KEEN INDUSTRIAL PUMP CO. Inc.
471 E State Route 250 East, Ashland, Ohio 44805
PH: 419-903-0160 FX: 419-207-8031

INSTALLATION AND SERVICE INSTRUCTIONS AND REPAIR PARTS LIST FOR 5-20HP TWO-STAGE CENTRIFUGAL PUMPS (Using Lithium Grease)

P/N O&M-KI-TSC-LI

High Capacity, High Pressure, Two Stage Centrifugal Pump

-- Pump Unit Only
-- Base Mounted, Direct Connected
-- Base Mounted, Direct Connected, Complete W/Motor

Location

The pump should be located in an easily accessible place as close to the liquid source as possible. It should be installed in a clean, dry, well ventilated place, allowing room to inspect and service pump and driver.

Foundation

The pump should be bolted securely to a rigid foundation, either concrete or steel. The 2" N.P.T. Suction can be rotated at 180 degree intervals to 2 different positions. As standard, the suction will be on the right side when facing the pump end. The 1 ½" N.P.T. Discharge can be rotated at 45 degree intervals to 8 different positions. As standard, the discharge will point up.

Direct connected pumps should always be mounted in a horizontal position on a level foundation. It is the best practice on permanent installations to grout the baseplate in place, this is particularly important with the larger motors. The unit should be set in place with wedges under each corner, near the foundation bolts. Adjust wedges and foundation bolts until the baseplate is level, in proper relation to the piping so the flexible coupling halves are aligned. About ¾" should be allowed under the baseplate for grouting. The foundation bolts should be drawn up evenly until snug. When the alignment is correct, grout the unit in place. Do not tighten foundation bolts or connect piping until grout is thoroughly set.

Alignment

Direct connected units are accurately aligned at the factory but all baseplates are flexible to some extent, and therefore, must not be relied upon to maintain the factory alignment. A flexible coupling is intended to take care of only slight misalignment. Therefore the pump and driver must be carefully aligned at the installation. Parallel alignment can be checked by placing a straight edge across the coupling halves. It must rest evenly on both halves at four positions spaced at approximately 90 degree intervals around the coupling. Angular alignment can be checked with a feeler gauge between the coupling halves at four points at approximately 90 degree intervals around the coupling. The coupling halves are positioned on the shafts so there is a gap of 3/32" between the jaw of one half and the body of the other half.

On belt driven units the pump and driver shafts should be parallel; the pulleys or sheaves must be aligned also. This can be checked by placing a long straight edge or tight string across the edges of the pulley or sheaves. The pulley or sheave on both pump and driver should be mounted as close to the bearing housing as possible to minimize the overhang, allowing sufficient clearance for rotor and play.

Belt Drives

Avoid a vertical drive on flat belt drives; an angle of 45 degrees or less between the line of shaft centers and the horizontal is desirable. Normally the belt speed should not exceed 5000 feet per minute and the pulley ratio should not exceed 5 to 1. The distance between the shaft centers should be at least twice the diameter of the larger pulley. Wide, single ply flat belts are preferable to double ply belts due to the lower bearing pressures that result. Adjust belt tension just tight enough to prevent slippage; excess tension unnecessarily loads the bearings. V-belts do not require as much tension as flat belts.

Piping

Pipes must line up and not be forced into position by unions. Piping should be independently supported near the pump so that no strain will be placed on the pump casing. Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as pump tapings or larger, and use a minimum number of fittings to reduce friction losses.

Suction Piping

Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping, which would make it 2 ½" minimum. It should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points so that air pockets are eliminated. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve can be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks or pump will not operate properly.

- **75 psi Maximum suction pressure**

Discharge Piping

Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line to serve as a shut-off or throttling valve if capacity is not correct. To protect the pump and foot valve from water hammer and to prevent backflow, a check valve should be installed in the discharge line between the pump and the gate valve.

- **300 psi Maximum discharge pressure**

Electrical Connections

Be sure motor wiring is correct for voltage being used. Always use a separate fused switch / circuit breaker for the pump, and wire of sufficient size to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic. This switch to be supplied by customer. Never install a pump without proper overload protection. Check local code requirements.

Priming

The pump must be primed before starting. Be sure pump case is filled with water before operating. The mechanical shaft seal must never run dry. Remove the three top ¼" pipe plugs (27) while priming (one in each camber) to assure that all air is evacuated. The three individual chambers of the pump and the suction piping must be completely filled before starting the motor. If pump does not start immediately, stop and reprime.

Rotation

The pump must run in direction of arrow on pump case. Three phase motors may run either direction so if rotation is wrong when first starting motor, interchange any two line leads to change direction.

Starting

With all piping connected to the pump and the unit tightened down in place, check the alignment. If misalignment is apparent after grout has set, it must be corrected by placing shims under pump or driver. If the alignment is correct and the pump turns freely by hand, the unit is ready to start after it is primed.

It is good practice to close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. If the pump runs for an extended period of time without liquid being discharged, the liquid in the pump case can get extremely hot.

Stopping

Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps. A properly installed check valve will perform the same function.

Mechanical Seal Lubrication

The pump is provided with an oil chamber which lubricates the seal face of the mechanical seal. The oil level should be checked every 50 hours. Fill cavity through the oil cup (item 30) with S.A.E. No. 30 oil.

NOTE: If the suction bracket is rotated to a different position, the oil cup must be removed and rotated so it will remain in a vertical position.

Bearings – Lubrication

Lubricate electric motor bearings in accordance with the manufacturer's instructions.

Pump bearings are sealed one side, open one side ball bearings that are lubricated by grease in the bearing bracket. Normally, these bearings require no further attention. This grease cavity must not be overloaded and should not be filled more than about half full. Shell Dolium R, Dolium BRB and Stamina RL2 are equivalent greases to be used.

GREASES USED MUST BE FROM THE "LITHIUM" FAMILY.

DO NOT USE UREA BASE GREASE AS IT WILL CAUSE PREMATURE BEARING FAILURE.

DO NOT MIX UREA AND LITHIUM GREASES !!!

If, due to unusual operation conditions, it becomes necessary to revitalize the grease, proceed as follows:

1. **Remove bearings and shaft. (See instructions on "To Replace Bearings")**
2. **Clean out cavity between bearings.**
3. **Replace bearings and pump shaft. NOTE: Bearing open sides should face in toward grease cavity with seals facing out.**
4. **Fill cavity about ½ full (approx. ½ pound or ½ tube) of grease outlined above through top ¼" NPT.**

Bearing greases are usually a mixture of a thickener base, referred to chemically as soap, emulsified with a lubricating oil, usually mineral or vegetable based. The soap base merely acts to keep the oil in suspension. When moving parts of the bearing come in shear contact with the grease, a small quantity of the oil will adhere to the bearing surfaces.

The oil is picked up by the bearing (and removed from the grease) is gradually broken down by oxidation or lost to evaporation, centrifugal force, etc. The bearing cannot function properly unless this supply of oil keeps up with the demand as the grease will oxidize or the oil in the grease may be depleted.

Grease life cannot be measured accurately since such factors as speed, load, humidity, type of service and frequency of lubrication all have to be considered. In applications where elevated temperatures, high speed, severe dirt, high humidity or other extreme conditions are encountered, particularly with open type bearings, accelerated deterioration of the grease may occur. In such cases, periodic inspection during the first few months of operation will provide the required frequency of re-lubrication.

All grease should be free from dirt, abrasive matter, moisture, acid or alkali.

Old grease should always be replaced with new grease during overhaul.

Ball bearings are important for pump life and must be given proper care to allow reasonable life. Lack of knowledge or proper maintenance frequently results in a service call that should have been avoided.

ONLY LITHIUM BASE GREASES ARE TO BE USED TO LUBRICATE THESE PUMPS.

THE FOLLOWING LIST REPRESENTS SEVERAL RECOMMENDED LITHIUM BASE GREASES:

- **WOLF'S HEAD – Red Grease, Lithium Complex**

Freezing

Care should be taken to prevent the pump from freezing during cold weather. It may be necessary, when there is any possibility of this, to drain the pump when not in operation.

Three individual chambers must be drained. These chambers include the suction (seal bracket) and the first and second stage impeller chambers.

A. To drain the suction chamber, remove the ¼ pipe plugs (27) that are in the bottom position, unless the suction pipe is pointing down. If this is the case, drainage means must be provided in suction piping leading to the pump.

B. To drain the first and second stage impeller chambers, remove the two ¼" pipe plugs which are in the lower position of the case and the 1/8" pipe plug in the crossover casting.

To Remove and Replace Worn Impeller and Wearing Rings

To service pump, the suction and discharge piping must first be disconnected.

A. Remove back plate (25). Remove impeller cap screw (17) and washer in outer impeller eye. Remove tap bolts which hold volute case (21) to bracket (7). With two large screwdrivers on opposite sides of volute case, pry evenly and carefully to get volute case and outer impeller off. Care must be exercised to avoid bending pump shaft. In the event that the impeller is extremely difficult to pull, it can be expanded by warming with a torch. Be careful not to get it really hot. Then, before it has time to conduct heat to shaft, the impeller can be pried off with two screwdrivers, as described previously.

B. Remove Inner impeller (13) using two screwdrivers and heat, if necessary. Be careful not to get shaft hot. Remove snap ring (12). Slide old seal (11) off shaft. Remove tap bolts (5) holding bracket (7) to bearing bracket (1) and pull bracket off shaft. Remove old floating seat and seat cup from bracket.

C. Make sure the synthetic seat cup of the new seal is tight against the shoulder of the floating seat, with rounded edge at the rear to facilitate insertion. The seal is assembled this way when shipped. Wipe the lapped sealing face of the floating seat perfectly clean and oil face with a clean, light oil.

D. Oil outer surface of the seat cup, using light oil (not grease) and push this assembly in the cavity of the bracket, seating it firmly and squarely. If necessary to use a piece of tubing to push it in, bear on the outer edge of the floating seat, never on the lapped sealing face.

E. Replace lip seal (2) and lubricate oil seal face with S.A.E. No. 30 oil. Clean and oil the surface of the shaft with a light oil. Make sure slinger (10) is in place. Bolt (30 ft-lbs) bracket (less impellers) back on the bearing bracket, being careful not to strike floating seat with shaft Wipe the face of the sealing washer perfectly clean, and oil with a clean light oil. It is extremely important that only clean oil be used on the sealing faces. Any dirt whatsoever may cause seal failure. Put the sealing washer and bellows assembly on the shaft. Be sure sealing washer is in proper position. The notches on the washer should mate with lugs on the retainer. Use a sleeve of proper diameter to slide assembly into place. Note: When sliding seal assembly on the shaft, be sure to press only on tail sections of bellows and driving band. A smooth sleeve of about 1-9/32" diameter (1/32" larger than shaft), with a wall thickness of about ½" is suitable. Press assembly on until it is tight against floating seat.

F. Slip shaft seal spring over shaft, making sure that it, and the spring holding plate, are seated properly. Slip snap ring over shaft and slide it forward until it drops into place. Install inner impeller, with suction opening toward bearing bracket, making sure that key is in place on shaft. The inner and outer impellers have different wearing ring diameters. Therefore, it is impossible to assemble impellers in reverse order.

G. Place volute case back and bolt it to bracket torquing bolts to 30 ft. lbs. Install outer impeller with suction opening away from bearing bracket. Ring the beveled washer (shaft side) with a bead of Permatex to seal keyway and impeller shaft from corrosion. Assemble the impeller cap screw, with a 3/8" helical spring lock washer (302 stainless steel). XX part number ----------.Tighten the cap screw to 35 foot/pounds.

H. Be sure pump case is filled with water before operating. Seal must never run dry.

Replacing Wear Rings

With impellers removed, the wearing rings can be examined for wear. Replace wearing rings if clearance on diameter is over .030".

To remove and replace wearing rings:

1. Cut worn rings from casing with cold chisel. Be careful not to cut or damage the iron castings when removing rings. Cut rings nearly in half on opposite sides, then they can be easily bumped out.

2. **Put new rings in place and bump in with a hardwood block. New impeller wearing rings should always be installed in a pump at the same time a new impeller is installed. Worn wearing rings will cause excessive wear on the new impeller, thereby reducing the amount of service obtained from a new impeller.**

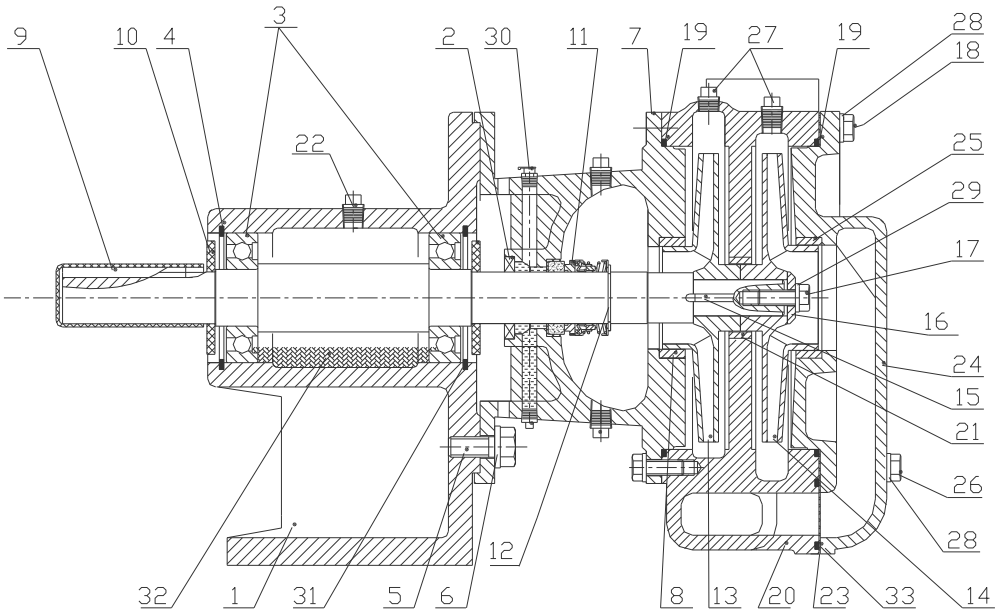
To Replace Bearings

Pump end must be removed. Pry pulley and bearing retaining ring out with a screwdriver. Press shaft and bearings through pulley end of bearing bracket. Press bearings off the shaft.

To reassemble: Press new bearings on shaft, pressing only on inner face of bearings. Insert shaft into housing. Also seals on bearings must face out on installation with open sides facing in (toward grease cavity). Replace snap rings. Beveled snap ring goes on pump end bearing, with bevel facing pump end.

Service Chart Troubleshooting Guide

A. No Water Delivered	
B. Not Enough Water Delivered	
C. Not Enough Pressure	
D. Pump Runs For Short While, Then Looses Prime	
Possible Cause Of Problem	
1. Pump not properly primed, repeat priming operation	**A.**
2. Discharge head to high. Check total head with gauge at pump inlet and discharge. (With water, the gauge would show shut-off pressure.)	**A. B.**
3. Excessive volume being discharged. Throttle discharge valve.	**C.**
4. Speed to low. Check pump drive belts for slippage. If hot, tighten belts. Check motor voltage and speed.	**B. C.**
5. Rotation wrong. Change shaft rotation.	**A. B. C.**
6. Suction lift too high. Check with vacuum gauge. This should not exceed 15 feet. When pumping hot water recheck NPSH.	**A. B. D.**
7. Air leak in suction line. Check line under pressure to find leak.	**A. B. C. D.**
8. Air pocket in suction line. Check line for proper slope.	**A. D.**
9. Insufficient submergence of suction pipe. Foot valve should be three feet below water level.	**B. D.**
10. Sediment chamber clogged. Remove and clean thoroughly. Make sure gasket is in good condition and sealing surfaces clean before reassembly of sediment chamber cap.	**C.**
11. Impeller or suction line plugged.	**A. B. C.**
12. Impeller and wearing rings badly worn. Disassemble pump and replace impeller and wearing rings if clearance on diameter is over .030"	**B. C.**
13. Suction strainer plugged. Clean strainer.	**D.**
14. Impeller diameter too small for condition required.	**B. C.**
15. Seal leaking – seal is worn or seal face cocked. Replace with new seal and carefully follow directions.	



REF. NO.	DESCRIPTION	QTY.	KEEN PART NO.
1	BRACKET, BEARING, CAST IRON	1	KI-001
2	SEAL, OIL	1	KI-002
3	BEARING, BALL	2	KI-003
4	RING, SNAP, STRAIGHT	1	KI-004
5	SCREW, CAP, 3/8-16UNC X 1-1/4" LG, STL	4	KI-005
6	WASHER 1/2" LOCK, STL	4	KI-006
7	BRACKET, SEAL, CAST IRON	1	KI-007
8	RING, WEAR, BRASS (SEAL BRACKET)	1	KI-008
9	SHAFT, SST	1	KI-009
10	SLINGER, RUBBER	2	KI-010
11	SEAL, MECHANICAL SHAFT	1	KI-011
12	RING, SNAP	1	KI-012
13	INNER IMPELLER 4 11/16" DIA., (5HP)	1	KI-013
13A	INNER IMPELLER 5 5/16" DIA., (7.5HP)	1	KI-014
13B	INNER IMPELLER 5 7/8" DIA., (10HP)	1	KI-015
13C	INNER IMPELLER 6 11/16" DIA., (15HP)	1	KI-016
13D	INNER IMPELLER 7" DIA., (20HP)	1	KI-017
14	OUTER IMPELLER 4 11/16" DIA., (5HP)	1	KI-018
14A	OUTER IMPELLER 5 5/16" DIA., (7.5HP)	1	KI-019
14B	OUTER IMPELLER 5 7/8" DIA., (10HP)	1	KI-020
14C	OUTER IMPELLER 6 11/16" DIA., (15HP)	1	KI-021
14D	OUTER IMPELLER 7" DIA., (20HP)	1	KI-022
15	KEY, IMPELLER, SST	1	KI-023
16	WASHER, IMPELLER	1	KI-024
17	SCREW, IMPELLER, 3/8-16UNC	1	KI-025
18	SCREW, CAP 3/8-16UNC X 1" LG., STL	16	KI-026
Ⓐ 19	O-RING, VOLUTE CASE, LARGE	2	KI-027
Ⓐ 20	CASE, VOLUTE (USE WITH PAPER GASKET)	1	KI-028
Ⓐ 20	CASE, VOLUTE (USE WITH O-RINGS)	1	KI-041
21	RING, WEAR, BRASS (VOLUTE)	1	KI-029
Ⓐ 22	PLUG 1/8" NPT	1	KI-030
23	PAPER GASKET	1	KI-031
24	PLATE, BACK, CAST IRON	1	KI-032
25	RING, WEAR, BRASS (BACK PLATE)	1	KI-033
26	SCREW, CAP, 3/8-16UNC X 2" LG., STL	2	KI-034
27	PLUG 1/4" NPT	10	KI-035
28	WASHER, 3/8" SEALING	18	KI-036
29	WASHER, 3/8" LOCK	1	KI--037
30	CUP, OIL, 1/4" NPT	1	KI-038
31	RING, SNAP, TAPERED	1	KI-039
Ⓐ 32	GREASE	7 OZ.	GREASE
33	O-RING, VOLUTE CASE, SMALL	1	KI-040

NOTE: ALL BOLTS AND NUTS TO BE TORQUED TO 30 FOOT/POUNDS

REV	INITIALS	DATE	DESCRIPTION
A	SE	03/09/2011	GASKETS DISCONTINUED AND REPLACED BY O-RINGS

KEEN PUMP COMPANY
KEEN PUMP CO.
1661 CLEVELAND AVE.
ASHLAND, OHIO 44805
PHONE: 419-207-9400
FAX: 419-207-8031

TITLE: ASSEMBLY, KI-TSC 2-STAGE CENTRIFUGAL PUMP

SCALE	DWG. #	REV.
NTS	KN-125	A

DWG. BY	DATE
BEN KEENER	03/30/09

KEEN INDUSTRIAL PUMP CO. Inc.

471 E State Route 250 East, Ashland, Ohio 44805
PH: 419-903-0160 FX: 419-207-8031

Limited Warranty

During the time periods and subject to the conditions hereinafter set forth, Keen Industrial Pump will repair or replace to the original user or consumer, any portion of your new Keen Industrial product which proves defective due to defective materials or workmanship of Keen Industrial Pump. Contact your closest authorized Keen Industrial Pump representative or distributor for warranty service. At all times, Keen Industrial Pump shall have and possess the sole right and option to determine whether to repair or replace defective equipment, parts or components. Damage caused by acts of GOD or conditions beyond the control of Keen Industrial Pump is not covered by this warranty.

WARRANTY PERIOD:
24 months from date of installation / 32 months from date of manufacture, which-ever occurs first.
Start-up reports may be required to support warranty claims. Warranty effective only if Keen Industrial Pump supplied or authorized control panels are used. Single phase pumps must utilize Keen Industrial Pump supplied start components.

THIS WARRANTY WILL NOT APPLY:

1. **To defects or malfunctions resulting from failure to properly install, operate or maintain the product in accordance with printed instructions provided.**
2. **To failures resulting from abuse, accident or negligence.**
3. **To normal maintenance services and the parts used in conjunction with such service.**
4. **To products which are not installed in accordance with applicable local codes, ordinances and good trade practices.**
5. **The product is used for purposes other than for what it was designed and manufactured.**
6. **If 3 phase motors are installed on a single phase power supply using a phase converter or if 3 phase power is supplied by only two transformers, making an open Delta system.**

WARRANTY EXCLUSIONS:
Keen Industrial Pump specifically disclaims the implied warranties of merchantability and fitness for a particular purpose after the termination of the warranty period set forth herein. No warranties or representations at any time made by any representatives of Keen Industrial Pump shall vary or expand the provision hereof.

LIABILITY LIMITATION:
In no event shall Keen Industrial Pump be liable or responsible for consequential, incidental or special damages resulting from or related in any manner to any Keen Industrial Pump product or parts thereof. Personal injury and/or property damage may result from improper installation. Keen Industrial Pump disclaims all liability, including liability under this warranty, for improper installation. Keen Industrial Pump recommends following the instructions in the installation manual. When in doubt, consult a professional. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

LABOR, ETC, COSTS:
Keen Industrial Pump shall in no event be responsible or liable for the cost of field labor or other charges incurred by any customer in removing and/or reaffixing any Keen Industrial Pump product, part or component thereof.

RETURNED OR REPLACED COMPONENTS:
Any item to be replaced under this Warranty must be returned to Keen Industrial Pump, or such other place as Keen Industrial Pump may designate, freight prepaid.

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

In the absence of suitable proof of this purchase date, the effective date of this warranty will be based upon the date of manufacture. Example: 0105 = Month-Year = January, 2005