1
56	Tee	1	1	1	1
57	Bushing	1	1	2	2
58	Press, Gauge, 0-160 PSI	1	1	1	1
59	Nipple	1	1	1	1
60	Check, Valve Spring	1	1	1	1
61	Male Elbow	—	2	1	1
62	Female Elbow	1	1	1	1
63	Nipple	—	—	1	1
64	Ball Valve	1	2	2	2
65	Check Valve, Swing	1	1	1	1
66	Angle Valve, G.B., 1/8 NPT	1	1	1	1
67	Relief Valve	1	1	1	1
68	Pipe Plug	2	1	1	1
69	Male Connector, Gas B.	1	1	4	4
70	U-Tube, Gas B.	—	—	2	2
71	ST Elbow	1	2	2	2
72	Bushing	—	1	1	1
73	Pipe Plug	1	1	2	2
74	Plate, Bearing Retainer	—	1	1	1
75	Socket Head Cap Screw	—	—	4	4
76	Nipple	1	1	4	4
77	Hex Head Cap Screw	36	20	33	44
78	Hex Head Cap Screw	4	34	12	16

ITEM NO.	PART DESCRIPTION	QTY			
		KT-150C	KT-300D	KT-500D	KT-850D
79	Hex Head Cap Screw	16	18	28	30
80	Hex Head Cap Screw	30	16	32	32
81	Hex Head Cap Screw	28	14	4	18
82	Hex Head Cap Screw	6	6	6	6
83	Socket Head Cap Screw	4	6	6	6
84	Socket Head Cap Screw	12	21	24	24
85	Dowel Pin	4	4	4	4
86	Pipe Plug, Hex Socket	1	2	1	1
87	Pipe Plug, Square Head	3	5	5	2
88	Steel Tubing	—	36	24	12
89	Steel Tubing	24	21	24	36
90	Hex Head Cap Screw	2	—	4	4
91	Spacer, Slide Pin	2	2	2	2
92	Pipe Plug, Hex Socket	—	3	3	1
93	Gasket, Oil Baffle	—	—	1	1
94	Tee	1	1	1	1
95	Hex Head Cap Screw	12	—	6	6
96	Mesh Pad	—	—	1	1
97	Male Elbow	1	—	1	1
98	ST Elbow	1	—	1	1
99	Temperature Gauge	1	1	1	1
100	Pipe Plug, Hex Socket	2	2	2	2
101	Ring, Shaft Seal Backup	1	1	—	1
102	Nipple	—	—	—	1
103	Female Elbow	—	—	—	1
104	Bushing	—	—	—	1
105	Dowel Pin	—	—	—	4
106	Pipe Plug, Hex Socket	—	—	—	2
107	Ring, Bearing Backup	1	1	—	—
108	Hex Head Cap Screw	2	—	—	—
109	Lock Washer Reg. Spring	2	—	—	—
110	Plate	1	—	—	—
111	Bushing	1	—	—	—
112	Key, Woodruff	—	—	—	1
113	Hex Head Cap Screw	—	—	—	4
114	Hex Head Cap Screw	—	10	—	—

NOTE: * Not shown.

FILTER SYSTEM KIT PARTS LIST – KT-150C

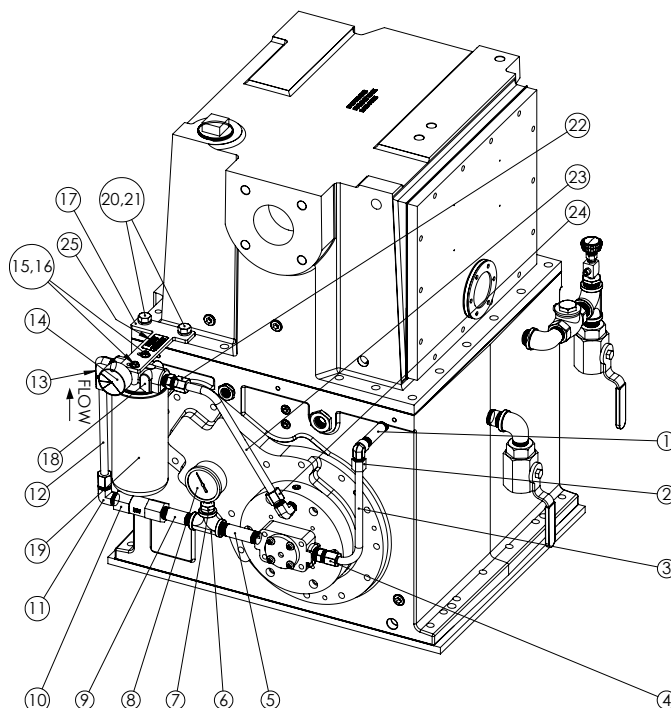
ITEM NO.	PART DESCRIPTION	QTY
1	Nipple *	1
2	Female Elbow *	1
3	Steel Tubing	1
4	Male Connector *	1
5	Nipple, Steel *	1
6	Tee *	1
7	Hex Head Bushing *	1
8	Pressure Gauge	1
9	Nipple *	1
10	Valve Spring Check	1
11	Male Elbow *	1
12	Steel Tubing	1
13	Male Elbow *	1
14	Filter Change Indicator/Gauge	1
15	Hex Head Cap Screw *	2
16	Plain Washer *	2
17	Bracket, Oil Filter	1
18	Oil Filter Housing	1
19	Oil Filter Spin-on	1
20	Hex Head Cap Screw *	2
21	Lock Washer Reg. Spring *	2
22	Male Connector *	1
23	Steel Tubing	1
24	Male Connector *	1
25	Label *	1
26	Sealant, Loctite #567 *	1



NOTE: *Not available for individual purchase.

FILTER SYSTEM KIT PARTS LIST – KT-300D

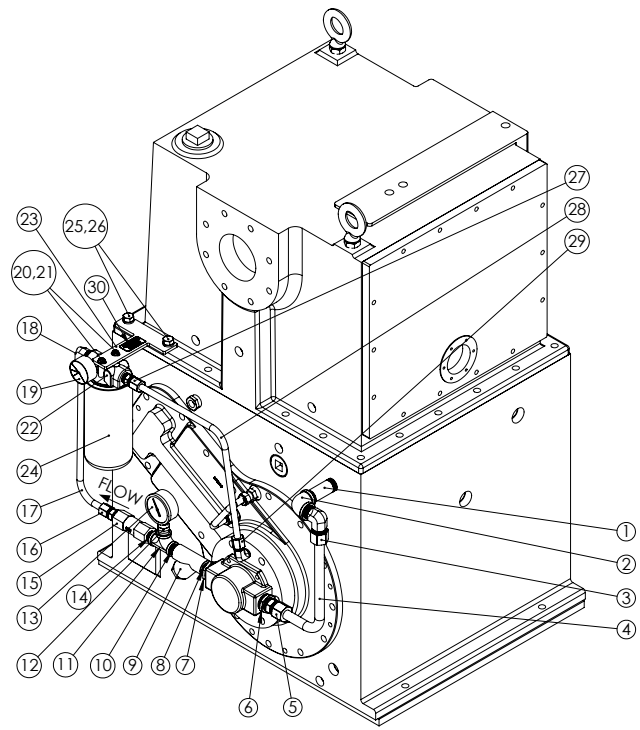
ITEM NO.	PART DESCRIPTION	QTY
1	Nipple *	1
2	Female Elbow *	1
3	Steel Tubing	1
4	Male Connector *	1
5	Nipple, Steel *	1
6	Tee *	1
7	Hex Head Bushing *	1
8	Pressure Gauge	1
9	Nipple *	1
10	Valve Spring Check	1
11	Male Elbow *	1
12	Steel Tubing	1
13	Male Elbow *	1
14	Filter Change Indicator/Gauge	1
15	Hex Head Cap Screw *	2
16	Plain Washer *	2
17	Bracket, Oil Filter	1
18	Oil Filter Housing	1
19	Oil Filter Spin-on	1
20	Hex Head Cap Screw *	2
21	Lock Washer Reg. Spring *	2
22	Male Connector *	1
23	Steel Tubing	1
24	Male Elbow *	1
25	Label *	1
26	Sealant, Loctite #567 *	1



NOTE: *Not available for individual purchase.

FILTER SYSTEM KIT PARTS LIST – KT-500D

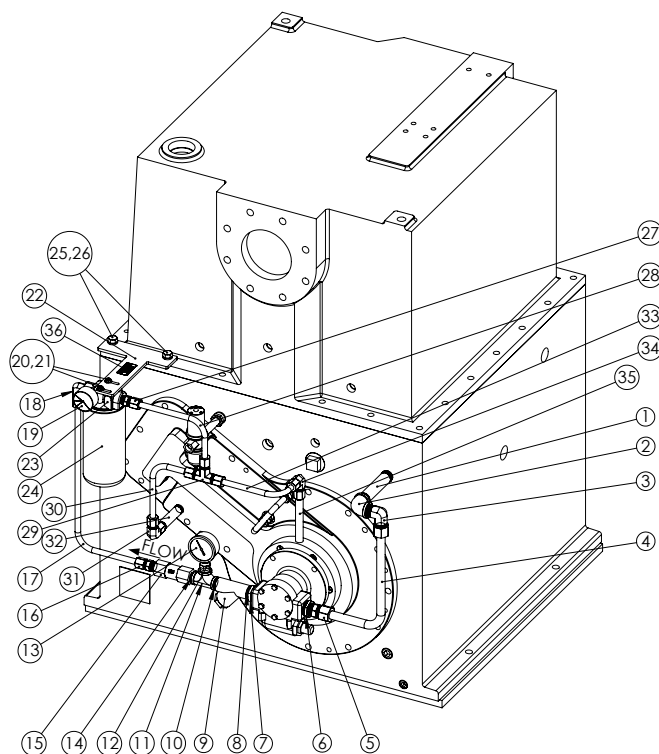
ITEM NO.	PART DESCRIPTION	QTY
1	Nipple *	1
2	Elbow *	1
3	Male Elbow *	1
4	Steel Tubing	1
5	Male Connector *	1
6	Hex Head Bushing *	1
7	Hex Head Bushing *	1
8	Nipple *	1
9	Y-Strainer *	1
10	Nipple *	1
11	Tee *	1
12	Hex Head Bushing *	1
13	Pressure Gauge	1
14	Nipple *	1
15	Valve Spring Check	1
16	Male Connector *	1
17	Steel Tubing	1
18	Male Elbow *	1
19	Filter Change Indicator/Gauge	1
20	Hex Head Cap Screw *	2
21	Plain Washer *	2
22	Oil Filter Housing	1
23	Bracket, Oil Filter	1
24	Oil Filter Spin-on	1
25	Hex Head Cap Screw *	2
26	Lock Washer Reg. Spring *	2
27	Male Connector *	1
28	Steel Tubing	1
29	Male Elbow *	1
30	Label *	1
31	Sealant, Loctite #567 *	1



NOTE: *Not available for individual purchase.

FILTER SYSTEM KIT PARTS LIST – KT-850D

ITEM NO.	PART DESCRIPTION	QTY
1	Nipple *	1
2	Elbow *	1
3	Male Elbow *	1
4	Steel Tubing	1
5	Male Connector *	1
6	Hex Head Bushing *	1
7	Hex Head Bushing *	1
8	Nipple *	1
9	Y-Strainer *	1
10	Nipple *	1
11	Tee *	1
12	Hex Head Bushing *	1
13	Pressure Gauge	1
14	Nipple *	1
15	Valve Spring Check	1
16	Male Connector *	1
17	Steel Tubing	1
18	Male Elbow *	1
19	Filter Change Indicator/Gauge	1
20	Hex Head Cap Screw *	2
21	Plain Washer *	2
22	Bracket, Oil Filter	1
23	Oil Filter Housing	1
24	Oil Filter Spin-on	1
25	Hex Head Cap Screw *	2
26	Lock Washer Reg. Spring *	2
27	Male Connector *	1
28	Steel Tubing	1
29	Tee *	1
30	Steel Tubing	1
31	Female Elbow *	1
32	Nipple *	1
33	Steel Tubing	1
34	Female Elbow *	1
35	Nipple *	1
36	Label *	1
37	Sealant, Loctite #567 *	1



NOTE: *Not available for individual purchase.

WARRANTY – VACUUM PRODUCTS

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Tuthill Springfield (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:

IMPORTANT

All blowers manufactured by Tuthill Springfield are date-coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card, or register online at **tuthillvacuumblower.com**.



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Manual 1843 Rev C p/n 001843 0000

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