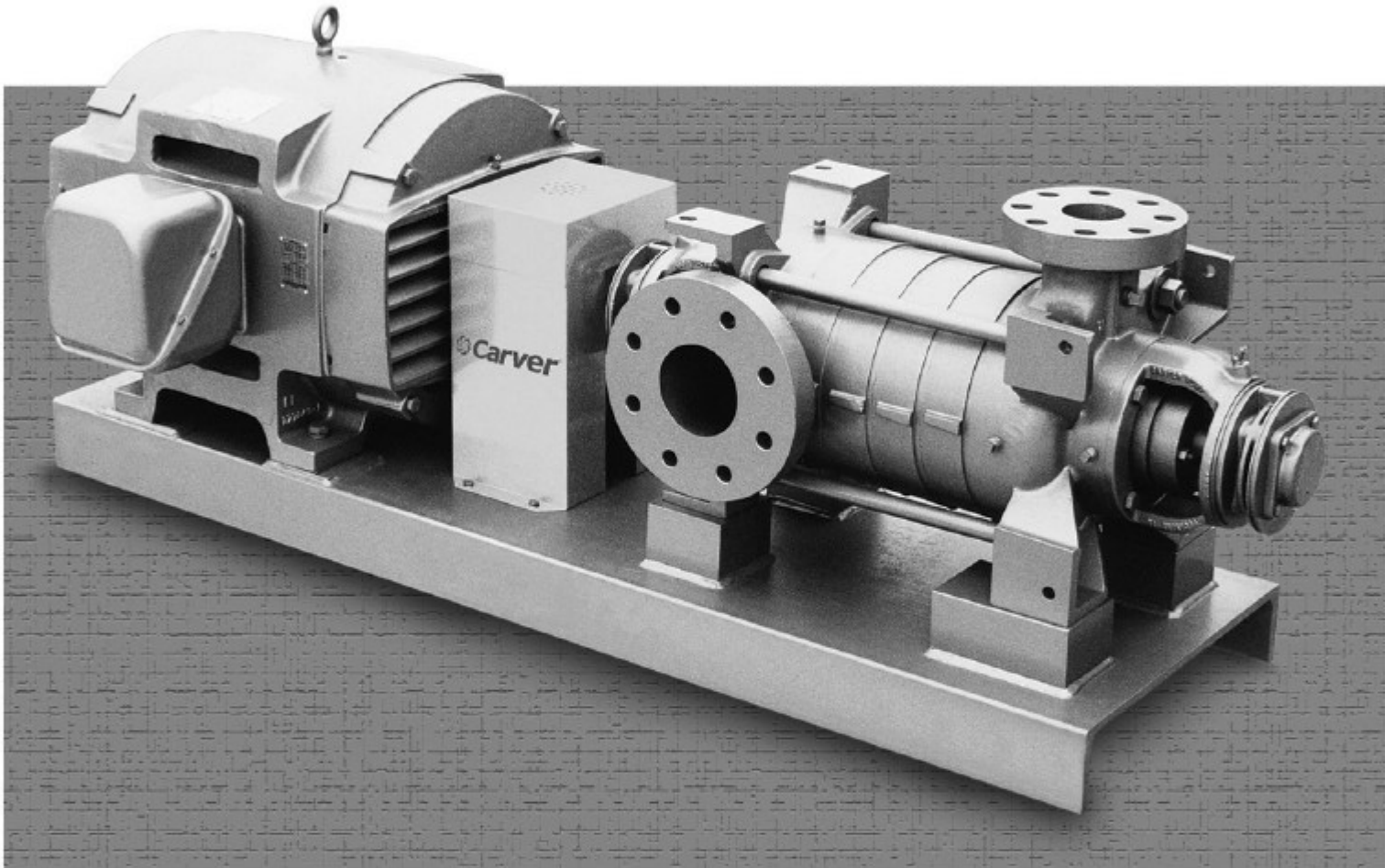


I-280

RS Series

*Installation, Operation
and Maintenance Manual*



 ***Carver***[®]

Creating Value.

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 Frame _____

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

TABLE OF CONTENTS

Location/Description	Page
I. General Information	1
A. Preface	1
B. Pump Identification	1
C. Parts Inventory Guide	1
D. Parts Ordering	1
E. Safety Precautions	1
F. Equipment Description	2
G. Effects of Fluids	2
H. Operating Limits	2
I. Mechanical Seal	2
J. Bearing Lubrication and Cooling	2
K. Grease Recommendations	4
L. Oil Lube Recommendations	4
M. Technical Data	7
N. Unpackaging	8
O. Packaging	8
P. Inspection upon Arrival	8
Q. Storage of Pump	8
R. Pump Protection during Prolonged Shutdown	8
II. Installation	9
A. Foundation and Mounting	9
B. Grouting	9
C. Handling	11
D. Coupling	11
E. Piping	12
F. Auxiliary Connections	12
III. Operation	13
A. Method of Operation	13
B. Pre-Start Cautions	13
C. Start-Up	13
D. Turbine Applications	14
IV. Troubleshooting	14
V. Maintenance and Repair	17
A. Scheduled Maintenance	17
B. Bearings	17
C. Torque Values	18
D. Disassembly and Assembly Preparations	19
E. Parts Cleaning and Inspection	20
F. Axial Impeller Alignment	21
G. Wear Ring Replacement	23
H. Oil Lubrication and Water Cooling Service	23
I. Pump Disassembly and Assembly RS A, RS B, RS C (with standard sleeve bearing) ..	27
J. Pump Disassembly and Assembly RS D and RS E (with standard sleeve bearing)	35
K. Pump Disassembly and Assembly RSA, RS B, RS C (with optional mechanical seals) ..	43
L. Pump Disassembly and Assembly RS D and RS E (with optional mechanical seals)	51

LIST OF TABLES

Table		Page
1.	Grease Recommendations	4
2.	Oil Recommendations	4
3.	Bearing Cooling Flow Rates	4
4.	Shaft Dimensions.....	7
5.	Sleeve Bearing Dimensions.....	7
6.	Standard Mechanical Seal Settings.....	7
7.	Optional Mechanical Seal Settings (Non-Cartridge)	7
8.	Minimum Flow Rates	14
9.	Pumping Unit Troubleshooting	15
10.	Recommended Torque Values.....	19
11.	Recommended Tools	19
12.	Axial Impeller Alignment Control Dimensions.....	22
13.	Maximum Wear Ring Clearances.....	23
14.	New Wear Ring Clearance Limits.....	23
15.	Recommended Spare Parts	59

LIST OF FIGURES

Figure		Page
A.	Ordering Codes	3
1.	Water Cooling	5
2.	Stuffing Box	6
3.	Grouting and Foundation Bolting	10
4.	Unit Leveling	10
5.	Coupling Alignment.....	11
6.	Adjusting Alignment	11
7.	Fluid Line Schematic	12
8.	Axial Impeller Alignment.....	22
9.	Cooling Options RS A, RS B, RS C, RS D, and RS E.....	25
10.	Sectional Assembly, RS A and RS B (with standard sleeve bearing).....	31
11.	Sectional Assembly, RS C (with standard sleeve bearing).....	33
12.	Sectional Assembly, RS D (with standard sleeve bearing).....	39
13.	Sectional Assembly, RS E (with standard sleeve bearing).....	41
14.	Sectional Assembly, RS A and RS B (with optional mechanical seals).....	47
15.	Sectional Assembly, RS C (with optional mechanical seals).....	49
16.	Sectional Assembly, RS D (with optional mechanical seals).....	55
17.	Sectional Assembly, RS E (with optional mechanical seals).....	57

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 this manual should be available to operating personnel. Additional copies of this manual are available upon request from Carver Pump Company and your local distributor. For comments and/or questions about information provided, please contact Carver Pump Company or your local distributor.

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. Record all necessary information on the pump service record page and inspection and repair record provided at the front of this manual. When ordering spare parts, check to make sure that the serial number and model number of the pump are correct. When ordering a pump, refer to Figure A, Ordering Codes. This information must be included in all correspondence regarding the unit. This will ensure that the correct pump and/or parts are ordered in a timely manner.

C. Parts Inventory Guide

To avoid unnecessary delays for maintenance, spare parts should be readily available for normal service. Most conditions will be covered if this manual is followed. For every one to three pumps, stock one spare set consisting of items listed in Table 15, Recommended Spare Parts. Part numbers correspond to Figures 9, through 17.

D. Parts Ordering

When ordering replacement parts, please specify:

- Serial number of pump (located on nameplate)
- Part name (located on parts list)
- 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 company 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 found on the driver nameplate.

E. Safety Precautions

The following general safety precautions do not relate to any specific procedure and therefore, do not appear elsewhere in this publication. Personnel must understand and apply the recommended precautions throughout the many phases of operation and maintenance of the pump. Personnel must also understand and apply the electrical driver, which is used to drive the pump. The safety precautions are as follows:

1. Various federal, state, and local laws affect installation, use, and operation of pumping equipment. Compliance with such laws relating to proper installation and safe operation of pumping equipment is the responsibility of the equipment owner.
2. Prior to working on pump or driver, ensure 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 or torn clothing around rotating machines.
5. While working near electricity, do NOT use metal rules, flashlights, metallic pencils, or any other objects having exposed conducting material.
6. Make sure you are NOT grounded while adjusting electrical equipment or using measuring equipment.
7. In general, use only one hand when servicing live electrical equipment.

8. Make sure to de-energize all electrical equipment before connecting or disconnecting meters or test leads.
9. For connecting a meter to terminals for measurement, use a range higher than the expected voltage.
10. Check to make sure that the frame of the driver and starter panel are securely grounded before operating pumping unit or performing any tests or measurements.
11. If a test meter must be held or adjusted while voltage is applied, ground case of meter before starting measurement. Do NOT touch live equipment while holding the meter. Some moving vane-type meters should not be grounded nor held during measurements.
12. Do NOT use test equipment known to be damaged or in poor condition.

The following specific safety precautions apply to the pumping 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 on discharge case.

F. Equipment Description

RS high-pressure pumps are multi-stage, 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. Due to prolonged operation, wear rings become worn and/or damaged. Replace all worn and/or damaged wear rings with new wear rings. The bearing frame is 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 the pump shaft by keys. All impellers face the same direction on the shaft.

RS 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.

G. Effects of Fluids

Effects of Viscosity

The pump is designed to deliver rated capacity at rated head for a fluid with a particular viscosity. If the pump is handling heavy viscous fluid, the fluid may have to be heated prior to starting the pump in order to travel through the pump easier. If contemplating operating the pump at a viscosity, other than 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 to 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.

H. Operating Limits

Pump operating temperature for uncooled bearings should NOT exceed 225 degrees Fahrenheit (F). Pumps of high temperature construction are provided with cooled bearings with an operating temperature range between 225 and 410 degrees F. Cooling water flows through cavities of the bearing frame and keeps temperature of the bearings within acceptable limits. Refer to Table 3 for cooling flow rates of water temperature of 60 degrees F for bearings. Refer to Figure 1 illustrating the water cooling (60 PSIG MAX.) system.

I. Mechanical Seal

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

J. Bearing Lubrication and Cooling

Refer to Figure 9, Cooling Options, for bearing lubrication and cooling options.

The following Ordering Code defines the new RS Series pump and pump/motor and baseplate arrangements. When quoting or ordering an RS pump **this Ordering Code must be used**. This Ordering Code enables Carver Pump Company to accept orders quickly and assures timely and correct manufacture of the desired pump.

EXAMPLE

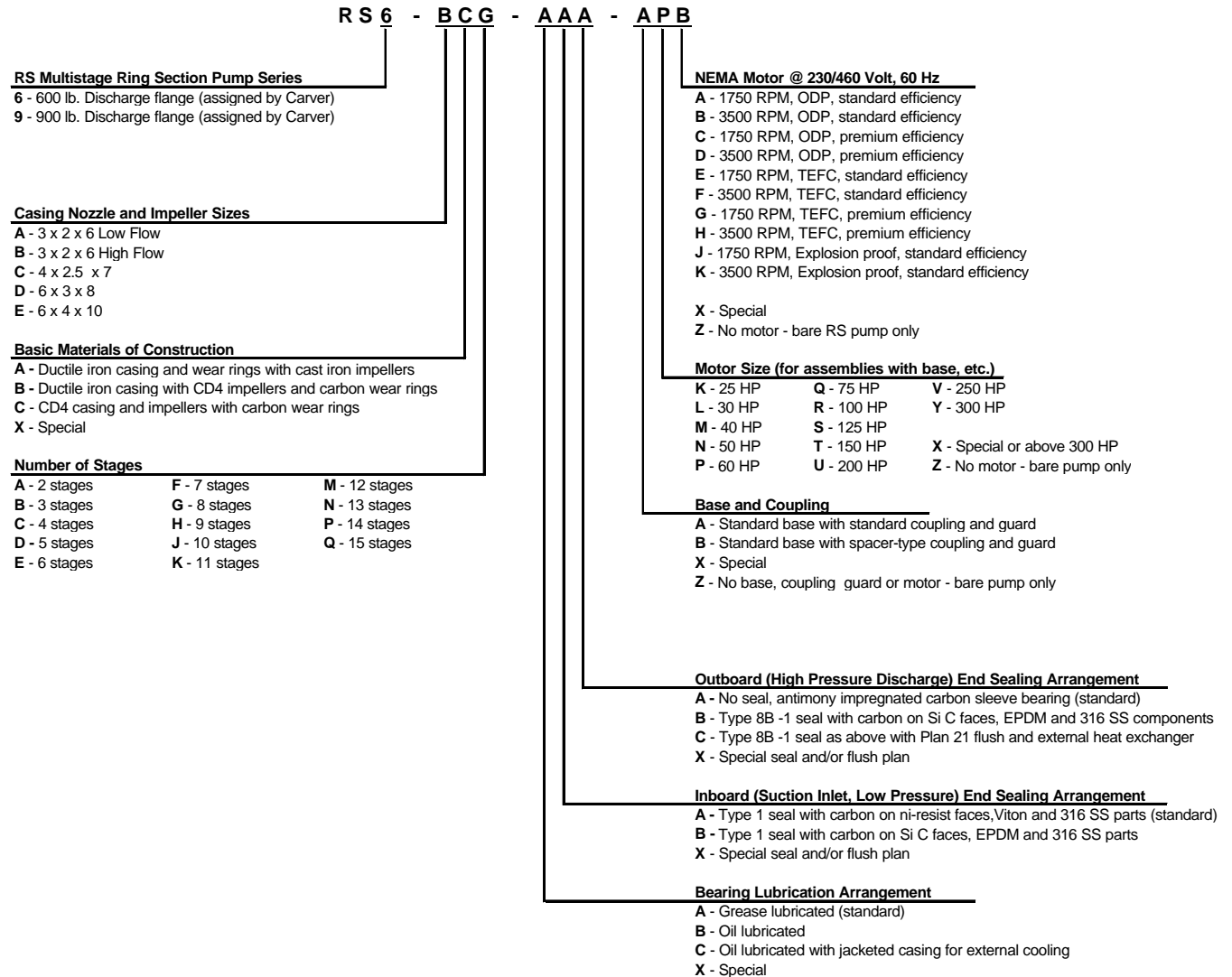


Figure A. Ordering Codes

K. Grease Recommendations

Standard pump bearings are grease lubricated. Refer to Section V, paragraph B, for grease-lubricated bearings.

A non-soap polyurea thickened grease with a drop point of 450 degrees Fahrenheit is recommended for bearing grease. 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, the type of grease added should NOT vary. Refer to Table 1 for specific recommended grease types.

L. Oil Lube Recommendations

Pumps with oil lubrication are shipped with no oil in the bearing frame. Adequate lubrication with ISO Grade 68 oil is essential at all times. Refer to Table 1, Oil Recommendations, for specific oil types. Refer to Section V, paragraph B for oil-lubricated bearings.

Table 1. Grease Recommendations

<i>Manufacturer</i>	<i>Number</i>
Amoco	2EP
Aero Shell	22
Mobil	28

Table 2. Oil Recommendations

<i>Manufacturer</i>	<i>ISO Grade 68</i>
Royal Purple	Snyfilm 68
Texaco	Regal R&O 68
Phillips	Magnus 68
Exxon	Teresstic 68
Mobil	DTE 16 M

Table 3. Bearing Cooling Flow Rates (60 PSIG MAX.)

<i>Temperature Range</i>	<i>Flow Rate</i>
-20 degrees to 180 degrees F -20 degrees to 225 degrees F 225 degrees to 285 degrees F 285 degrees to 410 degrees F	Grease Lube - Air Oil Lube - Air Oil Lube - Water-1 Gallons Per Minute (GPM) Oil Lube - Water-2 GPM

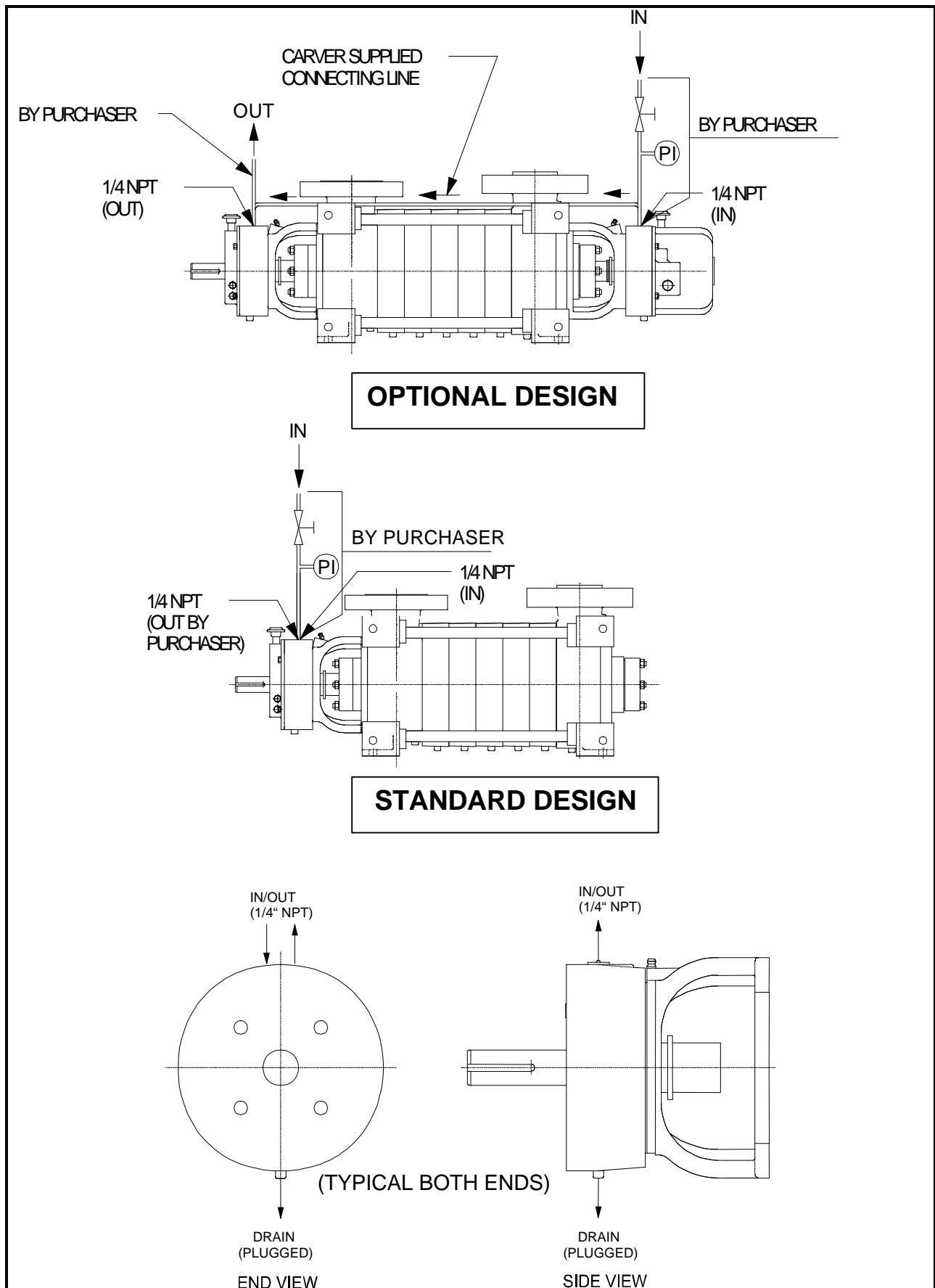


Figure 1. Water Cooling

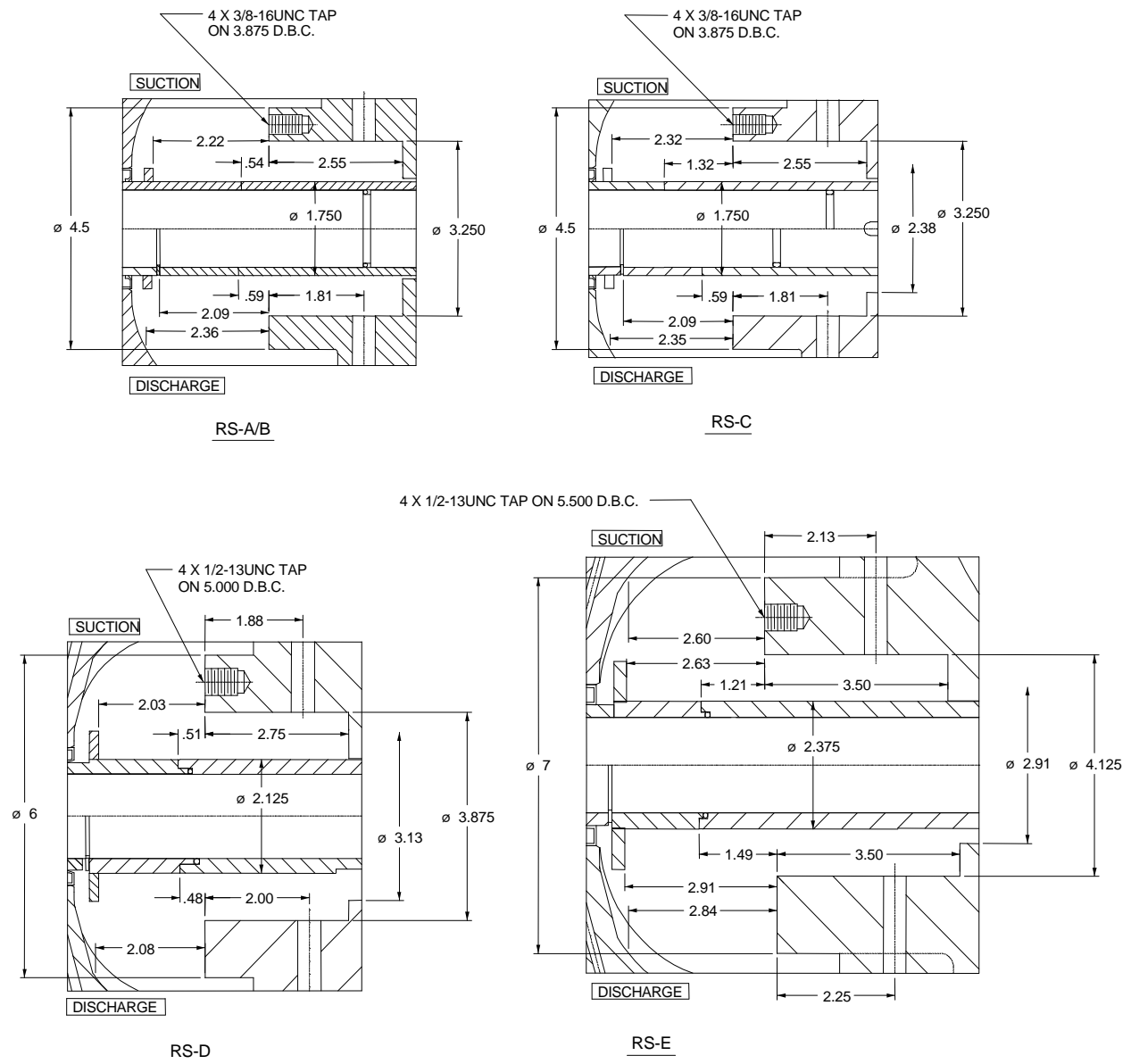


Figure 2. Stuffing Box

M. Technical Data

Specifications and operating limits should be recorded on the Service Record Page located in the front matter of this manual. Record the

necessary information upon receipt of the pumping unit.

Table 4. Shaft Dimensions

Pump Model	At Impeller	At Coupling
RS A	1.437 inches	1.250 inches
RS B	1.437 inches	1.250 inches
RS C	1.437 inches	1.250 inches
RS D	1.574 inches	1.500 inches
RS E	1.771 inches	1.625 inches

Table 5. Sleeve Bearing Dimensions

Pump Model	Sleeve Bearing		Sleeve	
	New	Replace	New	Replace
RS A	1.755/1.756 inches	>1.758 inches	1.751/1.749 inches	>1.746 inches
RS B	1.755/1.756 inches	>1.758 inches	1.751/1.749 inches	>1.746 inches
RS C	1.755/1.756 inches	>1.758 inches	1.751/1.749 inches	>1.746 inches
RS D	1.969/1.970 inches	>1.972 inches	1.965/1.963 inches	>1.961 inches
RS E	2.380/2.381 inches	>2.383 inches	2.375/2.373 inches	>2.371 inches

Table 6. Standard Mechanical Seal Settings (*from end of sleeve to face of collar*)

Pump Model	Suction End
RS A	1.479 inches
RS B	1.479 inches
RS C	2.237 inches
RS D	1.799 inches
RS E	2.807 inches

Table 7. Optional Mechanical Seal Settings (Non-Cartridge) (*from face of box to face of collar*)

Pump Model	Discharge End (Seal Type 8B1 or 8B1T) (for reference only)	Suction End (Seal Type 1 or 21)
RS A	1.375 inches	1.000 inch
RS B	1.375 inches	1.000 inch
RS C	1.375 inches	1.000 inch
RS D	1.750 inches	2.062 inches
RS E	1.812 inches	1.906 inches

N. Unpackaging

After receiving the pumping unit, inspect for missing hardware, flange covers or possible damage. In general, check to make sure the shipment complies with the purchase order. Inspect any parts containers that may be shipped with unit (i.e. coupling, seals, etc.). Immediately report any damage or shortage to the carrier's agent or factory. Claims that are made at a later time cannot be accepted.

O. Packaging

If the pumping unit is sent back to Carver Pump Company for repair, drain the unit, and re-seal all flanges and connections that were covered or plugged. Ship the pump(s) in an assembled condition to prevent damage to sealing faces of individual components. A Material Safety Data Sheet (MSDS) is required on all returned pumps. Copies of MSDS records should be kept and maintained by the customer. The customer is responsible for cleaning and flushing the pump before it is returned to the factory. Make sure to specify the fluid used in the service.

P. Inspection upon Arrival

NOTE

The pump and equipment, as shipped from Carver Pump Company, have adequate protection for short-term storage. If the equipment is NOT immediately installed and operated, store the equipment in a covered, clean, dry, well-ventilated location, free from vibrations, moisture, and rapid or wide variations in temperature.

Q. Storage of Pump

If the equipment is NOT immediately installed and operated, Carver Pump Company recommends rotating each shaft several revolutions at least once every two weeks to prevent flat spots on ball bearings.

Consider a unit to be in storage when any of the following situations occur:

- The pump has been delivered to the job site and is waiting to be installed.
- The pump has been installed but operation is delayed pending completion of construction.
- There are long (30 days or more) periods between operating cycles.

- The plant (or department) is shut down for periods of longer than 30 days.

caution

A pump which is made of cast or ductile iron that sits in extreme heat, high humidity, or full or partially full water over 30 days will rust and will most likely seize. If the pump rusts and/or seizes, a complete overhaul and repair may be necessary to refurbish the pump.

Storage requirements vary depending on the length of storage, the climatic environment, and the equipment. For storage periods of three months or longer, contact a representative from Carver Pump Company for specific instructions. Improper storage will damage the equipment and will require non-warranty restoration and/or non-warranty product failures. Refer to Section V, Maintenance and Repair, for pump disassembly and assembly procedures. When disassembling the pump, replace and repair rusted parts, as necessary.

R. Pump Protection during Prolonged Shutdown

NOTE

If the customer anticipates that the pump/equipment will be subject to an extended period of storage after installation, (for example, a unit used for seasonal operation), contact a representative from Carver Pump Company. If this is the case, Carver will provide specific instructions and special protection for the equipment during the extended period of storage. In general, if a pump is to be shut down for an extended period, the following steps are recommended:

1. Shut down the pumping unit in accordance with the Operating Procedures outlined in this manual.
2. Shut off system suction and discharge valves.
3. Drain the unit.
4. Fill unit with mineral oil or suitable non-corrosive protectant that is compatible with the system.
5. Provide pump and motor with a protective cover.

II. Installation

A. Foundation and Mounting

caution

A hoist or suitable lifting device should be used to lift the pumping unit. Do NOT lift the complete unit by the driver, the pump shafts or the 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. Consequently, maintaining the alignment is important for a flexible coupled unit. Refer to Figure 5 and Figure 6 illustrating alignment. A concrete foundation on a solid base is recommended. Use foundation bolts of the proper size embedded into the concrete. A pipe sleeve larger in diameter than the bolt should be used. This allows movement for final positioning of the bolts. Refer to Figure 3, Grouting and Foundation Bolting.

As soon as 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. The base plate should be supported on either rectangular metal blocks with shims or on metal wedges having a small taper. The support pieces should be placed close to the foundation bolts. Refer to Figure 4, Unit Leveling. Place supports directly under the part of the base plate, which carries the greatest weight. Space the supports closely enough to provide uniform support of the base

plate. Adjust the metal supports or wedges until the pump and driver shafts are level. Check coupling faces, as well as, suction and discharge flanges of the pump for horizontal or vertical positioning by means of a level. Make corrections, as necessary, by adjusting the supports or wedges under the base plate.

B. Grouting

After the pumping unit has been leveled and the alignment is correct, grout the unit to the foundation using a high-grade, non-shrinking grout. Proceed grouting using the following procedure:

1. Lightly tighten foundation bolts evenly but not fully. Refer to Figure 3, Grouting and Foundation Bolting.
2. Build a wooden dam around the base plate to retain the grout.
3. Pour grout through grouting holes provided in base plate. This should be done until the entire space under base plate is filled. While filling the holes, make sure there are no voids or air pockets.
4. Insert a stiff wire through the grouting holes to work the grout and release any voids or 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.

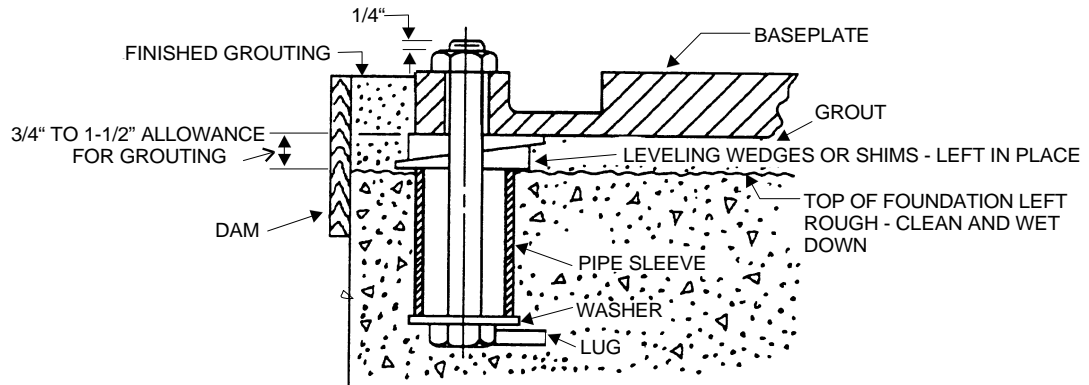


Figure 3. Grouting and Foundation Bolting

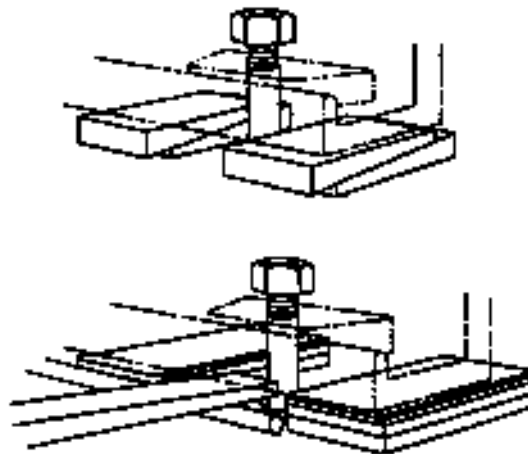


Figure 4. Unit Leveling

C. Handling

caution

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

The complete pumping unit must be handled with care. Do NOT pass the lifting slings through the 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 5, Coupling Alignment.

Proceed as follows with parallel alignment:

NOTE

The corrections, which are made to the alignment in one direction, may affect the alignment in the other direction. Angular and parallel misalignment are corrected by means of shims. The shims are placed under the driver mounting feet to align the coupling. Refer to Figure 6, Adjusting Alignment.

1. Check the parallel misalignment by fastening the dial indicator to the pump half of the coupling.

2. 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.

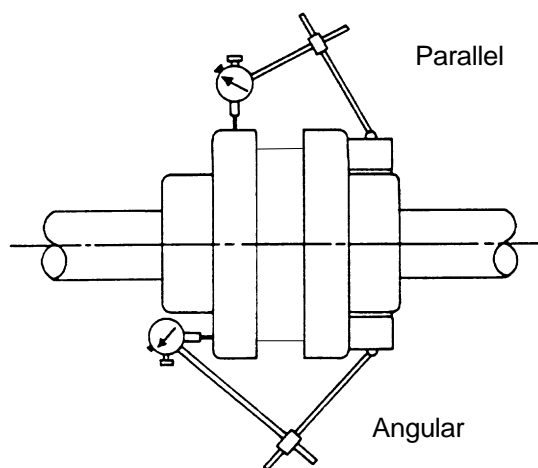


Figure 5. Coupling Alignment

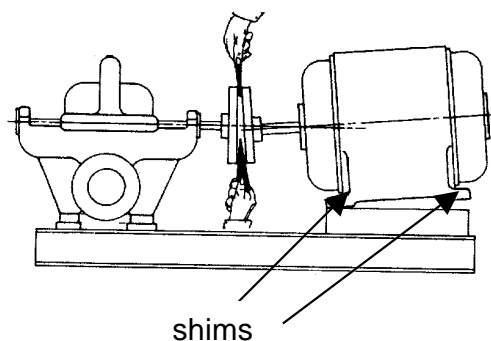


Figure 6. Adjusting Alignment

3. Shim all mounting feet on the driver until all four readings are identical (0.005) maximum Total Indicator Runout (TIR).

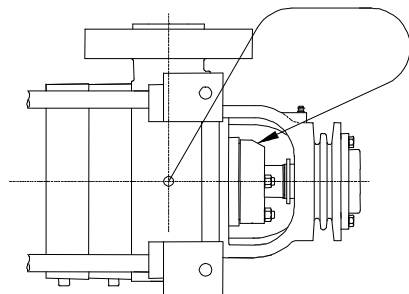
Proceed as follows with angular alignment:

1. Check the angular misalignment by fastening dial indicator to one coupling hub.
2. 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.
3. Adjust driver until all four readings are identical (0.008 maximum TIR).
4. Reconnect coupling halves.
5. Reinstall coupling guard.

E. Piping

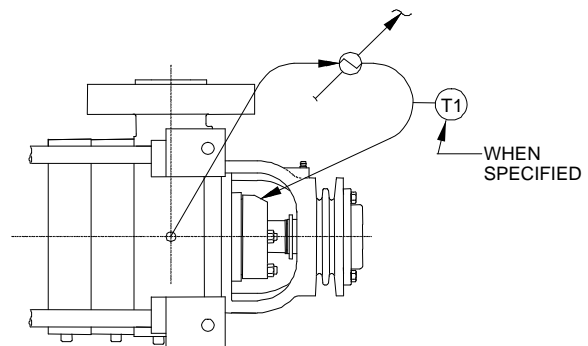
The pump is shipped with flange covers to protect flange faces and to prevent foreign matter from entering pump. Flange covers should remain intact until suction and discharge piping are connected to pump flanges.

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



RECIRCULATION FROM PUMP CASE TO SEAL

PLAN 11



RECIRCULATION FROM PUMP CASE THROUGH HEAT EXCHANGER TO SEAL

PLAN 21

caution

Extreme care should be taken when connecting new piping to make sure that no foreign matter such as dirt, slag, chips, tools, etc., are in the piping. Otherwise, the debris will be drawn into the pump and will 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 the pump and positive suction-head lines should be laid with a downward slope. This is done 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.

If necessary, the coupling should be realigned after installing piping. Realign, if necessary, by adjusting the driver end. Refer to Figure 6.

F. Auxiliary Connections

Connect auxiliary connections. For an illustration of bearing cooling, refer to Figure 1, Water Cooling. Figure 7, Fluid Line Schematic, illustrates the heat exchanger and cooling water for the seal.

Figure 7. 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. Through 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. Pre-Start Cautions

Before starting the pumping unit, make the following checks:



Before activating the pumping unit, check to make sure there are no personnel working on the unit. Serious injury or death to personnel could result if unit is activated while 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 that fluid in the pump is clean, clear, and free of debris. Never run pump dry because the close running fits that are 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 lubrication 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 the pumping unit.

6. If necessary, turn on cooling lines to check for sufficient flow. Refer to Table 8 for minimum cooling flow rates.
7. For other lubrication methods, refer to Section I, paragraphs J, K and L and Section V, paragraph H.

C. Start-Up

Before starting the pumping unit, refer to the safety precautions in Section I, paragraph E. Refer to Table 8 for minimum flow rates.



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 8, Minimum Flow Rates.

Proceed as follows to start the pumping unit:

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 the system.
4. Start electrical power supply to driver.
5. Slowly open system valve in discharge line until pumping unit reaches specified pumping conditions. (Refer to the pump nameplate for design point condition.)

Table 8. Minimum Flow Rates

<i>Pump Model</i>	<i>Speed</i>	<i>Minimum Flow</i>
<i>Minimum Flow Rates (RS 6)</i>		
RS A and RS B	1450 Revolutions Per Minute (RPM)	15 GPM
	1750 RPM	20 GPM
	2900 RPM	20 GPM
	3500 RPM	25 GPM
RS C	1450 RPM	30 GPM
	1750 RPM	40 GPM
	2900 RPM	40 GPM
	3500 RPM	50 GPM
RS D	1450 RPM	30 GPM
	1750 RPM	50 GPM
	2900 RPM	100 GPM
	3500 RPM	150 GPM
<i>Minimum Flow Rates (RS 9)</i>		
RS A and RS B	1450 Revolutions Per Minute (RPM)	15 GPM
	1750 RPM	20 GPM
	2900 RPM	25 GPM
	3500 RPM	35 GPM
RS C	1450 RPM	30 GPM
	1750 RPM	40 GPM
	2900 RPM	50 GPM
	3500 RPM	100 GPM
RS D	1450 RPM	30 GPM
	1750 RPM	50 GPM
	2900 RPM	120 GPM
	3500 RPM	200 GPM
RS E	1450 RPM	30 GPM
	1750 RPM	50 GPM
	2900 RPM	150 GPM
	3500 RPM	200 GPM

D. Turbine Applications

For turbine applications, consult your local distributor or a representative from 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 occur, use Table 9, Pumping Unit Troubleshooting, to eliminate the most common causes of those problems, or contact a representative from Carver Pump Company.

Table 9. Pumping Unit Troubleshooting

Symptom	Immediate Action	Probably Cause	Corrective Action
Pump does not deliver rated capacity	1. Stop driver.	1. Excessive system pressure. 2. Incomplete priming or venting of pump or piping 3. Suction line or strainer clogged. 4. Positive suction head is too low. 5. Valves are not fully open. 6. Clogged impeller. 7. Reverse rotation. 8. Improperly installed impeller. 9. Excessive wear of internal parts.	1. Check GPM and head against design conditions; pump impeller may be too small. Consult local distributor or Carver Pump Company. 1. Prime pump and piping again and carefully vent. 1. Clean out suction line or strainer. 1. Reduce the distance from centerline of pump to source of liquid being pumped. 1. Open valves and if necessary, lock valves open to prevent accidental closure. 1. Dismantle pump and clean impeller, if necessary. 1. Correct rotation is clockwise when viewed from driver end. 1. Disassembly pump and correctly axial align impeller. 1. Disassemble pump and replace worn parts.
Leakage at case joints.	1. Stop driver.	1. Bolts not sufficiently tightened. 2. O-rings damaged.	1. Release the pressure and tighten tie bolts evenly. 1. Replace o-rings.
Bearings run hot.	1. Stop driver.	1. Pump and driver shafts are misaligned. 2. Piping causes pump to "warp".	1. Check coupling alignment. 2. Check pipe strain. 1. Ensure piping transmits no stress to pump. Alter piping layout, if necessary. Realign pump and driver shafts.

Table 9. Pumping Unit Troubleshooting (CONT.)

Symptom	Immediate Action	Probably Cause	Corrective Action
<p>Pump discharge pressure excessive.</p>	<p>1. Stop driver.</p>	<p>3. Unsuitable grease. 4. Over greased or oiled bearings. 5. Insufficient grease (or oil) to bearings. 6. Insufficient cooling of bearing frame. 7. Worn bearings. 1. Excessive speed. 2. Wrong impeller trim. 3. Pump is pumping fluid with specific gravity in excess of that specified. (If temperature of fluid is lower, then specified specific gravity will be higher.)</p>	<p>1. Check for incorrect grease. 1. Remove excess grease or oil. 1. Add grease (or oil), as necessary. 1. Check cooling flow rate to bearing frame. 1. Replace bearings. 1. Check speed precisely. Decrease speed, if possible. 1. Trim outlet tips of impeller vanes. Consult Carver Pump Company specifying exact operating conditions. 1. If prescribed fluid temperature or specific gravity can not be attained, one or more of the following measures can be taken: a. Partially close discharge valve, reducing pump capacity to a point where driver is not overloaded. b. Remove one or more impellers and their diffusers and install special blind stage parts. c. Trim one or more impellers. d. Install more powerful driver. Consult Carver Pump Company specifying exact operating conditions.</p>

Table 9. Pumping Unit Troubleshooting (CONT.)

Symptom	Immediate Action	Probably Cause	Corrective Action
Driver overloaded.	1. Stop driver.	1. Pump discharge pressure is lower than design point (check pump nameplate) 2. Same as 3 under "Pump Discharge Pressure Excessive." 3. Wrong impeller trim.	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. Same as 3 under pump discharge pressure excessive. 1. Trim outlet tips of impeller vanes. Consult Carver Pump Company specifying exact operating conditions.

V. Maintenance and Repair

A. Scheduled Maintenance

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

Daily Inspection:

- Visually inspect unit.
- Check bearing temperatures.
- Refer to Table 3, to check bearing cooling flow rates, if applicable.
- Check for leakage at mechanical seals.
- Check for oil level, if applicable.

Weekly Inspection:

- Check power (amps) readings.
- Check pump discharge pressure. Prescribed operating discharge pressure should never drop below 90 percent of design point pressure.
- 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:

- Check coupling alignment.
- If necessary, grease coupling. Do NOT over grease.
- Check foundation bolts.

Semi-annual Inspection:

- Grease bearings. Do NOT over grease or add excess oil.
- Check coupling alignment due to settling of foundation.
- If stand-by pumps are installed, it is advisable to operate pumps on a rotation system to give each pump a certain duty. This ensures that stand-by pumps will always be in good condition for instant start-up.

B. Bearings

The thrust bearings are installed back-to-back. The standard package has a matched set of bearings located on the suction end. The optional package has a matched set of bearings located on the discharge end with a single bearing on the suction.

Grease Lubricated

The pump has grease-lubricated bearings, which are packed at the factory for six months or 1,000 hours continuous operation under normal conditions without re-lubrication. 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 the suitability to extreme pressures and high temperature stability. Never mix greases with differing properties. Polyurea base greases are NOT compatible with lithium or soda soap base greases. Therefore, the type of grease added should NOT vary. If it is necessary to change grease type, the following items should be removed, cleaned and flushed with a suitable solvent: bearings, bearing frame, and bearing caps. Refer to Section I, paragraph K, Grease Recommendations. If changing grease type, use the following procedure:

1. Place bearings, bearing frame end of bearing frame, 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 frame end of bearing frame, and bearing caps, rinse in a clean, light mineral solvent and agitate vigorously to remove all loosened hard grease and dirt.
3. Dip bearings in clean, light oil and spin by hand, ensuring that 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 1000 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 frame 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 frame. 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 9, Pumping Unit Troubleshooting, for common causes of high bearing temperatures.

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

Oil Lubricated**NOTE**

Pumps are shipped without oil and should be filled with oil before starting. Failure to operate without oil could result in damaged pump or parts.

To drain old oil from bearing frame, remove pipe plugs (426) at the bottom of oil caps (41A) and (41X). Add oil to bearing frame (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 frame (99). Add mark for proper level on oil level gauge (144) for easy visual reference. Refer to Section I, paragraph L, Oil Lube Recommendations. Carver recommends changing the oil every 1,000 service hours under normal conditions.

C. Torque Values

Refer to Table 10, Recommended Torque Values. Clean and properly lubricate threads.

Table 10. Recommended Torque Values

<i>Fastener Size</i>	<i>Torque (foot pounds)</i>
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

D. Disassembly and Assembly Preparations

NOTE

Refer to Section V, paragraph H for oil lubrication and water cooling disassembly and assembly procedures.

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. Carver Pump Company recommends that all o-rings and shims are only used once.

NOTE

To avoid damage to o-rings, check to make sure all parts are free of sharp edges or burrs.

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, components may not be easily removed from shaft. In such instances, rust solvent may be used and suitable extracting tools applied wherever possible. Do NOT use force under any circumstances. Refer to Table 11, Recommended Tools, for proper tooling during disassembly and assembly.

Refer to appropriate sectional drawing, for location of parts followed by an item number. Assemble the pump in accordance with accepted rules of engineering practice. Coat individual components with a suitable lubricant before assembling. Assembly of unit should be performed on a flat surface.

While assembling the pumping unit, Carver Pump Company recommends that the following parts be replaced with new:

- O-rings
- Shims
- Bearings
- Grease seals
- Mechanical seals

If new impellers or new shaft protecting sleeves are fitted, impellers must be axially aligned with respect to diffusers. Refer to paragraph F of this section for procedures regarding axial impeller alignment.

Table 11. Recommended Tools

<i>Tools</i>	<i>Materials</i>	<i>Testing Equipment</i>
Spanner wrench Rawhide or wood mallet Wooden wedge Allen wrench set Socket, open, & box wrench set Vice grips "C" clamp	Grease (Rykon) or oil	Coupling alignment gauges

Prepare the pumping unit for disassembly using the following list:

1. Read this entire section and review the applicable sectional assembly drawing and parts list before disassembling the pump. For cooling options, refer to Figure 9.



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 or death 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 the pump from the driver.

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

5. Remove the bolts that hold the pump to the base. Remove the pump from the base and take to a suitable work area.

E. Parts Cleaning and Inspection

NOTE

Mark or number each component while dismantling according to sequence. **IMPORTANT:** Check for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed or removed.

During disassembly of the pump, individual parts should be cleaned and inspected as follows:

1. Discard used oil seals, shims 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. A bent or excessively damaged shaft should be replaced.
3. Inspect mechanical seals. Repair or replace mechanical seals that are extremely dirty or damaged.
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. Replace impellers that are damaged. If new impellers are installed, check to make sure all impellers are balanced and axially aligned with respect to the 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 the 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 13 and Table 14 for specified clearance of wear rings.
 - d. If wear ring replacement is required, take casings and impellers to a suitable work area with access to machine shop equipment. Replace wear rings as described in paragraph G of this section.

F. Axial Impeller Alignment

If new parts are fitted during assembly, such as impellers and/or sleeves, the impellers must be axially aligned with respect to the diffuser. Refer to Figure 8 and Table 12.

Standard Sleeve Bearing

Measure distance from the outboard face of the suction or interstage case to the back shroud of the impeller. Compare the measured distance to the dimensions given in Table 12, Axial Impeller Alignment Control Dimensions. If shimming is

necessary, install shims between the impeller and the shaft sleeve, as shown in Figure 6. Repeat measuring and shimming until the correct control dimension is achieved.

Optional Mechanical Seal

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 12, Axial Impeller Alignment Control Dimensions. If shimming is necessary, install shims between the impeller and the shaft sleeve, as shown in Figure 6. Repeat measuring and shimming until the correct control dimension is achieved.

Table 12. Axial Impeller Alignment Control Dimensions

Pump Model	Distance "A" ± 0.020 inch	Distance "B" ± .0020 inch
<i>Standard Sleeve Bearing</i>		
RS A	0.650 inch	-
RS B	0.670 inch	-
RS C	0.770 inch	-
RS D	0.921 inch	-
RS E	1.377 inch	-
<i>Optional Mechanical Seals</i>		
RS A and RS B	0.138 inch	-
RS C	0.120 inch	-
RS D	-	0.153 inch
RS E	-	0.117 inch

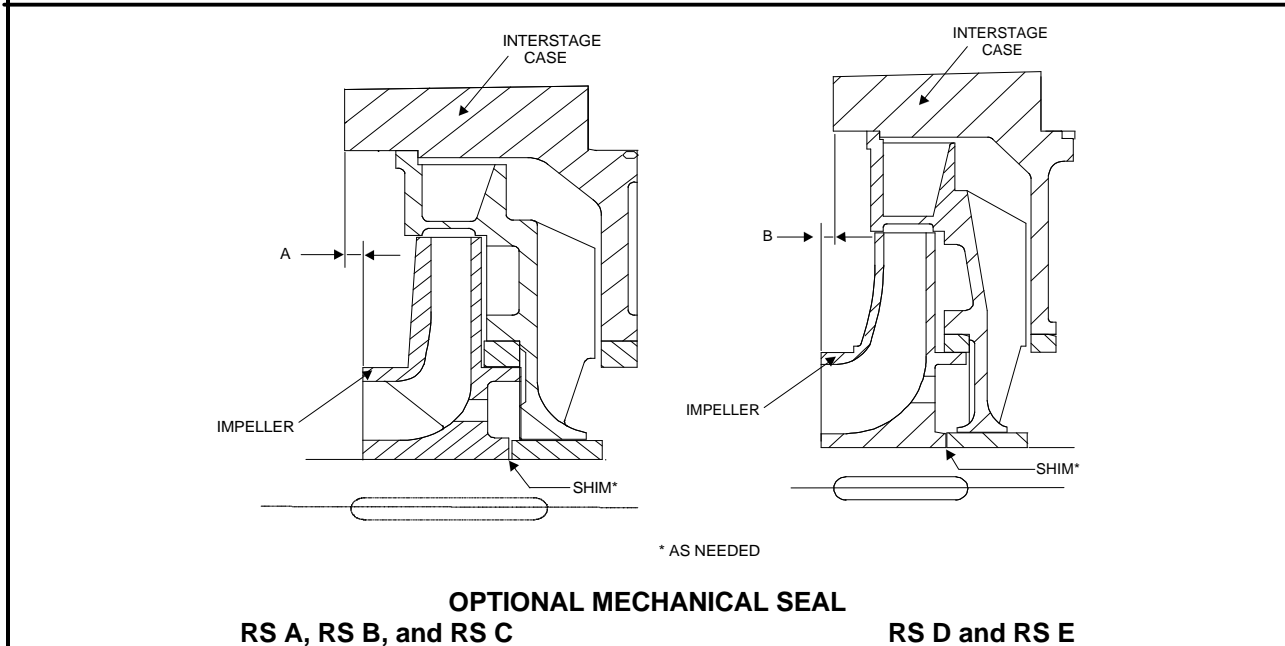
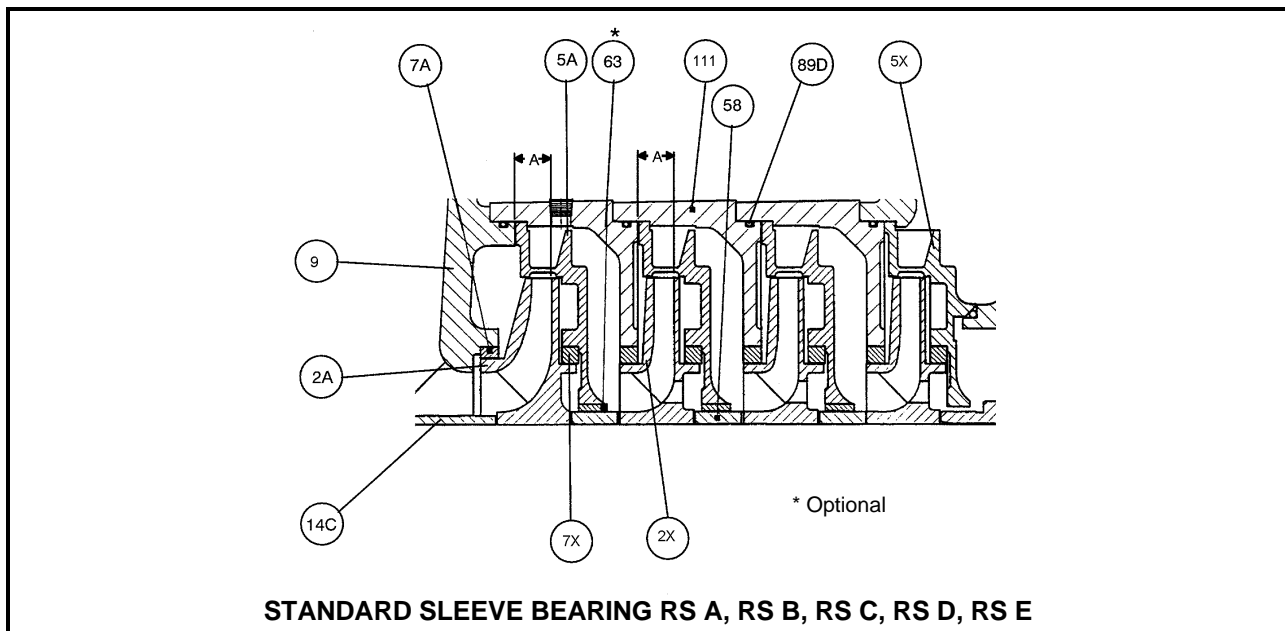


Figure 8. Axial Impeller Alignment

G. Wear Ring Replacement

To replace wear rings, proceed as follows:

1. Remove old wear ring from suction case, interstage case and/or diffuser. This can best be accomplished on a lathe.
2. Press new wear ring in suction case, interstage case and/or diffuser.
3. 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 make sure arbor and impeller are running square.
4. Turn wearing surface of impeller until a 63 Root Means Square (RMS) or better finish is obtained.
5. Measure outside diameter of impeller hub and record.
6. 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.
7. Bore wear ring to within the specified tolerance listed in Table 13 or Table 14 over the recorded size of outside diameters of impeller hub.
8. Return impeller and casings to pump assembly.

Table 13. Maximum Wear Ring Clearances

<i>Pump Model</i>	<i>Maximum Diametrical Clearance</i>
RS A	0.038 inch (casing & diffuser)
RS B	0.038 inch (casing & diffuser)
RS C	0.034 inch (casing & diffuser)
RS D	0.036 inch (casing & diffuser)
RS E	0.032 inch (casing & diffuser)

Table 14. New Wear Ring Clearance Limits

<i>Pump Model</i>	<i>Casing Diametrical Clearance Limit</i>	<i>Diffuser Diametrical Clearance Limit</i>
RS A	0.015 to 0.019 inches	0.015 to 0.019 inches
RS B	0.015 to 0.019 inches	0.015 to 0.019 inches
RS C	0.013 to 0.017 inches	0.013 to 0.017 inches
RS D	0.012 to 0.018 inches	0.017 to 0.021 inches
RS E	0.011 to 0.016 inches	0.011 to 0.016 inches

H. Oil Lubrication and Water Cooling Service (Refer to Figure 9.)

NOTE

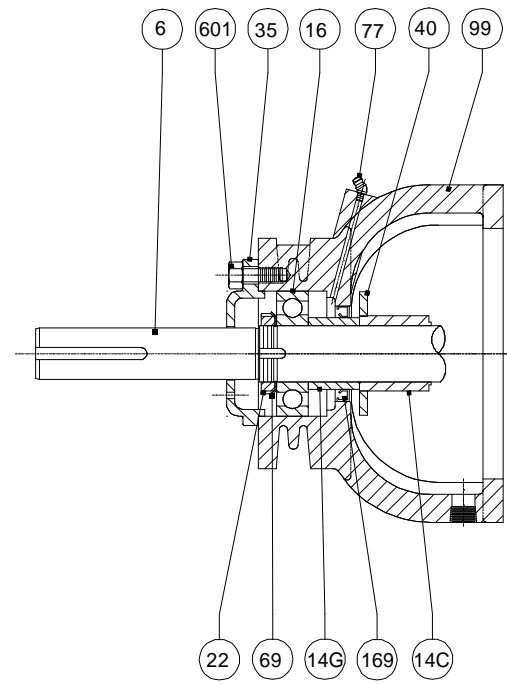
Mark or number each component during disassembly and assembly according to sequence.

DISASSEMBLY

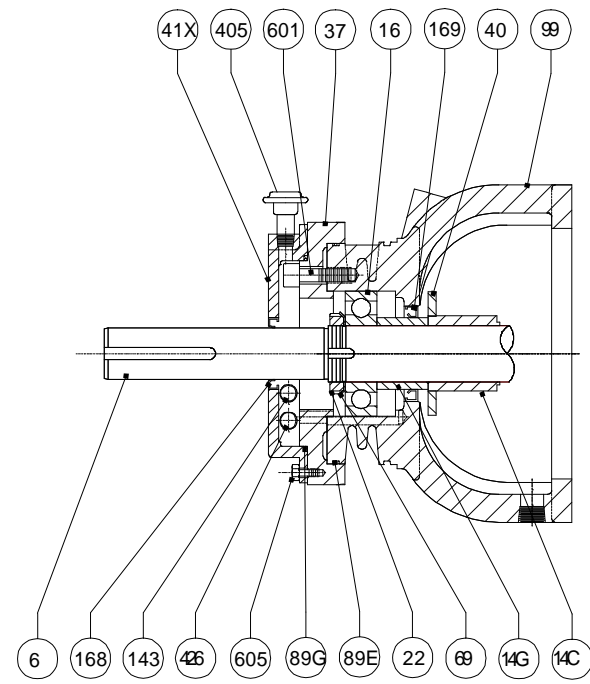
1. Remove plugs (425) from bearing caps (37) on both ends, if applicable. This allows unit to drain.
2. Remove plug (426) or (428) from bottom of oil caps (41A) and (41X) and drain oil.
3. Remove bolts (605) or (606) from oil cap (41A) and (41X). Remove oil caps (41A) and (41X). Remove o-ring (89G) from oil caps (41A) and (41X). Remove oil seal (168) from oil cap (41X).
4. Disconnect male connector retaining nuts from tube connector body (412). Remove tube (409). Retaining nuts will remain with tube.
5. Remove bearing caps (37) by removing bolts (601). Remove o-rings (89E) and (89F) from bearing frame (99).

ASSEMBLY

1. Install new o-rings (89E) and (89F) on bearing frame (99). Install bearing caps (37) and secure to bearing frame (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 (41X). Install new o-ring (89G) on oil caps (41X) and (41A). Install oil caps (41A) and (41X) and secure with bolts (605) and (606).
4. Install plug (426) and (428) in bottom of oil caps (41A) and (41X).
5. Install plugs (425) in bearing caps (37) on both ends. Fill through breather vent (405) to center of bullseye with oil according to Table 2.

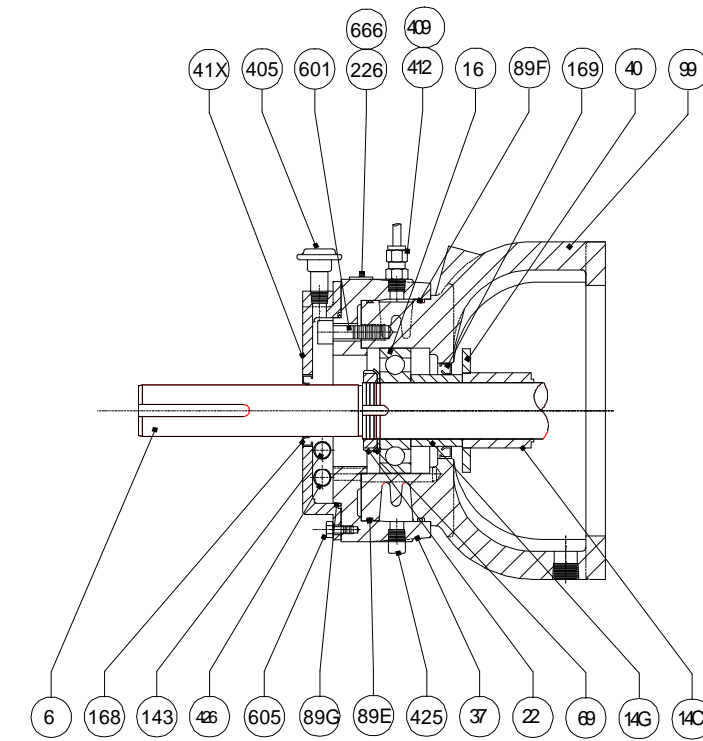


GREASE LUBE - AIR COOLED

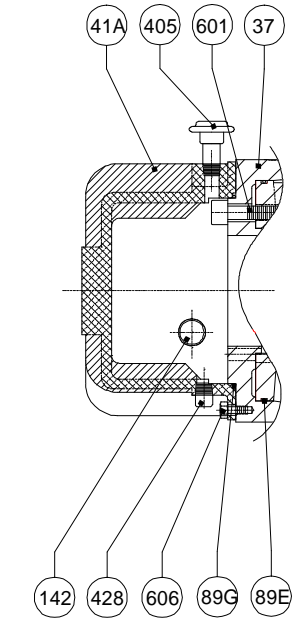


OIL LUBE - AIR COOLED

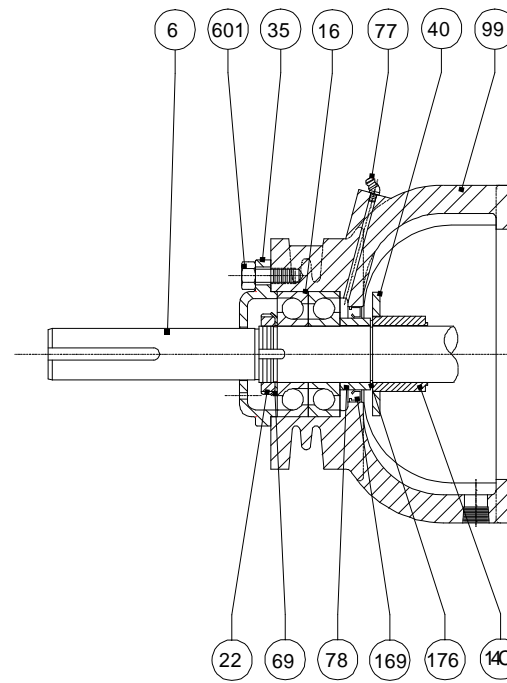
PUMP W/ OPTIONAL OUTBOARD MECHANICAL SEAL



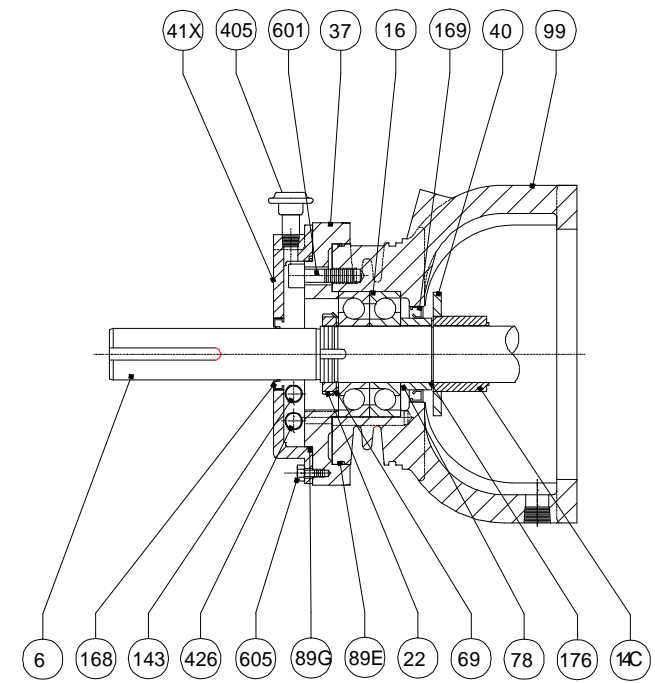
OIL LUBE - WATER COOLED



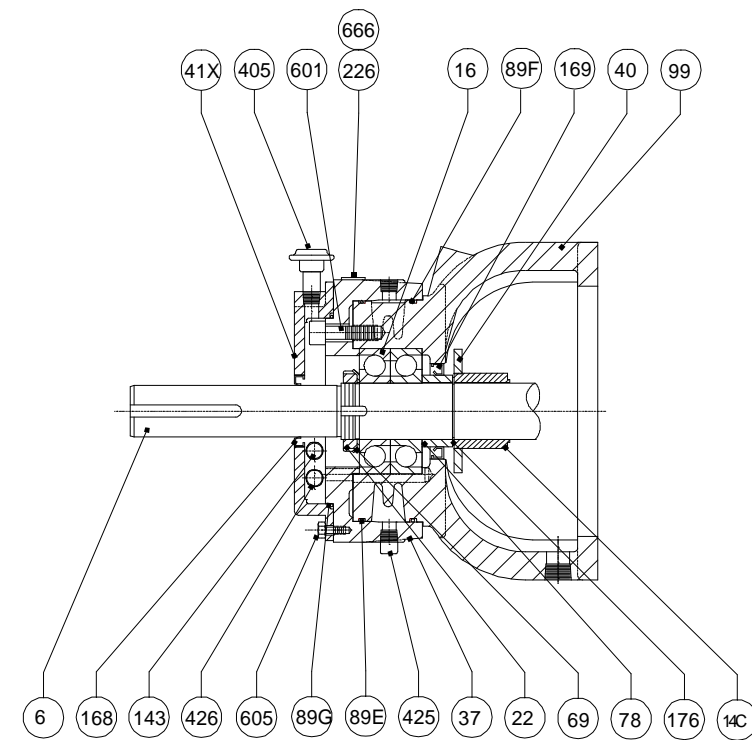
OIL LUBE - OUTBOARD DETAIL



GREASE LUBE - AIR COOLED



OIL LUBE - AIR COOLED
PUMP W/OUTBOARD SLEEVE BEARING - STANDARD



OIL LUBE - WATER COOLED

NO.	ITEM DESCRIPTION
6	SHAFT
14C	SPACER SLEEVE
14G	SPACER SLEEVE
16	I.B. BEARING
22	BEARING LOCKNUT
35	BEARING CAP
37	BEARING CAP
40	SLINGER
41A	OIL CAP - OUTBOARD
41X	OIL CAP - INBOARD
69	BEARING LOCKWASHER
77	GREASE ZERK
78	BEARING SPACER
89E	ORING - BEARING CAP
89F	ORING - BEARING CAP
89G	ORING - OIL CAP
99	BEARING FRAME
142	BULLSEYE SIGHT - OUTBOARD
143	BULLSEYE SIGHT - INBOARD
168	OIL SEAL - I.B. OIL CAP
169	OIL SEAL - BEARING FRAME
176	SNAP RING
226	COOLING NAMEPLATES
405	BREATHER VENT
409	TUBE
412	TUBE CONNECTOR
425	PLUG - BRG. CAP DRAIN
426	PLUG - OIL CAP
428	PLUG - O.B. OIL CAP
601	BOLT - BRG. CAP
605	BOLT - I.B. OIL CAP
606	BOLT - O.B. OIL CAP
666	DRIVE SCREW - NAMEPLATES

Figure 9. Cooling Options
RS A, RS B, RS C, RS D, and RS E

BLANK

I. Pump Disassembly and Assembly RS A, RS B, and RS C (with standard sleeve bearing) (Refer to Figure 10 and Figure 11.)

DISASSEMBLY

NOTE

Refer to Section I, paragraph E, Safety Precautions, before disassembling pump.

NOTE

Pump should be dismantled from discharge end. Mark or number each component while dismantling according to sequence. **IMPORTANT:** Check for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed or removed.

1. Remove coupling half from pump shaft (6). Remove coupling key (46).
2. Drain pump by removing the following plugs: plug (424) from the bottom of each interstage case (111), plug (421) from suction case (9) and plug (422) from discharge case (1).
3. Clamp down suction case foot to steady pump during disassembly.
4. Disconnect all male connector retaining nuts from male connector (410), (411), and (413) bodies, as applicable. Remove tubing (400) and (401), as applicable. Retaining nuts will remain with tubing.
5. Support interstage cases (111) before dismantling to prevent from being dropped while discharge case (1) is removed.
6. Remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting discharge case (1) and suction casing (9).

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Use of a hoist with adequate capacity is recommended for lifting the discharge case (1).

7. Remove discharge case (1). End cap (37A) and sleeve bearing (63Y) will be removed along with discharge case (1).
8. Remove nut (615) from stud (631). Remove end cap (37A) from discharge case (1). Remove o-ring (89H) from end cap (37A).

NOTE

Refer to Table 5, Sleeve Bearing Dimensions to determine if replacement of sleeve bearing is required.

9. If replacing sleeve bearing, remove sleeve bearing (63Y) from discharge case (1).
10. Remove jam nuts (614) and washer (28) from shaft (6). Remove shaft sleeve (14X) from shaft (6).

NOTE

Do NOT remove bushing (63X) at this point from last stage diffuser (5X).

NOTE

Do NOT remove diffuser (5X) from casing (1) unless wear ring (7X) replacement is required.

11. Remove wear ring (7X) with last stage diffuser (5X), which holds bushing (63X). Do NOT remove bushing (63X) from last stage diffuser (5X).
12. Remove sleeve key (32X) and spacer sleeve (14F), if applicable.
13. Remove last stage impeller (2X). Remove impeller key (32C) or (32A), as applicable.
14. Remove interstage casing (111) with casing o-ring (89D), diffuser (5A) and wear ring (7X) intact. Remove o-ring (89D) from interstage casing (111).
15. If necessary, remove diffuser (5A) with wear ring (7X). Remove impeller (2X).
16. Remove impeller key (32A). Remove interstage sleeve (58). Remove interstage shims (73G), as necessary, from both sides of interstage sleeve (58).
17. Repeat steps 14 through 16 for each stage.
18. Remove the first stage impeller (2A). Remove spacer sleeve (14D) or (14E).
19. Remove hex nuts (615) from studs (630) on seal gland (17A).
20. Remove bolts (600). Remove bearing frame (99). Shaft (6), mechanical seal (90), seal gland (17A) and oil seal (169) will come off with bearing frame (99).
21. Remove bolts (601) and remove bearing cap (35).
22. Uncrimp locking tab of bearing lockwasher (69). Remove bearing

- locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).
23. Remove back-to-back bearings (16) with bearing frame (99).
 24. Inspect back-to-back bearings (16) and oil seal (169) for wear, corrosion or contamination. Carver recommends replacing back-to-back bearings (16) and oil seal (169) after they have been removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.
 25. Remove bearing spacer (78) with slinger (40) intact, from shaft (6).
 26. Remove snap ring (176).
 27. Remove spacer sleeve (14C).

NOTE

Do NOT remove rotating element of mechanical seal (90) from shaft sleeve (14A) at this point, especially if mechanical seal (90) is relatively clean, in good working condition.

28. Remove o-ring (89X).
29. If necessary to replace mechanical seal, remove stationary element of mechanical seal (90) in seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
30. Remove sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90). If replacement is required, remove element from sleeve (14A).
31. Remove key (32X) from shaft (6).

NOTE

Do NOT remove seal collar (68), unless sleeve (14A) needs replaced.

32. Remove setscrews (665) from shaft collar (68). Remove shaft collar (68) from sleeve (14A).

ASSEMBLY

Refer to the applicable sectional drawing for location of parts followed by an item number. Assemble the pump in accordance with accepted rules of engineering practice. Assembly of the pumping unit should be performed on a flat surface. Carver recommends all nuts and bolts be torqued according to Table 10, Recommended Torque Values. Check to make sure components are fitted in correct sequence. Assembly begins at the suction

(inboard end) of the pump. Perform the following procedures to assemble the pumping unit:

NOTE

To ensure proper seating of bearing parts, rotate the bearing while clamping the parts.

1. Install sleeve key (32X) into keyway in shaft (6). Install o-ring (89X). Slide shaft sleeve (14A) onto end of shaft (6), lining up keyway of shaft sleeve (14A) with sleeve key (32X). Install spacer sleeve (14C).
2. To determine placement of seal collar (68) on shaft sleeve (14A), refer to Table 6. For installation of mechanical seal (90) rotating element, refer to the following procedure:
 - a. Scribe a mark on shaft sleeve (14A) at the distance from coupling end. Refer to Table 6, Standard Mechanical Seal Settings, for specified distance.
 - b. Install seal collar (68) immediately to the impeller side of the scribe mark. Secure seal collar (68) to shaft sleeve (14A) with setscrews (665).
3. Lubricate both gland (17A) and stationary element of mechanical seal (90) with petroleum jelly or suitable lubricant. Insert stationary element of mechanical seal (90) into gland (17A). Install o-ring (89H).
4. Slide gland (17A) onto end of shaft (6). As applicable, ensure tap flush lines in gland (17A) is positioned so flush lines can be connected.
5. Install snap ring (176) on shaft (6).
6. Install slinger (40) on bearing spacer (78). Slide bearing spacer (78) onto end of shaft (6).
7. Install oil seal (169) in frame.
8. Install end of shaft (6) through inboard side of bearing frame (99).

caution

While installing back-to-back bearings, do NOT unnecessarily hit bearings. If damage to bearings occurs, replace damaged bearings with new bearings. Refer to Section V, paragraph B.

9. Install new bearing (16) back-to-back on shaft (6).

10. Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6).
11. Install bearing locknut (22) and tighten against lockwasher (69). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
12. Secure bearing cap (35) to bearing frame (99) with bolts (601).
13. Install shaft assembly through inboard side of suction casing (9).
14. Secure bearing frame (99) to suction casing (9) by tightening bolts (600). Secure gland (17A) loosely in place with hex nuts (615) on studs (630). Do NOT tighten hex nuts (615) at this point.
15. Slide spacer sleeve (14D) or (14E) onto outboard end of shaft (6), next to shaft sleeve (14A).
16. Install impeller key (32A) into keyway on shaft (6).

NOTE

Replace the same number of new interstage shims (73G) during assembly that were removed during disassembly.

NOTE

IMPORTANT: Assemble any shims found during disassembly in correct sequence only if no sleeves or impellers were replaced.

NOTE

Check alignment in accordance with Figure 8, Axial Impeller Alignment.

17. Check to make sure wear ring (7A) is in casing (9). Slide first stage impeller (2A) onto shaft (6) from outboard end, fitting keyway of impeller to impeller key (32A) on shaft (6).
18. Install spacer sleeve (58).
19. Check impeller setting in accordance with Table 12, Axial Impeller Alignment Control Dimensions.
21. Install impeller (2X).
22. Check to make sure wear ring (7X) is in interstage casing (111). Lubricate and install o-ring (89D) onto suction casing (9). Check to make sure wear ring (7X) is in diffuser (5A). Install new lubricated o-ring (89D) in groove provided on interstage casing (111). Lightly tap diffuser (5A) into interstage casing (111). Align diffuser vanes on either side

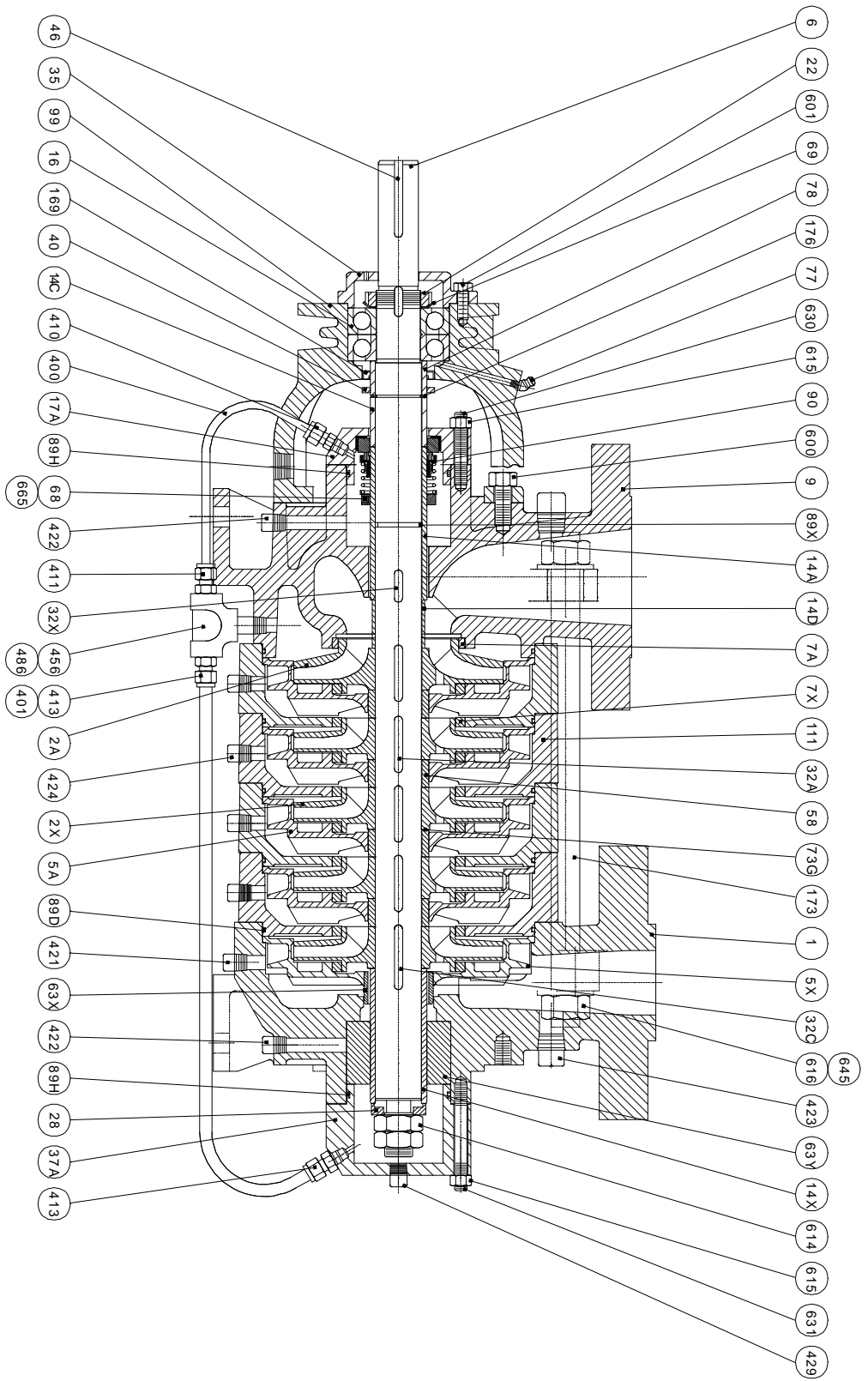
- of boss located in interstage casing (111).
23. Clamp interstage casing (111) to suction casing (9) and check impeller setting in accordance with Table 12.
24. Install interstage assembly onto previous interstage casing (111).
25. Install interstage casing assembly over shaft (6) and fit onto suction casing (9).
26. Repeat steps 17 through 25 for each stage.
27. Install impeller key (32A) or (32C) into keyway in shaft (6) before installing last impeller (2X).
28. Install the last stage impeller (2X). Install shaft sleeve (14F) and key (32X), if required.
29. Slide outboard shaft sleeve (14X) onto outboard end of shaft (6), aligning keyway in sleeve (14X) with impeller key (32C) or (32X).
30. Install washer (28). Install and tighten jam nut (614).
31. Install discharge casing (1) with diffuser (5X), wear ring (7X), and bushing (63X) on interstage casing (111).
32. Install tie bolts (173), washers (645) and hex nuts (616).

NOTE

Refer to Table 5, Sleeve Bearing Dimensions.

33. Install sleeve bearing (63Y) in discharge casing (1).
34. Install new lubricated o-ring (89H) on bearing cap (37A).
35. Secure bearing cap (37A) to discharge casing (1) with nuts (615) on studs (631).
36. Rotate shaft (6) by hand to ensure smooth rotation. Tighten nut (615) on gland (17A).
37. Install tubing (400) and (401), as applicable. Secure tubing by tightening nuts on male tube connector (410), (411) and (413) bodies, as applicable.
38. Install plugs (421), (422), (423), (424) and (429).
39. Install pump on base and secure with capscrews.
40. Install coupling key (46). Install coupling half on pump shaft (6).
41. Align coupling as outlined in Section II, paragraph D, Coupling, and reference Figure 5, Coupling Alignment.
42. Install coupling guard.

43. Connect suction, discharge and gauge lines. After connection of piping, check for smooth rotation of shaft.
44. Open system valves.
45. Unlock and connect electrical power supply to motor. Remove tags. Start pumping unit according to Section III, paragraph C, Start-Up.

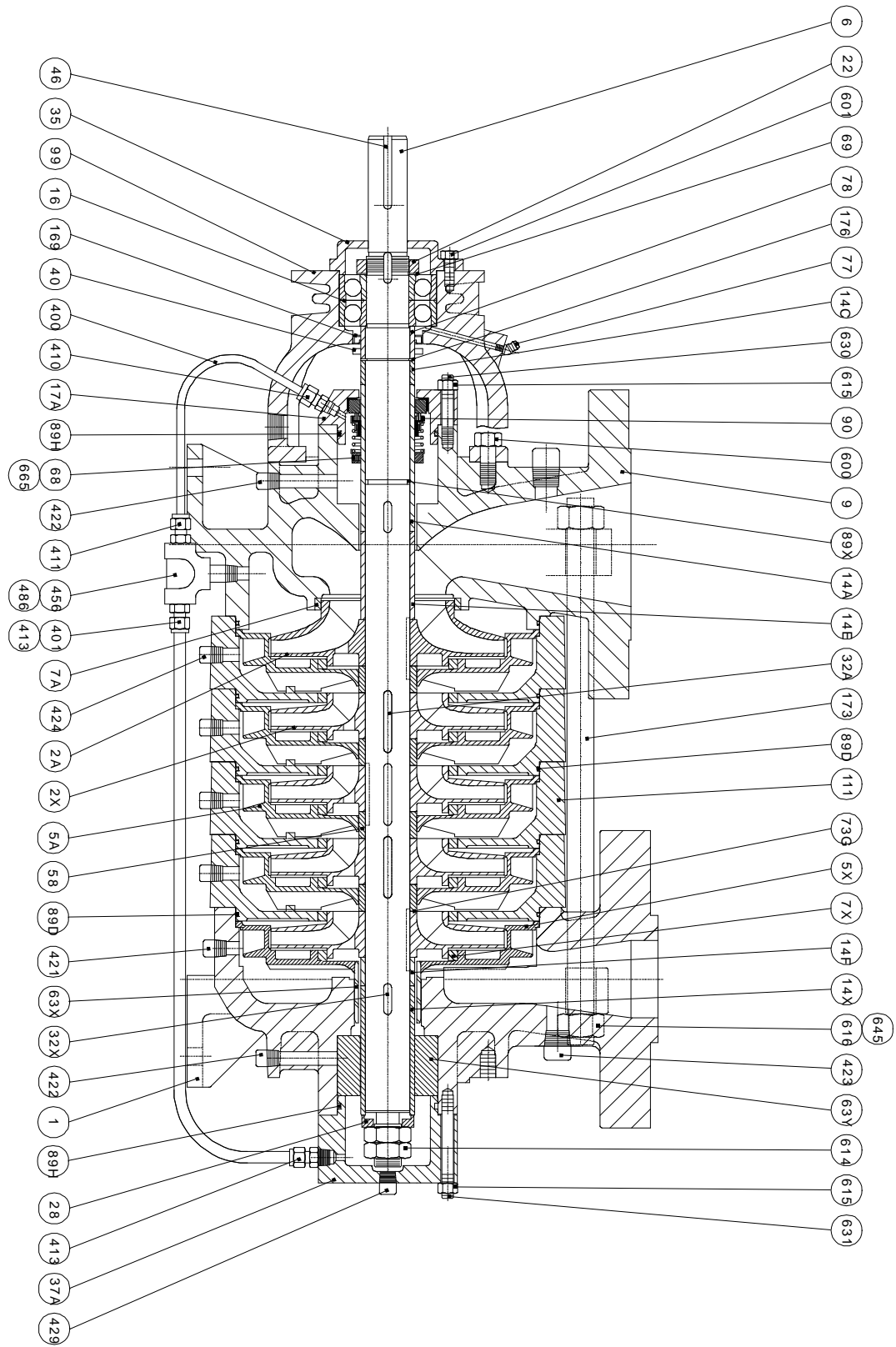


ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	28	WASHER	89D	O-RING-CASING	423	PLUG-GA CONN
2A	IMPELLER-1 ST STAGE	32A	KEY-IMPELLER	89H	O-RING-GLAND	424	PLUG-CASE DRAIN
2X	IMPELLER	32C	KEY-LAST STAGE	89X	O-RING-SLEEVE	429	PLUG-O.B. BRG CAP
5A	DIFFUSER	32X	KEY-SLEEVE	90	MECHANICAL SEAL	456	PIPE TEE
5X	DIFFUSER-LAST STAGE	35	BEARING CAP-I.B.	99	BEARING FRAME	486	PIPE NIPPLE
6	SHAFT	37A	BEARING CAP-O.B.	111	INTERSTAGE CASE	600	BOLT-BRG FRAME
7A	WEAR RING	40	SLINGER	169	OIL SEAL-BRG FRAME	601	BOLT-BRG CAP
7X	WEAR RING	46	KEY-COUPPLING	173	TIE BOLT	614	JAM NUT
9	SUCTION CASE	58	SLEEVE-INTERSTAGE	176	SNAP RING	615	NUT-GLAND
14A	SLEEVE	63X	BUSHING-LAST STG. DIF.	400	TUBE	616	NUT-TIEBOLT
14C	SPACER SLEEVE	63Y	SLEEVE BEARING	401	TUBE	630	STUD-GLAND
14D	SPACER SLEEVE	68	SLEEVE COLLAR	410	TUBE CONNECTOR	631	STUD-O.B. BRG CAP
14X	SLEEVE	69	BEARING LOCKWASHER	411	TUBE CONNECTOR	645	WASHER-TIEBOLT
16	IB BEARING	* 73G	SHIMS-INTERSTAGE	413	TUBE CONNECTOR	665	SETSCREW-SLEEVE COLLAR
17A	GLAND	77	GREASE ZERK	421	PLUG-DISCHARGE CASE		
22	BEARING LOCKNUT	78	BEARING SPACER	422	PLUG-STUFF. BOX		

* Use as required

Figure 10. Sectional Assembly Drawing RS A and RS B w/standard bearing

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ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	17A	GLAND	78	BEARING SPACER	422	PLUG-STUFF BOX
2A	IMPELLER-1 ST STAGE	22	BEARING LOCKNUT	89D	O-RING-CASING	423	PLUG-GAUGE CONN
2X	IMPELLER	28	WASHER	89H	O-RING-SEAL GLAND	424	PLUG-CASE DRAIN
5A	DIFFUSER	32A	KEY-IMPELLER	89X	O-RING-SLEEVE	429	PLUG-O.B. BRG CAP
5X	DIFFUSER-LAST STAGE	32X	KEY-SLEEVE	90	MECHANICAL SEAL	456	PIPE TEE
6	SHAFT	35	BEARING CAP-I.B.	99	BEARING FRAME	486	PIPE NIPPLE
7A	WEAR RING	37A	BEARING CAP-O.B.	111	INTERSTAGE CASE	600	BOLT-BRG FRM/CASING
7X	WEAR RING	40	SLINGER	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP/BRG FRM
9	SUCTION CASE	46	KEY-COUPPLING	173	TIE BOLT	614	JAM NUT
14A	SLEEVE	58	SLEEVE-INTERSTAGE	176	SNAP RING	615	NUT-GLAND
14C	SPACER SLEEVE	63X	BUSHING-LST STG DIFFUSER	400	TUBE	616	NUT-TIE BOLT
14D	SPACER SLEEVE	63Y	SLEEVE BEARING	401	TUBE	630	STUD-GLAND
14E	SPACER SLEEVE	68	SLEEVE COLLAR	410	TUBE CONNECTOR	631	STUD-O.B. BRG CAP
14F	SPACER SLEEVE	69	BEARING LOCKWASHER	411	TUBE CONNECTOR	645	WASHER-TIE BOLT
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	413	TUBE CONNECTOR	665	SETSCREW-SLEEVE COLLAR
16	I.B. BEARING	77	GREASE ZERK	421	PLUG-DISCHARGE CASE		* Use as required

Figure 11. Sectional Assembly Drawing, RS C w/standard sleeve bearing

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J. Pump Disassembly and Assembly RS D and RS E (with standard sleeve bearing) (Refer to Figure 12 and Figure 13.)

DISASSEMBLY

NOTE

Refer to Section I, paragraph E, Safety Precautions, before disassembling pump.

NOTE

Pump should be dismantled from discharge end. Mark or number each component while dismantling according to sequence. **IMPORTANT:** Check for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed or removed.

1. Remove coupling half from pump shaft (6). Remove coupling key (46).
2. Drain pump by removing the following plugs: plug (424) from the bottom of each interstage case (111), plug (421) from suction case (9) and plug (422) from discharge case (1).
3. Clamp down suction case foot to steady pump during disassembly.
4. Disconnect all male connector retaining nuts from male connector (410), (411), and (413) bodies, as applicable. Remove tubing (400) and (401), as applicable. Retaining nuts will remain with tubing.
5. Support interstage cases (111) before dismantling to prevent from being dropped while discharge case (1) is removed.
6. Remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting discharge case (1) and suction casing (9).

caution

Use of a hoist with adequate capacity is recommended for lifting the discharge case (1).

7. Remove discharge case (1). End cap (37A) and sleeve bearing (63Y) will be removed along with discharge case (1).
8. Remove nut (615) from stud (631). Remove end cap (37A) from discharge

case (1). Remove o-ring (89H) from end cap (37A).

NOTE

Refer to Table 5, Sleeve Bearing Dimensions to determine if replacement of sleeve bearings is required.

9. If replacing bearing, remove sleeve bearing (63Y) from discharge case (1).
10. Remove jam nuts (614) and washer (28) from shaft (6). Remove shaft sleeve (14X) from shaft (6).

NOTE

Do NOT remove bushing (63X) at this point from last stage diffuser (5X).

NOTE

Do NOT remove diffuser (5X) from casing (1) unless wear ring (7X) replacement is required.

11. Remove wear ring (7X) with last stage diffuser (5X), which holds bushing (63X). Do NOT remove bushing (63X) from last stage diffuser (5X).
12. Remove sleeve key (32X) and spacer sleeve (14E), if applicable.
13. Remove the last stage impeller (2X). Remove impeller key (32A).
14. Remove interstage casing (111) with casing o-ring (89D), diffuser (5A), and wear ring (7X) intact. Remove o-ring (89D) from interstage casing (111).
15. If necessary, remove diffuser (5A) with wear ring (7X). Remove impeller (2X).
16. Remove impeller key (32A). Remove interstage sleeve (58). Remove interstage shims (73G), as necessary, from both sides of interstage sleeve (58).
17. Repeat steps 14 through 16 for each stage.
18. Remove the first stage impeller (2A). Remove spacer sleeve (14D) or (14E).
19. Remove hex nuts (615) from studs (630) on seal gland (17A).
20. Remove bolts (600). Remove bearing frame (99). Shaft (6), mechanical seal (90), gland (17A) and oil seal (169) will come off with bearing frame (99).
21. Remove bolts (601) and remove bearing cap (35).
22. Uncrimp locking tab of bearing lockwasher (69). Remove bearing

locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).

23. Remove back-to-back bearings (16) with bearing frame (99).
24. Inspect back-to-back bearings (16) and oil seal (169) for wear, corrosion or contamination. Carver recommends replacing back-to-back bearings (16) and oil seal (169) after they have been removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.
25. Remove bearing spacer (78).
26. Remove snap ring (176).
27. Remove spacer sleeve (14C) with slinger (40) intact, from shaft (6).

NOTE

Do NOT remove rotating element of mechanical seal (90) from shaft sleeve (14A) at this point, especially if mechanical seal (90) is relatively clean, in good working condition.

28. Remove o-ring (89X).
29. If necessary to replace mechanical seal, remove stationary element of mechanical seal (90) in seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
30. Remove sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90). If replacement is required, remove element from sleeve (14A).
31. Remove key (32X) from shaft (6).

NOTE

Do NOT remove seal collar (68), unless sleeve (14A) needs replaced.

32. Remove setscrews (665) from shaft collar (68). Remove shaft collar (68) from sleeve (14A).

ASSEMBLY

Refer to the applicable sectional drawing for location of parts followed by an item number. Assemble the pump in accordance with accepted rules of engineering practice. Assembly of the pumping unit should be performed on a flat surface. Carver recommends all nuts and bolts be torqued according to Table 10, Recommended Torque Values. Check to make sure components are fitted in correct

sequence. Assembly begins at the suction (inboard end) of the pump. Perform the following procedures to assemble the pumping unit:

NOTE

To ensure proper seating of bearing parts, rotate the bearing while clamping the parts.

1. To determine placement of seal collar (68) on shaft sleeve (14A) refer to Table 5. For installation of mechanical seal (90) rotating element, refer to the following procedure:
 - a. Scribe a mark on shaft sleeve (14A) at the distance specified in Table 6, Mechanical Seal Settings (standard).
 - b. Install seal collar (68) immediately to the impeller side of the scribe mark. Secure seal collar (68) to shaft sleeve (14A) with setscrews (665).
 - c. Install rotating element of mechanical seal (90) onto shaft sleeve (14A).
2. Install sleeve key (32X) into keyway in shaft (6). Slide shaft sleeve (14A) onto end of shaft (6), lining up keyway of shaft sleeve (14A) with sleeve key (32X). Lubricate and install o-ring (89X).
3. Lubricate both gland (17A) and stationary element of mechanical seal (90) with suitable lubricant. Install stationary element of mechanical seal (90) into gland (17A). Lubricate and install o-ring (89H).
4. Slide gland (17A) onto end of shaft (6). As applicable, ensure tap flush lines in gland (17A) is positioned so flush lines can be connected.
5. Install spacer sleeve (14C) with slinger (40) intact.
6. Install snap ring (176) on shaft (6).
7. Slide bearing spacer (78) onto end of shaft (6).
8. Install oil seal (169) into bearing frame (99).

caution

While installing back-to-back bearings, do NOT unnecessarily hit bearings. If damage to the bearings occurs, replace damaged bearings with new bearings. Refer to Section V, paragraph B.

9. Install end of shaft (6) through inboard side of bearing frame (99).
10. Install new bearings (16) back-to-back on shaft (6).
11. Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6).
12. Install bearing locknut (22) and tighten against lockwasher (69). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
13. Secure bearing cap (35) to bearing frame (99) with bolts (601).
14. Install shaft assembly through inboard side of suction casing (9).
15. Secure bearing frame (99) to suction casing (9) by tightening bolts (600). Secure gland (17A) loosely in place with hex nuts (615) on studs (630). Do NOT tighten hex nuts (615) at this point.
16. Slide spacer sleeve (14D) or (14E) onto outboard end of shaft (6), next to shaft sleeve (14A).
17. Install impeller key (32A) into keyway on shaft (6).

NOTE

Replace the same number of interstage shims (73G) during assembly that were removed during disassembly.

NOTE

IMPORTANT: Assemble any shims found during disassembly in correct sequence, if no sleeves or impellers were replaced.

NOTE

Check alignment in accordance with Figure 8, Axial Impeller Alignment.

18. Check to make sure wear ring (7A) is in casing (9). Slide first stage impeller (2A) onto shaft (6) from outboard end, fitting keyway of impeller to impeller key (32A) on shaft (6).
19. Install spacer sleeve (58).
20. Check impeller setting in accordance with Table 12, Axial Impeller Alignment Control Dimensions.
21. Install impeller (2X).
22. Check to make sure wear ring (7X) is in interstage casing (111). Lubricate and install o-ring (89D) onto suction casing (9). Check to make sure wear ring (7X) is in diffuser (5A). Install new lubricated o-ring (89D) in groove provided on interstage casing (111). Lightly tap diffuser (5A) into interstage

- casing (111). Align diffuser vanes on either side of boss located in interstage casing (111).
23. Clamp interstage casing (111) to suction casing (9) and check impeller setting in accordance with Table 12.
24. Install interstage assembly onto previous interstage casing (111).
25. Install interstage casing assembly over shaft (6) and fit onto suction casing (9).
26. Repeat steps 18 through 25 for each stage.
27. Install impeller key (32A) into keyway in shaft (6) before installing last impeller (2X).
28. Install the last stage impeller (2X). Install shaft sleeve (14E) and key (32X), if required.
29. Slide outboard shaft sleeve (14X) onto outboard end of shaft (6), aligning keyway in sleeve (14X) with impeller key (32A) or (32X).
30. Install washer (28). Install and tighten jam nut (614).
31. Install discharge casing (1) with diffuser (5X), wear ring (7X), and bushing (63X) on interstage casing (111).
32. Install tie bolts (173), washers (645), and hex nuts (616). Install sleeve bearing (63Y) and o-ring (89J) in discharge casing (1).
33. Install new lubricated o-ring (89H) on bearing cap (37A).
34. Secure bearing cap (37A) to discharge casing (1) with nuts (615) on studs (631).
35. Rotate shaft (6) by hand to ensure smooth rotation. Tighten nut (615) on gland (17A).
36. Install tubing (400) and (401), as applicable. Secure tubing by tightening nuts on male tube connector (410), (411) and (413) bodies, as applicable.
37. Install plugs (421), (422), (423), (424) and (429).
38. Install pump on base and secure with capscrews.
39. Install coupling key (46). Install coupling half on pump shaft (6).
40. Align coupling as outlined in Section II, paragraph D, Coupling, and reference Figure 5, Coupling Alignment.
41. Install coupling guard.
42. Connect suction, discharge and gauge lines. After connection of piping, check for smooth rotation of shaft.
43. Open system valves.
44. Unlock and connect electrical power supply to motor. Remove tags. Start pumping unit according to Section III, paragraph C, Start-Up.

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ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	28	WASHER	89H	O-RING-SEAL GLAND	423	PLUG-GAUGE CONN
2A	IMPELLER-1 ST STAGE	32A	KEY-IMPELLER	89J	O-RING-O.B. BRG CAP	424	PLUG-CASE DRAIN
2X	IMPELLER	32X	KEY-SLEEVE	89X	O-RING-SLEEVE	429	PLUG-O.B. BRG CAP
5A	DIFFUSER	35	BEARING CAP-I.B.	90	MECHANICAL SEAL	456	PIPE TEE
5X	DIFFUSER-LAST STAGE	37A	BEARING CAP-O.B.	99	BEARING FRAME	486	PIPE NIPPLE
6	SHAFT	40	SLINGER	111	INTERSTAGE CASE	600	BOLT-BRG FRM/CASING
7A	WEAR RING	46	KEY-COUPPLING	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP/BRG FRM
7X	WEAR RING	58	SLEEVE-INTERSTAGE	173	TIE BOLT	614	JAM NUT
9	SUCTION CASE	63X	BUSHING-L1ST STG DIFFUSER	176	SNAP RING	615	NUT-GLAND
14A	SLEEVE	63Y	SLEEVE BEARING	400	TUBE	616	NUT-TIE BOLT
14C	SPACER SLEEVE	68	SLEEVE COLLAR	401	TUBE	630	STUD-GLAND
14E	SPACER SLEEVE	69	BEARING LOCKWASHER	410	TUBE CONNECTOR	631	STUD-O.B. BRG CAP
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	411	TUBE CONNECTOR	645	WASHER-TIE BOLT
16	I.B. BEARING	77	GREASE ZERK	413	TUBE CONNECTOR	665	SETSCREW-SLEEVE COLLAR
17A	GLAND	78	BEARING SPACER	421	PLUG-DISCHARGE CASE		
22	BEARING LOCKNUT	89D	O-RING-CASING	422	PLUG-STUFF BOX		

* Use as required

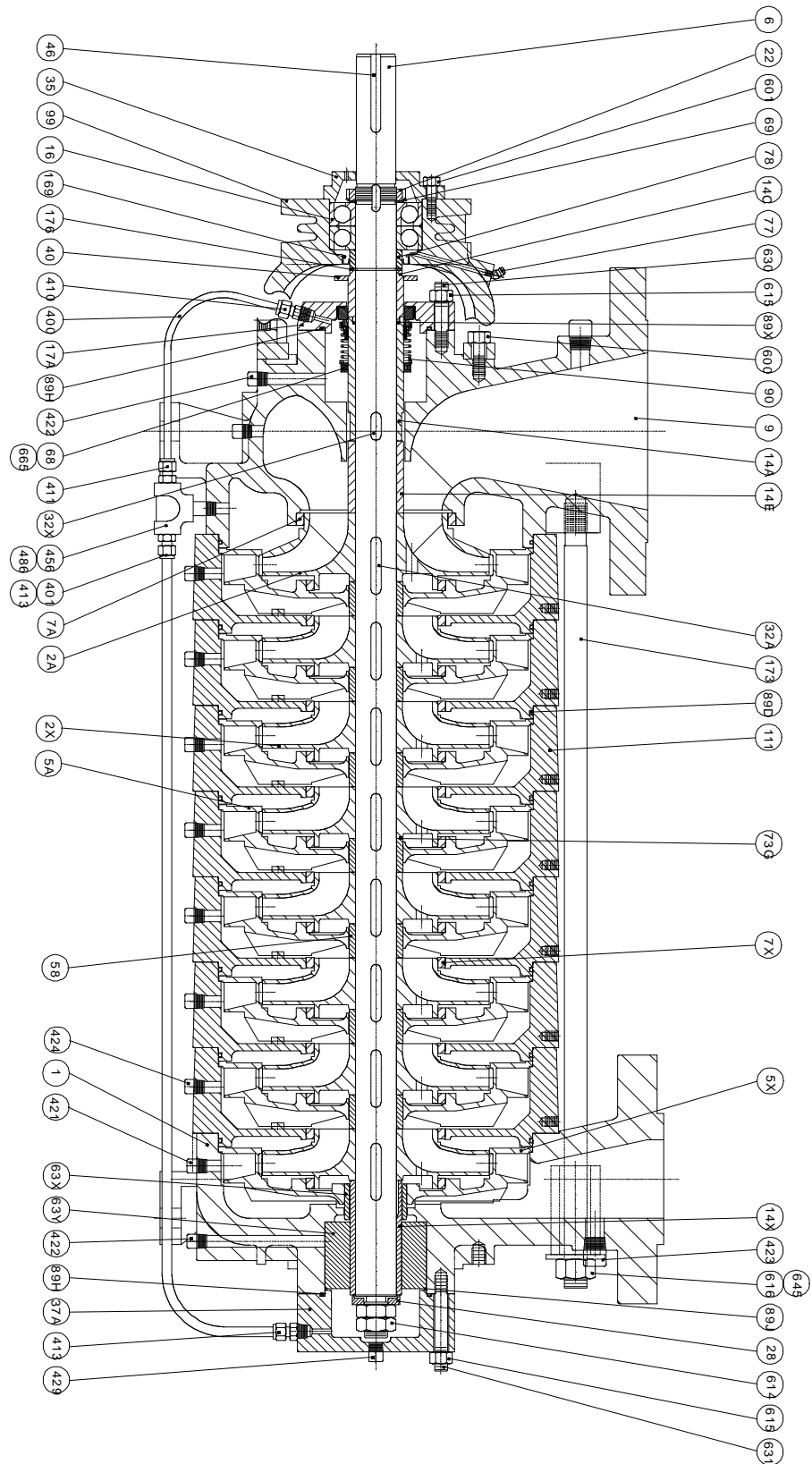
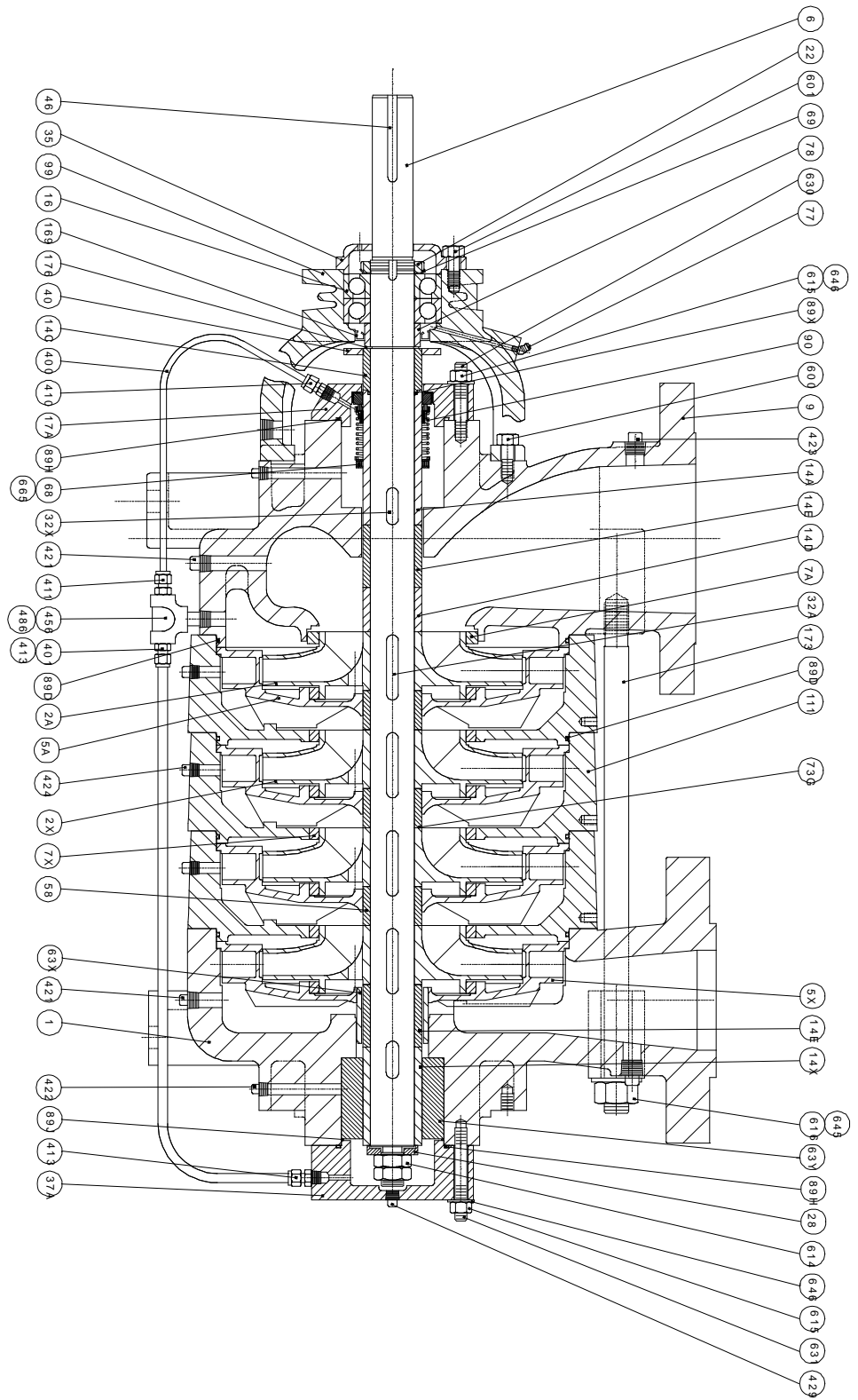


Figure 12. Sectional Assembly Drawing, RS D w/standard sleeve bearing

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ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	22	BEARING LOCKNUT	89D	O-RING-CASING	422	PLUG-STUFF BOX
2A	IMPELLER-1 ST STAGE	28	WASHER	89H	O-RING-SEAL GLAND	423	PLUG-GAUGE CONN
2X	IMPELLER	32A	KEY-IMPELLER	89J	O-RING-O.B. BRG CAP	424	PLUG-CASE DRAIN
5A	DIFFUSER	32X	KEY-SLEEVE	89X	O-RING-SLEEVE	429	PLUG-O.B. BRG CAP
5X	DIFFUSER-LAST STAGE	35	BEARING CAP-I.B.	90	MECHANICAL SEAL	456	PIPE TEE
6	SHAFT	37A	BEARING CAP-O.B.	99	BEARING FRAME	486	PIPE NIPPLE
7A	WEAR RING	40	SLINGER	111	INTERSTAGE CASE	600	BOLT-BRG FRM/CASING
7X	WEAR RING	46	KEY-COUPLING	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP/BRG FRM
9	SUCTION CASE	58	SLEEVE-INTERSTAGE	173	TIE BOLT	614	JAM NUT
14A	SLEEVE	63X	BUSHING-LST STG DIFFUSER	176	SNAP RING	615	NUT-GLAND
14C	SPACER SLEEVE	63Y	SLEEVE BEARING	400	TUBE	616	NUT-TIE BOLT
14D	SPACER SLEEVE	68	SLEEVE COLLAR	401	TUBE	630	STUD-GLAND
14E	SPACER SLEEVE	69	BEARING LOCKWASHER	410	TUBE CONNECTOR	631	STUD-O.B. BRG CAP
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	411	TUBE CONNECTOR	645	WASHER-TIE BOLT
16	I.B. BEARING	77	GREASE ZERK	413	TUBE CONNECTOR	646	WASHER-GLAND
17A	GLAND	78	BEARING SPACER	421	PLUG-DISCHARGE CASE	665	SETSCREW-SLEEVE COLLAR

* Use as required

Figure 13. Sectional Assembly Drawing, RS E w/standard sleeve bearing

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K. Pump Disassembly and Assembly RS A, RS B, and RS C (with optional mechanical seals) (Refer to Figure 14 and Figure 15.)

DISASSEMBLY

NOTE

Refer to Section I, paragraph E, Safety Precautions, before disassembling pump.

NOTE

Pump should be dismantled from suction end. Mark or number each component while dismantling according to sequence. IMPORTANT: Check for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed or removed.

1. Remove coupling half from pump shaft (6). Remove coupling key (46).
2. Drain pump by removing the following plugs: plug (424) from the bottom of each interstage case (111), plug (423) from suction case (9) and plug (422) from discharge case (1).
3. Clamp down discharge case foot to steady pump during disassembly.
4. Disconnect male connector retaining nuts from tube connector bodies (410), (411) and (413). Remove tube (400), (401) and (408). Retaining nuts will remain with tube. Pipe elbow (455), pipe tee (456) and pipe nipple (486) will remain in casing. If necessary, remove orifice (135) from male tube connector and pipe elbow.
5. Support interstage cases (111) before dismantling to prevent them from dropping when suction case (9) is removed.
6. Remove bolts (601) and remove bearing cap (35).
7. Uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).
8. Remove bolts (600). Remove bearing frame (99). Radial bearing (16) and oil seal (169) will come off with bearing frame (99).
9. Inspect radial bearing (16) and oil seal (169) for wear, corrosion or contamination. Carver recommends

replacing radial bearing (16) and oil seal (169) after they have been removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.

10. Remove spacer sleeve (14C) with slinger (40) intact.
11. Remove nuts (615) from studs (630) on seal gland (17A) and remove gland.

NOTE

Do NOT remove rotating element of mechanical seal (90) from sleeve (14A) at this point, especially if mechanical seal (90) is relatively clean, in good working condition.

12. Remove sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90). If replacement is required, remove element from sleeve (14A).
13. If necessary to replace mechanical seal, remove stationary element of mechanical seal (90) in seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
14. Remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting suction case (9) and discharge case (1).

caution

Use of a hoist with adequate capacity is recommended for lifting suction case (9).

NOTE

Refer to Table 13, Maximum Wear Ring Clearances, before removing wear ring from casing.

15. Remove wear ring (7A) and suction case (9).
16. Remove case o-ring (89D) from suction casing (9).
17. Remove sleeve o-ring (89X) and key (32X). Remove spacer sleeve (14D) or (14E). Remove first impeller (2A).
18. Remove interstage case (111) with wear ring (7X), diffuser (5A) and case o-ring (89D) intact. Remove o-ring (89D) from interstage case (111).
19. Remove impeller key (32A). Remove interstage sleeve (58). Remove interstage shims (73G), as necessary, from both sides of interstage sleeve (58).

20. Remove interstage impeller (2X).
21. Repeat steps 18 through 20 for each remaining stage. Number and match mark impellers during removal.
22. If required for wear ring replacement, remove wear ring (7X) and last stage diffuser (5X), which holds bushing (63X). Do NOT remove bushing (63X) from last stage diffuser (5X).
23. Remove spacer sleeve (14F), if applicable.
24. Remove nut (615) from stud (630).
25. Remove bolts (600).
26. Remove bearing frame assembly with seal (91) and shaft (6).
27. Remove bolts (601) from bearing cap (37). Remove bearing cap (37).
28. Uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17X).
29. Remove bearing frame (99). Bearings (18) and oil seal (169) will come off with bearing frame (99).
30. Inspect back-to-back bearings (18) and oil seal (169) for wear, corrosion or contamination. Carver recommends that the back-to-back bearings (18) and oil seal (169) be replaced after removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.
31. Remove bearing spacer (78) with slinger (40) intact from shaft (6).
32. Remove snap ring (176).
33. Remove spacer sleeve (14D).

NOTE

Do NOT remove rotating element of mechanical seal (91) from sleeve (14X) at this point, especially if mechanical seal (91) is relatively clean, in good working condition.

34. If necessary to replace mechanical seal, remove stationary element from mechanical seal (91) in seal gland (17X). Remove gland o-ring (89H) from seal gland (17X).
35. Remove sleeve o-ring (89X). Remove seal sleeve (14X) and sleeve key (32X), as applicable.
36. Remove rotating element of mechanical seal (91). If replacement is required, remove from shaft sleeve (14X).
37. Remove remaining impeller key (32A), as necessary.

ASSEMBLY

Refer to the applicable sectional drawing for location of parts followed by an item number. Assemble the pump in accordance with accepted rules of engineering. Assembly of the pumping unit should be performed on a flat surface. Carver recommends all nuts and bolts be torqued according to Table 10, Recommended Torque Values. Check to make sure components are fitted in correct sequence. Assembly begins at the discharge (outboard) end of the pump. Perform the following procedures to assemble the pumping unit:

NOTE

To ensure proper seating of bearing parts, rotate the bearing while clamping the parts.

1. Secure discharge casing to work area.
2. Install sleeve key (32X) or (32C), as required, into keyway in shaft (6). Lubricate inside of shaft sleeve (14X) and slide onto shaft (6), lining up keyway of shaft sleeve (14X) with sleeve key (32X) or (32C), as required.
3. Lubricate and install sleeve o-ring (89X) into groove on discharge end of shaft.
4. Install spacer sleeve (14D).
5. Install rotating element of mechanical seal (91) onto shaft sleeve (14X). Tighten setscrews in mechanical seal (91).
6. Install sleeve (14X) on shaft (6) with rotating element through discharge casing (1).
7. Install spacer sleeve (14F), if applicable.
8. If stationary element of mechanical seal is replaced, clean, dry, and lubricate seal gland (17X).
9. Lubricate and install stationary element of mechanical seal (91) in seal gland (17X).
10. Lubricate and install o-ring (89H) on seal gland (17X).
11. Install seal gland (17X) over shaft (6), onto discharge casing (1). Check to make sure seal gland is correctly positioned to orient piping. Secure seal gland (17X) with nuts (615) on studs (630) to discharge case (1), finger tight.
12. Install snap ring (176).
13. Install bearing spacer (78) with slinger (40) intact.
14. Install oil seal (169) into bearing frame (99).

caution

While installing back-to-back bearings, do NOT unnecessarily hit bearings. If damage to the bearings occurs, replace damaged bearings with new bearings. Refer to Section V, paragraph B.

15. Install end of shaft (6) through outboard side of bearing frame (99).
16. Install new bearings (18) back-to-back on shaft (6).
17. Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6).
18. Install bearing locknut (22) and tighten against lockwasher (69). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
19. Install bearing cap (37) with bolts (601) on bearing frame (99).
20. Install bearing frame (99) with bolts (600).
21. Install impeller key (32A). Install wear ring (7X) in diffuser (5X).
22. Install last stage diffuser (5X) with bushing (63X) into discharge casing (1).
23. Install the last stage impeller (2X). Check depth reading in accordance with Figure 8 and Table 12.

NOTE

Replace the same number of new interstage shims (73G) during assembly that were removed during disassembly.

NOTE

IMPORTANT: Assemble any shims found during disassembly in correct sequence only if no sleeves or impellers were replaced.

24. Install shims (73G), as necessary.
25. Install impeller key (32A) and interstage sleeve (58).
26. Lubricate and install o-ring (89D) into interstage casing (111).
27. Install wear ring (7X) in diffuser (5A) into interstage casing (111). Check to make sure locking tab engages the diffuser to keep from rotating.

NOTE

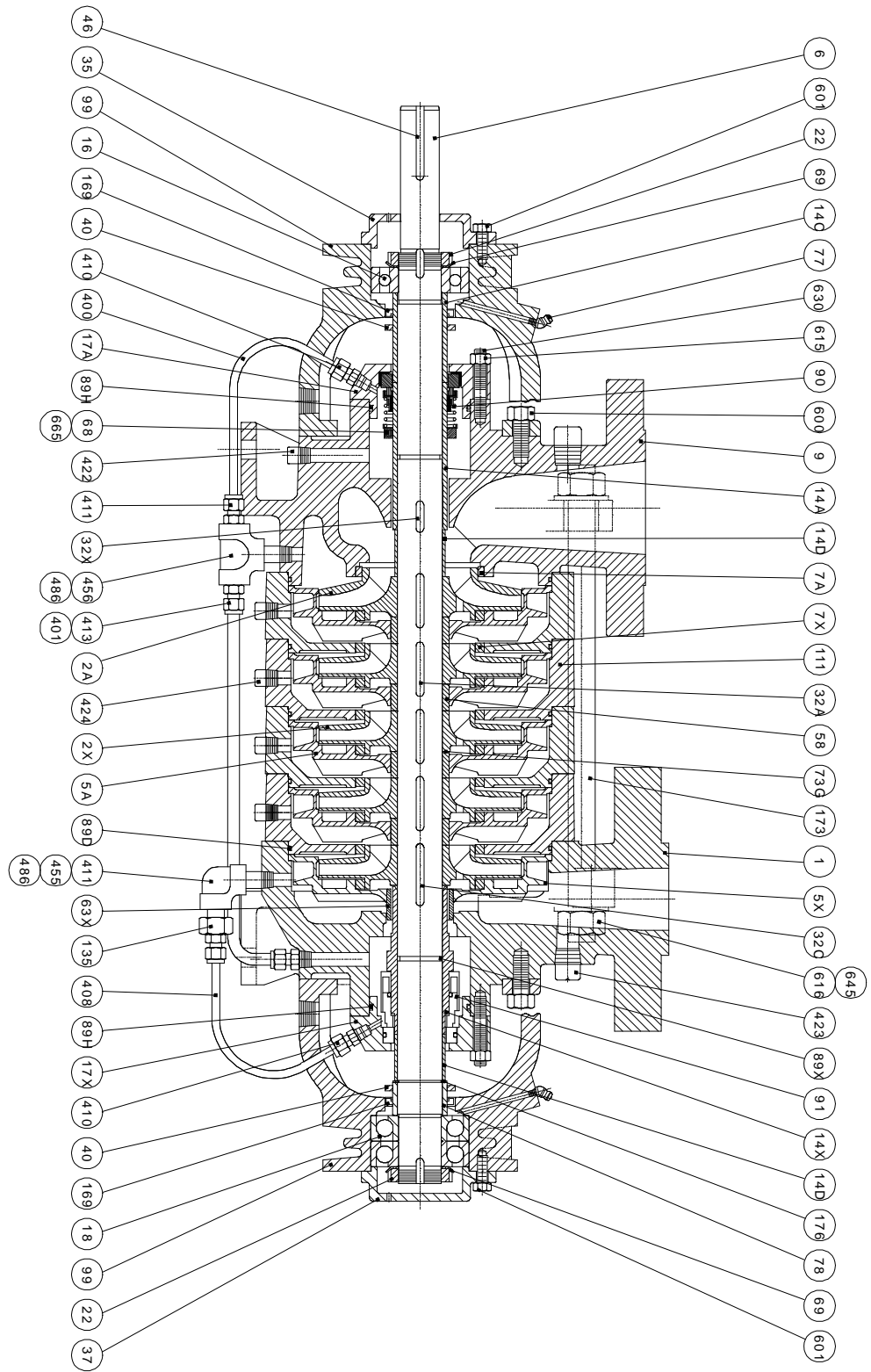
Check alignment in accordance with Figure 8, Axial Impeller Alignment.

28. Install interstage casing (111) into discharge casing (1).
29. Install the next stage impeller (2X) and impeller key (32A).
30. Repeat steps 23 through 25 for each stage.
31. Install spacer sleeve (14D) or (14E) onto shaft (6).
32. Install key (32X).
33. Install sleeve (14A).
34. Mark sleeve and end of shaft to determine location of key aligning key to keyway.
35. Lubricate and install o-ring (89D) onto suction casing (9).
36. Install suction casing (9) and tap into place against interstage casing (111).
37. Install tie bolts (173) and secure with flat washers (645) and hex nuts (616). Tighten hex nuts (616) firmly and evenly. Refer to Table 10 for recommended torque requirements.
38. Scribe a mark on sleeve (14A) flush with stuffing box face.
39. Remove sleeve (14A). Make second scribe mark according to Table 7.
40. Install locking collar (68) with setscrews (665) to the impeller side of the second scribed mark for seal setting on sleeve (14A).
41. Lubricate and install o-ring (89X) and slide into groove on shaft (6).
42. Lubricate inside of sleeve (14A).
43. Align keyway to mark scribed in step 34.
44. Slide sleeve (14A) over o-ring (89X).
45. If stationary element of mechanical seal is replaced, clean, dry and lubricate seal gland (17A).
46. Install stationary element of mechanical seal into seal gland.
47. Lubricate and install o-ring (89H) on seal gland (17A).
48. Install rotating elements of mechanical seal onto sleeve (14A).
49. Install seal gland with elements of mechanical seal gland (17A) onto suction casing with studs (630) and nuts (615) finger tight.
50. Install bearing spacer sleeve (14C) with slinger (40) onto shaft (6).
51. Install bearing frame oil seal (169).
52. Install bearing frame (99) to suction casing (9) with bolts (600).

caution

While installing bearings, do NOT unnecessarily hit bearings. If damage to the bearings occurs, replace damaged bearings with new bearings. Refer to Section V, paragraph B.

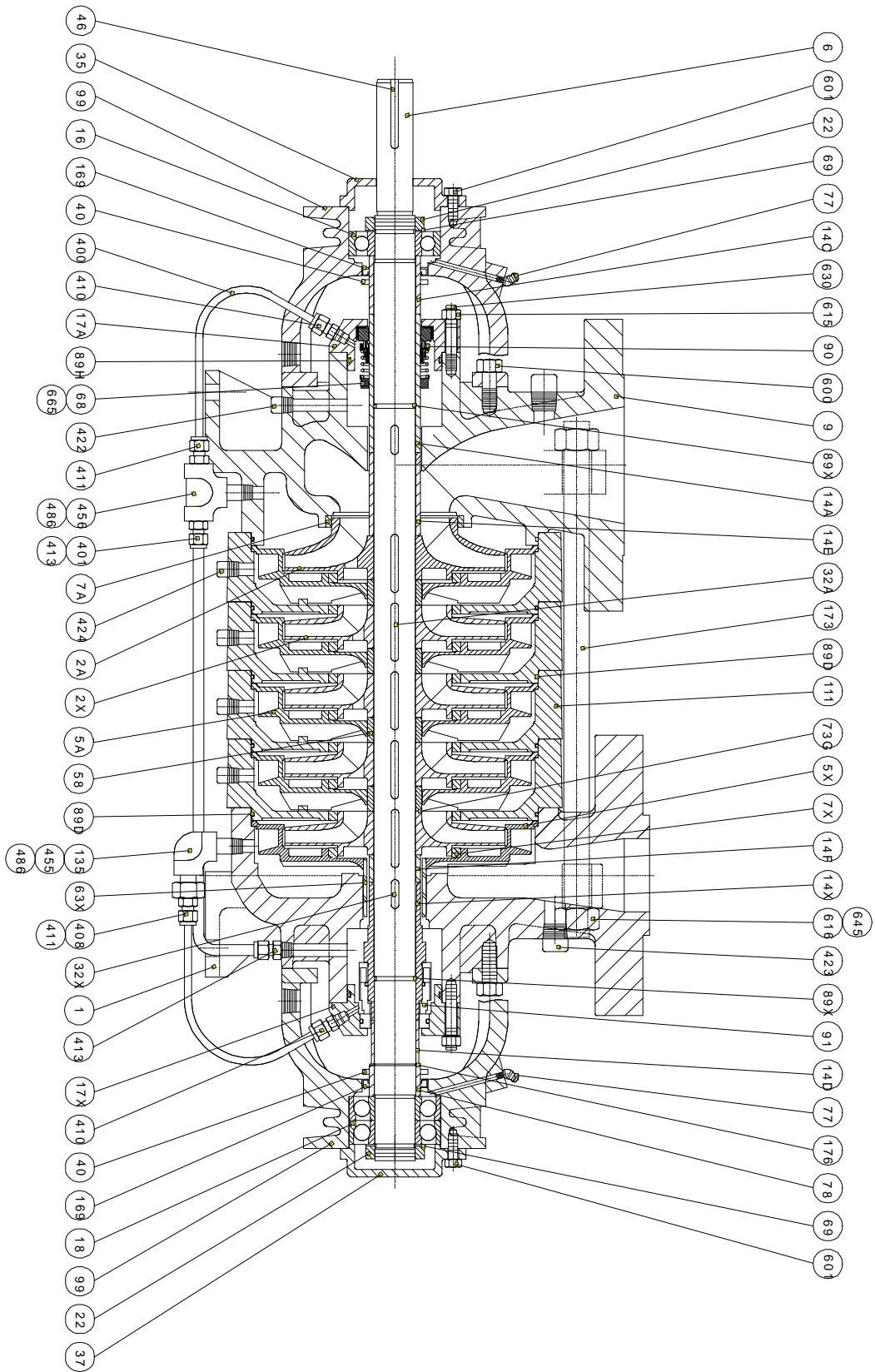
53. Install new radial bearing (16) on shaft (6).
54. Install bearing lockwasher (69) so that tab of lockwasher (69) fits into keyway on shaft (6).
55. Install bearing locknut (22) and tighten against lockwasher (69). Crimp lockwasher tab into slot provided on outside of bearing locknut (22).
56. Secure bearing cap (35) onto bearing frame (99) with bolts (601).
57. Rotate shaft (6) by hand to ensure smooth rotation. Tighten nut (615) on gland (17A).
58. Add grease to bearings through grease zerks in bearing frame (99). Refer to this section, paragraph B, Bearings, for bearing maintenance.
59. If removed, install orifice (135) onto pipe nipple (486) and pipe elbow (455).
60. Install tubing (408) to orifice assembly with male tube connector (410) and (411) bodies.
61. Install tubing (401) with male tube connector (413) bodies.
62. Install tubing (400) with male tube connector (410) and (411) bodies. After connecting tubing, inspect shaft for concentricity.
63. Install plugs (422) for stuffing box, (423) for gauge connector and (424) for the casing drain.
64. Return pump to installation site. Install pump on base and secure with bolts.
65. Install coupling key (46). Install coupling half on pump shaft (6). Align coupling as outlined in Section II, paragraph D, Coupling, and reference Figure 5, Coupling Alignment.
66. Install coupling guard.
67. Connect suction, discharge and gauge lines. After connecting piping, check once more for smooth rotation of shaft.
68. Open system valves.
69. Unlock and reconnect the electrical power supply to the driver. Remove all tags. Start the pumping unit in accordance with paragraph C, Start-Up, of Section III, Operation.



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	18	O.B. BEARING	89D	O-RING-CASING	413	TUBE CONNECTOR
2A	IMPELLER-1 ST STAGE	22	BEARING LOCKNUT	89H	O-RING-SEAL GLAND	422	PLUG-STUFF BOX
2X	IMPELLER	32A	KEY-IMPELLER	89X	O-RING-SLEEVE	423	PLUG-GAUGE CONN
5A	DIFFUSER	32C	KEY-LAST STAGE	90	MECHANICAL SEAL	424	PLUG-CASE DRAIN
5X	DIFFUSER-LAST STAGE	32X	KEY-SLEEVE	91	MECHANICAL SEAL	455	PIPE ELBOW
6	SHAFT	35	BEARING CAP-I.B.	99	BEARING FRAME	456	PIPE TEE
7A	WEAR RING	37	BEARING CAP-O.B.	111	INTERSTAGE CASE	486	PIPE NIPPLE
7X	WEAR RING	40	SLINGER	135	ORIFICE	600	BOLT-BRG FRM
9	SUCTION CASE	46	KEY-COUPPLING	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP
14A	SLEEVE	58	SLEEVE-INTERSTAGE	173	TIE BOLT	615	NUT-GLAND
14C	SPACER SLEEVE	63X	BUSHING-LST STG DIFFUSER	176	SNAP RING	616	NUT-TIE BOLT
14D	SPACER SLEEVE	68	SLEEVE COLLAR	400	TUBE	630	STUD-GLAND
14X	SLEEVE	69	BEARING LOCKWASHER	401	TUBE	645	WASHER-TIE BOLT
16	I.B. BEARING	*73G	SHIMS-INTERSTAGE	408	TUBE	665	SETSCREW-SLEEVE COLLAR
17A	GLAND	77	GREASE ZERK	410	TUBE CONNECTOR		
17X	GLAND	78	BEARING SPACER	411	TUBE CONNECTOR		

* Use as required

Figure 14. Sectional Assembly Drawing. RS A and RS B w/optional mechanical seals



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	17A	GLAND	78	BEARING SPACER	411	TUBE CONNECTOR
2A	IMPELLER-1 ST STAGE	17X	GLAND	89D	O-RING-CASING	413	TUBE CONNECTOR
2X	IMPELLER	18	O.B. BEARING	89H	O-RING-SEAL GLAND	422	PLUG-STUFF BOX
5A	DIFFUSER	22	BEARING LOCKNUT	89X	O-RING-SLEEVE	423	PLUG-GAUGE CONN
5X	DIFFUSER-LAST STAGE	32A	KEY-IMPELLER	90	MECHANICAL SEAL	424	PLUG-CASE DRAIN
6	SHAFT	32X	KEY-SLEEVE	91	MECHANICAL SEAL	455	PIPE ELBOW
7A	WEAR RING	35	BEARING CAP-I.B.	99	BEARING FRAME	456	PIPE TEE
7X	WEAR RING	37	BEARING CAP-O.B.	111	INTERSTAGE CASE	486	PIPE NIPPLE
9	SUCTION CASE	40	SLINGER	135	ORIFICE	600	BOLT-BRG FRM/CASING
14A	SLEEVE	46	KEY-COUPLING	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP/BRG FRM
14C	SPACER SLEEVE	58	SLEEVE-INTERSTAGE	173	TIE BOLT	615	NUT-GLAND
14D	SPACER SLEEVE	63X	BUSHING-LST STG DIFFUSER	176	SNAP RING	616	NUT-TIE BOLT
14E	SPACER SLEEVE	68	SLEEVE COLLAR	400	TUBE	630	STUD-GLAND
14F	SPACER SLEEVE	69	BEARING LOCKWASHER	401	TUBE	645	WASHER-TIE BOLT
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	408	TUBE	665	SETSCREW-SLEEVE COLLAR
16	I.B. BEARING	77	GREASE ZERK	410	TUBE CONNECTOR		* Use as required

Figure 15. Sectional Assembly Drawing, RS C w/optional mechanical seals

L. Pump Disassembly and Assembly RS D and RS E (with optional mechanical seals) (Figure 16 and Figure 17.)

DISASSEMBLY

NOTE

Refer to Section I, paragraph E, Safety Precautions, before disassembling pump.

NOTE

Pump should be dismantled from suction end. Mark or number each component while dismantling according to sequence. **IMPORTANT:** Check for shims between impellers and spacer sleeves, and mark the sequence accordingly. The individual components should be unscrewed or removed.

1. Remove coupling half from pump shaft (6). Remove coupling key (46).
2. Drain pump by removing the following plugs: plug (424) from the bottom of each interstage case (111), plug (423) from suction case (9) and plug (422) from discharge case (1).
3. Clamp down discharge case foot to steady pump during disassembly.
4. Disconnect male connector retaining nuts from tube connector bodies (410), (411), (413), and (414). Remove tube (400), (401) and (408). Retaining nuts will remain with tube. Pipe elbow (455), pipe tee (456) and pipe nipple (486) will remain in casing.
5. Support interstage cases (111) before dismantling to prevent them from dropping when suction case (9) is removed.
6. Remove bolts (601) and remove bearing cap (35).
7. Uncrimp locking tab of bearing lockwasher (69). Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17A).
8. Remove bolts (600). Remove bearing frame (99). Radial bearing (16) and oil seal (169) will come off with bearing frame (99).
10. Inspect radial bearing (16) and oil seal (169) for wear, corrosion or contamination. Carver recommends replacing radial bearing (16) and oil seal

- (169) after they have been removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.
11. Remove spacer sleeve (14G), if applicable.
 12. Remove spacer sleeve (14C) with slinger (40) intact. Remove sleeve o-ring (89X).
 13. Remove nuts (615) from studs (630) on seal gland (17A) and remove gland.

NOTE

Do NOT remove rotating element of mechanical seal (90) from sleeve (14A) at this point, especially if mechanical seal (90) is relatively clean, in good working condition.

14. Remove sleeve (14A) and rotating element of mechanical seal (90). Inspect rotating element of mechanical seal (90). If replacement is required, remove element from sleeve (14A).
15. If necessary to replace mechanical seal, remove stationary element of mechanical seal (90) in seal gland (17A). Remove gland o-ring (89H) from seal gland (17A).
16. Remove hex nuts (616) and washers (645). Remove tie bolts (173) connecting suction case (9) and discharge case (1).

caution

Use of a hoist with adequate capacity is recommended for lifting suction case (9).

NOTE

Refer to Table 13, Maximum Wear Ring Clearances, before removing wear ring from casing.

17. Remove wear ring (7A) and suction case (9).
18. Remove case o-ring (89D) from suction casing (9).
19. Remove key (32X). Remove spacer sleeve (14D) and/or (14E), as applicable. Remove first impeller (2A).
20. Remove interstage case (111) with diffuser (5A), wear ring (7X), and case o-ring (89D) intact. Remove o-ring (89D) from interstage case (111).
21. Remove impeller key (32A). Remove interstage sleeve (58). Remove interstage shims (73G), as necessary,

- from both sides of interstage sleeve (58).
22. Remove interstage impeller (2X).
 23. Repeat steps 20 through 22 for each remaining stage. Number and match mark impellers during removal.
 24. If required for wear ring replacement, remove wear ring (7X) and last stage diffuser (5X), which holds bushing (63X). Do NOT remove bushing (63X) from last stage diffuser (5X).
 25. Remove spacer sleeve (14E), if applicable.
 26. Remove bolts (601) from bearing cap (37). Remove bearing cap (37).
 27. Uncrimp locking tab of bearing lockwasher (69).
 28. Remove bearing spacer (78).
 29. Remove bearing locknut (22) and bearing lockwasher (69). Remove male connector (410) body from seal gland (17X).
 30. Remove bolts (600). Remove bearing frame (99). Back-to-back bearings (18) and oil seal (169) will come off with bearing frame (99).
 31. Inspect back-to-back bearings (18) and oil seal (169) for wear, corrosion or contamination. Carver recommends that the back-to-back bearings (18) and oil seal (169) be replaced after removed from shaft (6). Refer to paragraph B of this section for bearing maintenance.
 32. Remove bearing spacer (78).
 33. Remove snap ring (176).
 34. Remove spacer sleeve (14D) or (14C) with slinger (40) intact from shaft (6).
 35. Remove nuts (615) from studs (630) on seal gland (17X).

NOTE

Do NOT remove rotating element of mechanical seal (91) from sleeve (14X) at this point, especially if mechanical seal (91) is relatively clean, in good working condition.

36. If necessary to replace mechanical seal, remove stationary element from mechanical seal (91) in seal gland (17X). Remove gland o-ring (89H) from seal gland (17X).
37. Remove sleeve o-ring (89X). Remove seal sleeve (14X) and sleeve key (32X), as applicable.
38. Remove rotating element of mechanical seal (91). If replacement is required, remove from shaft sleeve (14X).

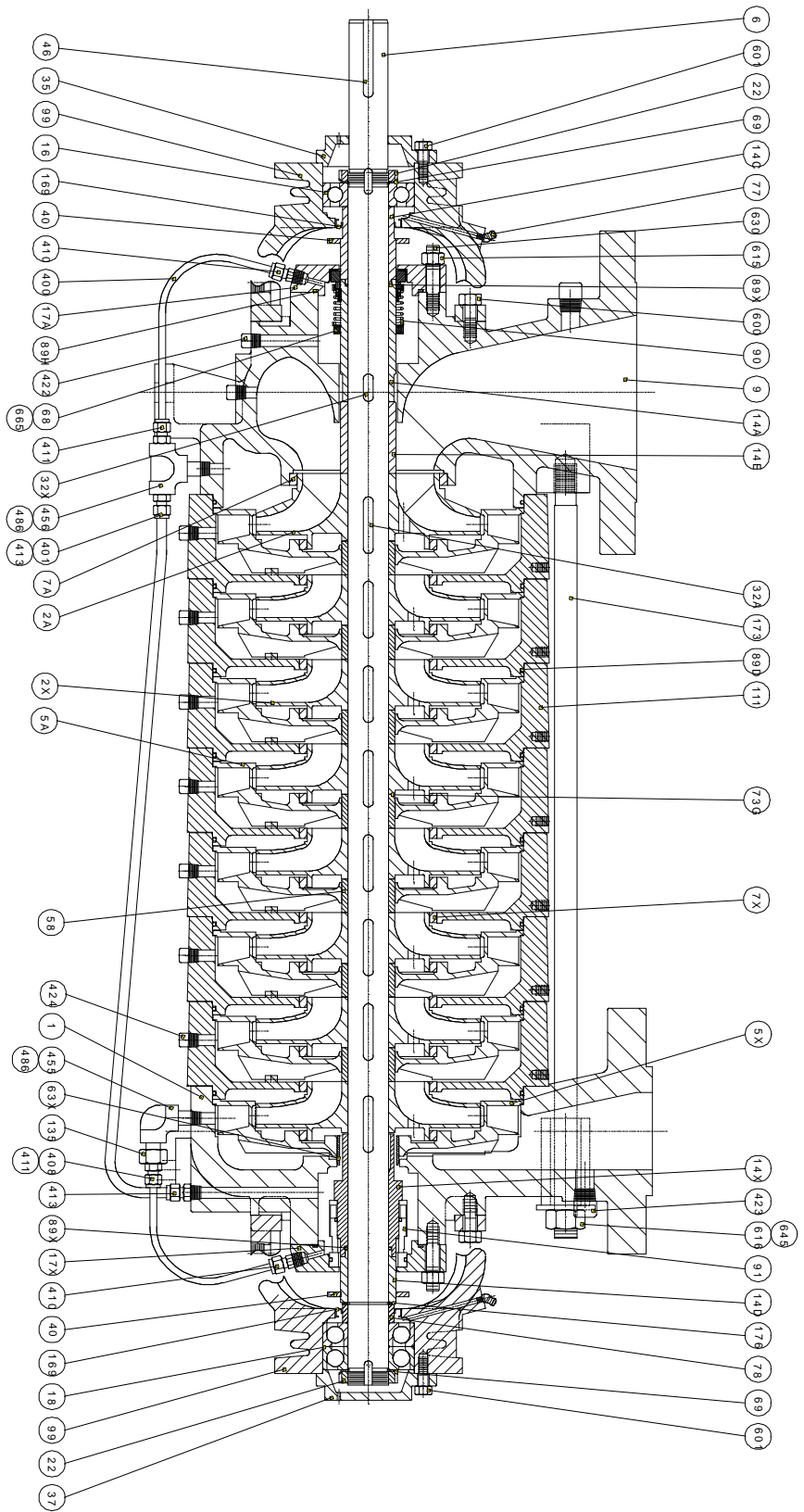
39. Remove remaining impeller key (32A), if applicable.

ASSEMBLY

1. Secure discharge casing to work area.
2. Install sleeve key (32X) or (32C), as required, and shaft sleeve (14X). If stationary element of mechanical seal is replaced, clean and dry seal gland (17X). Install stationary element of mechanical seal (91) in seal gland (17X). Install seal gland (17X) on shaft (6).
3. Install sleeve o-ring (89X) on shaft.
4. Lubricate the interior diameter of mechanical seal (91) rotating elements and slide on shaft sleeve (14X). Tighten setscrews in mechanical seal (91).
5. Install gland o-ring (89H) on seal gland (17X). Slide seal gland (17A) or (17X) over shaft.
6. Install spacer sleeve (14D) or (14C) and snap ring (176) on shaft (6). Check to make sure bushing (63X) is inside last stage diffuser. Install sleeve key (32A) and last stage diffuser (5X) and last stage impeller (2X). Install oil seal (169) suction casing (9).
7. Install bearing spacer (78) with slinger (40) intact.
8. Install bearing frame (99) and secure to discharge case (1) with bolts (600).
9. Slip fit thrust bearings (18) back-to-back 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).
10. Position bearing cap (37) so that grease overflow hole is on lower half of cap. Bolt cap (37) to bearing frame (99) with bolts (601).
11. Install spacer sleeve (14E), as necessary, onto shaft (6). Line up keyway of sleeve with end of sleeve key (32X).
12. Install lubricated o-ring (89D) on interstage case (111). Lightly tap diffuser (5A) onto interstage case (111). Align diffuser vanes on either side of boss located in interstage case (111).
13. Install interstage sleeve shims (73G) on both sides of interstage sleeve (58). Slip interstage sleeve (58) onto shaft (6) and insert impeller key (32A).

14. Install interstage case (111) with diffuser (5A) over shaft and fit into discharge case (1). Check to make sure wear ring (7X) is in interstage case (111). Slide next impeller (2X) onto shaft (6) and align keyway of impeller with key (32A) in shaft (6).
15. Repeat step 14 for each remaining stage.
16. Slide spacer sleeve (14E) and/or (14D) into position on shaft (6). Insert sleeve key (32X) in keyway in shaft (6).
17. Slide lubricated casing o-ring (89D) on suction case (9).
18. Slide suction case (9) onto shaft (6) and tap into place against interstage case (111). Install tie bolts (173) and secure with washers (645) and hex nuts (616). Tighten hex nuts (616) firmly and evenly. Refer to Table 10 for recommended torque values.
19. If non-cartridge seal (90) does not need replaced, proceed to step 19. If a new non-cartridge seal needs to be installed, omit step 17 and proceed as follows:
 - a. Mark shaft sleeve (14A) for key slot location. Slide shaft sleeve (14A) onto shaft (6). Align keyway of shaft sleeve with key (32X) in shaft (6).
 - b. 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 stuffing box drawing, Figure 2. 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.
20. 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 (32X), as applicable. Slide lubricated sleeve o-ring (89X) onto notch in sleeve (14D) or (14C).
21. Install o-ring (89H) on seal gland (17A). Slide seal gland (17A) complete with stationary element of mechanical seal (90) over shaft and onto studs (630). Ensure taps for flush line in gland are positioned so that the flush lines can be connected.
22. Install slinger (40) on spacer sleeve (14C). Slide spacer sleeve (14C) onto shaft (6).
23. Install oil seal (169) onto frame (99).
24. Bolt bearing frame (99) to suction case (9) with bolts (600). Position bearing frame (99) so that grease fitting is located on top of frame.
25. 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).
26. Install inboard bearing cap (35) and bolt to bearing frame (99) with bolts (601). Position cap (35) with the grease overflow hole located on lower half of cap.
27. Tighten hex nuts (615) on studs (630) firmly and evenly securing seal gland (17A). Install male connector (410) body in seal gland (17A).
28. Install tube (400), (401) and (408). Secure tube by tightening retaining nuts on tube connectors (410), (413) and (411).
29. Install plugs (424) in bottom of discharge case (1), suction case (9), and each interstage (111). Install vent plug (423) in suction case (9) and discharge case (1).
30. Return pump to installation site. Reinstall pump on base and secure with bolts.
31. Install coupling key (46) in keyway in shaft (6). Reconnect coupling halves.

32. Align coupling. Reconnect coupling between pump and driver. Install coupling guard.
33. Add grease to bearings through grease zerks (77) in bearing frame (99). Refer to paragraph B of this section for bearing maintenance.
34. Reconnect suction, discharge, and gauge lines. After connecting piping, inspect shaft for concentricity.
35. Open system valves.
36. Unlock and reconnect the electrical power supply to the driver. Remove all tags. Start the pumping unit in accordance with paragraph C of Section III.



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	17X	GLAND	89D	O-RING-CASING	413	TUBE CONNECTOR
2A	IMPELLER-1 ST STAGE	18	O.B. BEARING	89H	O-RING-SEAL GLAND	422	PLUG-STUFF BOX
2X	IMPELLER	22	BEARING LOCKNUT	89X	O-RING-SLEEVE	423	PLUG-GAUGE CONN
5A	DIFFUSER	32A	KEY-IMPELLER	90	MECHANICAL SEAL	424	PLUG-CASE DRAIN
5X	DIFFUSER-LAST STAGE	32X	KEY-SLEEVE	91	MECHANICAL SEAL	455	PIPE ELBOW
6	SHAFT	35	BEARING CAP-I.B.	99	BEARING FRAME	456	PIPE TEE
7A	WEAR RING	37	BEARING CAP-O.B.	111	INTERSTAGE CASE	486	PIPE NIPPLE
7X	WEAR RING	40	SLINGER	135	ORIFICE	600	BOLT-BRG FRM/CASING
9	SUCTION CASE	46	KEY-COUPLING	169	OIL SEAL-BRG FRM	601	BOLT-BRG CAP/BRG FRM
14A	SLEEVE	58	SLEEVE-INTERSTAGE	173	TIE BOLT	615	NUT-GLAND
14C	SPACER SLEEVE	63X	BUSHING-LST STG DIFFUSER	176	SNAP RING	616	NUT-TIE BOLT
14D	SPACER SLEEVE	68	SLEEVE COLLAR	400	TUBE	630	STUD-GLAND
14E	SPACER SLEEVE	69	BEARING LOCKWASHER	401	TUBE	645	WASHER-TIE BOLT
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	408	TUBE	665	SETSCREW-SLEEVE COLLAR
16	I.B. BEARING	77	GREASE ZERK	410	TUBE CONNECTOR		
17A	GLAND	78	BEARING SPACER	411	TUBE CONNECTOR		

* Use as required

Figure 16. Sectional Assembly Drawing, RS D w/optional mechanical seals

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ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DISCHARGE CASE	17X	GLAND	89D	O-RING-CASING	413	TUBE CONNECTOR
2A	IMPELLER-1 ST STAGE	18	O.B. BEARING	89H	O-RING-SEAL GLAND	414	TUBE CONNECTOR
2X	IMPELLER	22	BEARING LOCKNUT	89X	O-RING-SLEEVE	421	PLUG-SUCT. & DISCH. CASE
5A	DIFFUSER	32A	KEY-IMPELLER	90	MECHANICAL SEAL	422	PLUG-STUFF BOX
5X	DIFFUSER-LAST STAGE	32X	KEY-SLEEVE	91	MECHANICAL SEAL	423	PLUG-GAUGE CONN
6	SHAFT	35	BEARING CAP-I.B.	99	BEARING FRAME	424	PLUG-CASE DRAIN
7A	WEAR RING	37	BEARING CAP-O.B.	111	INTERSTAGE CASE	455	PIPE ELBOW
7X	WEAR RING	40	SLINGER	135	ORIFICE	456	PIPE TEE
9	SUCTION CASE	46	KEY-COUPLING	169	OIL SEAL-BRG FRM	486	PIPE NIPPLE
14A	SLEEVE	58	SLEEVE-INTERSTAGE	173	TIE BOLT	600	BOLT-BRG FRM/CASING
14C	SPACER SLEEVE	63X	BUSHING-LST STG DIFFUSER	176	SNAP RING	601	BOLT-BRG CAP/BRG FRM
14D	SPACER SLEEVE	68	SLEEVE COLLAR	400	TUBE	615	NUT-GLAND
14E	SPACER SLEEVE	69	BEARING LOCKWASHER	401	TUBE	616	NUT-TIE BOLT
14G	SPACER SLEEVE						
14X	SLEEVE	*73G	SHIMS-INTERSTAGE	408	TUBE	630	STUD-GLAND
16	I.B. BEARING	77	GREASE ZERK	410	TUBE CONNECTOR	645	WASHER-TIE BOLT
17A	GLAND	78	BEARING SPACER	411	TUBE CONNECTOR	665	SETSCREW-SLEEVE COLLAR

* Use as required

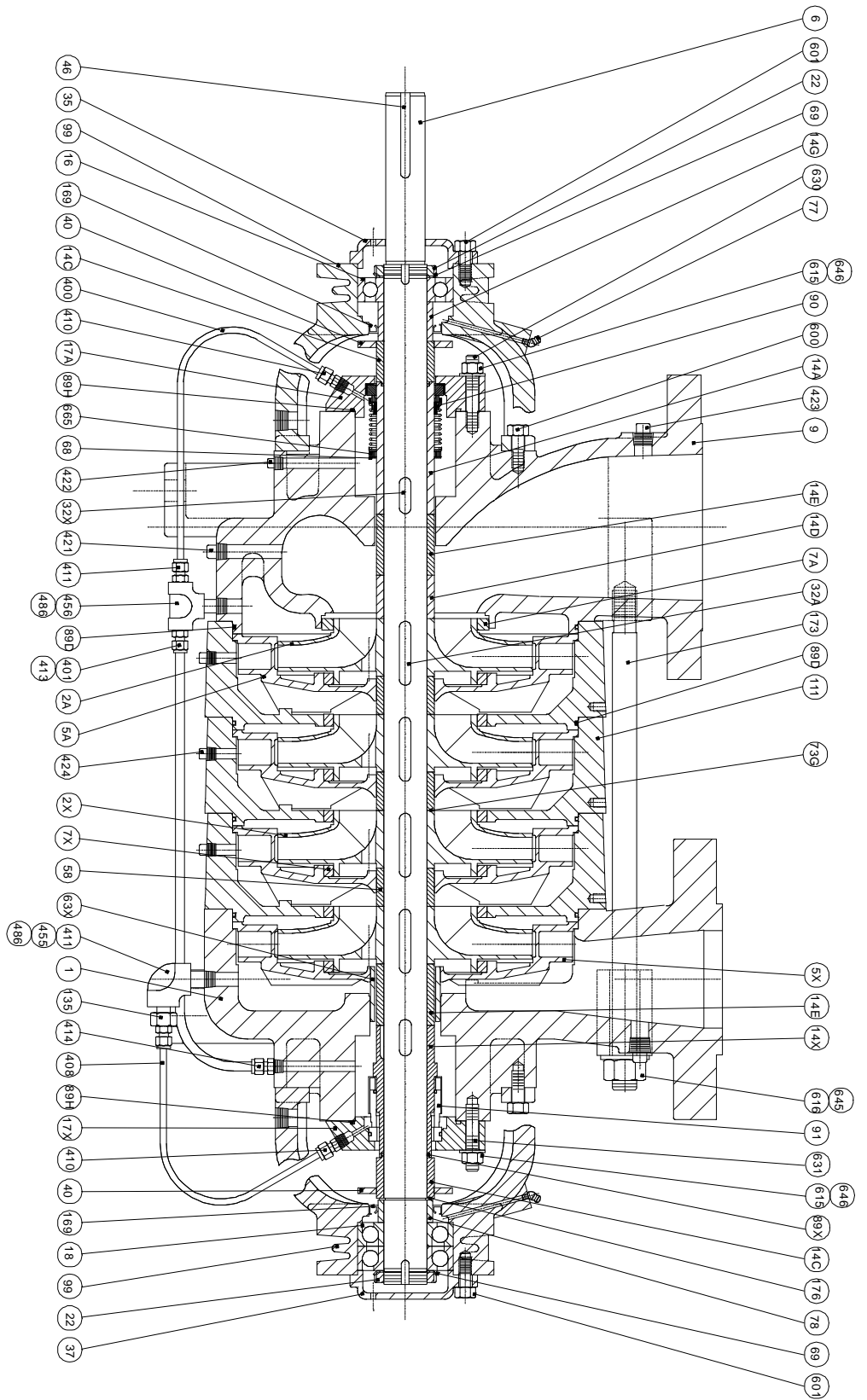


Figure 17. Sectional Assembly Drawing, RS E w/optional mechanical seals

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Table 15. Recommended Spare Parts

<i>Quantity</i>	<i>Item No.</i>	<i>Description</i>
1	2A	Impeller
AR	2X	Impeller, Per Stage
1	6	Shaft
1	7A	Wear Ring
AR	7X	Wear Ring
1	14A	Shaft Sleeve
1	14X	Shaft Sleeve
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
1	17A	Gland
2	18	Thrust Bearing, Discharge End
1	22	Bearing Locknut
1	28	Washer
1	32A	Key, Impeller
1	32X	Key, Sleeve
1	46	Key, Coupling
AR	58	Interstage Sleeve
AR	73G	Shims, Interstage Sleeve
2	89X	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

* Options



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I-280, REV. 04

March 2002