Carver®

Creating Value.

I-246

# Installation, Operation, and Maintenance Instructions

## for

# Models WKH 50, 65, 80 & 100 High Pressure Multi-Stage Centrifugal Pumps

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# I. GENERAL INFORMATION

## A. Preface

Carver Pump Company products are carefully engineered and manufactured and, if properly installed, maintained and operated, should provide maintenance free operation and a long service life.

Follow instructions in this manual carefully. Factory warranty applies only when pump operates under conditions as specified on order acknowledgment, and if pump is properly installed and maintained as recommended herein. A copy of these instructions should be available to operating personnel. Additional copies of this manual are available on request from Carver Pump Company office or your local distributor, where service personnel will answer your questions.

## B. Pump Identification

The type of pump, pump size, operating data, and serial number are all stamped on the nameplate attached to the pump. Pump specifications should be recorded upon receipt of the pumping unit. A pump service record page and inspection and repair record are provided for this purpose in the front of this manual. To facilitate correctness when ordering spare parts, the serial number and model number of the pump must be included in all correspondence regarding the unit.

## C. Safety Precautions

The following are general safety precautions that do not relate to any specific procedure and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance of the pump and the electrical driver used to drive the pump.

1. Installation, use, and operation of pumping equipment is affected by various federal, state, and local laws. Compliance with such laws relating to proper installation and safe operation of pumping equipment is the responsibility of equipment owner.
2. Prior to working on pump or driver, ensure that all switches and circuit breakers have been locked in the open (off) position and tagged: "Out of Service."
3. All circuits not known to be dead must be considered live at all times.
4. Do not wear loose clothing when working with rotating machines.
5. When working near electricity, do not use metal rules, flashlights, metallic pencils, or any other objects having exposed conducting material.
6. Be certain you are not grounded whenever you are adjusting electrical equipment or using measuring equipment.
7. In general, use only one hand when servicing live electrical equipment.
8. Be sure to de-energize all electrical equipment before connecting or disconnecting meters or test leads.
9. When connecting a meter to terminals for measurement, use a range higher than the expected voltage.
10. Before operating pumping unit or performing any tests or measurements, make certain that the frame of the driver and starter panel are securely grounded.
11. If a test meter must be held or adjusted while voltage is applied, ground case of meter before starting measurement and do not touch live equipment while your are holding meter. Some moving vane type meters should neither be grounded nor should they be held during measurements.
12. Do not use test equipment known to be in poor condition.

The following are specific safety precautions that apply to the pump unit.

1. Hydro suction case separately if unit hydro is greater than 620 PSIG.
2. Isolate pump for system hydro.
3. Do not exceed maximum suction pressure of 415 PSIG on suction case.
4. Do not exceed maximum discharge pressure of 1200 PSIG.

## D. Equipment Description

WKH high pressure pumps are multistage centrifugal pumps with vertically split casings. The pump consists of a suction case and a discharge case, plus a number of intermediate (stage) casings, all secured with tie bolts. Diffusers are inserted in individual stage casings. O-rings seal the individual stage casings. Suction and stage casings are provided with wear rings which can be replaced if, after prolonged operation, wear has become excessive. Bearing housings are attached to the suction case and discharge case by bolts.

The pump shaft is protected against corrosion and wear by interstage sleeves, spacer sleeves, and shaft sleeves. Impellers are secured on pump shaft by keys. All impellers face the same direction on the shaft.

WKH high pressure pumps incorporate special design refinements which help to absorb the appreciable axial thrust generated by their high head operation. Residual axial thrust is absorbed by the bearings.

## E. Operating Limits

Pump operating temperature for uncooled bearings should not exceed 230 degrees Fahrenheit (F). Pumps of high temperature construction are provided with cooled bearings with an operating temperature range between 230 and 400 degrees F. Cooling water flows through cavities of the bearing housing and keeps temperature of the bearings within acceptable limits. Refer to Table 1 for cooling flow rates of water temperature of 60 degrees F for bearings. Refer to Figure 1 for typical water cooling setup.

Table 1. Bearing Cooling Flow Rates

| Temperature Range | Flow Rate |
|---|---|
| -20 degrees to 230 degrees F | Air |
| 231 degrees to 300 degrees F | Water-1/2 Gallons Per Minute (GPM) |
| 301 degrees to 350 degrees F | Water-1 GPM |
| 351 degrees to 400 degrees F | Water-2 GPM |

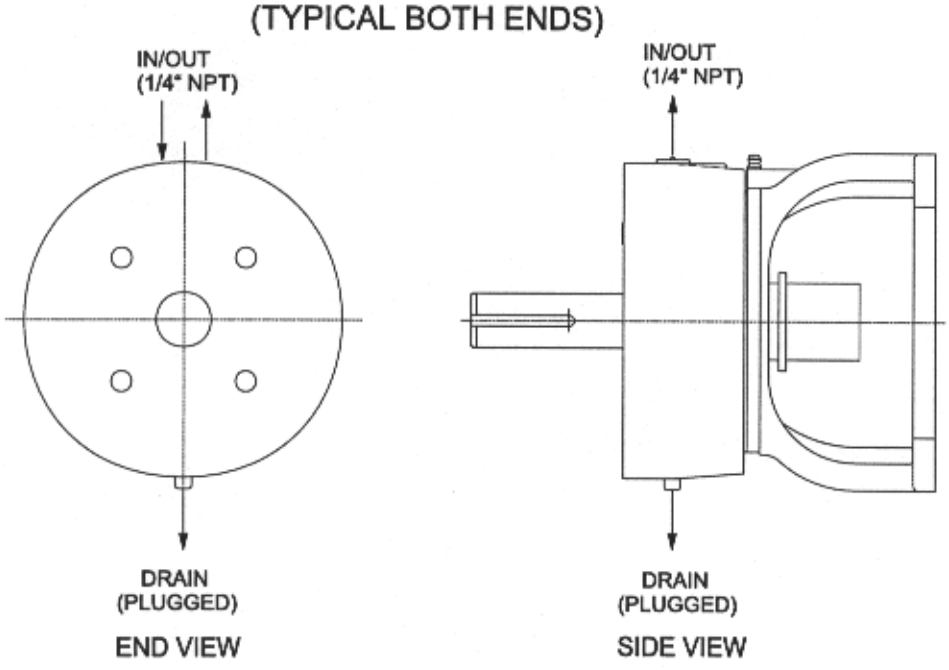



Figure 1. Water Cooling

## F. Bearing Lubrication and Cooling

Refer to Section VI for bearing lubrication and cooling options.

## G. Grease Recommendations

Standard pump bearings are grease lubricated. Refer to Section VI for oil lube and oil mist options.

A non-soap polyurea thickened grease with a drop point of 450 degrees F is recommended for bearing grease. Refer to Table 2 for specific recommended Rykon grease types. This grease is selected due to its suitability to extreme pressures and its high temperature stability. Never mix greases with differing properties. Polyurea base greases are not compatible with lithium or soda soap base greases; therefore, type of grease added should not vary.

Table 2. Grease Recommendations

| Manufacturer | Number |
|---|---|
| Amoco | 2EP |
| Aero Shell | 22 |
| Mobil | 28 |

## H. Technical Data

Specifications and operating limits should be recorded on the Service Record Page located in the front of this manual upon receipt of the pumping unit. For further information, refer to Tables 3 and 4.

Table 3. Shaft Dimensions

| Pump Model | At Impeller | At Coupling |
|---|---|---|
| 50 & 65 | 1.437 inches | 1.250 inches |
| 80 | 1.574 inches | 1.500 inches |
| 100 | 1.771 inches | 1.625 inches |

Table 4. Stuffing Box Dimensions

| Pump Model | Bore | Depth | DBC |
|---|---|---|---|
| 50 & 65 | 2.625 inches | 3.000 inches | 3.375 inches |
| 80 | 3.125 inches | 3.000 inches | 4.125 inches |
| 100 | 3.375 inches | 3.500 inches | 4.875 inches |

## I. Unpackaging

Inspect pumping unit when it is received for missing hardware, flange covers or possible damage. In general, make certain the shipment complies with purchase order. Inspect any parts containers that may be shipped with unit (coupling, seals, etc.). Report any damage or shortage immediately to carrier's agent or factory. Claims made at a later time cannot be accepted. For cartridge seal pumps, centering tabs are enclosed in a bag and attached to the pump. Use of the centering tabs are explained in Section V.

## J. Packaging

If pump is sent back to Carver Pump Company for repair, it must be drained and all flanges and connections covered or plugged. Ship pumps in assembled condition to prevent damage to sealing faces of individual components. Material Safety Data Sheet (MSDS) is required on all returned pumps. It is the responsibility of the customer to clean and flush the pump before returning it to the factory. The fluid used in the service should be specified.

## K. Pump Protection During Prolong Shutdown

If the equipment is not immediately installed and operated, store the equipment in a clean, dry, well-ventilated place, free from vibrations, moisture, and rapid or wide variations in temperature.

Rotate both shafts several revolutions at least once every two weeks to prevent flat spots on ball bearings.

Consider a unit to be in storage when:

1. It has been delivered to the job site and is waiting to be installed.
2. It has been installed but operation is delayed pending completion of construction.
3. There are long (30 days or more) periods between operation cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

**NOTE**

Storage requirements vary depending on the length of storage, the climatic environment, and the equipment. For storage periods of three months or longer, contact Carver Pump Company for specific instructions. Improper storage could damage the equipment and would result in non-warranty covered restoration requirements or non-warranty covered product failures.

# II. Installation

## A. Foundation and Mounting

**CAUTION**

A hoist or suitable lifting device should be used to lift pumping unit. Do not pick up the complete unit by the driver or pump shafts or driver lifting eyes.

Hydraulic Institute (HI) recommends a foundation capable of absorbing vibration at least five times the weight of the pumping unit and to form a permanent, rigid support for the base plate. It is important to maintain the alignment for a flexible coupled unit. A concrete foundation on a solid base is recommended with foundation bolts of the proper size embedded into the concrete. A pipe sleeve larger in diameter than the bolt should be used to allow movement for final positioning of the bolts, refer to Figure 2.

When the pump and driver mounted on a base plate is placed on the foundation, remove the coupling guard and disconnect coupling halves. Reconnect the coupling after alignment operations have been completed. Base plate should be supported on rectangular metal blocks and shims or on metal wedges having a small taper. The support pieces should be placed close to the foundation bolts, refer to Figure 3. Place supports directly under the part of the base plate carrying the greatest weight and space closely enough to give uniform support. Adjust metal supports or wedges until the pump and driver shafts are level. Check coupling faces and suction and discharge flanges of the pump for horizontal or vertical position by means of a level. Make corrections as necessary by adjusting the supports or wedges under the base plate.

## B. Grouting

When the pump unit has been leveled and alignment is correct, grout the unit to the foundation using a high grade non-shrinking grout. Proceed as follows:

1. Tightened foundation bolts evenly but not fully, refer to Figure 2.
2. Build a wooden dam around base plate to retain the grout.
3. Pour grout through grouting holes provided in base plate until entire space under base plate is filled, with no voids or air pockets.
4. Insert a stiff wire through the grouting holes to work the grout and release any air pockets.
5. After grout has hardened (usually 48 hours) remove the dam and shims or wedges under the base plate, if desired. Fill remaining holes by the shims with grout.
6. Tighten foundation bolts loosely. Allow the grout to fully cure before firmly tightening the foundation bolts.

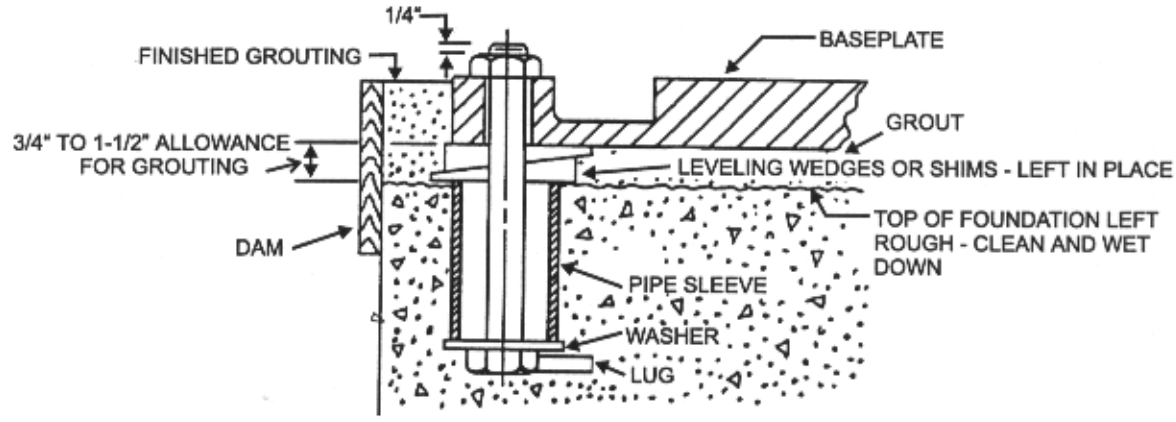



Figure 2. Grouting and Foundation Bolting

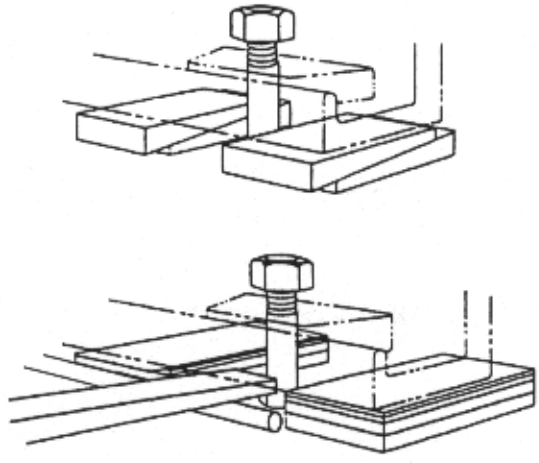


Figure 3. Unit Leveling

## C. Handling

**CAUTION**

A hoist or suitable lifting device should be used to lift pumping unit. Do not pick up the complete unit by the driver or pump shafts or driver lifting eyes.

Complete pumping unit must be handled with care. Do not pass lifting slings through lifting eyes on driver.

## D. Coupling

The coupling should not be reconnected until the alignment has been completed. Align coupling using a dial indicator to attain more accurate coupling alignment, refer to Figure 4. Proceed as follows:

**NOTE**

Corrections to alignment in one direction may affect alignment in the other direction. Angular and parallel misalignment are corrected by means of shims under the driver mounting feet so it can be raised or lower during aligning procedures.

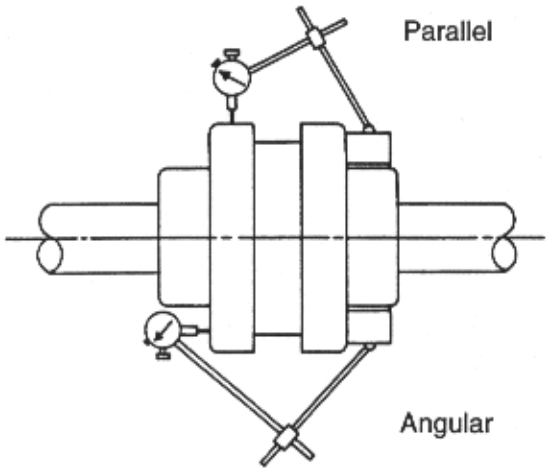



Figure 4. Coupling Alignment

Check parallel misalignment by fastening dial indicator to the pump half of the coupling. Set the dial on the indicator to zero and rotate both hubs 360 degrees. With the dial indicator needle against the face of the other hub, take indicator readings at four points, 90 degrees apart. Shim all driver mounting feet until all four readings are identical (0.005 maximum Total Indicator Runout (TIR).

Check angular misalignment by fastening dial indicator to one coupling hub. Set the dial on the indicator to zero and rotate both hubs 360 degrees. With the dial indicator needle in contact with the surface of the outside diameter of the opposite coupling hub, take indicator readings at four points, 90 degrees apart. Adjust driver until all four readings are identical (0.008 maximum TIR). Reconnect coupling halves. Reinstall coupling guard.

## E. Piping

Pump is shipped with flange covers to protect flange faces and to prevent foreign matter from entering pump. Flange covers should remain intact until suction and discharge piping are connected to pump flanges.

All piping should be supported so that no undue piping strain weight is placed upon pump. Do not force piping. Never use pump as an anchorage point for the piping.

**CAUTION**

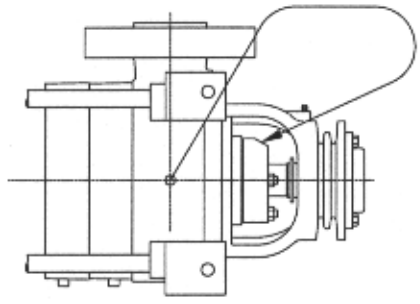
Extreme care should be taken when connecting new piping to see that no foreign matter such as dirt, slag, chips, tools, etc., are in the piping as this debris will be drawn into pump and cause excessive damage. During initial installation and testing, a strainer should be installed in suction piping to keep debris from entering pump.

Suction lift lines should be laid with a rising slope toward pump and positive suction head lines should be laid with a downward slope to avoid air pocket formation. Suction piping must be at least the same size as pump suction nozzle. Compensation for heat elongation must be provided where required.

Coupling alignment must be rechecked after installation of piping. Realign if required by adjusting driver end.

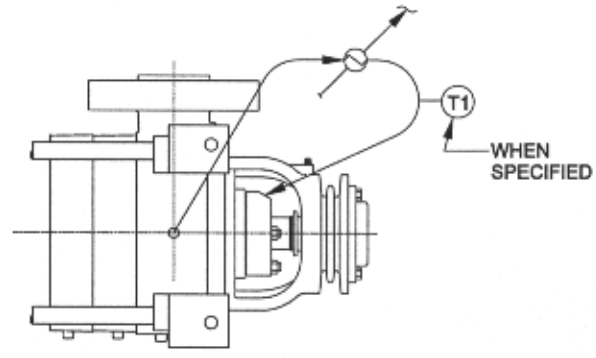
## F. Auxiliary Connections

Connect auxiliary connections referring to the fluid line schematic drawing, Figure 5.



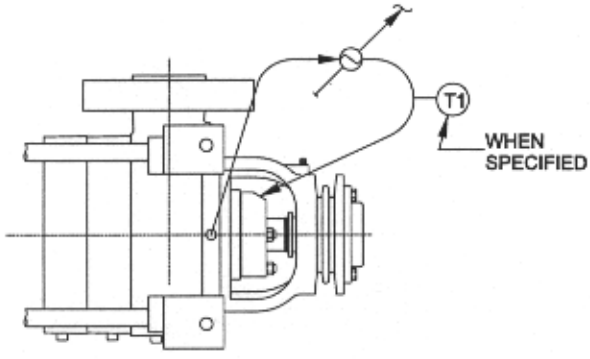
RECIRCULATION FROM PUMP CASE TO SEAL

PLAN 2411



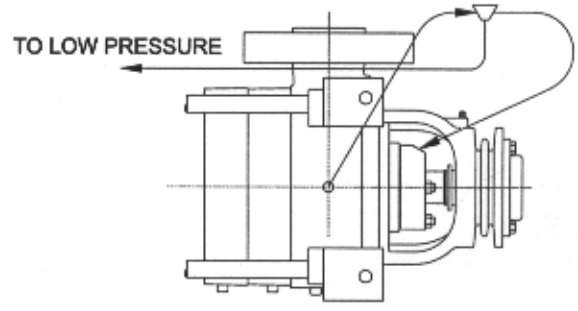

RECIRCULATION FROM PUMP CASE THROUGH HEAT EXCHANGER TO SEAL

PLAN 2421



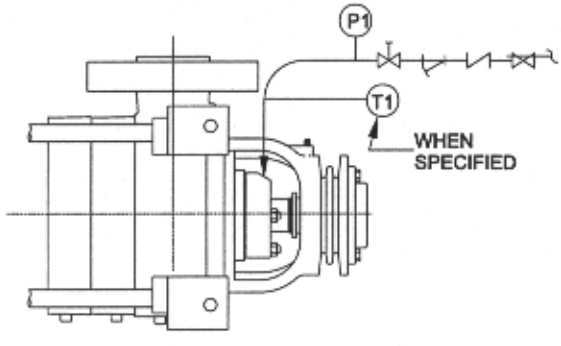

RECIRCULATION FROM SEAL WITH PUMPING RING THROUGH HEAT EXCHANGER AND BACK TO SEAL

PLAN 2423



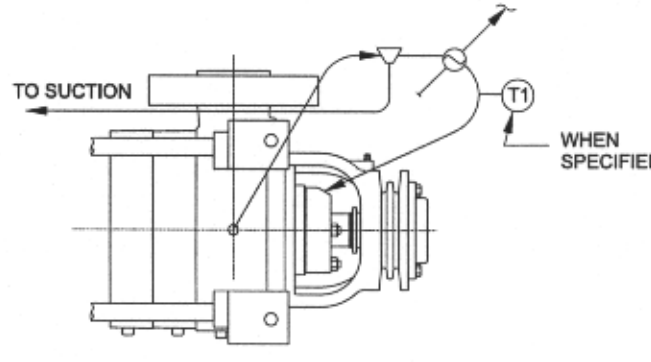

RECIRCULATION FROM PUMP CASE THROUGH ABRASIVE SEPARATOR DELIVERING CLEAN FLUID TO SEAL AND FLUID WITH SOLIDS BACK TO LOW PRESSURE

PLAN 2431




INJECTION TO SEAL FROM EXTERNAL SOURCE OF CLEAN COOL FLUID

PLAN 2432




RECIRCULATION FROM PUMP CASE THROUGH ABRASIVE SEPARATOR DELIVERING CLEAN FLUID THROUGH HEAT EXCHANGER TO SEAL AND FLUID WITH SOLIDS BACK TO PUMP SUCTION

PLAN 2441

Figure 5. Fluid Line Schematic

# III. Operation

## A. Method of Operation

Pumped fluid enters suction case and passes into first stage impeller, which propels fluid into first stage diffuser. The fluid then flows into the next impeller. This process is repeated from one stage to the next. At each stage fluid pressure increases (this is termed "stage head"). After leaving final stage diffuser, fluid enters discharge case and passes into discharge piping.

## B. Prestart Cautions

Before starting pumping unit make the following checks:

**WARNING**

Before activating the pumping unit, make sure no one is working on the unit. Serious injury or death could result to personnel if unit is activated when it is being worked on.

1. Rotate both shafts by hand to assure all moving parts are free.
2. If necessary, recheck coupling alignment.
3. Install closed guards around all exposed rotating parts.
4. Check to make sure there is fluid in the pump. Never run pump dry because the close running fits within the pump are lubricated by the fluid being pumped. Dry running may result in pump seizure.
5. Standard grease lubricated pumps are shipped with factory lube packed bearings. Lubrication is adequate for a minimum of 1,000 operating hours or six months of continuous operation under normal conditions. After extended storage or exposure to unusually humid or hot environmental conditions, the bearings and their lubricant should be checked before operating pumping unit.
6. If necessary, turn on cooling lines and check to see if there is sufficient flow, refer to Table 5.
7. For other lube methods refer to Section VI.

## C. Start-Up

Before starting pumping unit, refer to safety precautions in paragraph C of section I. Refer to Table 5 for minimum flow rates.

**WARNING**

Do not operate pumping unit against a closed discharge system. If pump has any chance of operation against a closed system, a bypass system allowing a minimum design flow should be installed. Refer to Table 5 for minimum flow rates.

1. Completely open system valve in suction line to pump and fill with fluid.
2. Open system valve in discharge line to pump to allow a minimum design flow.
3. Open valves to pressure gauges in system.
4. Start electrical power supply to driver.
5. Slowly open system valve in discharge line until pumping unit reaches specified pumping conditions (See pump nameplate for design point condition).

Table 5. Minimum Flow Rates

| Pump Model | Speed | Minimum Flow |
|---|---|---|
| 50 | 1750 Revolutions Per Minute (RPM) | 40 GPM |
| | 3500 RPM | 65 GPM |
| 65 | 1750 RPM | 90 GPM |
| | 3500 RPM | 95 GPM |
| 80 | 1750 RPM | 150 GPM |
| | 3500 RPM | 200 GPM |
| 100 | 1750 RPM | 200 GPM |
| | 3500 RPM | 300 GPM |

### D. Turbine Applications

For turbine applications consult your local distributor or Carver Pump Company.

# IV. Troubleshooting

If the installation and starting procedures outlined in this manual have been followed, the pump should provide reliable service and long life. However, if operating problems do occur, significant time and expense can be saved if Table 6 is used to eliminate the most common causes of those problems.

Table 6. Pumping Unit Troubleshooting

| Symptom | Immediate Action | Probable Cause | Corrective Action |
|---|---|---|---|
| Pump does not deliver rated capacity. | 1. Stop driver. | 1. Excessive system pressure. | 1. Check GPM and head against design conditions; pump impeller may be too small. Consult local distributor or Carver Pump Company. |
| | | 2. Incomplete priming or venting of pump or piping. | 1. Prime pump and piping again and carefully vent. |
| | | 3. Suction line or strainer clogged. | 1. Clean out suction line or strainer. |
| | | 4. Positive suction head is too low. | 1. Reduce the distance from centerline of pump to source of liquid being pumped.<br>2. Check design and lay of suction line for features which cause excessive pressure drop. |
| | | 5. Valves are not fully open. | 1. Open valves and if necessary lock valves open to prevent accidental closure. |
| | | 6. Clogged impeller. | 1. Dismantle pump and clean impeller if necessary. |
| | | 7. Reverse rotation. | 1. Correct rotation is clockwise when viewed from driver end. |
| | | 8. Improperly installed impeller. | 1. Disassemble pump and correctly axial align impeller. |
| | | 9. Excessive wear of internal parts. | 1. Disassemble pump and replace worn parts. |

Table 6. Pumping Unit Troubleshooting (CONTD)

| Symptom | Immediate Action | Probable Cause | Corrective Action |
|---|---|---|---|
| Leakage at case joints. | 1. Stop driver. | 1. Bolts not sufficiently tightened. | 1. Release pressure and tighten tie bolts evenly. |
| | | 2. O-rings damaged. | 1. Replace o-rings. |
| Bearings run hot. | 1. Stop driver. | 1. Pump and driver shafts are misaligned. | 1. Check coupling alignment.<br>2. Check pipe strain. |
| | | 2. Piping causes pump to "warp". | 1. Ensure piping transmits no stress to pump. Alter piping layout if necessary. Realign pump and driver shafts. |
| | | 3. Insufficient or unsuitable grease. | 1. Top off grease nipples. If necessary change grease.<br>2. Check for incorrect grease. |
| | | 4. Over greased or oiled bearings. | 1. Remove excess grease or oil. |
| | | 5. Insufficient grease (or oil) to bearings. | 1. Add grease (or oil) as necessary. |
| | | 6. Insufficient cooling of bearing housing. | 1. Check cooling flow rate to bearing housing. |
| | | 7. Worn bearings. | 1. Replace bearings. |
| Pump discharge pressure excessive. | | 1. Excessive speed. | 1. Check speed precisely. Decrease speed if possible. |
| | 1. Stop driver. | 2. Wrong impeller trim. | 1. Trim outlet tips of impeller vanes. Consult Carver Pump Company specifying exact operating conditions. |
| | | 3. Pump is pumping fluid with specific gravity in excess of that specified. (If temperature of fluid is lower than specified specific gravity will be higher). | 1. If prescribed fluid temperature or specific gravity can not be attained, one or more of the following measures can be taken:<br>a. Partially close discharge valve reducing pump capacity to a point where driver is not overloaded.<br>b. Remove one or more impellers and their diffusers and install special blind stage parts. |

Table 6. Pumping Unit Troubleshooting (CONTD)

| Symptom | Immediate Action | Probable Cause | Corrective Action |
|---|---|---|---|
| Pump discharge pressure excessive.(CONTD) | | | c. Trim one or more impellers.<br>d. Install more powerful driver. Consult Carver Pump Company specifying exact operating conditions. |
| Driver overloaded. | | 1. Pump discharge pressure is lower than design point (check pump nameplate). | 1. Partially close discharge valve until pressure at discharge flange is as specified. Decrease speed or trim impellers if driver remains overloaded (consult Carver Pump Company before taking this step). |
| | 1. Stop driver. | 2. Same as 3 under pump discharge pressure excessive. | 1. Same as 3 under pump discharge pressure excessive. |
| | | 3. Wrong impeller trim. | 1. Trim outlet tips of impeller vanes. Consult Carver Pump Company specifying exact operating conditions. |

# V. Maintenance

## A. General Operating Checks

The pump should always run quietly and smoothly, without vibration. To ensure such operation, the following maintenance should be carried out at regular intervals during operation of the pump. A pump service record and inspection and repair record are provided for this purpose in the front of this manual.

**Daily Inspection:**

1. Visually inspect unit.
2. Check bearing temperatures. Refer to Table 1 for rates.
3. Check leakage at mechanical seals.

**Weekly Inspection:**

1. Check power (amps) readings.
2. Check pump discharge pressure. Prescribed operating discharge pressure should never drop below 90 percent of design point pressure.
3. Check vibration on pump and driver bearings. Vibration should not exceed 1.8 overall displacement (unfiltered) peak to peak mils (0.001") at 3600 RPM and 3.5 overall displacement (unfiltered) peak to peak mils (0.001") at 1750 RPM.

**Monthly Inspection:**

1. Check coupling alignment.
2. If necessary, grease coupling. Do not over grease.
3. Check foundation bolts.

**Semiannual Inspection:**

1. Grease (or oil) radial bearing. Do not over grease or add excessive oil.
2. Check coupling alignment due to settling of foundation.
3. If stand-by pumps are installed, it is advisable to operate pumps on a rotation system to give each pump a certain amount of operational duty. This ensures that stand-by pumps will always be in condition for instant start-up.

## B. Bearings

The pump bearings are mounted in bearing housings, which are bolted onto the suction case and discharge case of the pump. The suction end bearing is an ABEC 1, class 3 single row ball bearing. The discharge end bearing is an ABEC1, class 3 matched face-to-face angular contact ball bearing set.

Pump grease lubricated bearings are packed at the factory for six months or 1,000 hours continuous operation under normal conditions without relubrication. Carver Pump Company lubricates bearings with Rykon premium grease, a non soap polyurea thickened grease with a drop point of 450 degrees F. This grease was selected due to its suitability to extreme pressures and its high temperature stability. Never mix greases with differing properties. Polyurea base greases are not compatible with lithium or soda soap base greases; therefore, type of grease added should not vary. If it is necessary to change grease type, bearings, bearing housings, and bearing caps should be removed, cleaned and flushed with suitable solvent as described below:

1. Place bearings, bearing housing end of bearing housing, and bearing caps in a wire or mesh basket and suspend basket in a light mineral solvent and allow to soak, preferably overnight.
2. After soaking and cleaning, bearings, bearing housing end of bearing housings, and bearing caps should be rinsed in a clean, light mineral solvent and agitated vigorously to remove all loosened hard grease and dirt.
3. Dip bearings in clean, light oil and spin by hand, ensuring all foreign matter has been removed. Failure to remove all foreign matter could cause poor bearing performance later.
4. After cleaning, repack bearings on both sides with recommended grease. One to two pumps with a hand-operated grease gun every 500 hours is adequate. Do not over grease.

If bearing temperatures increase by 10 to 15 degrees F during a period of one week and there is not a variance in ambient or liquid temperature, add grease to bearings through grease fittings on top of bearing housings with a hand-operated grease gun. Over greasing will cause bearings to overheat.

Pump should run a minimum of one hour to permit expulsion of excess grease through overflow opening in bearing cap. After greasing, bearing temperatures may exceed 200 degrees F at 100 degrees ambient due to excess grease in bearing housings. After the run in period, bearing temperatures should stabilize and not exceed 185 degrees F at 100 degrees ambient. If bearing temperatures remain high, the pump should be shut-down and the cause determined. Refer to Table 6 for common causes of high bearing temperatures.

Before the pumping unit is started after prolong shutdown, grease level must be checked. Add grease as required. Check temperature of bearings and listen for quiet running at regular intervals.

## C. Disassembly Preparations

During disassembly, match mark parts so they can be replaced in their original position. All parts should be thoroughly cleaned or replaced with new if necessary. Sealing faces should be perfectly clean. It is recommended that all o-rings and gaskets be used only once. Close suction and/or discharge valves. The pump cases should be cooled down to ambient temperature. Cases must be empty and not under pressure.

After prolonged operation, it may be difficult to pull components from shaft. In such instances, rust solvent may be used and suitable extracting tools applied where possible. Never use force under any circumstances. The following tools are recommended for disassembly and reassembly:

1. Spanner wrench.
2. Rawhide or wood mallet.
3. Wooden wedge (support interstage case).
4. Allen wrench set.
5. Punch.
6. Socket, open, and/or box wrench set.
7. Vice grips.
8. "C" clamp.
9. Proper lubricant (o-rings and gaskets).

1. Read this entire section and review the applicable sectional assembly drawing and parts list before disassembling the pump. Refer to Figure 9 for bearing lubrication and cooling options and parts list Table 14.
   WKH 50 sectional assembly drawing see Figure 10 and parts list Table 15
   WKH 65 sectional assembly drawing see Figure 11 and parts list Table 16
   WKH 80 sectional assembly drawing see Figure 12 and parts list Table 17
   WKH 100 sectional assembly drawing see Figure 13 and parts list Table 18

**WARNING**

Before attempting to disassemble the pump, the electrical power supply from the driver must be locked and tagged in the OFF position to prevent injury to personnel servicing the pump.

2. Stop the pumping unit.
3. Disconnect suction, discharge, and gauge lines. Disconnect auxiliary connections, as applicable.
4. Remove coupling guard. Uncouple pump from driver.

**CAUTION**

Use of a hoist with adequate capacity is recommended when removing pump from base.

5. Remove bolts holding pump to base. Remove pump from base and take to a suitable work area.

## D. Pump Disassembly WKH 50 and WKH 65

**NOTE**

Refer to paragraph C of Section I for safety precautions before disassembling pump.

1. Remove coupling half. Remove coupling key (46).
2. For cartridge seals, install centering tabs on seal cartridges to keep seal glands (17A) and (17B) in position.
3. Drain pump by removing drain plug (424) from the bottom each of interstage case (1), suction case (203), and discharge case (197).
4. Clamp down discharge case foot to steady pump during disassembly.
5. Number and match mark interstage cases so that suction case (203), interstage cases (1), impellers (2A) and (2B), and discharge case (197) will be reassembled in correct sequence and position.
6. Disconnect male connector retaining nuts from tube connector bodies (410) and (411). Remove tube (400) and (408). Retaining nuts will remain with tube. Pipe elbow (455) and pipe nipple (486) will remain in casing.
7. Support interstage cases (1) before dismantling to prevent them from dropping when suction case (203) is removed.

**NOTE**

Pump should be dismantled from suction end. Mark or number each component as it is dismantled according to sequence. IMPORTANT: Watch for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed, pulled off, or removed.

8. From suction end, remove bolts (601) and remove bearing cap (35).
9. From suction end, uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).
10. From suction end, remove bolts (600). Remove bearing housing (99). Radial bearing (16) and oil seal (169) will come off with bearing housing (99).
11. Inspect radial bearing (16) and oil seal (169) for wear, corrosion or contamination. It is recommended that the bearing (16) and oil seal (169) be replaced when they are removed from the shaft (6). Refer to paragraph B of this section for bearing maintenance.
12. From suction end, remove spacer sleeve (14C) with slinger (40) intact.
13. For cartridge seals, make sure centering tabs are installed before loosening seal gland (17A) from cartridge. From suction end, remove nuts (615) from studs (630) on seal gland (17A). Remove seal gland (17A) with seal cartridge intact. Remove gland o-ring (89H) from seal gland (17A).
14. For non-cartridge seals, remove nuts (615) from studs (630) on seal gland (17A) from suction end. Remove seal gland (17A). Inspect stationary element of mechanical seal (90), if replacement is required remove from seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
15. From suction end, remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting suction case (203) and discharge case (197).

**CAUTION**

Use of a hoist with adequate capacity is recommended when lifting suction case (203).

16. From suction end, remove suction case (203) along with shaft sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90), if replacement is required remove from shaft sleeve (14A). Remove setscrews (665) from shaft collar (68). Remove shaft collar (68) from shaft.
17. From suction end, remove case o-ring (89D) from suction casing (203).
18. From suction end, remove sleeve o-ring (89B) and sleeve key (32B). Remove spacer sleeve (14E) or (14D). Remove first stage impeller (2A).
19. Remove interstage case (1) with diffuser (5A) and case o-ring (89D) intact. Remove o-ring (89D) from interstage case (1). Remove interstage sleeve (58). Remove interstage gaskets (73G) from both sides of interstage sleeve (58).
20. Remove impeller key (32A). Remove interstage impeller (2B).

21. Repeat steps 19 and 20 for each remaining stage. Number and match mark impellers as they are removed.
22. Remove last stage diffuser (5B). Do not remove bushing (63X) from last stage diffuser (5B).
23. From discharge end, remove bolts (601) from bearing cap (37). Remove bearing cap (37).
24. From discharge end, uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17B).
25. From discharge end, remove bolts (600). Remove bearing housing (99) and shaft assembly from discharge case (197). Thrust bearings (18) and oil seal (169) will come off with bearing housing (99).

**NOTE**

Bearing housing and shaft assembly consists of shaft (6), bearing spacer sleeve (78), discharge shaft sleeve (14B), mechanical seal (91), seal gland (17B), gland o-ring (89H), sleeve key (32B) discharge end only on WKH 65, o-rings (89D) and (89B), spacer sleeve (14D), spacer sleeve (14F) WKH 65 pumps only, slinger (40), oil seal (169), snap ring (176), thrust bearings (18), and bearing housing (99).

26. Inspect thrust bearings (18) and oil seal (169) for wear, corrosion or contamination. It is recommended that the bearings (18) and oil seal (169) be replaced when they are removed from the shaft (6). Refer to paragraph B of this section for bearing maintenance.
27. From discharge end, remove bearing spacer sleeve (78) with slinger (40) intact. Remove snap ring (176). Remove spacer sleeve (14D).
28. For cartridge seal, make sure centering tabs are installed before loosening seal gland (17B) from cartridge. From discharge end, remove nuts (615) from studs (630) on seal gland (17B). Remove seal gland (17B) with seal cartridge intact. Remove gland o-ring (89H) from seal gland (17B).
29. For non-cartridge mechanical seal, remove nuts (615) from studs (630) on seal gland (17B) from discharge end. Remove seal gland (17B). Inspect stationary element of mechanical seal (91), if replacement is required remove from seal gland (17B). Remove gland o-ring (89H) from seal gland (17B).
30. From discharge end, remove discharge shaft sleeve (14B). Remove spacer sleeve (14F) and sleeve key (32B), if necessary.
31. Remove o-ring (89B) from groove in shaft. Remove remaining impeller key (32A). Remove impeller key (32C), as necessary. Remove o-ring (89D) from discharge case (197).

## E. Parts Cleaning and Inspection

Whenever pump is disassembled, individual parts should be cleaned and inspected as follows:

1. Discard used oil seals, gaskets and o-rings. Thoroughly wash and clean all parts with a suitable solvent.
2. Check shaft for runout, scratches, grooves, or any possible damage. Touch up scratches and grooves with a polishing cloth and inspect for remaining grooves or deep scratches. Bent or excessively damaged shaft should be replaced.
3. Inspect mechanical seals. If mechanical seals are extremely dirty or damaged, they should be replaced or repaired.
4. Check all shaft sleeves and spacer sleeves visually for score marks, scratches, pits, grooves or burrs. Touch up sleeves with polishing cloth and inspect for remaining grooves or deep scratches. Remove burrs with a file. Shaft sleeves and spacer sleeves should be replaced if any marks, pits or grooves are still visible after touching up.
5. Inspect impellers for pitting, erosion, or clogged vanes. If impellers are damaged in any way, they should be replaced. If new impellers are installed, they must be axially aligned with respect to diffusers. Refer to paragraph F of this section for axial alignment procedures.
6. Inspect wear ring clearance for each stage as follows:
   a. Measure outside diameters of impeller hubs in three places.
   b. Measure inside diameters of corresponding wear rings in three places.
   c. Corresponding differences between high readings of inside diameters of wear rings and low readings of outside diameters of impellers. Refer to Table 7 for specified maximum diametrical clearance of wear rings.
   d. If replacement is required, take casings and impellers to a work area with access to machine shop equipment. Replace wear rings as described in paragraph G of this section.

Table 7. Wear Ring Clearances

| Pump Model | Maximum Diametrical Clearance |
|---|---|
| 50 | 0.038 inch (casing & diffuser) |
| 65 | 0.034 inch (casing & diffuser) |
| 80 | 0.036 inch (casing)<br>0.042 inch (diffuser) |
| 100 | 0.036 inch (casing & diffuser) |

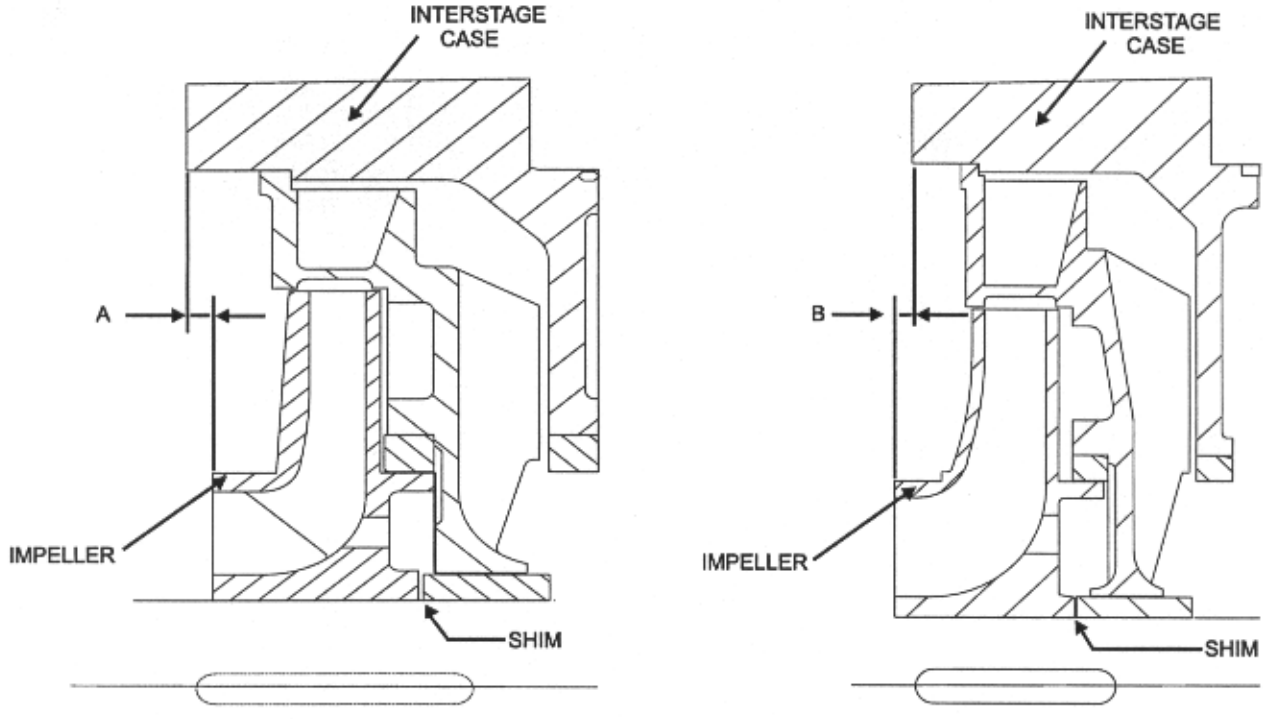
## F. Axial Impeller Alignment

If new parts are fitted during reassembly, such as impellers and/or sleeves, the last stage impeller must be axially aligned with respect to the diffuser, refer to Figure 6.

Measure distance from the inboard face of the interstage case to the inboard face of the impeller hub. Compare the measured distance to the dimensions given in Table 8. If shimming is required install shim between the impeller and the shaft sleeve as shown in Figure 6. Repeat measuring and shimming until the correct control dimension is achieved.

Table 8. Axial Alignment Control Dimensions

| Pump Model | Distance "A" ± 0.020 inch | Distance "B" ± 0.020 inch |
|---|---|---|
| 50 & 65 | 0.138 inch | |
| 80 | | 0.138 inch |
| 100 | | 0.098 inch |




WKH 50, 65

WKH 80, 100

Figure 6. Axial Impeller Alignment

## G. Wear Ring Replacement

1. Take casings and impellers to a machine shop.
2. Remove old wear ring from suction case, interstage case and/or diffuser. This can best be accomplished on a lathe.
3. Press new undersized wear ring in suction case, interstage case and/or diffuser.
4. Place impeller on an arbor and mount between centers in a lathe. Indicate back of impeller hub to within 0.002 inch TIR maximum to be sure arbor and impeller are running square.
5. Turn wearing surface of impeller until a 63 Root Means Square (RMS) or better finish is obtained.
6. Measure outside diameter of impeller hub and record.
7. Mount suction case, interstage case and/or diffuser in a lathe, with wear ring inserted. Indicate male rabbet to within 0.002 inch TIR maximum.
8. Bore wear ring to within the specified tolerance listed in Table 9 over the recorded size of outside diameter of impeller hub.
9. Return impeller and casings to pump assembly.

Table 9. New Wear Ring Clearance Limits

| Pump Model | Diametrical Clearance |
|---|---|
| 50 | 0.015 to 0.019 inch (casing & diffuser) |
| 65 | 0.013 to 0.017 inch (casing & diffuser) |
| 80 | 0.012 to 0.018 inch (casing) |
| | 0.017 to 0.021 inch (diffuser) |
| 100 | 0.011 to 0.016 inch (casing & diffuser) |

## H. Pump Reassembly WKH 50 and WKH 65

### Non-Cartridge Seal Settings

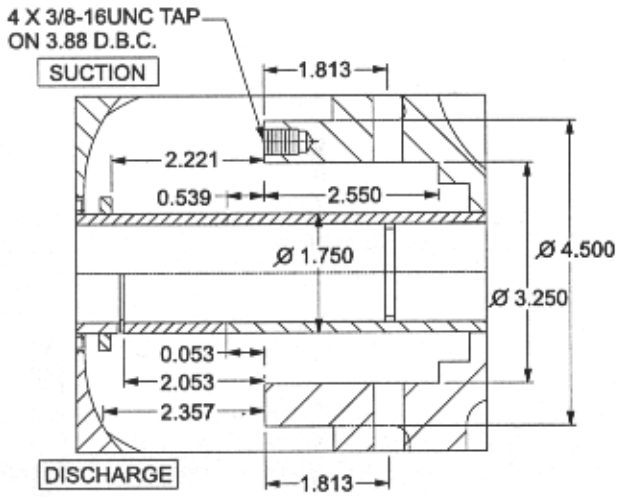
1. On discharge end, install sleeve o-ring (89B) in groove in shaft. Install sleeve key (32B), as necessary, and shaft sleeve (14B). For non-cartridge seal, if stationary element of mechanical seal is replaced, clean and dry seal gland (17B). Install stationary element of mechanical seal (91) in seal gland (17B). Install seal gland (17B) on shaft (6).
2. Install spacer sleeve (14D). Install bearing housing (99) and bolt to discharge case (197) with bolts (600). To obtain correct reading, install fake thrust bearings (recommend a piece of metal the same size of the bearings) on shaft.
3. Scribe a mark on shaft sleeve (14B) corresponding to bolting face of stuffing box in discharge case (197).
4. Remove bearing housing (99) from discharge case (197). Remove fake thrust bearings.
5. Scribe a second mark on shaft sleeve (14B) at the distant specified in Table 10 and applicable stuffing box drawing on Figure 7, to obtain seal setting. Remove spacer sleeve (14D) and seal gland (17B).

### Reassembly

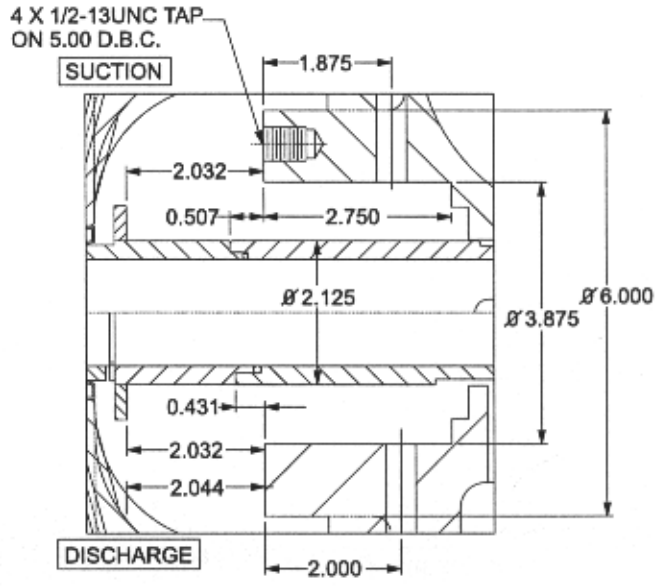
1. For non-cartridge seal, lubricate the interior diameter of mechanical seal (91) rotating elements and slide on shaft sleeve (14B), locating back edge of seal at second scribe mark. Tighten setscrews in mechanical seal (91).
2. Install gland o-ring (89H) on seal gland (17B). For non-cartridge seal, slide seal gland (17B) over shaft. For cartridge seal, install seal cartridge and seal gland (17B). Position seal cartridge on shaft. Secure seal gland (17B) with nuts (615) on studs (630), finger tight.
3. Install spacer sleeve (14D) and snap ring (176) on the shaft (6). Insure bushing (63X), if applicable, is inside last stage diffuser (5B). Install last stage diffuser (5B) and last stage impeller (2B) from suction end side.
4. Install bearing housing (99) and secure to discharge case (197) with bolts (600).
5. Install spacer sleeve (78) with slinger (40) intact. Carefully slide oil seal (169) over bearing spacer sleeve (78).
6. Slip fit thrust bearings (18) face-to-face on shaft (6). Install bearing lockwasher (69) so that tab of lockwasher fits into keyway on shaft (6). Install bearing locknut (22) and tighten against lockwasher (69) and bearing (18). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
7. Position bearing cap (37) so that grease overflow hole is on lower half of cap. Bolt cap (37) to bearing housing (99) with bolts (601).

Table 10. Mechanical Seal Settings (Non-Cartridge)

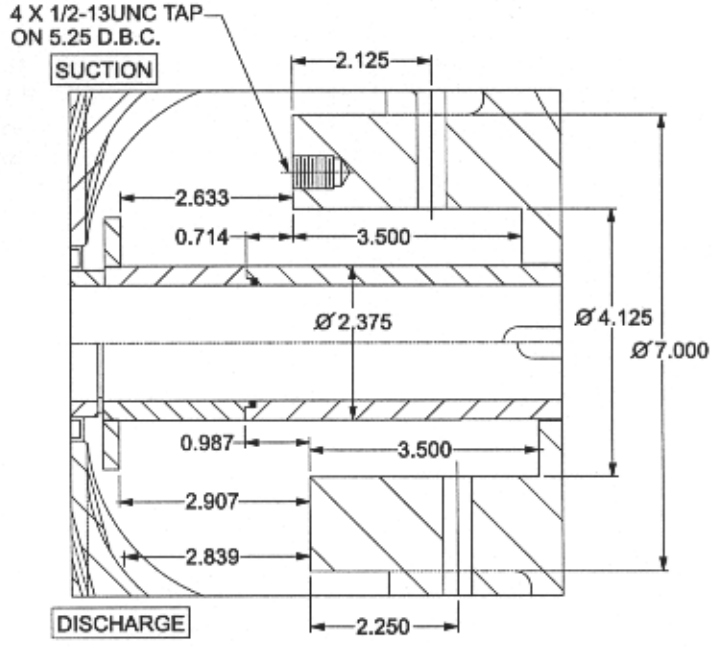
| Pump Model | Discharge End (Seal Type 8B1) | Suction End (Seal Type 1 or 21) |
|---|---|---|
| 50 & 65 | 1.375 inches | 1.000 inch |
| 80 | 1.750 inches | 2.187 inches |
| 100 | 1.812 inches | 1.906 inches |




WKH 50 & 65




WKH 80




WKH 100

Figure 7. Stuffing Box Drawings

8. From suction end, install spacer sleeve (14F) onto shaft (6), as necessary. Line up keyway of sleeve with end of sleeve key (32B).
9. Install lubricated o-ring (89D) on interstage case (1). Lightly tap diffuser (5A) into interstage case (1). Align diffuser vanes on either side of boss located in interstage case (1).
10. Install interstage sleeve gaskets (73G) on both sides of interstage sleeve (58). Slip stage sleeve (58) onto shaft (6) and insert impeller key (32A) and/or (32C).
11. Install interstage case (1) with diffuser (5A) over shaft and fit into discharge case (197). Make sure that wear ring (7B) is in stage case (1). Slide next impeller (2A) onto shaft (6) and align keyway of impeller with key (32A) in shaft (6).
12. Repeat steps 9 through 11 for each remaining stage.
13. On suction end, slide spacer sleeve (14E) or (14D) into position on shaft (6). Insert sleeve key (32B) in keyway in shaft (6).
14. Slide lubricated sleeve o-ring (89B) into groove in shaft (6). Slide lubricated casing o-ring (89D) on suction case (203). Make sure that suction case wear ring (7A) is in suction case (203).
15. Slide suction case (203) onto shaft (6) and tap into place against interstage case (1). Install tie bolts (173) and secure with washers (645) and hex nuts (616). Tighten hex nuts (616) firmly and evenly. Refer to Table 11 for recommended torque requirements.
16. If non-cartridge seal (90) does not need to be replaced, proceed to step 17. If a new non-cartridge seal needs to be installed, omit step (17) and proceed as follows:
    a. From suction end, mark shaft sleeve (14A) for key slot location. Slide shaft sleeve (14A) onto shaft (6). Align keyway of shaft sleeve with key (32B) in shaft.
    b. On suction end, slide spacer sleeve (14C) onto shaft (6) next to shaft sleeve (14A).
    c. Push impeller components toward discharge end with spacer sleeve (14C).
    d. Scribe a mark on shaft sleeve (14A) corresponding to outer edge of stuffing box.
    e. Remove suction end spacer sleeve (14C) and shaft sleeve (14A).
    f. Scribe a second mark on shaft sleeve (14A) at distance specified in Table10 from first scribe mark, toward discharge end.
    g. Slide shaft collar (68) onto shaft sleeve (14A). Locate suction end edge of collar at second scribe mark, refer to applicable stuffing box drawing on Figure 7. Secure shaft collar (68) with setscrews (665).
    h. Lubricate shaft sleeve (14A). If necessary, remove clips from new rotating element of mechanical seal. Slide mechanical seal (90) rotating elements onto suction end of shaft sleeve (14A), flush against shaft collar (68).
    i. Clean and dry seal gland. Carefully install lubricated mechanical seal (90) stationary element into seal gland (17A).
17. From suction end, mark shaft sleeve (14A) for key slot location. Slide shaft sleeve (14A) complete with shaft collar (68) and rotating element of mechanical seal (90) onto shaft. Align keyway of shaft sleeve with sleeve key (32B), as applicable. Stuffing box seal face setting should be checked using the scribe mark on shaft sleeve (14A). Secure shaft collar (68) with setscrews (665).
18. From suction end, install o-ring (89H) on seal gland (17A). For non-cartridge seal, slide seal gland (17A) complete with stationary element of mechanical seal (90) over shaft and onto studs (630). Ensure tap for flush line in gland is positioned so that the flush lines can be connected. For cartridge seal, install seal cartridge and seal gland (17A) on shaft (6). Position seal cartridge on shaft and install centering tabs. Secure seal gland (17A) with nuts (615) on studs (630), finger tight.
19. Bolt bearing housing (99) to suction case (203) with bolts (600). Position bearing housing (99) so that grease fitting is located on top of frame.
20. From suction end, install slinger (40) on spacer sleeve (14C). Slide spacer sleeve (14C) and oil seal (169) onto shaft (6).
21. Slip fit radial bearing (16) on shaft (6). Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6). Install bearing locknut (22) and tighten against lockwasher (69) and bearing (16). Ensure bearing (16) is pushed back completely. Crimp lockwasher (69) tab into slot provided on outside of bearing locknut (22).
22. From suction end, install inboard bearing cap (35) and bolt to bearing housing (99) with bolts (601). Position cap (35) with the grease overflow hole located on lower half of cap.

23. On both ends, tighten hex nuts (615) on studs (630) firmly and evenly securing seal gland (17A) and (17B). Install male connector (410) body in seal glands (17A) and (17B).
24. Install tube (400) and (408). Secure tube by tightening retaining nuts on tube connectors (410) and (411).
25. Install plugs (424) in bottom of discharge case (197), suction case (203), and each interstage (1). Install vent plug (423) in suction case (203) and discharge case (197).
26. Return pump to installation site. Reinstall pump on base and secure with bolts.
27. Install coupling key (46) in keyway in shaft (6). Reconnect coupling halves.
28. Align coupling. Reconnect coupling between pump and driver. Install coupling guard.
29. For cartridge seal pumps, remove centering tabs from cartridge.
30. Add grease to bearings through grease jerks (77) in bearing housings (99). Refer to paragraph B this section for bearing maintenance.
31. Reconnect suction, discharge, and gauge lines. After connecting piping, inspect shaft for concentricity.
32. Open system valves.
33. Unlock and reconnect the electrical power supply to the driver. Remove all tags. Start the pumping unit according to paragraph C of Section IV.

## I. Pump Disassembly WKH 80 and WKH 100

**NOTE**

Refer to paragraph C of Section I for safety precautions before disassembling pump.

1. Remove coupling half. Remove coupling key (46).
2. For cartridge seals, install centering tabs on seal cartridges to keep seal glands (17A) and (17B) in position.
3. Drain pump by removing drain plug (424) from the bottom each of interstage case (1), suction case (203), and discharge case (197).
4. Clamp down discharge case foot to steady pump during disassembly.
5. Number and match mark interstage cases so that suction case (203), interstage cases (1), impellers (2A) and (2B), and discharge case (197) will be reassembled in correct sequence and position.
6. Disconnect male connector retaining nuts from tube connector bodies (410) and (411). Remove tube (400) and (408). Retaining nuts will remain with tube. Pipe elbow (455) and pipe nipple (486) will remain in casing.
7. Support interstage cases (1) before dismantling to prevent them from dropping when suction case (203) is removed.

**NOTE**

Pump should be dismantled from suction end. Mark or number each component as it is dismantled according to sequence. IMPORTANT: Watch for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed, pulled off, or removed.

8. From suction end, remove bolts (601) and remove bearing cap (35).
9. From suction end, uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).
10. From suction end, remove bolts (600). Remove bearing housing (99). Radial bearing (16) and oil seal (169) will come off with bearing housing (99).
11. Inspect radial bearing (16) and oil seal (169) for wear, corrosion or contamination. It is recommended that the bearing (16) and oil seal (169) be replaced when they are removed from the shaft (6). Refer to paragraph B of this section for bearing maintenance.
12. From suction end, remove spacer sleeve (14G), as necessary. Remove spacer sleeve (14C) with slinger (40) intact.
13. For cartridge seals, make sure centering tabs are installed before loosening seal gland from cartridge. From suction end, remove nuts (615) from studs (630) or (631) and washers (646) WKH 100 units only, on seal gland (17A). Remove seal gland (17A) with seal cartridge intact. Remove gland o-ring (89H) from seal gland (17A).

14. For non-cartridge seals, remove nuts (615) from studs (630) or (631) and washers (646) WKH 100 units only, on seal gland (17A) from suction end. Remove seal gland (17A). Inspect stationary element of mechanical seal (90), if replacement is required remove from seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
15. From suction end, remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting suction case (203) and discharge case (197).

**CAUTION**

Use of a hoist with adequate capacity is recommended when lifting suction case (203).

16. From suction end, remove suction case (203) along with shaft sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90), if replacement is required remove from shaft sleeve (14A). Remove setscrews (665) from shaft collar (68). Remove shaft collar (68) from shaft.
17. From suction end, remove case o-ring (89D) from suction casing (203).
18. From suction end, remove sleeve o-ring (89B) and sleeve key (32B). Remove spacer sleeve (14E) and/or (14D). Remove first stage impeller (2A).
19. Remove interstage case (1) with diffuser (5A) and case o-ring (89D) intact. Remove o-ring (89D) from interstage case (1). Remove interstage sleeve (58). Remove interstage gaskets (73G) from both sides of interstage sleeve (58).
20. Remove impeller key (32A). Remove interstage impeller (2B), as applicable.
21. Repeat steps 19 and 20 for each remaining stage. Number and match mark impeller as they are removed.
22. Remove last stage diffuser (5B). Do not remove bushing (63X) from last stage diffuser (5B).
23. From discharge end, remove bolts (601) from bearing cap (37). Remove bearing cap (37).
24. From discharge end, uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17B).
25. From discharge end, remove bolts (600). Remove bearing housing (99) and shaft assembly from discharge case (197). Thrust bearings (18) and oil seal (169) will come off with bearing housing (99).

**NOTE**

Bearing housing and shaft assembly consists of shaft (6), bearing spacer sleeve (78), discharge shaft sleeve (14B), mechanical seal (91), seal gland (17B) or (17A), gland o-ring (89H), sleeve key (32B) or impeller key (32A), o-rings (89D) and (89B), spacer sleeve (14C), (14D) and/or (14E), slinger (40), oil seal (169), snap ring (176), thrust bearings (18), and bearing housing (99).

26. Inspect thrust bearings (18) and oil seal (169) for wear, corrosion or contamination. It is recommended that *the bearings (18) and oil seal (169) be replaced when they are removed from the shaft (6). Refer to paragraph* B of this section for bearing maintenance.
27. From discharge end, remove bearing spacer sleeve (78) with slinger (40) in intact. Remove snap ring (176). Remove spacer sleeve (14C) or (14D).
28. For cartridge seal, make sure centering tabs are installed before loosening seal gland (17B) from cartridge. From discharge end, remove nuts (615) from studs (630) on seal gland (17B) or (17A). Remove seal gland (17B) with seal cartridge intact. Remove gland o-ring (89H) from seal gland (17B) or (17A).
29. For non-cartridge mechanical seal, remove nuts (615) from studs (630) on seal gland (17B) or (17A) from discharge end. Remove seal gland (17B) or (17A). Inspect stationary element of mechanical seal (91), if replacement is required remove from seal gland (17B) or (17A). Remove gland o-ring (89H) from seal gland (17B) or (17A).
30. From discharge end, remove discharge shaft sleeve (14B). As necessary, remove spacer sleeve (14E) .
31. Remove o-ring (89B) from notch in sleeve (14C) or (14D). Remove remaining impeller key (32A) or sleeve key (32B). Remove o-ring (89D) from discharge case (197).
32. Refer to paragraphs E, F, and G of this section for additional maintenance.

## J. Pump Reassembly WKH 80 and WKH 100

### Non-Cartridge Seal Settings

1. On discharge end, install sleeve o-ring (89B) in groove in shaft. Install sleeve key (32B) and shaft sleeve (14B). For non-cartridge seal, if stationary element of mechanical seal is replaced, clean and dry seal gland (17A) or (17B). Install stationary element of mechanical seal (91) in seal gland (17A) or (17B). Install seal gland (17B) on shaft (6).
2. Install spacer sleeve (14C) or 14D), as necessary. Install bearing housing (99) and bolt to discharge case (197) with bolts (600). To obtain correct reading, install fake thrust bearings (recommend a piece of metal the same size of the bearings) on shaft.
3. Scribe a mark on shaft sleeve (14B) corresponding to bolting face of stuffing box in discharge case (197).
4. Remove bearing housing (99) from discharge case (197). Remove fake thrust bearings.
5. Scribe a second mark on shaft sleeve (14B) at the distant specified in Table 10 and applicable stuffing box drawing on Figure 7, to obtain seal setting. Remove spacer sleeve (14C) or (14D) and seal gland (17A) or (17B).

### Reassembly

1. For non-cartridge seal, lubricate the interior diameter of mechanical seal (91) rotating elements and slide on shaft sleeve (14B), locating back edge of seal at second scribe mark. Tighten setscrews in mechanical seal (91).
2. Install gland o-ring (89H) on seal gland (17A) or (17B). For non-cartridge seal, slide seal gland (17A) or (17B) over shaft. For cartridge seal, install seal cartridge and seal gland (17B). Position seal cartridge on shaft. Secure seal gland (17A) or (17B) with nuts (615) on studs (630), finger tight.
3. Install spacer sleeve (14D) or (14C) and snap ring (176) on the shaft (6). Insure bushing (63X) is inside last stage diffuser. Install sleeve key (32A) or (32B) and last stage diffuser (5B) and last stage impeller (2B), from suction end side.
4. Install bearing housing (99) and secure to discharge case (197) with bolts (600).
5. Install spacer sleeve (78) with slinger (40) intact. Carefully slide oil seal (169) over bearing spacer sleeve (78).
6. Slip fit thrust bearings (18) face-to-face on shaft (6). Install bearing lockwasher (69) so that tab of lock-washer fits into keyway on shaft (6). Install bearing locknut (22) and tighten against lockwasher (69) and bearing (18). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
7. Position bearing cap (37) so that grease overflow hole is on lower half of cap. Bolt cap (37) to bearing housing (99) with bolts (601).
8. From suction end, install spacer sleeve (14E), as necessary, onto shaft (6). Line up keyway of sleeve with end of sleeve key (32B).
9. Install lubricated o-ring (89D) on interstage case (1). Lightly tap diffuser (5A) into interstage case (1). Align diffuser vanes on either side of boss located in interstage case (1).
10. Install interstage sleeve gaskets (73G) on both sides of interstage sleeve (58). Slip stage sleeve (58) onto shaft (6) and insert impeller key (32A).
11. Install interstage case (1) with diffuser (5A) over shaft and fit into discharge case (197). Make sure wear ring (7B) is in stage case (1). Slide next impeller (2A) onto shaft (6) and align keyway of impeller with key (32A) in shaft (6).
12. Repeat steps 9 through 11 for each remaining stage.
13. On suction end, slide spacer sleeve (14E) and/or (14D) into position on shaft (6). Insert sleeve key (32B) in keyway in shaft (6).
14. Slide lubricated sleeve o-ring (89B) onto notch in sleeve (14D) or (14C). Slide lubricated casing o-ring (89D) on suction case (203).
15. Slide suction case (203) onto shaft (6) and tap into place against interstage case (1). Install tie bolts (173) and secure with washers (645) and hex nuts (616). Tighten hex nuts (616) firmly and evenly. Refer to Table 11 for recommended torque requirements.

16. If non-cartridge seal (90) does not need to be replaced, proceed to step 17. If a new non-cartridge seal needs to be installed, omit step (17) and proceed as follows:
    a. From suction end, mark shaft sleeve (14A) for key slot location. Slide shaft sleeve (14A) onto shaft (6). Align keyway of shaft sleeve with key (32B) in shaft.
    b. On suction end, slide spacer sleeve (14C) onto shaft (6) next to shaft sleeve (14A).
    c. Push impeller components toward discharge end with spacer sleeve (14C).
    d. Scribe a mark on shaft sleeve (14A) corresponding to outer edge of stuffing box.
    e. Remove suction end spacer sleeve (14C) and shaft sleeve (14A).
    f. Scribe a second mark on shaft sleeve (14A) at distance specified in Table 10 from first scribe mark, toward discharge end.
    g. Slide shaft collar (68) onto shaft sleeve (14A). Locate suction end edge of collar at second scribe mark, refer to applicable stuffing box drawing on Figure 7. Secure shaft collar (68) with setscrews (665).
    h. Lubricate shaft sleeve (14A). If necessary, remove clips from new rotating element of mechanical seal. Slide mechanical seal (90) rotating elements onto suction end of shaft sleeve (14A), flush against shaft collar (68).
    i. Clean and dry seal gland (17A). Carefully install lubricated mechanical seal stationary element into seal gland.
17. From suction end, mark shaft sleeve (14A) for key slot location. Slide shaft sleeve (14A) complete with shaft collar (68) and rotating element of mechanical seal (90) onto shaft aligning keyway of shaft sleeve with sleeve key (32B) as applicable. Stuffing box seal face setting should be checked using the scribe mark on shaft sleeve (14A). Secure shaft collar (68) with setscrews (665).
18. From suction end, install o-ring (89H) on seal gland (17A). For non-cartridge seal, slide seal gland (17A) complete with stationary element of mechanical seal (90) over shaft and onto studs (630). Ensure tap for flush line in gland are positioned so that the flush lines can be connected. For cartridge seal, install seal cartridge and seal gland (17A) on shaft (6). Position seal cartridge on shaft and install centering tabs. Secure seal gland (17A) with nuts (615) on studs (630) or (631), finger tight.
19. Bolt bearing housing (99) to suction case (203) with bolts (600). Position bearing housing (99) so that grease fitting is located on top of frame.
20. From suction end, install slinger (40) on spacer sleeve (14C). Slide spacer sleeve (14C) and install oil seal (169) onto shaft (6).
21. Slip fit radial bearing (16) on shaft (6). Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6). Install bearing locknut (22) and tighten against lockwasher (69) and bearing (16). Ensure bearing (16) is pushed back completely. Crimp lockwasher (69) tab into slot provided on outside of bearing locknut (22).
22. From suction end, install inboard bearing cap (35) and bolt to bearing housing (99) with bolts (601). Position cap (35) with the grease overflow hole located on lower half of cap.
23. On both ends, tighten hex nuts (615) on studs (630) firmly and evenly securing seal gland (17A) and (17B). Install male connector (410) body in seal glands (17A) and (17B).
24. Install tube (400) and (408). Secure tube by tightening retaining nuts on tube connectors (410) and (411).
25. Install plugs (424) in bottom of discharge case (197), suction case (203), and each interstage (1). Install vent plug (423) in suction case (203) and discharge case (197).
26. Return pump to installation site. Reinstall pump on base and secure with bolts.
27. Install coupling key (46) in keyway in shaft (6). Reconnect coupling halves.
28. Align coupling. Reconnect coupling between pump and driver. Install coupling guard.
29. For cartridge seal pumps, remove centering tabs from cartridge.
30. Add grease to bearings through grease jerks (77) in bearing housings (99). Refer to paragraph B this section for bearing maintenance.
31. Reconnect suction, discharge, and gauge lines. After connecting piping, inspect shaft for concentricity.
32. Open system valves.
33. Unlock and reconnect the electrical power supply to the driver. Remove all tags. Start the pumping unit according to paragraph C of Section IV.

## K. Torque Values

Refer to Table 11 for recommended torque values. Clean and properly lubricate threads.

Table 11. Recommended Torque Values

| Fastener Size | Torque (foot pounds) |
|---|---|
| 1/4-20 UNC | 5 |
| 5/16-18 UNC | 10 |
| 3/8-16 UNC | 15 |
| 1/2-13 UNC | 30 |
| 7/8-14 UNF | 315 |
| 1-12 UNF | 446 |

## L. Parts Inventory Guide

To avoid unnecessary delays for maintenance, spare parts should be on hand for normal service. Most conditions may be covered if this guide is followed. For every one to three pumps, stock one spare set consisting of items listed in Table 12. Part numbers correspond to Figure 10, 11, 12 or 13.

Table 12. Recommended Spare Parts

| Quantity | Item No. | Description |
|---|---|---|
| 1 | 2A | Impeller |
| AR | 2B | Impeller, Per Stage |
| 1 | 7A | Wear Ring, Suction Case |
| AR | 7B | Wear Ring, Diffuser Interstage Case |
| 1 | 14A | Shaft Sleeve, Suction End |
| 1 | 14B | Shaft Sleeve, Discharge End |
| AR | 14C | Spacer Sleeve, Suction End and/or Discharge End |
| AR | 14D | Spacer Sleeve, Suction End and/or Discharge End |
| AR | 14E | Spacer Sleeve, Suction End and/or Discharge End |
| 1 | 14F | Spacer Sleeve, Discharge End |
| 1 | 14G | Spacer Sleeve, Suction End |
| 1 | 16 | Radial Bearing, Suction End |
| 2 | 18 | Thrust Bearing, Discharge End |
| AR | 58 | Interstage Sleeve, Stage |
| AR | 73G | Gasket, Interstage Sleeve |
| 2 | 89B | O-Ring, Sleeve |
| AR | 89D | O-Ring, Case |
| 2 | *89E | O-Ring, Bearing Cap |
| 2 | *89F | O-Ring, Bearing Cap |
| 2 | *89G | O-Ring, Oil Cap |
| 2 | 89H | O-Ring, Gland |
| 1 | 90 | Mechanical Seal, Suction End |
| 1 | 91 | Mechanical Seal, Discharge End |
| 1 | 176 | Snap Ring, Discharge End |
| | | (AR As Required) |
| | | * Option |

## M. Parts Ordering

When ordering replacement parts, please specify:

1. Serial number of pump (located on nameplate).
2. Part name (located on parts list).
3. Quantity of parts needed.

Carver Pump Company may ship an interchangeable part that is not identical in appearance or symbol. This is done only if the part has been improved. Examine parts carefully upon delivery before questioning factory or representative. Never return parts to the factory without authorization from Carver Pump Company.

If an impeller is ordered, specify diameter across blade tips. Be sure diameter was not trimmed further than diameter shown on Carver Pump Company records.

If a driver or driver parts are ordered, specify name of manufacturer and all other data on driver nameplate.

# VI. Technical Data

**Effects of Viscosity.** The pump is designed to deliver rated capacity at rated head for a fluid with a particular viscosity. When pump is handling heavy viscous fluid, the viscosity of the fluid must allow it to be pumped easily. The fluid may have to be heated prior to starting the pump. When contemplating operation at some viscosity other than that for which the pump was originally designed, check with Carver Pump Company.

**Effects of Specific Gravity.** The capacity and total head in feet of fluid developed by a centrifugal pump are fixed for every point on the curve and are always the same for the same speed. Neither capacity nor total head will be affected by a change in the specific gravity of the fluid pumped. However, since the discharge pressure in pounds per square inch (psi) and the brake horsepower required to drive the pump are functions of the specific gravity of the fluid, both will be affected in direct proportion by any change in specific gravity. Therefore, an increase in specific gravity will raise the discharge pressure and is dangerous, as it might overload the driver, or exceed the pump case allowable pressure.

# VII. Options

## A. Oil Lube or Oil Mist Recommendations

Pump bearings can be of oil lube or oil mist option. Determine option before adding oil to pump.

**Oil Lube**

Pumps with oil lube option are shipped with no oil in bearing housing. Adequate lubrication with ISO Grade 68 oil is essential at all times. Refer to Table 13 for specific recommended oil types. To drain old oil from bearing housings, remove pipe plugs (426) at the bottom of oil caps (41A) and (41B). Add oil to bearing housing (99) through breather vent (405) until oil is at the center of the bullseye sight (143). Use bullseye sight (143) to check oil level in bearing housing (99). Add mark for proper level on oil level gauge (144) for easy visual reference. (Refer to oil level gauge drawing, Figure 8.)

Table 13. Oil Recommendations

| Manufacturer | ISO Grade 68 |
|---|---|
| Royal Purple | Snyfilm 68 |
| Texaco | Regal R&O 68 |
| Phillips | Magnus 68 |
| Exxon | Teresstic 68 |
| Mobil | DTE 16 M |

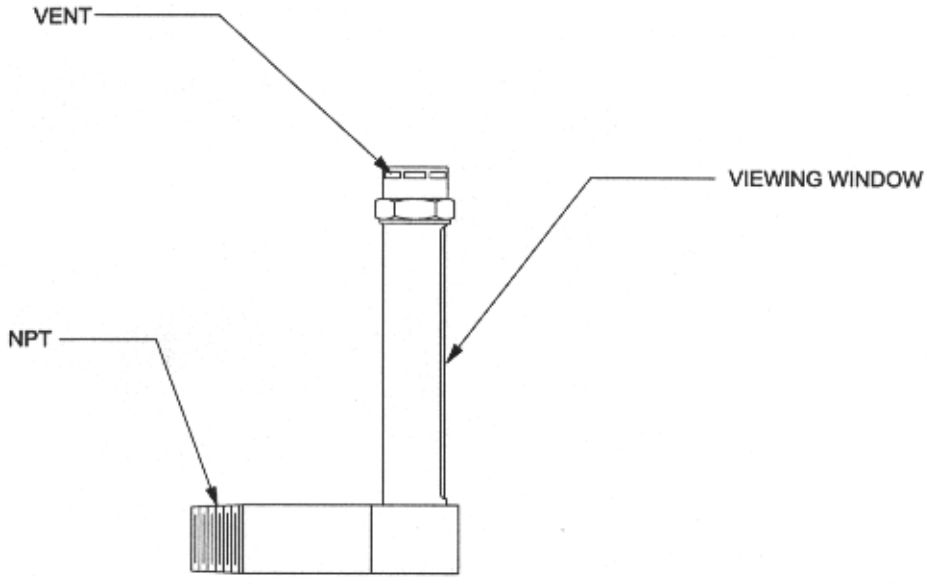



Figure 8. Oil Level Gauge

**Oil Mist**

Pumps with oil mist option come equipped with appropriate connections, 1/8 NPT for the oil mist and 1/4 NPT for the drain, to allow for the installation of an oil mist system. Proper oil mist lubrication provides the greatest protection against contamination by dirt and water. Plug (426) in bearing cap (41A) and (41B) remains plugged for oil mist lubricated bearings. For water cooled options, plug (425) in the bottom of the bearing cap (41A) and (41B) should be removed so that condensation can be drained and/or removed from the bearing housing (99).

## B. Bearing Lubrication and Cooling

Bearing lubrication and cooling options are shown on Figure 9 and parts list Table 14.

## C. Water Cooling Pump Repair

**Pump Disassembly**

1. Remove plugs (425) from bearing caps (35) or (37) on both ends and allow it to drain.
2. Remove plug (426) from bottom of oil caps (41A) and (41B) and drain oil.
3. Remove bolts (605) from oil cap (41A) and (41B). Remove oil caps (41A) and (41B). Remove o-ring (89G) from oil caps (41A) and (41B). Remove oil seal (168) from oil cap (41B).
4. Disconnect male connector retaining nuts from tube connector body (412). Remove tube (409). Retaining nuts will remain with tube.
5. Remove bearing caps (35) and (37) by removing bolts (601). Remove o-rings (89E) and (89F) from bearing caps.

**Pump Reassembly**

1. Install new o-rings (89E) and (89F) on bearing caps (35) and (37). Install bearing caps and secure to bearing housing (99) with bolts (601).
2. Install tube (409). Secure tube by tightening retaining nuts on tube connector (412).
3. Install new oil seal (168) on oil cap (41B). Install new o-ring (89G) on oil caps (41B) and (41A). Install oil caps (41A) and (41B) and secure with bolts (605).
4. Install plug (426) in bottom of oil caps (41A) and (41B).
5. Install plugs (425) in bearing caps (35) or (37) on both ends. Fill breather vent (405) with oil according to Table 13.

## D. Mechanical Seal

For a listing of mechanical seal options contact your local distributor or Carver Pump Company.

# VIII. Parts List and Drawing

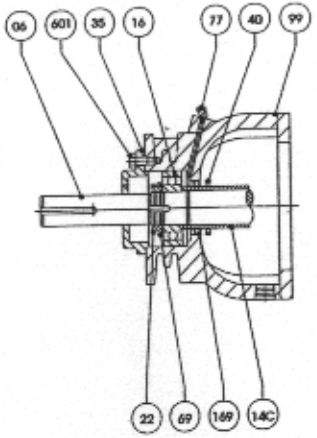
Refer to applicable WKH sectional drawing and table for the parts list for location of parts.

WKH 50 sectional assembly drawing see Figure 10 and parts list Table 15
WKH 65 sectional assembly drawing see Figure 11 and parts list Table 16
WKH 80 sectional assembly drawing see Figure 12 and parts list Table 17
WKH 100 sectional assembly drawing see Figure 13 and parts list Table 18

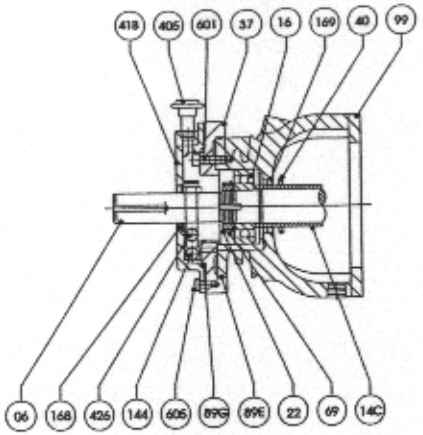
Table 14. Bearing Lubrication and Cooling Options Parts List

| Item No. | Part Name (Qty.) |
|---|---|
| 6 | Shaft (1) |
| 14C | Spacer Sleeve, Suction and/or Discharge Ends (1) |
| 16 | Radial Bearing (1) |
| 22 | Bearing Locknut (2) |
| 35 | Bearing Cap, Suction End or Discharge End (1) |
| 37 | Bearing Cap, Suction End or Discharge End (1) |
| 40 | Slinger (2) |
| *41A | Oil Cap, Discharge End (1) |
| 41B | Oil Cap, Suction End (1) |
| 69 | Bearing Lockwasher (2) |
| **76 | Oil Mist Fitting (1) |
| 77 | Grease Zerk (2) |
| 89E | O-Ring, Bearing Cap (2) |
| 89F | O-Ring, Bearing Cap (2) |
| 89G | O-Ring, Oil Cap (2) |
| 99 | Bearing Housing (2) |
| *143 | Bullseye Sight (2) |
| 144 | Oil Level Gauge (2) |
| 168 | Oil Seal, Suction End Oil Cap (1) |
| 169 | Oil Seal, Bearing Housing (2) |
| 226 | Cooling Nameplate (2) |
| 405 | Breather Vent, Oil Cap (2) |
| 409 | Tube (length varies with # of stages) |
| 412 | Male Connector (2) |
| 425 | Plug, Bearing Cap Drain (AR) |
| 426 | Plug, Oil Mist and Oil Lube (AR) |
| 601 | Bolt, Bearing Cap/Bearing Housing (8) |
| 605 | Bolt, Oil Cap/Bearing Cap (6) |
| 666 | Drivescrew (8) |

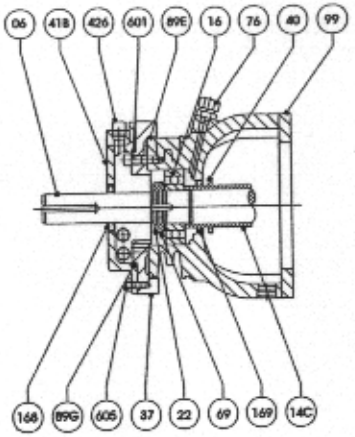
* Not shown on drawing
** Supplied by customer



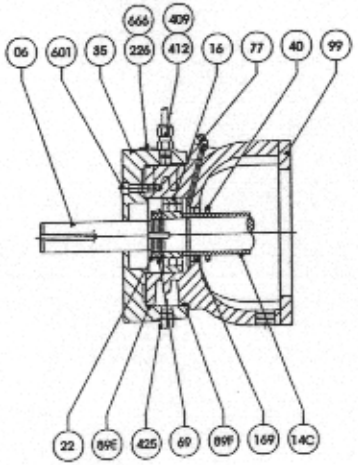

GREASE LUBE - AIR COOLED



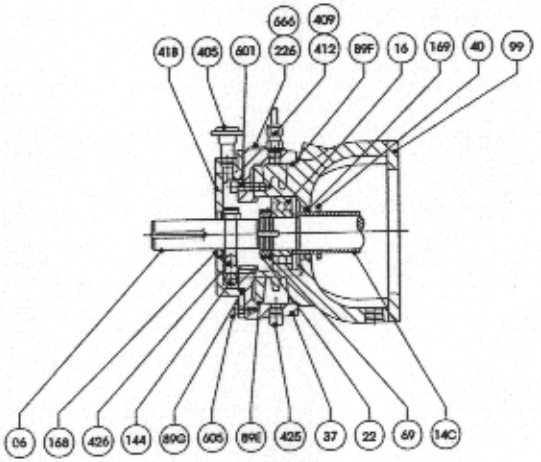

OIL LUBE - AIR COOLED



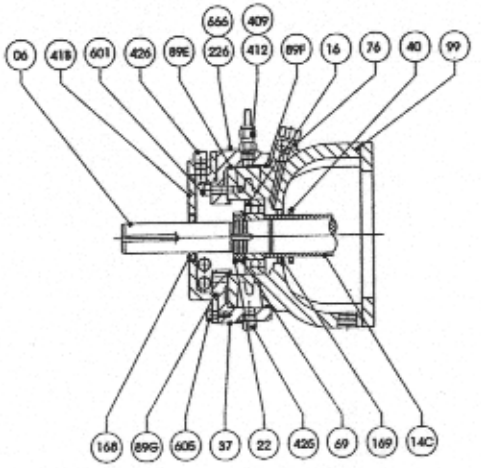

OIL MIST - AIR COOLED




GREASE LUBE - WATER COOLED




OIL LUBE - WATER COOLED




OIL MIST - WATER COOLED

Figure 9. Bearing Lubrication and Cooling Options

Table 15. Parts List Model WKH 50

| Item No. | Part Name (Qty.) | Item No. | Part Name (Qty.) |
|---|---|---|---|
| 1 | Interstage Case, Stage (AR) | 400 | Tube (1 piece 10" long) |
| 2A | Impeller, First Stage (1) | *405 | Breather Vent, Oil Cap (2) |
| 2B | Impeller, Stage (AR) | 408 | Tube (1 piece 24" long) |
| 5A | Diffuser, Stage (AR) | *409 | Tube (length varies with # of stages) |
| 5B | Diffuser, Last Stage (1) | 410 | Male Connector (2) |
| 6 | Shaft (1) | 411 | Male Connector (2) |
| 7A | Wear Ring, Suction Case (1) | *412 | Male Connector (2) |
| 7B | Wear Ring, Diffuser Interstage Case (AR) | 422 | Plug, Stuffing Box (4) |
| | | 423 | Plug, Gauge Connection (2) |
| 14A | Shaft Sleeve, Suction End (1) | 424 | Plug, Case Drain (AR) |
| 14B | Shaft Sleeve, Discharge End (1) | *425 | Plug, Bearing Cap Drain (AR) |
| 14C | Spacer Sleeve, Suction End (1) | *426 | Plug, Oil Mist and Oil Lube (AR) |
| 14D | Spacer Sleeve, Suction & Discharge Ends (2) | 455 | Pipe Elbow (2) |
| | | 486 | Pipe Nipple (2) |
| 16 | Radial Bearing, Suction End (1) | 600 | Bolt, Bearing Housing/Case (8) |
| 17A | Seal Gland, Suction End (1) | 601 | Bolt, Bearing Cap/Bearing Housing (8) |
| 17B | Seal Gland, Discharge End (1) | *605 | Bolt, Oil Cap/Bearing Cap (6) |
| 18 | Thrust Bearing, Discharge End (2) | 615 | Hex Nut, Seal Gland (8) |
| 22 | Bearing Locknut (2) | 616 | Hex Nut, Tie Bolt (8) |
| 32A | Impeller Key, Stage (AR) | 630 | Stud, Seal Gland (8) |
| 32B | Key, Sleeve (1) | 645 | Washer, Tie Bolt (8) |
| 32C | Key, Last Stage Sleeve (1) | 665 | Socket Head Setscrew, Shaft Collar (2) |
| 35 | Bearing Cap, Suction End (1) | | |
| 37 | Bearing Cap, Discharge End (1) | *666 | Drivescrew (8) |
| 40 | Slinger (2) | | |
| *41A | Oil Cap, Discharge End (1) | | |
| *41B | Oil Cap, Suction End (1) | | |
| 46 | Coupling Key (1) | | |
| 58 | Interstage Sleeve, Stage (AR) | | |
| 63X | Bushing, Last Stage Diffuser (1) | | |
| 68 | Shaft Collar, Suction End (1) | | |
| 69 | Bearing Lockwasher (2) | | |
| 73G | Gasket, Interstage Sleeve (AR) | | |
| 77 | Grease Zerk (2) | | |
| 78 | Spacer Sleeve, Bearing (1) | | |
| 89B | O-Ring, Sleeve (2) | | |
| 89D | O-Ring, Case (AR) | | |
| *89E | O-Ring, Bearing Cap (2) | | |
| *89F | O-Ring, Bearing Cap (2) | | |
| *89G | O-Ring, Oil Cap (2) | | |
| 89H | O-Ring, Gland (2) | | |
| 90 | Mechanical Seal, Suction End (1) | | |
| 91 | Mechanical Seal, Discharge End (1) | | |
| 99 | Bearing Housing (2) | | |
| *143 | Bullseye Sight (2) | | |
| *144 | Oil Level Gauge (2) | | |
| *168 | Oil Seal, Suction End Oil Cap (1) | | |
| 169 | Oil Seal, Bearing Housing (2) | | |
| 173 | Tie Bolt (4) | | |
| 176 | Snap Ring, Discharge End (1) | | |
| 197 | Discharge Case (1) | | |
| 203 | Suction Case (1) | | (AR As Required) |
| *226 | Cooling Nameplate (2) | | * Option |

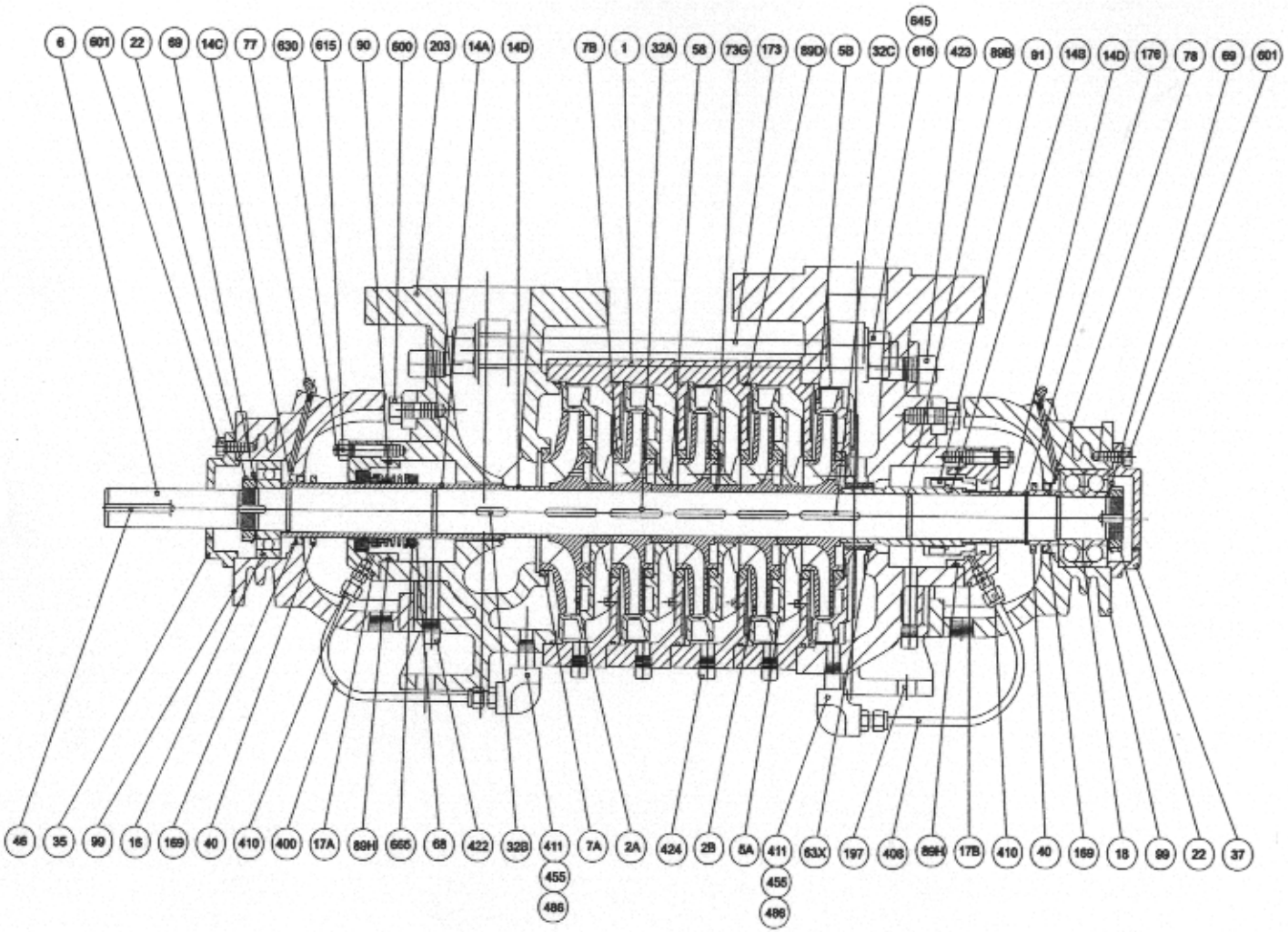



Figure 10. Sectional Assembly Drawing, WKH 50

Table 16. Parts List Model WKH 65

| Item No. | Part Name (Qty.) | Item No. | Part Name (Qty.) |
|---|---|---|---|
| 1 | Interstage Case, Stage (AR) | 400 | Tube (1 piece 10" long) |
| 2A | Impeller, First Stage (1) | *405 | Breather Vent, Oil Cap (2) |
| 2B | Impeller, Stage (AR) | 408 | Tube (1 piece 26" long) |
| 5A | Diffuser, Stage (AR) | *409 | Tube (length varies with # of stages) |
| 5B | Diffuser, Last Stage (1) | 410 | Male Connector (2) |
| 6 | Shaft (1) | 411 | Male Connector (2) |
| 7A | Wear Ring, Suction Case (1) | *412 | Male Connector (2) |
| 7B | Wear Ring, Diffuser Interstage Case (AR) | 422 | Plug, Stuffing Box (4) |
| | | 423 | Plug, Gauge Connection (2) |
| 14A | Shaft Sleeve, Suction End (1) | 424 | Plug, Case Drain (AR) |
| 14B | Shaft Sleeve, Discharge End (1) | *425 | Plug, Bearing Cap Drain (AR) |
| 14C | Spacer Sleeve, Suction End (1) | *426 | Plug, Oil Mist and Oil Lube (AR) |
| 14D | Spacer Sleeve, Discharge End (1) | 455 | Pipe Elbow (2) |
| 14E | Spacer Sleeve, Suction End (1) | 486 | Pipe Nipple (2) |
| 14F | Spacer Sleeve, Discharge End (1) | 600 | Bolt, Bearing Housing/Case (8) |
| 16 | Radial Bearing, Suction End (1) | 601 | Bolt, Bearing Cap/Bearing Housing (8) |
| 17A | Seal Gland, Suction End (1) | *605 | Bolt, Oil Cap/Bearing Cap (6) |
| 17B | Seal Gland, Discharge End (1) | 615 | Hex Nut, Seal Gland (8) |
| 18 | Thrust Bearing, Discharge End (2) | 616 | Hex Nut, Tie Bolt (8) |
| 22 | Bearing Locknut (2) | 630 | Stud, Seal Gland (8) |
| 32A | Impeller Key, Stage (AR) | 645 | Washer, Tie Bolt (8) |
| 32B | Key, Sleeve (2) | 665 | Socket Head Setscrew, Shaft Collar (2) |
| 35 | Bearing Cap, Suction End (1) | | |
| 37 | Bearing Cap, Discharge End (1) | *666 | Drivescrew (8) |
| 40 | Slinger (2) | | |
| *41A | Oil Cap, Discharge End (1) | | |
| *41B | Oil Cap, Suction End (1) | | |
| 46 | Coupling Key (1) | | |
| 58 | Interstage Sleeve, Stage (AR) | | |
| 63X | Bushing, Last Stage Diffuser (1) | | |
| 68 | Shaft Collar, Suction End (1) | | |
| 69 | Bearing Lockwasher (2) | | |
| 73G | Gasket, Interstage Sleeve (AR) | | |
| 77 | Grease Zerk (2) | | |
| 78 | Spacer Sleeve, Bearing (1) | | |
| 89B | O-Ring, Sleeve (2) | | |
| 89D | O-Ring, Case (AR) | | |
| *89E | O-Ring, Bearing Cap (2) | | |
| *89F | O-Ring, Bearing Cap (2) | | |
| *89G | O-Ring, Oil Cap (2) | | |
| 89H | O-Ring, Gland (2) | | |
| 90 | Mechanical Seal, Suction End (1) | | |
| 91 | Mechanical Seal, Discharge End (1) | | |
| 99 | Bearing Housing (2) | | |
| *143 | Bullseye Sight (2) | | |
| *144 | Oil Level Gauge (2) | | |
| *168 | Oil Seal, Suction End Oil Cap (1) | | |
| 169 | Oil Seal, Bearing Housing (2) | | |
| 173 | Tie Bolt (4) | | |
| 176 | Snap Ring, Discharge End (1) | | |
| 197 | Discharge Case (1) | | |
| 203 | Suction Case (1) | | (AR As Required) |
| *226 | Cooling Nameplate (2) | | *Option |

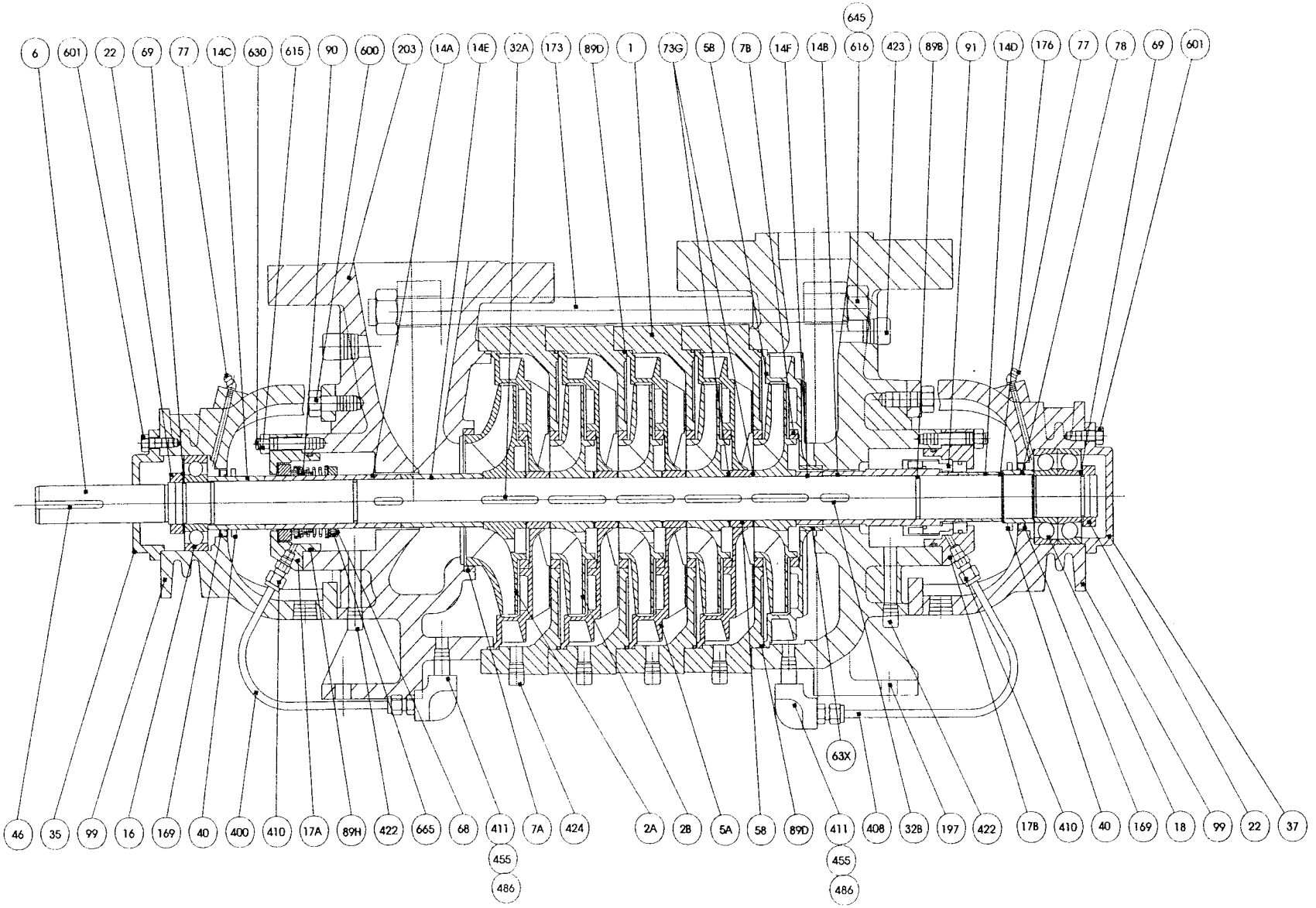



Figure 11. Sectional Assembly Drawing, WKH 65

Table 17. Parts List Model WKH 80

| Item No. | Part Name (Qty.) | Item No. | Part Name (Qty.) |
|---|---|---|---|
| 1 | Interstage Case, Stage (AR) | 400 | Tube (1 piece 14" long) |
| 2A | Impeller, First Stage (1) | *405 | Breather Vent, Oil Cap (2) |
| 2B | Impeller, Stage (AR) | 408 | Tube (1 piece 14" long) |
| 5A | Diffuser, Stage (AR) | *409 | Tube (length varies with # of stages) |
| 5B | Diffuser, Last Stage (1) | 410 | Male Connector (4) |
| 6 | Shaft (1) | 411 | Male Connector (2) |
| 7A | Wear Ring, Suction Case (1) | *412 | Male Connector (2) |
| 7B | Wear Ring, Diffuser Interstage Case (AR) | 422 | Plug, Stuffing Box (4) |
| | | 423 | Plug, Gauge Connection (3) |
| 14A | Shaft Sleeve, Suction End (1) | 424 | Plug, Case Drain (AR) |
| 14B | Shaft Sleeve, Discharge End (1) | *425 | Plug, Bearing Cap Drain (AR) |
| 14C | Spacer Sleeve, Suction End (1) | *426 | Plug, Oil Mist and Oil Lube (AR) |
| 14D | Spacer Sleeve, Discharge End (1) | 455 | Pipe Elbow (2) |
| 14E | Spacer Sleeve, Suction End (1) | 486 | Pipe Nipple (2) |
| 16 | Radial Bearing, Suction End (1) | 600 | Bolt, Bearing Housing/Case (8) |
| 17A | Seal Gland, Suction & Discharge Ends (2) | 601 | Bolt, Bearing Cap/Bearing Housing (8) |
| | | *605 | Bolt, Oil Cap/Bearing Cap (6) |
| 18 | Thrust Bearing, Discharge End (2) | 615 | Hex Nut, Seal Gland (8) |
| 22 | Bearing Locknut (2) | 616 | Hex Nut, Tie Bolt (8) |
| 32A | Impeller Key, Stage (AR) | 630 | Stud, Seal Gland (8) |
| 32B | Key, Sleeve (1) | 645 | Washer, Tie Bolt (8) |
| 35 | Bearing Cap, Suction End (1) | 665 | Socket Head Setscrew, Shaft Collar (2) |
| 37 | Bearing Cap, Discharge End (1) | | |
| 40 | Slinger (2) | *666 | Drivescrew (8) |
| *41A | Oil Cap, Discharge End (1) | | |
| *41B | Oil Cap, Suction End (1) | | |
| 46 | Coupling Key (1) | | |
| 58 | Interstage Sleeve, Stage (AR) | | |
| 63X | Bushing, Last Stage Diffuser (1) | | |
| 68 | Shaft Collar, Suction End (1) | | |
| 69 | Bearing Lockwasher (2) | | |
| 73G | Gasket, Interstage Sleeve (AR) | | |
| 77 | Grease Zerk (2) | | |
| 78 | Spacer Sleeve, Bearing (1) | | |
| 89B | O-Ring, Sleeve (2) | | |
| 89D | O-Ring, Case (AR) | | |
| *89E | O-Ring, Bearing Cap (2) | | |
| *89F | O-Ring, Bearing Cap (2) | | |
| *89G | O-Ring, Oil Cap (2) | | |
| 89H | O-Ring, Gland (2) | | |
| 90 | Mechanical Seal, Suction End (1) | | |
| 91 | Mechanical Seal, Discharge End (1) | | |
| 99 | Bearing Housing (2) | | |
| *143 | Bullseye Sight (2) | | |
| *144 | Oil Level Gauge (2) | | |
| *168 | Oil Seal, Suction End Oil Cap (1) | | |
| 169 | Oil Seal, Bearing Housing (2) | | |
| 173 | Tie Bolt (8) | | |
| 176 | Snap Ring, Discharge End (1) | | |
| 197 | Discharge Case (1) | | |
| 203 | Suction Case (1) | | (AR As Required) |
| *226 | Cooling Nameplate (2) | | * Option |

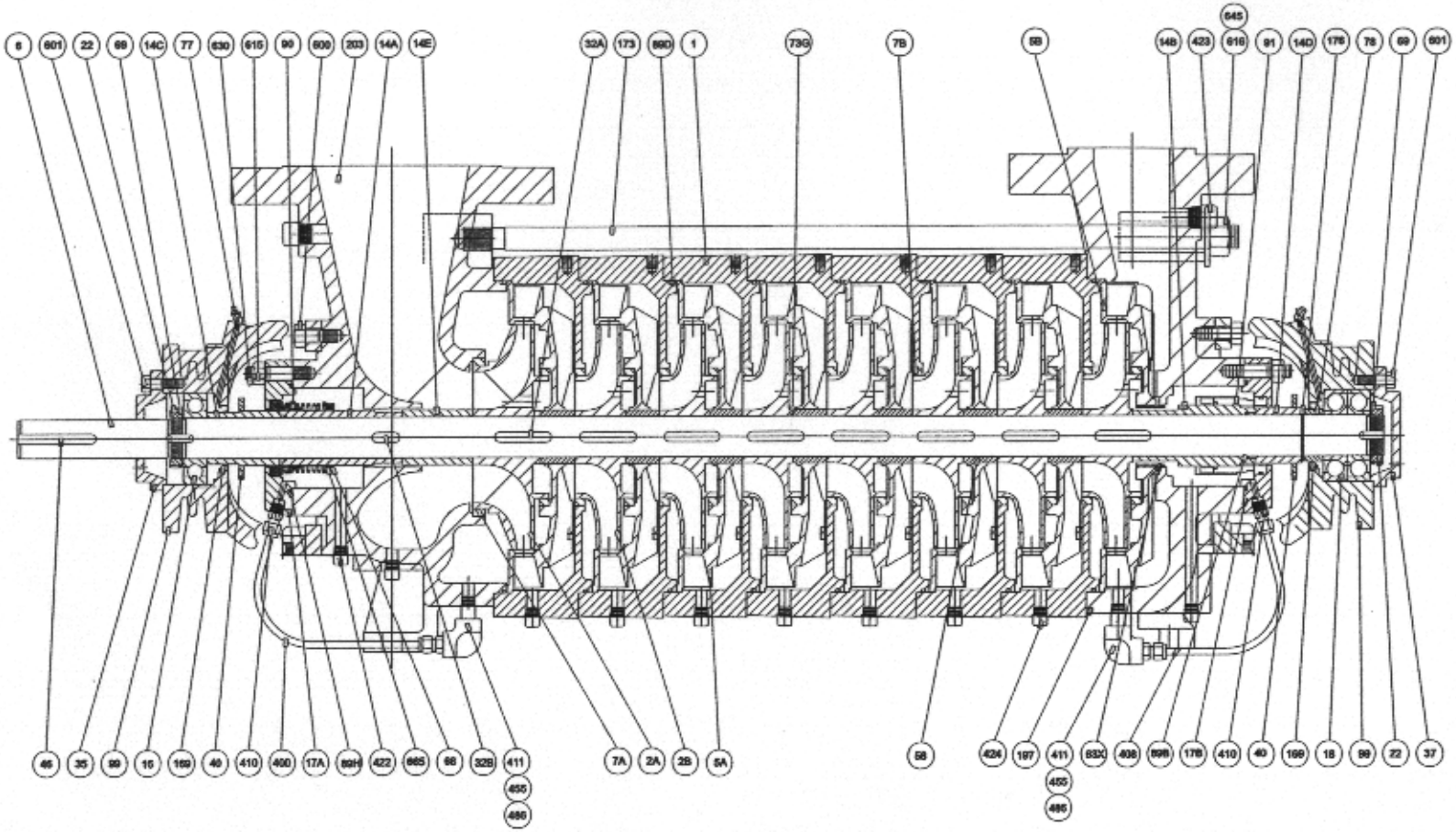



Figure 12. Sectional Assembly Drawing, WKH 80

Table 18. Parts List Model WKH 100

| Item No. | Part Name (Qty.) | Item No. | Part Name (Qty.) |
|---|---|---|---|
| 1 | Interstage Case, Stage (AR) | 203 | Suction Case (1) |
| 2A | Impeller, First Stage(AR) | *226 | Cooling Nameplate (2) |
| 2B | Impeller, Stage (AR) | 400 | Tube (1 piece 14" long) |
| 5A | Diffuser, Stage (AR) | *405 | Breather Vent, Oil Cap (2) |
| 5B | Diffuser, Last Stage (1) | 408 | Tube (1 piece 14" long) |
| 6 | Shaft (1) | *409 | Tube (length varies with # of stages) |
| 7A | Wear Ring, Suction Case (AR) | 410 | Male Connector (2) |
| 7B | Wear Ring, Diffuser Interstage Case (AR) | 411 | Male Connector (2) |
| | | *412 | Male Connector (2) |
| 14A | Shaft Sleeve, Suction End (1) | 422 | Plug, Stuffing Box (4) |
| 14B | Shaft Sleeve, Discharge End (1) | 423 | Plug, Gauge Connection (2) |
| 14C | Spacer Sleeve, Suction & Discharge Ends (2) | 424 | Plug, Case Drain (AR) |
| | | *425 | Plug, Bearing Cap Drain (AR) |
| 14D | Spacer Sleeve, Suction End (1) | *426 | Plug, Oil Mist and Oil Lube (AR) |
| 14E | Spacer Sleeve, Suction & Discharge Ends (2) | 455 | Pipe Elbow (2) |
| | | 486 | Pipe Nipple (2) |
| 14G | Spacer Sleeve Suction End (1) | 600 | Bolt, Bearing Housing/Case (8) |
| 16 | Radial Bearing, Suction End (1) | 601 | Bolt, Bearing Cap/Bearing Housing (8) |
| 17A | Seal Gland, Suction End (1) | *605 | Bolt, Oil Cap/Bearing Cap (6) |
| 17B | Seal Gland, Discharge End (1) | 615 | Hex Nut, Seal Gland (8) |
| 18 | Thrust Bearing, Discharge End (2) | 616 | Hex Nut, Tie Bolt (8) |
| 22 | Bearing Locknut (2) | 630 | Stud, Seal Gland Discharge End (4) |
| 32A | Impeller Key, Stage (AR) | 631 | Stud, Seal Gland Suction End (4) |
| 32B | Key, Sleeve (2) | 645 | Washer, Tie Bolt (8) |
| 35 | Bearing Cap, Suction End (1) | 646 | Washer, Suction End Seal Gland (8) |
| 37 | Bearing Cap, Discharge End (1) | 665 | Socket Head Setscrew, Shaft Collar (2) |
| 40 | Slinger (2) | | |
| *41A | Oil Cap, Discharge End (1) | *666 | Drivescrew (8) |
| *41B | Oil Cap, Suction End (1) | | |
| 46 | Coupling Key (1) | | |
| 58 | Interstage Sleeve, Stage (AR) | | |
| 63X | Bushing, Last Stage Diffuser (1) | | |
| 68 | Shaft Collar, Suction End (1) | | |
| 69 | Bearing Lockwasher (2) | | |
| 73G | Gasket, Interstage Sleeve (AR) | | |
| 77 | Grease Zerk (2) | | |
| 78 | Spacer Sleeve, Bearing (1) | | |
| 89B | O-Ring, Sleeve (2) | | |
| 89D | O-Ring, Case (AR) | | |
| *89E | O-Ring, Bearing Cap (2) | | |
| *89F | O-Ring, Bearing Cap (2) | | |
| *89G | O-Ring, Oil Cap (2) | | |
| 89H | O-Ring, Gland (2) | | |
| 90 | Mechanical Seal, Suction End (1) | | |
| 91 | Mechanical Seal, Discharge End (1) | | |
| 99 | Bearing Housing (2) | | |
| *143 | Bullseye Sight (2) | | |
| *144 | Oil Level Gauge (2) | | |
| *168 | Oil Seal, Suction End Oil Cap (1) | | |
| 169 | Oil Seal, Bearing Housing (2) | | |
| 173 | Tie Bolt (8) | | |
| 176 | Snap Ring, Discharge End (1) | | (AR As Required) |
| 197 | Discharge Case (1) | | * Option |

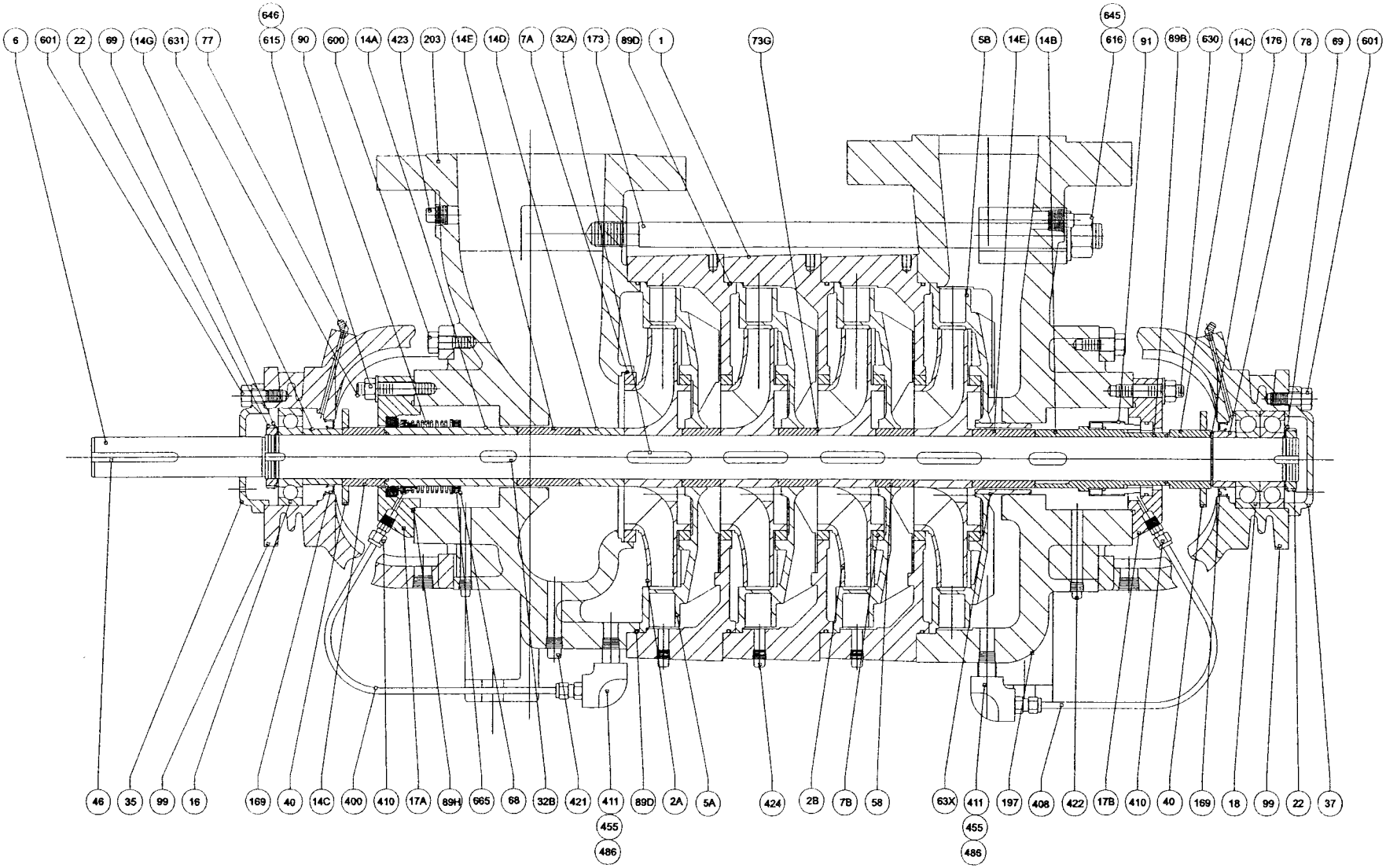



Figure 13. Sectional Assembly Drawing, WKH 100

## SERVICE RECORD PAGE

Service No. _____ Size and Type _____ Make _____

Cust. Order No. _____ Date Installed _____

| Installation Date | Location | Application |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## PUMP RATING

Capacity (GPM) _____ Total Head (ft) _____

Suction Pressure _____ Speed (RPM) _____

Liquid _____ Temperature _____

Specific Gravity _____ Viscosity _____

Impeller Diameter (inches) _____

## PUMP MATERIALS

Casings _____ Impeller _____ Diffuser _____

Shaft _____ Wear Ring _____

O-rings _____ Bearing Housing _____

Mechanical Seal, Suction End (Low Pressure) _____

Mechanical Seal, Discharge End (High Pressure) _____

## DRIVER DATA

Motor _____ Make _____ Serial No. _____

Type _____ Frame _____ AC or DC _____

HP _____ RPM _____ Volts _____

Phase _____ Cycles _____

## NOTES ON INSPECTION AND REPAIRS

| INSPECTION DATE | REPAIR TIME | REPAIRS | COST | REMARKS |
|---|---|---|---|---|
| | | | | |

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**CARVER PUMP COMPANY**
2415 Park Avenue • Muscatine, Iowa 52761-5691
(563) 263-3410 • FAX (563) 262-0510
E-Mail: carverpump@muscanet.com
WEB: www.carverpump.com

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