



(F998) I-780

780 – 17.01.EN

M Series-Marine Duty, Close Coupled Pump

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Part Number: _____

Serial Numbers: _____



These operating instructions contain fundamental information and precautionary notes. Please read the manual thoroughly prior to installation of unit, electrical connection and commissioning. It is imperative to comply with all other operating instructions referring to components of individual units.



This manual shall always be kept close to the unit's location of operation or directly on the pump set.

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SERVICE RECORD PAGE

Service No. _____ Model _____ Size and Type _____

Customer Order No. _____ Date Installed _____

Installation Date	Location	Application

PUMP RATING

Capacity _____ Total Head _____

Suction Pressure _____ Speed (RPM) _____

Liquid pumped _____ Temperature _____

Specific Gravity _____ Viscosity _____

Service _____

PUMP MATERIALS

Volute _____ Impeller _____ Shaft _____

Gaskets _____ Bearing Frame _____

Mechanical Seal/Packing _____ P/N _____

MOTOR DATA

Motor _____ Make _____ Serial No. _____

Type _____ Frame _____ AC or DC _____

HP _____ RPM _____ Volts _____

Phase _____ Cycles _____ P/N _____

NOTES ON INSPECTION AND REPAIRS

INSPECTION DATE	REPAIR TIME	REPAIRS	COST	REMARKS

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

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I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

A. GENERAL INFORMATION. M Series pumps are horizontal or vertical, single-stage, single entry, close coupled centrifugal pumps for handling fresh water, sea water, potable water and light hydrocarbons in commercial marine and naval (Navy, USCG, MSC) applications. These pumps conform to the requirements of ASTM F998, and the Navy supplement as required. Hydraulic performance for these units extends to 6000 GPM and 700 feet of head. All models are back pull out design with replaceable wear rings and enclosed impellers. Standard materials are 316 stainless steel with composite internals for fresh and potable water, duplex stainless (CD4MCu) with composite internals for seawater applications, and 316 stainless steel materials for hydrocarbon applications.

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. Factory warranty applies to pumps operating under conditions specified on the order acknowledgement, and that are properly installed and maintained, as recommended in this manual. Additional copies of this manual are available on our website, www.carverpump.com, and upon request from Carver Pump Company.



CAUTION

These instructions must always be kept close to the product's operating location or directly with the product.

This manual is designed to provide sufficient material to properly maintain the total pumping unit. The information presented should improve your knowledge and understanding of the M Series pumps, thus upgrading the reliability, service life, and quality of pump maintenance.

These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation. Compliance with such laws relating to the proper installation and safe operation of the pumping equipment is the responsibility of the equipment owner and all necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment. These instructions are intended to facilitate familiarization with the product and its permitted use to help satisfy safety requirements. Always coordinate repair activity with operations

personnel, and follow all ship safety requirements and applicable safety and health laws/regulations.

Refer to the exploded view for the location of parts identified by item numbers. Variations do exist between configurations, not all parts described in the text may be on your configuration. For specifics of your application, including the performance curve, dimensional drawings, sectional drawing with parts list and for torque values, clearances, etc., refer to Appendix A of this manual. For motor information refer to Appendix B of this manual.



CAUTION

These instructions should be read prior to installing, operating, using and maintaining the equipment in any region worldwide and in conjunction with the main user instructions provided. The equipment must not be put into service until all the conditions relating to safety instructions have been met.

B. DISCLAIMER. Information in these User Instructions is believed to be reliable. In spite of all the efforts of Carver Pump Company to provide sound and all necessary information the content of this manual may appear insufficient and is not guaranteed by Carver Pump Company as to its completeness or accuracy.

C. PERSONNEL QUALIFICATION AND TRAINING.

All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may commission the manufacturer/supplier to provide applicable training.

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.

D. 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. Table 1 provides information on pump size and standard motor frame size. 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.

E. PARTS INVENTORY GUIDE. To avoid unnecessary delays for maintenance, spare parts should be readily available, purchase before and keep in stock, 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 Tables 10 or 11, Recommended Spare Parts. For actual part numbers for your unit see the sectional assembly drawing located in Appendix A.

F. PARTS ORDERING. When ordering replacement parts, please specify:

- Serial number of pump (located on nameplate)
- Part name (Refer to Sectional drawing in Appendix A.)

- Part number (Refer to Sectional drawing in Appendix A.)
- Item number (Refer to Sectional drawing in Appendix A.)
- 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 a Returned Goods Authorization (RGA) Number 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 the dimensional drawing in Appendix A.

If motor or motor parts are ordered, specify name of manufacturer and all other data found on the motor nameplate.

Table 1. Pump Sizing, Motor Frame, Disassembly, and Reassembly Information

Pump Size	Motor Frame with Shaft Extension	Disassembly	Reassembly
1-1/4 X 1 X 7	143 to 215 JM	Section VII, Paragraph B and Figure 3	Section VII, Paragraph C and Figure 3
1-1/2 X 1-1/4 X 7	143 to 215 JM		
2-1/2 X 2 X 7	143 to 215 JM		
3 X 2-1/2 X 7	143 to 215 JM		
4 X 3 X 7	143 to 215 JM		
5 X 4 X 7	143 to 215 JM		
1-1/2 X 1-1/4 X 10	143 to 286 JM	Section VII, Paragraph B and Figure 3	Section VII, Paragraph C and Figure 3
2 X 1-1/2 X 10	143 to 286 JM		
2-1/2 X 2 X 10	182 to 326 JM		
3 X 2-1/2 X 10	182 to 365 JM		
4 X 3 10	182 to 326 JM		
5 X 4 X 10	213 to 444 JM		
6 X 4 X 10	213 to 444 JM		
6 X 5 X 10	184 to 286 JM		
2 X 1 X 11	182 to 326 JM	Section VII, Paragraph B and Figure 3	Section VII, Paragraph C and Figure 3
4 X 2 X 11	213 to 365 JM		
4 X 3 X 11	213 to 445 JM		

Table 1. Pump Sizing, Motor Frame, Disassembly, and Reassembly Information - Continued

Pump Size	Motor Frame with Shaft Extension	Disassembly	Reassembly
5 X 4 X 11	213 to 286 JM	Section VII, Paragraph B and Figure 3	Section VII, Paragraph C and Figure 3
6 X 4 X 11	254 to 405 JP	Section VII, Paragraph D and Figure 4	Section VII, Paragraph E and Figure 4
8 X 6 X 11	254 to 326 JP		
4 X 3 X 13	254 to 405 JP	Section VII, Paragraph D or F and Figure 4 or 5	Section VII, Paragraph E or G and Figure 4 or 5
6 X 4 X 13	284 to 447 JP		
6 X 6 X 13	284 to 405 JP		
8 X 6 X 13	324 to 405 JP		
10 X 8 X 13	364 to 445 JP		
12 X 10 X 13	364 to 445 JP		

G. SAFETY PRECAUTIONS. The manual is designed to provide adequate instructions for the safe and efficient installation, operation, or maintenance of the pump. Failure or neglect to properly install, operate, or maintain the pump may result in personal injury, property damage, or unnecessary damage to the pump. This manual must be read and understood both by the installing personnel and the responsible trained personnel/operators prior to installation and operation, and it must always be kept close to the location of the pumping unit for easy access.

G.1 Summary of Safety Marking.

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the symbol:



General hazard sign to ISO 7000 - 0434.

Notes highlight an operating or maintenance procedure, condition, or statement which is essential, but is not of known hazardous nature as indicated by DANGERS, WARNINGS and CAUTIONS.

The word "CAUTION" is used to introduce safety instructions whose non-observance may lead to damage to the machine and its functions.

The word "WARNING" is used to introduce safety instructions whose non-observance may lead to a potential hazard exists, capable of producing injury to personnel, if approved procedures are not followed.

The word "DANGER" indicates a location, equipment, or system where imminent hazards exist, capable of producing immediate injury or death to personnel or threatens the primary mission of the ship.

Instructions attached directly to the machine, e.g.

- Arrow indicating the direction of rotation
- Markings for fluid connections must always be complied with and be kept in a perfectly legible condition at all times.

Observe all note, caution, warning, or danger tags attached to the equipment or included in this manual.

G.2 Non-compliance with Safety Instructions.

Non-compliance with safety instructions may result in personal injury, property damage, or unnecessary damage to the pumping unit. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages. Non-compliance, can for example, result in:

- Failure of important pumping unit functions.
- Hazard to personnel by electrical, mechanical, and chemical effects as well as explosion.
- Hazard to the environment due to leakage of hazardous substances.

G.3 Safety Instructions for Maintenance, Inspection, and installation Work.

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified personnel who are thoroughly familiar with the manual and pumping unit.

The pumping unit must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained before working on any pumping unit.

Work on the pumping unit must be carried out during shutdown. The shutdown procedure described in the manual for taking the unit out of service must be adhered to.

Pumps handling fluids that are hazardous to personnel must be decontaminated prior to being worked on.

Immediately following completion of the work, all safety relevant and protective devices must be reinstalled and/or reactivated.

Please observe all instructions set out in the section on start-up before returning the pumping unit to service.

Before operating this equipment, read the following safety precautions, which are to be observed at all times:

1. Prior to working on pump or motor, ensure all switches and circuit breakers have been locked in the open (off) position and tagged, "Out of Service."
2. Do not wear loose clothing or jewelry when working with rotating machines. Secure dog tags, tool belts and anything else which could be pulled into the machinery.
3. Any circuit should be considered energized (live) and dangerous unless it is absolutely proven to be de-energized (dead).
4. In general, try to keep one hand free when servicing electrical equipment.
5. When working near electricity, be careful with any metal tools or equipment being used so that they do not touch a live circuit.
6. Be sure to de-energize all equipment before connecting or disconnecting any meters or test leads.
7. Personnel shall make absolutely certain that they are not grounded when adjusting or measuring equipment.
8. When connecting a meter to terminals for measurement, always use a range higher than

the expected voltage, and then adjust accordingly.

9. Before operating this motor or performing any test or measurement, make sure that motor frame and starter panel are securely grounded.
10. If a test meter must be held or adjusted while voltage is being applied, ground the case of the meter before starting measurement and do not touch the live equipment while you are holding the meter. Some moving vane type meters should neither be grounded nor should they be held during measurement. Review meter operating manual before each use.
11. DO NOT use test equipment known to be damaged or in poor condition.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the (OFF) position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances shall any person reach into or enter the area of the pump for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages shall be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

G.4 Unauthorized Modification and Manufacture of Spare Parts.

Modifications or alterations of the pumping unit supplied are only permitted after consultation with Carver Pump Company and to the extent permitted by Carver Pump Company. Original spare parts and accessories authorized by Carver Pump Company ensure safety. The use of other parts can invalidate any liability of Carver Pump Company for consequential damage and/or warranty.

G.5 Unauthorized Modes of Operation.

The warranty relating to the operating reliability and safety of the unit supplied is only valid if the pumping unit is used in accordance with its designated use as described in the following sections. The limits stated on the nameplate must not be exceeded under any circumstances.

II. INSPECTION AND STORAGE.

A. INSPECTION. Upon receipt of the shipment, unpack and inspect the pumping unit and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Immediately report any missing parts or damage incurred during shipment to the factory and to the Transportation Company and file your “damage and/or lost in shipment” claim with the carrier.

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

Carver Pump Company recommends rotating each motor/pump shaft several revolutions at least once every month. This is done to prevent flat spots on ball bearings and indentations in the race of the ball bearing, which is termed “false brinelling.” False brinelling will lead to premature bearing failure.

NOTE

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

The pumping unit is shipped with flange covers to protect flange faces and to prevent foreign matter from entering the pump. Keep flange covers intact until suction and discharge piping are connected to pump flanges.

The motor bearings should be prepared for storage according to the motor manufacturer's instructions, in the motor manufacturer's maintenance manual, refer to Appendix B.

Consider a unit to be in storage when:

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

Measures to be taken for prolonged shutdown of installed pumping unit. If the pumping unit remains installed a periodic check of operation is in order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area. Start up the pumping unit regularly once a month for a short time (approximately 5 minutes) during prolonged shutdown periods. Prior to operation ensure that there is sufficient liquid available for operating the pump.

III. INSTALLATION.

A. LOCATION. The pump assembly should be located in an area that will permit periodic inspection and maintenance. Sufficient area and access should be provided and all units should be installed in a dry location with adequate drainage. The discharge piping should be direct with as few elbows and fittings as possible.

The pump assembly should be installed as close to the fluid source as possible. A short, direct suction pipe can be used to keep suction losses at a minimum. If possible, locate the pump so fluid will flow by gravity to the suction opening. The discharge piping should be direct with as few elbows and fittings as possible. The total net positive suction head available (NPSHA), which includes the suction lift and pipe friction losses, must be greater than the net positive suction head required (NPSHR) by the pump.

B. HANDLING.



WARNING

If the pumping unit slips out of the sling arrangement, it may cause injury to personnel and/or damage to the pumping unit.



CAUTION

Use a hoist with adequate lifting capacity.

Do not pick up the complete unit by the motor or the pump shafts or motor lifting eyes.

Moving the unit requires proper preparation and handling. Always make sure that the pump or the pumping unit remains in a horizontal position while being moved and cannot slip out of the transport suspension arrangement. Use a sling for pumps without baseplates, see Figure 1. To lift a horizontal mounted unit, a hoist or suitable lifting device should be attached to each corner of base structure, see Figure 2. The individual motor may be lifted using proper eyebolts provided by the manufacturer, but these should not be used to lift the assembled unit.

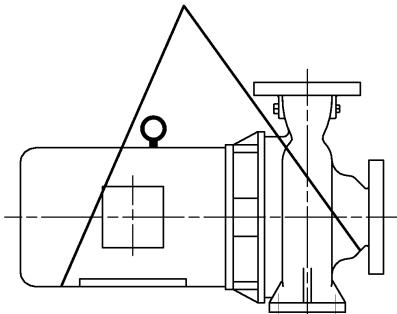


Figure 1. Sling Position for Lifting Pump

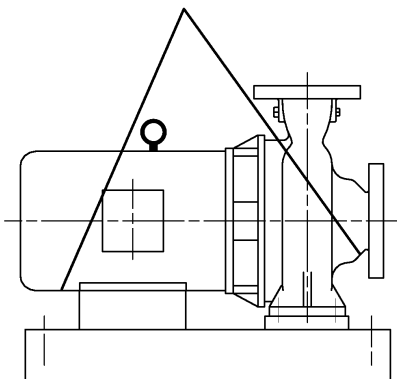


Figure 2. Sling Position for Lifting Pumping Unit

C. FOUNDATION. The foundation should be 3 to 6 inches wider and longer than the baseplate, have a level surface, and be of sufficient mass to prevent vibration and form a permanent rigid support for the unit. This will allow for accurate positioning of the unit.

D. LEVELING OF UNIT. When the pump is supplied complete with motor, and baseplate, the unit is assembled at the factory. Lower unit onto foundation, positioning base structure so anchor bolts are aligned in middle of holes in base.

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. 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 discharge flange is level. Check suction and discharge flanges of the pump by means of a level. Make corrections, as necessary, by adjusting the supports or wedges under the base plate.

The base should be supported on metal shims or metal wedges placed directly beneath the part of the base supporting the most weight. The shims or wedges should be spaced close enough to give support and stability.

Adjust metal supports or wedges until suction and discharge flanges are level.



CAUTION

Do not attempt to straighten the base by using the anchor bolts.

E. PRE-INSTALLATION PROCEDURES.

1. Check the pump foundation and confirm the bolting surface is flat and the bolt pattern is correct.
2. Slowly lower pump onto the foundation.
3. Rotate the pump by hand. Check for any mechanical hesitation, binding or any acoustically transmitted signals from the pump. Hand rotation should be smooth and silent. Install the pump to foundation bolting and tighten to the system torque values. The pump should be rotated frequently during the procedure to tighten down the pumping unit.
4. After the pumping unit has been completely tightened down to the foundation, confirm that there is no binding.
5. Connect the piping.

F. PIPING. All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pumping unit.



CAUTION

All piping connections must be made with the pipe in a freely supported state. Do not apply vertical or side pressure to align the piping with the pump flange.

Before connecting suction, discharge, and auxiliary piping, check to see that the piping is absolutely clean internally. Any debris in the piping will be drawn into the pump passageways and can cause extreme damage. The internal diameters of the suction and discharge lines must be equal to the internal diameters of the pump suction and discharge nozzles.

Suction lift lines shall be laid with a rising slope toward the pump and suction head lines with a downward slope towards the pump.

The suction pipe must be air tight and sloped upward to pump flange to avoid air pockets which will impair pump operation. The discharge pipe should be as direct as possible using a minimum number of valves to reduce pipe friction losses.

Never use a straight taper (concentric) reducer in a horizontal suction line because air pockets may form in the top of the reducer and the pipe. Use an offset (eccentric) reducer instead.

It is recommended to install a check valve and closing valve in discharge line and closing valve in suction line, depending on the type of service and pump. The check valve, between the pump and valve, protects pump from water hammer and prevents reverse rotation in the event of power failure. Valve closure is used during priming, starting, and pump shut down. Pump must never be throttled by use of a valve in the suction line.

Thermal expansions of the pipeline must be compensated by appropriate measures so as not to impose any extra loads on the pump exceeding the permissible pipeline forces and moments.

G. AUXILIARY PIPING CONNECTIONS AND GAUGES. In addition to primary piping connections, the pump may require other connections such as gauges or drains. All these lines and gauges should now be installed.

H. MOTOR. See motor vendor's manual for motor information and information on connecting to the power supply, refer to Appendix B.



CAUTION

Connection to the power supply must be effected by a trained electrician only. Check available main voltage against the data on the motor rating plate and select appropriate start-up method.

I. DIRECTION OF ROTATION. Correct pump rotation is indicated by an arrow on the pumping unit. The standard direction of rotation, viewed from the motor end, is clockwise.

IV. OPERATION.

Before starting or operating the pump, read this entire manual, especially Paragraph I, Section G, Safety Precautions.

A. PRE-START CAUTIONS.



DANGER

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 the unit is activated while being worked on.

1. Observe all caution or danger tags attached to the equipment.



CAUTION

Never run the pump dry. Close running fits within the pump are liquid lubricated. Dry running will result in pump seizure or damage.

2. Before starting the pump, rotate shaft by hand to assure all moving parts are free from rubbing.
3. Before starting the pump, install guards to enclose all exposed rotating parts.
4. Before starting the pump, fill the volute and suction line with liquid. The pump is primed in accordance with Section IV, Paragraph B.
5. Before starting a mechanical seal pump equipped with external flush lines, turn on seal water, and confirm the seal water is at sufficient pressure.

6. Make sure all fasteners are torqued to the proper torque values to avoid equipment damage and injury to personnel.

B. PRIMING. Dry running a centrifugal pump can result in extensive damage and possible seizing. It is, therefore, imperative that the pump be primed prior to initial start-up and that prime must be maintained through subsequent start-stop cycles.

The priming procedure is different for positive (flooded) and negative suction head (suction lift) systems. Follow the procedure listed below.

Positive Suction Head (Flooded):

1. Open the vent on the highest point on the pump volute.
2. Open all suction valves.
3. Allow liquid to flow from vent hole until all air bubbles are vented. Then close the vent.
4. The pump is now primed.

Negative Suction Head (Suction Lift):

1. Install an ejector or vacuum pump on the vent at the highest point on the volute.
2. Close the discharge valve.
3. Open the suction valve.
4. Start the ejector or vacuum pump.
5. Allow liquid to flow until a continuous flow is exhausted from ejector. Then close the valve to the vent.
6. The pump is now primed.

C. STARTING THE PUMP.



DANGER

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 the unit is activated while being worked on.



CAUTION

DO NOT operate pumping unit against a closed discharge system. If pump must operate against a closed system, a bypass system allowing a minimum design flow should be installed. This bypass will be satisfactory for short periods of operation. For extended periods of operation the bypass should be sized to the minimum continuous flow required by the pump to prevent overheating.

1. Check pump for proper priming and lubrication.
2. If unit is equipped with mechanical seal cooling lines, turn on mechanical seal cooling water.
3. Fully open the suction valve and partially open the discharge valve.
4. Start the pumping unit in accordance with the directions on the electrical power supply.
5. Slowly open the discharge valve and adjust pressure and flow to the appropriate operating conditions. Refer to pump nameplate and system operating procedures for design point condition.

D. OPERATING CHECKS.

1. Check for undue vibration or noise. If any occurs and does not stop within a short period of time, turn off the pump. For determination of the cause and its remedy refer to troubleshooting in Section V or consult Carver Pump Company.
2. Check and record pressure readings. The pressure readings should be within the operating system guidelines and similar to number stamped on the pump nameplate.
3. Check and record bearing temperature. It should not exceed 180 degrees F.
4. Check and record power input to the motor.
5. Check for leakage at mechanical seals.

E. STOPPING THE PUMP.

1. If the pump is being stopped for overhaul, slowly close the discharge valve. Otherwise leave discharge valves set at condition.
2. Stop the pumping unit in accordance with the directions on the electrical power supply.
3. Tagout and lockout power to motor according to OSHA Standard 1910.147.
4. Close suction valves and any auxiliary fluid lines.
5. The pumping unit is now off.

F. EMERGENCY SHUTDOWN.

1. Stop the pumping unit in accordance with the directions on the motor electric power supply.
2. If there is a loss of fluid to the pump, shutdown the pump in accordance with the shutdown procedure in Section IV, Paragraph E.
3. Isolate and correct the problem in accordance with Troubleshooting Operating Problems, Section V, Table 2.

G. INDEFINITE SHUTDOWN.

Lubricate motor bearings per motor manual refer to Appendix B. Provide pump assembly with a protective cover. Drain volute (1) by removing plug (422) in bottom of volute. If necessary, flush pump to remove corrosive or toxic pumpage. Reinstall plug in volute when fluid is completely drained. Drain all piping if there is a possibility of liquid freezing.

V. TROUBLESHOOTING OPERATING PROBLEMS.

If you have followed the installation and starting procedures outlined in this manual, the pump should provide reliable service and long life. However, if operating problems do occur; significant time and expense can be saved if you refer to Table 2 to eliminate the most common causes of those problems.

For the motor troubleshooting refer to the motor manual in Appendix B.

Table 2. Pumping Unit Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Failure to deliver liquid.	<ol style="list-style-type: none"> 1. System head greater than anticipated. 2. Pump not primed. 3. Check valve stuck or improperly installed. 4. Impeller or suction clogged. 	<ol style="list-style-type: none"> 1. Check pump rating against actual head condition. 2. Prime pump in accordance with Section IV, Paragraph B. 3. Adjust and/or reverse valve. 4. Inspect suction and impeller. Clean as necessary.
Excessive power consumption.	<ol style="list-style-type: none"> 1. System head lower than anticipated 2. Specific gravity or viscosity of fluid is too high 3. Mechanical defects such as binding rotating elements. 4. System head lower than anticipated design condition. 5. Incorrect impeller diameter. 	<ol style="list-style-type: none"> 1. Adjust pressure flow. 2. Check oil temperature and adjust as necessary. 3. Check for excessive pipe strain. Check foundation bolting. Replace defective parts. 4. Adjust system head. Trim impellers to actual condition. 5. Replace impeller or trim impeller to correct diameter. Consult with Carver Pump Company before trimming impellers.
Insufficient discharge or flow.	<ol style="list-style-type: none"> 1. Discharge head greater than anticipated. 2. Air or gases in fluid. 	<ol style="list-style-type: none"> 1. Check pump rating against actual head condition. 2. Adjust and/or redesign suction system. Add fluid to system. Check for air leaks in suction.

Table 2. Pumping Unit Troubleshooting - Continued

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Insufficient discharge or flow. - Continued	3. Impeller or suction partially clogged. 4. Wrong direction of rotation. 5. Specific gravity or viscosity of fluid is too high. 6. Incorrect impeller diameter.	3. Inspect strainer and impeller and clean as necessary. 4. Reverse direction of rotation. 5. Check oil temperature and adjust as necessary. 6. Replace impeller or trim impeller to correct diameter. Consult with Carver Pump Company before trimming impeller.
Vibration excessive.	1. Foundation bolting loose. 2. Impeller partially blocked. 3. Wrong rotation. 4. Insufficient foundation. 5. Pipe strain. 6. Motor improperly balanced.	1. Torque bolting to proper values. 2. Inspect impeller and clean as necessary. 3. Adjust direction of rotation. 4. Stiffen foundation as necessary. 5. Modify piping as necessary. 6. Balance motor.
Excessive leakage around mechanical seal housing.	1. Faulty mechanical seal.	1. Replace mechanical seal in accordance with procedures in Section VII, Service and Repair.

VI. MAINTENANCE.

Generally the pump does not need continuous supervision. 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. Occasional visual checks are recommended. Data should be recorded periodically for each pump to keep track of maintenance which has been performed and to note operational problems. A sample maintenance record sheet is provided for this purpose at the front of this manual.

Daily Inspection:

- Visually inspect unit.
- Check bearing temperatures.
- Check for leakage at mechanical seals.

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 motor bearings. Vibration should NOT exceed 1.5 of overall displacement (unfiltered) peak to peak mils (0.001") at 3550 RPM and 3.0 of overall

displacement (unfiltered) peak to peak mils (0.001") at 1750 RPM.

Monthly Inspection:

- Check foundation bolts.

Semi-annual Inspection:

- Grease bearings. DO NOT over grease.
- If stand-by pumps are installed, it is advisable to operate pumps on a rotational system to give each pump a periodic duty. This ensures that stand-by pumps will have periodic operation and always be in good condition for instant start-up.

25000 Hours - Overhaul

- For pump overhaul, complete Section VII, Service and Repair.

A. LUBRICATION OF MOTOR BEARINGS. See motor manufacturer's instructions to be sure motor bearings are properly lubricated.

B. TORQUE VALUES. Refer to Table 3, Recommended Torque Values. Clean and properly lubricate threads and bearing face of the fastener to obtain the proper fastener loading from these torque values. Fasteners should be tightened evenly and in stages.

Table 3. Recommended Torque Values

Fastener Size	Torque Value by Fastener Material (Maximum) (ft-lbs)				
	Steel Gr 2	NI-CU Alloy	316 SS	NI-CU-AL Alloy	Alloy 20
3/8-16 UNC	15	22	18	33	18
1/2-13 UNC	37	50	38	80	38
5/8-11 UNC	73	111	82	159	82
3/4-10 UNC	129	153	111	282	111
7/8-9 UNC	125	231	172	455	172
1-8 UNC	187	344	254	681	254

Impeller Capscrew – Refer to Sectional in Appendix A for impeller capscrew torque value specific for your unit.

Table 4. Recommended Equipment

Tools	Materials	Test Equipment
Spanner Wrench Rawhide or Wood Mallet Wooden Wedge Allen Wrench Set Socket, Open, & Box Wrench Set Vice Grips Torque Wrench Bearing Heater Bearing Puller	O-ring Lubricant Dow 111 Loctite 242 Rust Solvent Anti-Seize	Volt-Amp Meter Calipers Micrometer (ID and OD) Flow Meter

VII. SERVICE AND REPAIR.

Refer to Table 1 to see if your pump size has a JM or JP shaft extension. Continue with Paragraph A for both JM and JP shaft extensions. Proceed to Paragraph B for disassembly of pumping units with JM shaft extensions and Paragraph C for assembly of pumping units with JM shaft extensions. Proceed to Paragraph D for disassembly if your pump has a JP shaft extension and separate adaptor and backcover and Paragraph E, for assembly of pumping units with a JP shaft extension and separate adaptor and

backcover. Proceed to Paragraph F for disassembly if your pump has a JP shaft extension and a one piece adaptor/backcover and Paragraph G, for assembly of pumping units with a JP shaft extension and a one piece adaptor/backcover. During disassembly, reference the sectional drawing in Appendix A for the Parts List that corresponds to the part numbers used in this manual. Refer to Paragraph H for parts inspection. Refer to Tables 10 and 11 for recommended spare parts.

A. PREPARATIONS FOR DISASSEMBLY OF PUMP.

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.



CAUTION

Factory authorized parts must be used to safely maintain your Carver Pump.

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 volute should be cooled down to ambient temperature. The volute 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 4, Recommended Equipment, 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 clean, flat surface.

NOTE

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

- O-rings / gaskets
- Shims
- Locknuts / Lockwashers
- Grease seals
- Mechanical seals

Prepare the pumping unit for disassembly using the following list:

1. Read this entire section and study the exploded view or sectional assembly drawing refer to Appendix A for your specific drawing, before disassembling the pump.



DANGER

Before attempting to disassemble the pump, the electrical power supply to the motor must be locked out and tagged in the “OFF” position to prevent injury or death to personnel servicing the pumping unit.

2. Stop the pumping unit; refer to Section IV, Paragraph E.
3. Confirm discharge valves are closed.
4. Remove terminal box cover. Disconnect motor leads. Reconnect terminal box cover.



DANGER

Be sure to adequately support the piping prior to disconnecting the pumping unit. Failure to adequately support the piping could result in serious injury or death to personnel and/or damage to the pumping unit.



CAUTION

Properly decontaminate pump and piping before disconnecting the pumping unit. Applicable hazardous material procedures must be followed.

5. Shut off and close all valves controlling flow of liquid to and from pump. Disconnect piping and gauge line as necessary.
6. Drain volute (1) by removing plug (422). If necessary, flush pump to remove corrosive or toxic pumpage. Reinstall plug in volute when fluid is completely drained.

B. DISASSEMBLY OF PUMP WITH JM SHAFTS.

The instructions that follow are an aid for properly trained personnel to service your Carver Pump. These instructions refer to Figure 3 and Table 6. If a specific sectional assembly drawing exists for a pumping unit then that drawing should be referred to for service work, see Appendix A. Read this entire section and study Figure 3 and Table 6 before disassembling the pump.

The back pull-out design of the M Series pump enables the pump to be disassembled without disconnecting the piping or removing the pump volute.

After completion of dismantling, all parts should be thoroughly cleaned or replaced by new ones if necessary. All gaskets and sealing faces should be perfectly clean. When cutting new gaskets, make sure they are the same thickness as the old ones.

NOTE

Mark or number each component while dismantling according to sequence.

1. Assure Section VII, Paragraph A has been reviewed before continuing with disassembly.

NOTE

Male tube connectors (410) are removed from pumping unit to avoid damage to tubing (400) and to allow separation of pump parts. Do not attempt to reshape tubing (400) as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (410) nuts from tubing (400). Remove tubing. Remove male tube connector (410) body. Remove O-rings (89D) from male tube connector (410) body.
3. If equipped with an abrasive separator, see Section VII, Paragraph K for disassembly of abrasive separator.
4. Remove locknuts (616) from studs (631) attaching the backcover/adaptor (71) to the volute (1).
5. Remove the bolt (639) and lockwasher (659) from the backcover/adaptor (71) foot. Remove bolt (638) and lockwasher (658) from the motor (200) foot.



CAUTION

Use a hoist with adequate lifting capacity; refer to Section III, Paragraph B.

When handling the motor with mounted impeller, do not exceed the rated capacity of the hoisting equipment.

6. Support the volute (1) and suction cover (9). Attach hoisting straps to lifting lugs on motor (200) and through the backcover/adaptor (71) to distribute weight evenly and support the motor during disassembly. Loosen jam nuts (620) on

forcing bolts (610). Tighten forcing bolts (610) to loosen backcover/adaptor (71) from volute (1).



CAUTION

When removing motor/backcover/adaptor assembly slowly pull straight back. Do not lift motor more than is necessary to pull straight back as this will cause damage to the composite impeller or wear ring.

7. Carefully remove the motor/impeller assembly from the volute (1) and move it to a suitable work area. Keep motor feet shims in place for reassembly.



CAUTION

Any debris caught in the pump passageway will be drawn into the pumping unit, causing damage, and cause the pumping unit to be out of balance causing vibration.

8. The volute (1), suction cover wear ring (7), and suction cover (9) will remain assembled. Ensure that no foreign matter such as dirt, chips, tools, etc. are caught in the piping or volute (1) as this debris will be drawn into the pump and cause extensive damage.
9. Remove O-ring (89A) from backcover/adaptor (71).



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during disassembly or service. Excessive force should never be used during the disassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame should never be applied to these parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

The spring holder from the mechanical seal (90) may remain attached to the impeller (2), unless necessary to remove it.

NOTE

Impeller capscrew (24) has right handed threads.

Impeller washer gasket is a multi-piece gasket.

10. Remove impeller capscrew (24), impeller washer (28), impeller washer gasket (73X), impeller capscrew O-ring (89F) and impeller (2) from motor shaft. Remove impeller key (32).
11. Remove sleeve gasket (73).

NOTE

DO NOT remove rotating element of mechanical seal (90) from shaft sleeve (14) at this point, especially if mechanical seal is relatively clean and in good working condition. If removed from the sleeve Carver Pump Company recommends the mechanical seal be replaced.

12. Remove shaft sleeve (14) with rotating elements of mechanical seal (90) from motor shaft. If mechanical seal is to be replaced, remove rotating elements of mechanical seal from shaft sleeve (14).
13. Remove locknuts (615) from studs (630). Remove backcover/adaptor (71) from motor (200). Backcover wear ring (7X) will remain secured to backcover/adaptor with setscrews (667), if present.
14. Remove stationary element of mechanical seal (90) from backcover/adaptor (71).
15. Remove throttle bushing (63) from backcover/adaptor (71).
16. Remove shaft sleeve O-ring (89C) from motor shaft.
17. If necessary, remove slinger (40) from motor shaft.

C. REASSEMBLY OF PUMP WITH JM SHAFTS.

During reassembly, install parts in accordance with instructions. These instructions refer to Figure 3 and Table 6. If a specific sectional assembly drawing exists for a pumping unit that drawing takes precedence and should be referred to for service work, see Appendix A. Read this entire section and study Figure 3 and Table 6 before reassembling the pump.



CAUTION

During reassembly, install new locknuts, as they have a self-locking feature. Locknuts with a self-locking feature may not provide adequate security once removed.

During reassembly, install new O-rings, gaskets and mechanical seals if removed from position. O-rings, gaskets, and the mechanical seal may have been damaged during disassembly.

NOTE

All parts should be thoroughly cleaned or replaced with new ones if worn or damaged. All sealing faces should be perfectly clean, but do not scratch or alter surface finish on seal faces.

1. Complete Section VII, Paragraph H before continuing with reassembly.
2. If removed, install slinger (40) on motor shaft.
3. Lubricate and install shaft sleeve O-ring (89C) onto motor shaft.
4. Install throttle bushing (63) into backcover/adaptor (71) making sure to line up pin of throttle bushing with groove in backcover/adaptor.



CAUTION

Damage to shaft sleeve (14) will occur if clearance of throttle bushing (63) is less than the outside diameter of the shaft sleeve. Clearance listed on the sectional assembly in (Appendix A) must be adhered to. Throttle bushing failure may cause damage to mechanical seal (90).

5. After throttle bushing (63) is installed in the backcover/adaptor (71) the ID of the throttle bushing must be measured. This dimension is to be compared to the outside diameter of the shaft sleeve (14). The throttle bushing to shaft sleeve clearance listed on the sectional

assembly (Appendix A) must be maintained. Remove material from ID of the throttle bushing to achieve clearance as required. Failure to maintain this clearance will cause damage to the sleeve, throttle bushing and may cause mechanical seal failure.

NOTE

Refer to mechanical seal vendor instructions for proper mechanical seal installation procedure.

6. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into backcover/adaptor (71) aligning pin in bushing to groove in stationary element.
7. Ensure backcover wear ring (7X) is secured with setscrews (667) to backcover/adaptor (71).
8. Secure backcover/adaptor (71) to motor with locknuts (615) on studs (630). Back out forcing bolts (610) below seating surface of the backcover/ adaptor.



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during reassembly or service. Excessive force should never be used during the reassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame should never be applied to these parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

9. Lubricate outside of the motor shaft sleeve (14) to facilitate the axial positioning of mechanical seal (90). Install rotating element of mechanical seal on the motor shaft sleeve. Clean and dry seal faces.
10. Lubricate outside of the motor shaft with Dow 111. Install shaft sleeve (14) with rotating element of mechanical seal (90) assembly onto motor shaft. Install sleeve gasket (73).

NOTE

If equipped with a composite impeller, it needs to be dynamically balanced in accordance with NAVSEA drawing, 803-7226047. Do not attempt to dynamic balance composite products by removal of material. If found to be out of balance, refer to NAVSEA Reference Material Centrifugal Pump Composite Component Maintenance and Repair Process Manual.

11. If removed, glue spring holder of mechanical seal (90) to impeller (2) hub as follows:

NOTE

The tool used to assure proper centering of the spring holder is a bar with two diameters, the OD of the shaft sleeve and the OD of the motor shaft at the impeller. Special tool, part number can be found in Table 5. This tool is optional to help facilitate in installation of spring holder.

- a. Insert tool into impeller hub.



CAUTION

Keep fingers away from glue to avoid injury to personnel or parts.

- b. Apply 4-6 droplets of glue around impeller side of spring holder.
- c. Slip spring holder over tool and press onto impeller hub. Allow glue to set.
- d. Remove the tool from impeller bore.

Table 5. Seal Retainer Tool Parts List

Impeller Bore Size (Inches)	Description	Part Number
7/8	Tool/Seal Retainer JM Seal Installation	250-1100101-801
1-1/4	Tool/Seal Retainer JM Seal Installation	250-1100102-801
1-5/8	Tool/Seal Retainer JM Seal Installation	250-1100103-801



CAUTION

Over tightening of impeller capscrew (24) may damage composite shaft sleeve (14). DO NOT over torque impeller capscrew.

NOTE

Impeller capscrew (24) has right handed threads.

Impeller washer gasket (73X) is a multi-piece gasket to allow for various thicknesses to compensate for tolerance stack-up. Add or subtract to gasket thickness to obtain .010" to .030" gasket protuberance from impeller washer face on the impeller, when impeller is completely seated against the shaft sleeve. This will assure proper gasket compression and proper tension to properly locate the impeller on the shaft.

12. Install impeller key (32), into motor shaft keyway. Install mechanical seal spring in spring holder. Align impeller (2) with impeller key and spring with mechanical seal, then slowly slide impeller straight on motor shaft. Avoid sideways motion that may damage composite impeller. Install impeller washer gasket (73X), impeller washer (28), and O-ring (89F). Secure impeller with impeller capscrew (24). Torque impeller capscrew as required on sectional assembly shown in Appendix A.
13. Install O-ring (89A) on backcover/adaptor (71).
14. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
15. Return rotor assembly to pump location.
16. Ensure volute wear ring (7) is secured with setscrews (667) to volute (1).
17. Confirm that the shims for the backcover/adaptor (71) feet and motor (200) feet, if present from disassembly, are in place.



CAUTION

When installing motor/backcover/adaptor assembly slowly push assembly straight into volute. Do not lift motor more than is necessary to push assembly straight in as this will cause damage to the composite impeller or wear ring.

18. Install motor/backcover/adaptor assembly into volute (1), being careful not to damage composite impeller (2). Secure volute (1) to backcover/adaptor (71) with locknuts (616) on studs (631). Tighten forcing bolts (610) finger tight. Tighten jam nuts (620) to secure forcing bolts (610).
19. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
20. If removed, install suction cover (9) on volute (1) with locknuts (617) on studs (632).
21. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.
22. Install O-rings (89D) on male tube connector (410). Install male tube connectors. Install tubing (400) and reconnect male tube connectors.
23. Install O-ring (89D) on plug (422). Reinstall plug in volute (1).
24. Secure motor (200) feet to base (23) with bolts (638) and lockwashers (658).
25. Secure backcover/adaptor (71) feet to the base (23) with bolts (639) and lockwashers (659).
26. Connect auxiliary piping.
27. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
28. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

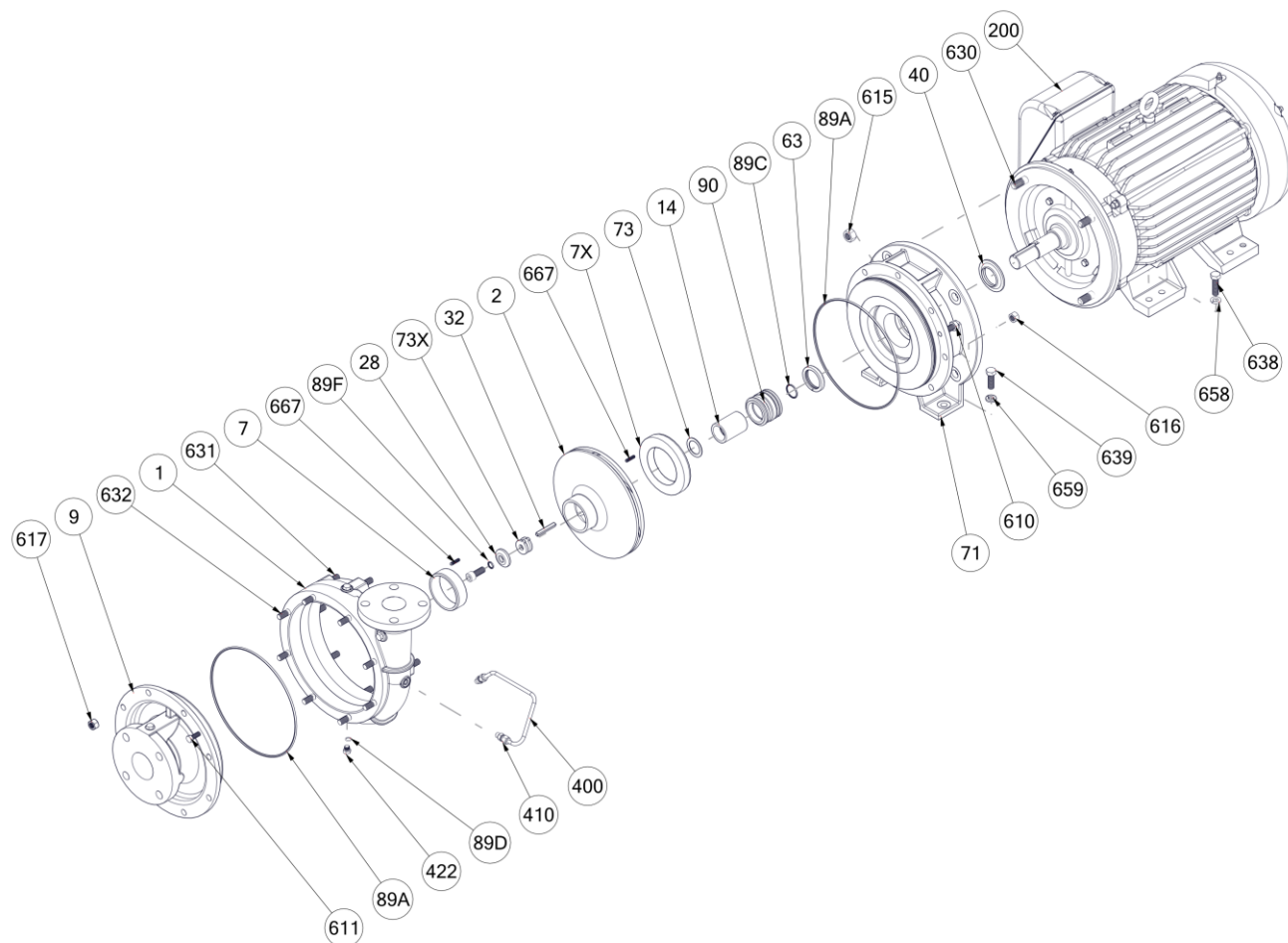


Figure 3. Reference Exploded View for Pumps with JM Shafts

Table 6. Parts List for Pumps with JM Shafts

Item Number	Description	Item Number	Description
1	Volute	*226	Nameplate
2	Impeller	*226X	Rotation Plate
7	Wear Ring – Suction Cover	400	Tubing
7X	Wear Ring – Backcover	410	Male Tube Connector
9	Suction Cover	422	Plug
14	Shaft Sleeve	610	Forcing Bolt – Backcover
*23	Base	611	Forcing Bolt – Suction Cover
24	Capscrew – Impeller	615	Locknut – Bracket/Motor
28	Washer – Impeller	616	Locknut – Bracket/Volute
32	Key – Impeller	617	Locknut – Suction/Volute
40	Slinger	*620	Jam Nut – Backcover Forcing
63	Throttle Bushing	*621	Jam Nut – Suction Forcing
71	Backcover/Adaptor	630	Stud – Bracket/Motor
73	Gasket – Sleeve	631	Stud – Bracket/Motor
73X	Gasket – Impeller Washer	632	Stud – Suction/Volute
89A	O-ring – Suction and Backcover/Volute	638	Bolt – Motor/Base
89C	O-ring – Shaft Sleeve	639	Bolt – Bracket/Base
89D	O-ring – Plugs and Tube Connector	658	Lockwasher – Motor/Base
89F	O-ring – Impeller Capscrew	659	Lockwasher – Bracket/Base
90	Mechanical Seal	667	Setscrew – Wear Rings
200	Electric Motor	*888	Drivescrew - Nameplates

*Items not shown on exploded view

D. DISASSEMBLY OF PUMP WITH JP SHAFTS WITH SEPARATE BACKCOVER AND ADAPTOR.

The instructions that follow are an aid for properly trained personnel to service your Carver Pump. These instructions refer to Figure 4 and Table 7. If a specific sectional assembly drawing exists for a pumping unit then that drawing should be referred to for service work, see Appendix A. Read this entire section and study Figure 4 and Table 7 before disassembling the pump.

The back pull-out design of the M Series pump enables the pump to be disassembled without disconnecting the piping or removing the pump volute from the baseplate.

After completion of dismantling, all parts should be thoroughly cleaned or replaced by new ones if worn or damaged. All gaskets and sealing faces should be perfectly clean. When cutting new gaskets, make sure they are exactly the same thickness as the old ones.

NOTE

Mark or number each component while dismantling according to sequence.

1. Assure Section VII, Paragraph A has been reviewed before continuing with disassembly.

NOTE

Male tube connectors (410) are removed from pumping unit to avoid damage to tubing (400) and to allow separation of pump parts. Do not attempt to reshape tubing (400) as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (410) nuts from tubing (400). Remove tubing. Remove male tube connector (410) body. Remove O-rings (89H) from male tube connector body.
3. If equipped with an abrasive separator, see Section VII, Paragraph K for disassembly of abrasive separator.
4. Remove the bolt (638) and lockwasher (658) from the motor (200) foot. Keep shims in place for reassembly.



Use a hoist with adequate lifting capacity; refer to Section III, Paragraph B.

When handling the motor with mounted impeller, do not exceed the rated capacity of the hoisting equipment.

5. Attach hoisting straps to lifting lugs on motor (200) and through the adaptor (71) to distribute weight evenly and support motor during disassembly. Tighten forcing bolts (610) to loosen backcover (11) from volute (1).



When removing motor/backcover/adaptor assembly slowly pull straight back. Do not lift motor more than is necessary to pull straight back as this will cause damage to the composite impeller or wear ring.

6. Carefully remove the motor/impeller assembly from the volute (1) and move it to a suitable work area. Keep motor feet shims in place for reassembly.



Any debris caught in the pump passageway will be drawn into the pumping unit, causing damage, and cause the pumping unit to be out of balance causing vibration.

7. The volute (1) with volute wear ring (7) is left secured in place. Ensure that no foreign matter such as dirt, chips, tools, etc. are caught in the piping or volute (1) as this debris will be drawn into the pump and cause extensive damage.
8. Remove O-ring (89A) from the backcover (11).
9. Remove locknuts (615) from studs (630) to relieve spring pressure on the mechanical seal gland (17).



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during disassembly or service. Excessive force should never be used during the disassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame or direct heat should never be applied to composite parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

Impeller bolt (24) has right handed threads.

10. Remove impeller bolt (24), impeller washer (28), impeller washer gasket (73X), and impeller (2) from motor shaft. Remove impeller key (32).
11. Remove sleeve gasket (73).

NOTE

DO NOT remove rotating element of mechanical seal (90) from shaft sleeve (14) at this point, especially if mechanical seal is relatively clean and in good working condition. If removed from the sleeve Carver Pump Company recommends the mechanical seal be replaced.

12. Remove shaft sleeve (14) with rotating elements of mechanical seal (90) from the motor shaft. If mechanical seal is to be replaced, remove rotating elements of mechanical seal from shaft sleeve.
13. Remove locknuts (613) from studs (636).
14. Remove backcover (11) and mechanical seal gland (17). Backcover wear ring (7X) will remain secured to backcover (11) with setscrews (667).
15. Remove mechanical seal gland from motor shaft.
16. Remove stationary element of mechanical seal (90) from mechanical seal gland (17), if mechanical seal is to be replaced.
17. Remove throttle bushing (63) from mechanical seal gland (17).

18. Remove mechanical seal gland O-ring (89E) from mechanical seal gland (17).
19. Remove shaft sleeve O-ring (89D) from motor (200) shaft.
20. Remove locknuts (614) from studs (632). Remove adaptor (71) from motor (200).
21. If necessary, remove slinger (40) from motor shaft.

E. REASSEMBLY OF PUMP WITH JP SHAFTS WITH SEPARATE BACKCOVER AND ADAPTOR.

During reassembly, install parts as in accordance with instructions. These instructions refer to Figure 4 and Table 7. If a specific sectional assembly drawing exists for a pumping unit that drawing takes precedence and should be referred to for service work, see Appendix A. Read this entire section and study Figure 4 and Table 7 before reassembling the pump.



CAUTION

During reassembly, install new locknuts, as they have a self-locking feature. Locknuts with a self-locking feature may not provide adequate security once removed.

During reassembly, install new O-rings, gaskets and mechanical seals if removed. O-rings, gaskets, and the mechanical seal may have been damaged during disassembly.

NOTE

All parts should be thoroughly cleaned or replaced with new ones if worn or damaged. All sealing faces should be perfectly clean, but do not scratch or alter surface finish on seal faces.

1. Complete Section VII, Paragraph H before continuing with reassembly.
2. If removed, install slinger (40) on motor shaft.
3. Lubricate and install shaft sleeve O-ring (89D) onto motor shaft.
4. Install throttle bushing (63) into mechanical seal gland (17) making sure to line up pin of throttle bushing with groove in mechanical seal gland.



CAUTION

Damage to shaft sleeve (14) will occur if clearance of throttle bushing (63) is less than the outside diameter of the shaft sleeve. Clearance listed on the sectional assembly in (Appendix A) must be adhered to. Minimum clearance is 0.015 inches diametrical, unless otherwise stated. Throttle bushing failure may cause damage to mechanical seal (90).

5. After throttle bushing (63) is installed in the mechanical seal gland (17) the ID of the throttle bushing must be measured. This dimension is to be compared to the outside diameter of the shaft sleeve (14). The throttle bushing to shaft sleeve clearance listed on the sectional assembly (Appendix A) must be maintained. Remove material from ID of the throttle bushing to achieve clearance as required. Failure to maintain this clearance will cause damage to the sleeve, throttle bushing and may cause mechanical seal failure.

NOTE

Refer to mechanical seal vendor instructions for proper mechanical seal installation procedure.

6. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into mechanical seal gland (17).
7. Install mechanical seal gland (17) assembly on motor (200) shaft.
8. Secure adaptor (71) to motor with locknuts (614) on studs (632).
9. Ensure backcover wear ring (7X) is secured with setscrews (667) to backcover (11). Back out forcing bolts (610) below seating surface of the backcover.
10. Secure backcover (11) to adaptor (71) with locknuts (613) on studs (636).



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during reassembly or service. Excessive force should never be used during the reassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame should never be applied to these parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

11. Lubricate outside of the motor shaft sleeve (14) to facilitate the axial positioning of mechanical seal (90). Install rotating element of mechanical seal on the motor shaft sleeve. Clean and dry seal faces.
12. Lubricate outside of the motor shaft with Dow 111. Install shaft sleeve (14) with rotating element of mechanical seal (90) assembly onto motor shaft. Install sleeve gasket (73).

NOTE

If equipped with a composite impeller, it needs to be dynamically balanced in accordance with NAVSEA drawing, 803-7226047. Do not attempt to dynamic balance composite products by removal of material. If found to be out of balance, refer to NAVSEA Reference Material Centrifugal Pump Composite Component Maintenance and Repair Process Manual.



CAUTION

Over tightening of impeller capscrew (24) may damage composite shaft sleeve (14). DO NOT over torque impeller capscrew.

NOTE

Impeller capscrew (24) has right handed threads.

Impeller washer gasket (73X) is a multi-piece gasket to allow for various thicknesses to compensate for tolerance stack-up. Add or subtract to gasket thickness to obtain .010 to .030 inch gasket protuberance from impeller washer face on the impeller, when impeller is completely seated against the shaft sleeve. This will assure proper gasket compression and proper tension to properly locate the impeller on the shaft.

13. Install impeller key (32), into motor shaft keyway. Align impeller (2) with impeller key then slowly slide put impeller straight on motor shaft. Avoid sideways motion that may damage composite impeller. Install impeller washer gasket (73X), impeller washer (28), and O-ring (89J). Secure impeller with impeller bolt (24). Torque impeller bolt as required on sectional assembly shown in Appendix A.
14. Secure mechanical seal gland (17) to backcover (11) with locknuts (630) on studs (615).
15. Install O-ring (89A) on backcover (11).

16. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
17. Return rotor assembly to pump location.
18. Ensure volute wear ring (7) is secured with setscrews (667) to volute (1).
19. Confirm that the shims for the motor (200) feet, if present from disassembly, are in place.



CAUTION

When installing motor/backcover/adaptor assembly slowly push assembly straight into volute. Do not lift motor more than is necessary to push assembly straight in as this will cause damage to the composite impeller or wear ring.

20. Install motor/backcover/adaptor assembly into volute (1), being careful not to damage composite impeller (2). Secure volute (1) to backcover (11) with locknuts (616) on studs (631). Tighten forcing bolts (610) finger tight.
21. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
22. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.
23. Install O-rings (89H) on male tube connector (410). Install male tube connectors. Install tubing (400) and reconnect male tube connectors.
24. Install O-ring (89F) on plug (422). Reinstall plug in volute (1).
25. Secure motor (200) feet to base (23) with bolts (638) and lockwashers washers (658).
26. Connect auxiliary piping.
27. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
28. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.



Table 7. Parts List for Pumps with JP Shafts with Separate Backcover and Adaptor

Item Number	Description	Item Number	Description
1	Volute	*200	Electric Motor
2	Impeller	*226	Nameplate
7	Wear Ring – Volute	*226U	UID Plate
7X	Wear Ring – Backcover	*226X	Rotation Plate
11	Backcover	400	Tubing
14	Shaft Sleeve	410	Male Tube Connector
17	Mechanical Seal Gland	*422	Plug – Volute Drain
*23	Base	*423	Plug
24	Impeller Bolt	610	Forcing Bolt – Backcover
28	Washer – Impeller	613	Locknut – Adaptor/Backcover
32	Key – Impeller	614	Locknut – Adaptor/Motor
40	Slinger	615	Locknut – Mechanical Seal Gland
63	Throttle Bushing	616	Locknut – Backcover/Volute
71	Adaptor	*619	Locknut –Volute/Base
73	Gasket – Sleeve	630	Stud – Seal Gland/Backcover
73X	Gasket – Impeller Washer	631	Stud – Backcover/Volute
89A	O-ring – Backcover	632	Stud – Adaptor/Motor
89D	O-ring – Shaft Sleeve	636	Stud – Adaptor/Backcover
89E	O-ring – Mechanical Seal Gland	*638	Bolt – Motor/Base
*89F	O-ring – Volute Drain	*639	Bolt – Volute/Base
*89H	O-ring –Tube Connector, Plug	*658	Lockwasher – Motor/Base
89J	O-ring – Impeller Washer	667	Setscrew – Wear Rings
90	Mechanical Seal	*888	Drivescrew – Nameplates
*131	Shaft Guard		

* Items not shown on exploded view

F. DISASSEMBLY OF PUMP WITH JP SHAFTS WITH ONE PIECE BACKCOVER/ADAPTOR.

The instructions that follow are an aid for properly trained personnel to service your Carver Pump. These instructions refer to Figure 5 and Table 8. If a specific sectional assembly drawing exists for a pumping unit then that drawing should be referred to for service work, see Appendix A. Read this entire section and study Figure 5 and Table 8 before disassembling the pump.

The back pull-out design of the M Series pump enables the pump to be disassembled without disconnecting the piping or removing the pump volute from the baseplate.

After completion of dismantling, all parts should be thoroughly cleaned or replaced by new ones if worn or damaged. All gaskets and sealing faces should be perfectly clean. When cutting new gaskets, make sure they are the same thickness as the old ones.

NOTE

Mark or number each component while dismantling according to sequence.

1. Assure Section VII, Paragraph A has been reviewed before continuing with disassembly.

NOTE

Male tube connectors (410) are removed from pumping unit to avoid damage to tubing (400) and to allow separation of pump parts. Do not attempt to reshape tubing (400) as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (410) nuts from tubing (400). Remove tubing. Remove male tube connector (410) body. Remove O-rings (89H) from male tube connector body.
3. If equipped with an abrasive separator, see Section VII, Paragraph K for disassembly of abrasive separator.
4. Remove the bolt (638) and lockwasher (658) from the motor (200) foot. Keep shims in place for reassembly.



CAUTION

Use a hoist with adequate lifting capacity; refer to Section III, Paragraph B.

When handling the motor with mounted impeller, do not exceed the rated capacity of the hoisting equipment.

5. Attach hoisting straps to lifting lugs on motor (200) and through the backcover/adaptor (71) to distribute weight evenly and support the motor during disassembly. Loosen jam nuts (620) on forcing bolts (610). Tighten forcing bolts (610) to loosen backcover/adaptor (71) from volute (1).



CAUTION

When removing motor/backcover/adaptor assembly slowly pull straight back. Do not lift motor more than is necessary to pull straight back as this will cause damage to the composite impeller or wear ring.

6. Carefully remove the motor/impeller assembly from the volute (1) and move it to a suitable work area. Keep motor feet shims in place for reassembly.



CAUTION

Any debris caught in the pump passageway will be drawn into the pumping unit, causing damage, and cause the pumping unit to be out of balance causing vibration.

7. The volute (1) with volute wear ring (7) is left in place. Ensure that no foreign matter such as dirt, chips, tools, etc. are caught in the piping or volute (1) as this debris will be drawn into the pump and cause extensive damage.
8. Remove O-ring (89A) from the backcover/adaptor (71).



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during disassembly or service. Excessive force should never be used during the disassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame should never be applied to these parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

Impeller capscrew (24) has right handed threads.

9. Remove impeller capscrew (24), impeller washer (28), impeller washer gasket (73X), and impeller (2) from motor shaft. Remove impeller key (32).
10. Remove sleeve gasket (73).

NOTE

DO NOT remove rotating element of mechanical seal (90) from shaft sleeve (14) at this point, especially if mechanical seal is relatively clean and in good working condition. If removed from sleeve Carver Pump Company recommends the mechanical seal be replaced.

11. Remove shaft sleeve (14) with rotating elements of mechanical seal (90) from motor shaft. If mechanical seal is to be replaced, remove rotating elements of mechanical seal from shaft sleeve.
12. Remove locknuts (614) from studs (632). Remove backcover/adaptor (71) from motor (200).
13. Backcover/adaptor wear ring (7X) will remain secured to backcover/adaptor with setscrews (667).

14. Remove stationary element of mechanical seal (90) from backcover/adaptor (71).
15. Remove throttle bushing (63) from backcover/adaptor (71).
16. Remove shaft sleeve O-ring (89D) from motor (200) shaft.
17. If necessary, remove slinger (40) from motor (200) shaft.

G. REASSEMBLY OF PUMP WITH JP SHAFTS WITH ONE PIECE BACKCOVER/ADAPTOR.

During reassembly, install parts in accordance with instructions. These instructions refer to Figure 5 and Table 8. If a specific sectional assembly drawing exists for a pumping unit that drawing takes precedence and should be referred to for service work, see Appendix A. Read this entire section and study Figure 5 and Table 8 before reassembling the pump.



CAUTION

During reassembly, install new locknuts, as they have a self-locking feature. Locknuts with a self-locking feature may not provide adequate security once removed.

During reassembly, install new O-rings, gaskets and mechanical seals if removed. O-rings, gaskets, and the mechanical seal may have been damaged during disassembly.

NOTE

All parts should be thoroughly cleaned or replaced with new ones if worn or damaged. All sealing faces should be perfectly clean, but do not scratch or alter surface finish on seal faces.

1. Complete Section VII, Paragraph H before continuing with reassembly.
2. If removed, install slinger (40) on motor shaft.
3. Lubricate and install shaft sleeve O-ring (89D) onto motor shaft.
4. Install throttle bushing (63) into backcover/adaptor (71) making sure to line up pin of throttle bushing with groove in backcover/adaptor.



CAUTION

Damage to shaft sleeve (14) will occur if clearance of throttle bushing (63) is less than the outside diameter of the shaft sleeve. Clearance listed on the sectional assembly in (Appendix A) must be adhered to. Minimum clearance is 0.015 inches diametrical, unless otherwise stated. Throttle bushing failure may cause damage to mechanical seal (90).

5. After throttle bushing (63) is installed in the backcover/adaptor (71) the ID of the throttle bushing must be measured. This dimension is to be compared to the outside diameter of the shaft sleeve (14). The throttle bushing to shaft sleeve clearance listed on the sectional assembly (Appendix A) must be maintained. Remove material from ID of the throttle bushing to achieve clearance as required. Failure to maintain this clearance will cause damage to the sleeve, throttle bushing and may cause mechanical seal failure.

NOTE

Refer to mechanical seal vendor instructions for proper mechanical seal installation procedure.

6. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into backcover/adaptor (71).
7. Secure backcover/adaptor (71) to motor with locknuts (614) on studs (632).
8. Ensure backcover/adaptor wear ring (7X) is secured with setscrews (667) to backcover/adaptor (71). Back out forcing bolts (610) below seating surface of the backcover.



CAUTION

Composite parts should never be struck with or pried on with a hard tool or foreign object during reassembly or service. Excessive force should never be used during the reassembly of composite parts. The use of pullers or similar extraction devices is prohibited for composite parts. Although Carver Pump Company composite components are dimensionally stable over a wide temperature range, a direct flame should never be applied to these parts.

NOTE

The following parts may be composite; impeller (2), suction cover wear ring (7), backcover wear ring (7X), and shaft sleeve (14).

9. Lubricate outside of the motor shaft sleeve (14) to facilitate the axial positioning of mechanical seal (90). Install rotating element of mechanical seal on the motor shaft sleeve. Clean and dry seal faces.
10. Install O-ring (89D). Lubricate outside of the motor shaft with Dow 111. Install shaft sleeve (14) with rotating element of mechanical seal (90) assembly onto motor shaft. Install sleeve gasket (73).

NOTE

If equipped with a composite impeller, it needs to be dynamically balanced in accordance with NAVSEA drawing, 803-7226047. Do not attempt to dynamic balance composite products by removal of material. If found to be out of balance, refer to NAVSEA Reference Material Centrifugal Pump Composite Component Maintenance and Repair Process Manual.



CAUTION

Over tightening of impeller capscrew (24) may damage composite shaft sleeve (14). DO NOT over torque impeller capscrew.

NOTE

Impeller capscrew (24) has right handed threads.

Impeller washer gasket (73X) is a multi-piece gasket to allow for various thicknesses to compensate for tolerance stack-up. Add or subtract to gasket thickness to obtain .010 to .030 inch gasket protuberance from impeller washer face on the impeller, when impeller is completely seated against the shaft sleeve. This will assure proper gasket compression and proper tension to properly locate the impeller on the shaft.

11. Install impeller key (32), into motor shaft keyway. Align impeller (2) with impeller key then slowly slide impeller straight on motor shaft. Avoid sideways motion that may damage composite impeller. Install impeller washer gasket (73X), impeller washer (28), and O-ring (89J). Secure impeller with impeller bolt (24). Torque impeller capscrew as required on sectional assembly shown in Appendix A.
12. Install O-ring (89A) on backcover/adaptor (71).
13. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
14. Return rotor assembly to pump location.
15. Ensure volute wear ring (7) is secured with setscrews (667) to volute (1).
16. Confirm that the shims for the motor (200) feet, if present from disassembly, are in place.



CAUTION

When installing motor/backcover/adaptor assembly slowly push assembly straight into volute. Do not lift motor more than is necessary to push assembly straight in as this will cause damage to the composite impeller or wear ring.

17. Install motor/backcover/adaptor assembly into volute (1), being careful not to damage composite impeller (2). Secure volute (1) to backcover/adaptor (71) with locknuts (616) on studs (631 and 631X). Tighten forcing bolts (610) finger tight. Tighten jam nuts (620) to secure forcing bolts (610).
18. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
19. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.
20. Install O-rings (89H) on male tube connector (410). Install male tube connectors. Install tubing (400) and reconnect male tube connectors.
21. Install O-ring (89F) on plug (422). Reinstall plug in volute (1).
22. Secure motor (200) feet to base (23) with bolts (638) and lockwashers washers (658).
23. Connect auxiliary piping.
24. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
25. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

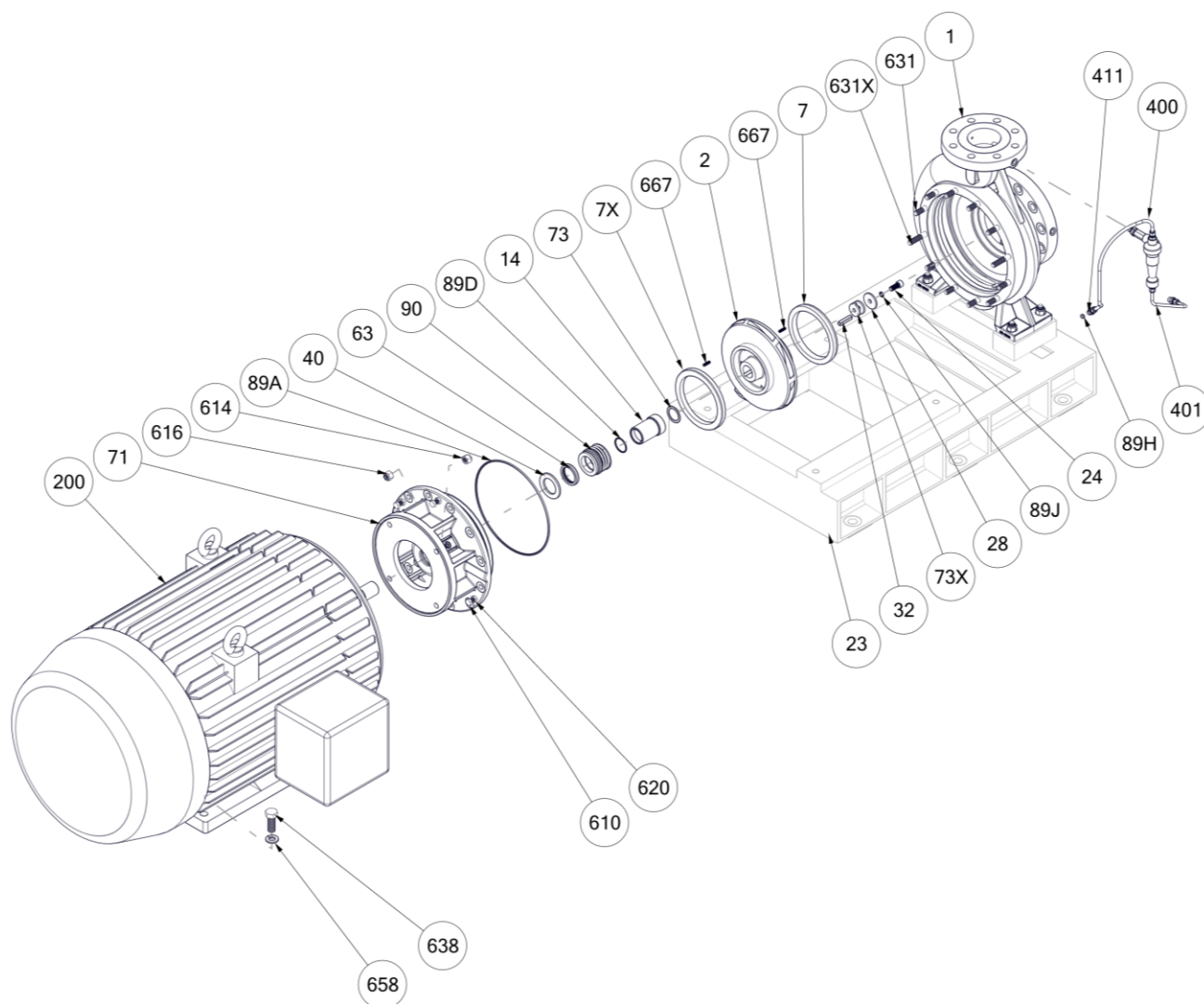


Figure 5. Reference Exploded View for Pumps with JP Shafts and One Piece Backcover/Adaptor

Table 8. Parts List for Pumps with JP Shafts and One Piece Backcover/Adaptor

Item Number	Description	Item Number	Description
1	Volute	200	Electric Motor
2	Impeller	*226	Nameplate
7	Wear Ring – Volute	*226U	UID Plate
7X	Wear Ring – Adaptor	*226X	Rotation Plate
14	Shaft Sleeve	400	Tubing
23	Base	410	Male Tube Connector
24	Impeller Bolt	*422	Plug – Volute Drain
28	Washer – Impeller	*423	Plug
32	Key – Impeller	610	Forcing Bolt – Backcover
40	Slinger	614	Locknut – Adaptor/Motor
63	Throttle Bushing	616	Locknut – Adaptor/Volute
71	Adaptor	619	Locknut –Volute/Base
73	Gasket – Sleeve	620	Jam Nut – Backcover Forcing
73X	Gasket – Impeller Washer	631	Stud – Adaptor/Volute
89A	O-ring – Adaptor	631X	Stud – Adaptor/Volute
89D	O-ring – Shaft Sleeve	632	Stud – Adaptor/Motor
*89F	O-ring – Volute Drain	638	Bolt – Motor/Base
*89G	O-ring – Tube Connector, Plug	639	Bolt – Volute/Base
89H	O-ring – Seal Tube Connector	658	Lockwasher – Motor/Base
89J	O-ring – Impeller Washer	667	Setscrew – Wear Rings
90	Mechanical Seal	*888	Drivescrew - Nameplates

* Items not shown on exploded view

H. PARTS INSPECTION.

1. All parts should be thoroughly cleaned with a suitable solvent or replaced with new ones if necessary. All sealing faces should be perfectly clean. It is recommended that all gaskets, O-rings, grease seals, lip seals, and locking devices with a nylock feature, such as locknuts, be replaced with new if removed position.
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. Refer to Appendix B for further information.
3. Inspect volute for pitting, scoring, and erosion. The inside of the volute should be free of any pits or grooves. Replace the volute if any of these defects are present.
4. Inspect mechanical seals. Repair or replace mechanical seals that are extremely worn or damaged.
5. Inspect impeller key for distortion and push fit into keyway. The key should be square on all four edges. They should fit without having to be forced. The key should not rock in keyway. Replace key or shaft if necessary.
6. Inspect tubing for kinking. Replace kinked tubing.

7. If the impeller shows excessive wear due to erosion or pitting, so that performance cannot be restored, it must be replaced. If a new impeller is installed, check to make sure that it is balanced and of the correct trim diameter.
8. Check the wear ring clearance as follows:
 - a. Measure Outside Diameter (OD) of front impeller hub (2) in three places.
 - b. Measure Inside Diameter (ID) of wear ring (7) in three places.
 - c. If difference between the high reading of the ID of the wear ring (7) and the low reading of the OD of the impeller (2) hub exceeds double the maximum clearances given in

Table 9, replace the wear ring according to Section VII, Paragraph J.

- d. Measure OD of back impeller hub (2) in three places.
- e. Measure ID of wear ring (7X) in three places.
- f. If difference between the high reading of the ID of the wear ring (7) and the low reading of the OD of the impeller (2) hub exceeds double the maximum clearances given in Table 9, replace the wear ring according to Section VII, Paragraph J.

Table 9. Factory Wear Ring Diametrical Clearance (Inches)
(If not otherwise stated on sectional assembly in Appendix A.)

Pump Size	Shaft Extension	Front Wear Ring Clearance (Inches)*	Back Wear Ring Clearance (Inches)*
1-1/4 X 1 X 7	JM	.016/.020	N/A
1-1/2 X 1-1/4 X 7	JM	.016/.020	N/A
2-1/2 X 2 X 7	JM	.012/.016	N/A
3 X 2-1/2 X 7	JM	.012/.016	N/A
4 X 3 X 7	JM	.014/.018	.014/.018
5 X 4 X 7	JM	.014/.020	.012/.016
1-1/2 X 1-1/4 X 10	JM	.014/.020	N/A
2 X 1-1/2 X 10	JM	.018/.020	N/A
2-1/2 X 2 X 10	JM	.008/.016	.008/.016
3 X 2-1/2 X 10	JM	.016/.020	.016/.020
4 X 3 X 10	JM	.010/.016	.010/.016
5 X 4 X 10	JM	.016/.020	.016/.020
6 X 4 X 10	JM	.016/.020	.016/.020
6 X 5 X 10	JM	.023/.025	.021/.026
2 X 1 X 11	JM	.012/.015	.012/.015
4 X 2 X 11	JM	.016/.020	.016/.020
4 X 3 X 11	JM	.016/.020	.016/.020
5 X 4 X 11	JM	.016/.020	.016/.020
6 X 4 X 11	JP	.018/.022	.018/.022
8 X 6 X 11	JP	.019/.023	.019/.023
4 X 3 X 13	JP	.017/.021	.017/.021
6 X 4 X 13	JP	.018/.022	.018/.022

*Verify clearance by checking sectional drawing in Appendix A.

Table 9. Factory Wear Ring Clearance (Inches) - Continued

Pump Size	Shaft Extension	Front Wear Ring Clearance (Inches)*	Back Wear Ring Clearance (Inches)*
6 X 6 X 13	JP	.019/.023	.019/.023
8 X 6 X 13	JP	.020/.024	.020/.024
10 X 8 X 13	JP	.021/.025	.021/.025
12 X 10 X 13	JP	.023/.027	.023/.027

*Verify clearance by checking sectional drawing in Appendix A.

J. REPLACEMENT OF WEAR RINGS. The M Series pump has a replaceable wear rings (7 and 7X) inserted into the volute (1) for JP shafts or the suction cover (9) for JM shafts and the backhead (11) or backhead/adaptor (71). The clearance between the wear ring and impeller hub will increase with wear. Internal leakage will result and pump performance will decrease. The allowable clearance and method of measurement is described in Section VII, Paragraph H.

J.1 Follow these steps for the replacement of the volute wear ring (7) and backcover/adaptor wear ring (7X) for JP Shafts.

NOTE

To replace the volute wear ring (7) for JP shafts, the volute (1) must be removed from system.

1. Assure Section VII, Paragraph A has been reviewed before continuing with disassembly.
2. Disconnect suction and discharge piping.
3. Remove locknuts (619) from studs (639) in foot of volute (1). Remove locknuts (616) from studs (631 and 631X). If applicable, loosen jam nuts (620) on forcing bolts (610). Tighten forcing bolts to loosen volute from backcover/adaptor (71 or 11) as applicable. Remove volute from base (23). Set volute aside.
4. For pumps with JP shafts with separate backcover (11) and adaptor (71) continue disassembly per Section VII, Paragraph D, steps 8 through 15. Set impeller (2) and backcover (11) aside.
5. For pumps with JP shafts with one piece backcover/adaptor (71) continue disassembly per Section VII, Paragraph F, steps 8 through 15. Set impeller (2) and backcover/adaptor (71) aside.

6. Remove setscrews (667) from volute wear ring (7). Remove the volute wear ring from the volute (1). This can be best accomplished on a lathe. Take this work to a machine shop.
7. Inspect the impeller hub for damage.

NOTE

Volute (1) may be drilled for new setscrews (667) as many times as necessary, as long as it will support the wear ring and allow setscrews (667) to be installed.

8. Carefully press new undersized volute wear ring (7) into volute (1). The beveled edge of the volute wear ring is installed towards the impeller (2). Ensure that the new volute wear ring is seated flat in volute.

NOTE

The drill center point for the composite part is offset radially one-quarter of the setscrew diameter into the metal volute so that only 20 to 25 percent of the installed setscrew is in the composite wear ring. Seventy-five to eighty percent of the setscrew shall be in the metal part, which prevents the drill or tap from walking into the softer composite material. Drilling and tapping are to be done following standard procedures. Suitable fixtures shall be employed as needed to avoid drill or tap walking. Refer to Figure 6 for proper pinning of pressed-in composite wear ring.

9. To secure volute wear ring (7) drill and tap two holes, number 10-24 UNC x 3/8 inch deep 120 degrees apart, along edge of volute wear ring. Insert setscrews (667) in holes.
10. Measure volute wear ring (7) ID and record.

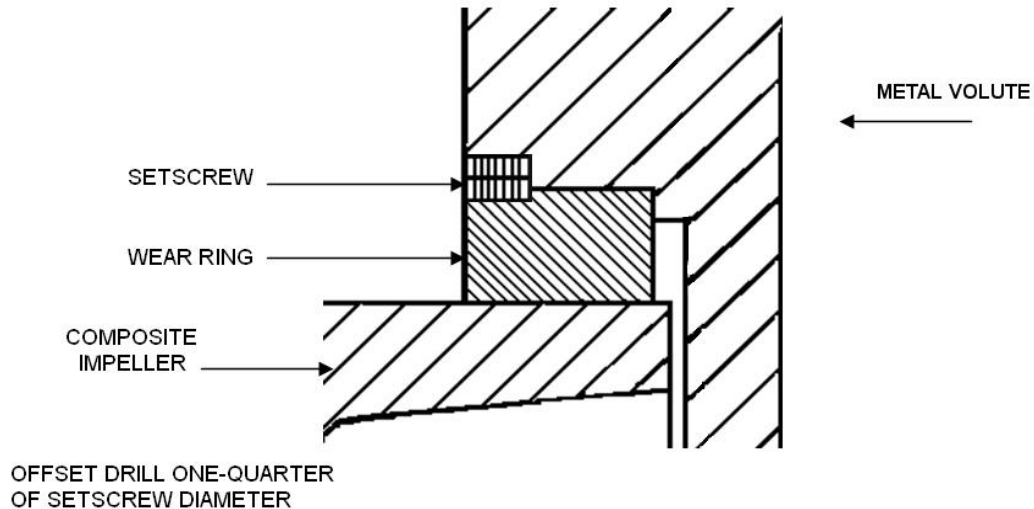


Figure 6. Proper Pinning of Pressed-In Wear Ring

11. Check front impeller (2) wear ring wearing surface for concentricity and wear. Place impeller on an arbor and mount between centers in either a lathe or a grinder. Indicate hub to within 0.004 Total Indicator Runout (TIR) maximum to be sure that arbor and impeller are running square. Grind or turn front impeller wear ring wearing surface (Up to 0.050 inch material removal for metal and 0.030 inch material removal for composite.) until a 63 Root Mean Square (RMS) for metal or a 250 RMS finish for composite is obtained to meet 0.004 inch TIR requirement.
12. Measure front impeller (2) wear ring wearing surface OD and record.
13. Mount the volute (1) with new volute wear ring (7) installed in a lathe. Indicate male rabbet to within 0.002 TIR maximum. Listed in Table 9 or provided on the sectional assembly drawing in Appendix A.
14. Bore volute wear ring (7) to within the specified tolerance listed in Table 9 over the recorded size of the outside diameter of the front impeller hub.
15. Remove setscrews (667) from backcover/adaptor wear ring (7X). Remove the backcover/adaptor wear ring from the backcover/adaptor. This can be best accomplished on a lathe. Take this work to a machine shop.

NOTE

Backcover/adaptor (11 or 71) may be drilled for new setscrews (667) as many times as necessary, as long as it will support the wear ring and allow setscrews (667) to be installed.

16. Carefully press new undersized backcover/adaptor wear ring (7X) into backcover/adaptor (11 or 71). The beveled edge of the backcover/adaptor wear ring is installed towards the impeller (2). Ensure that the new backcover/adaptor wear ring is seated flat in backcover/adaptor.

NOTE

The drill center point for the composite part is offset radially one-quarter of the setscrew diameter into the metal volute so that only 20 to 25 percent of the installed setscrew is in the composite wear ring. Seventy-five to eighty percent of the setscrew shall be in the metal part, which prevents the drill or tap from walking into the softer composite material. Drilling and tapping are to be done following standard procedures. Suitable fixtures shall be employed as needed to avoid drill or tap walking. Refer to Figure 6 for proper pinning of pressed-in composite wear ring.

17. To secure backcover/adaptor wear ring (7X) drill and tap two holes, number 10-24 UNC x 3/8 inch deep 120 degrees apart, along edge of volute wear ring. Insert setscrews (667) in holes.

18. Measure backcover/adaptor wear ring (7) ID and record.
19. Check front impeller (2) wear ring wearing surface for concentricity and wear. Place impeller on an arbor and mount between centers in either a lathe or a grinder. Indicate hub to within 0.004 Total Indicator Runout (TIR) maximum to be sure that arbor and impeller are running square. Grind or turn front impeller wear ring wearing surface (Up to 0.050 inch material removal for metal and 0.030 inch material removal for composite.) until a 63 Root Mean Square (RMS) for metal or a 250 RMS finish for composite is obtained to meet 0.004 inch TIR requirement.
20. Measure back impeller (2) wear ring wearing surface OD and record.
21. Mount the backcover/adaptor (11 or 71) with new backcover/adaptor wear ring (7X) installed in a lathe. Indicate male rabbet to within 0.002 TIR maximum. Listed in Table 9 or provided on the sectional assembly drawing in Appendix A.
22. Bore backcover/adaptor wear ring (7X) to within the specified tolerance listed in Table 9 over the recorded size of the outside diameter of the back impeller hub.
23. For pumps with JP shafts with separate backcover (11) and adaptor (71) continue reassembly per Section VII, Paragraph E, steps 3 through 16.
24. For pumps with JP shafts with one piece backcover/adaptor (71) continue reassembly per Section VII, Paragraph G, steps 3 through 16.
25. Make sure that the forcing bolts (610) are below the surface of the backcover/adaptor (11 or 71) Align volute (1) with backcover/adaptor and slowly slide volute onto backcover/adaptor. Avoid sideways motion that may damage composite impeller or volute wear ring (7). Secure volute with locknuts (616) on studs (631 and 631X). Tighten forcing bolts finger tight. If applicable, tighten jam nuts (620) to secure forcing bolts.
26. Secure volute (1) to base with locknuts (619) on studs (639). Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
27. Reconnect suction and discharge piping. Connect auxiliary piping.

28. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
29. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

J.2 Follow these steps for the replacement of the suction cover wear ring (7) and backcover wear ring (7X) for JM Shafts.

NOTE

To replace the suction cover wear ring (7) for JM shafts, the suction cover (9) must be removed from the system.

1. Assure Section VII, Paragraph A has been reviewed before continuing with disassembly.
2. Disconnect suction and discharge piping.
3. Remove locknuts (617) from studs (632). If applicable, loosen jam nuts (621) on forcing bolts (611). Tighten forcing bolts to loosen suction cover (9) from volute (1) as applicable. Remove suction cover from volute. Set suction cover aside.
4. Continue disassembly per Section VII, Paragraph B, steps 2 through 16. Set backcover/adaptor (71) and impeller (2) aside.
5. Remove setscrews (667) from suction cover wear ring (7). Remove the suction cover wear ring from the suction cover (9). This can be best accomplished on a lathe. Take this work to a machine shop.
6. Inspect the impeller hub for damage.

NOTE

Suction cover (9) may be drilled for new setscrews (667) as many times as necessary, as long as it will support the suction cover wear ring and allow setscrews (667) to be installed.

7. Carefully press new undersized suction cover wear ring (7) into suction cover (9). The beveled edge of the suction cover wear ring is installed towards the impeller (2). Ensure that the new suction cover wear ring is seated flat in suction cover.

NOTE

The drill center point for the composite part is offset radially one-quarter of the setscrew diameter into the metal volute so that only 20 to 25 percent of the installed setscrew is in the composite wear ring. Seventy-five to eighty percent of the setscrew shall be in the metal part, which prevents the drill or tap from walking into the softer composite material. Drilling and tapping are to be done following standard procedures. Suitable fixtures shall be employed as needed to avoid drill or tap walking. Refer to Figure 6 for proper pinning of pressed-in composite wear ring.

8. To secure suction cover wear ring (7) drill and tap two holes, number 10-24 UNC x 3/8 inch deep 120 degrees apart, along edge of volute wear ring. Insert setscrews (667) in holes.
9. Measure suction cover wear ring (7) ID and record.
10. Check front impeller (2) wear ring wearing surface for concentricity and wear. Place impeller on an arbor and mount between centers in either a lathe or a grinder. Indicate hub to within 0.004 Total Indicator Runout (TIR) maximum to be sure that arbor and impeller are running square. Grind or turn front impeller wear ring wearing surface (Up to 0.050 inch material removal for metal and 0.030 inch material removal for composite.) until a 63 Root Mean Square (RMS) for metal or a 250 RMS finish for composite is obtained to meet 0.004 inch TIR requirement.
11. Measure front impeller (2) wear ring wearing surface OD and record.
12. Mount the suction cover (9) with new suction cover wear ring (7) installed in a lathe. Indicate male rabbet to within 0.002 TIR maximum. Listed in Table 9 or provided on the sectional assembly drawing in Appendix A.
13. Bore suction cover wear ring (7) to within the specified tolerance listed in Table 9 over the recorded size of the OD of the front impeller hub.
14. Remove setscrews (667) from backcover/adaptor wear ring (7X). Remove the backcover/adaptor wear ring from the backcover/adaptor (71). This can be best accomplished on a lathe. Take this work to a machine shop.

NOTE

Backcover/adaptor (71) may be drilled for new setscrews (667) as many times as necessary, as long as it will support the backcover/adaptor wear ring and allow setscrews (667) to be installed.

15. Carefully press new undersized backcover/adaptor wear ring (7X) into backcover/adaptor (71). The beveled edge of the backcover/adaptor wear ring is installed towards the impeller (2). Ensure that the new backcover/adaptor wear ring is seated flat in backcover/adaptor.

NOTE

The drill center point for the composite part is offset radially one-quarter of the setscrew diameter into the metal volute so that only 20 to 25 percent of the installed setscrew is in the composite wear ring. Seventy-five to eighty percent of the setscrew shall be in the metal part, which prevents the drill or tap from walking into the softer composite material. Drilling and tapping are to be done following standard procedures. Suitable fixtures shall be employed as needed to avoid drill or tap walking. Refer to Figure 6 for proper pinning of pressed-in composite wear ring.

16. To secure backcover/adaptor wear ring (7X) drill and tap two holes, number 10-24 UNC x 3/8 inch deep 120 degrees apart, along edge of backcover/adaptor wear ring. Insert setscrews (667) in holes.
17. Measure backcover/adaptor wear ring (7X) ID and record.
18. Check front impeller (2) wear ring wearing surface for concentricity and wear. Place impeller on an arbor and mount between centers in either a lathe or a grinder. Indicate hub to within 0.004 Total Indicator Runout (TIR) maximum to be sure that arbor and impeller are running square. Grind or turn front impeller wear ring wearing surface (Up to 0.050 inch material removal for metal and 0.030 inch material removal for composite.) until a 63 Root Mean Square (RMS) for metal or a 250 RMS finish for composite is obtained to meet 0.004 inch TIR requirement.
19. Measure back impeller (2) wear ring wearing surface OD and record.

20. Mount the backcover/adaptor (71) with new backcover/adaptor wear ring (7X) installed in a lathe. Indicate male rabbet to within 0.002 TIR maximum. Listed in Table 9 or provided on the sectional assembly drawing in Appendix A.
21. Bore backcover/adaptor wear ring (7X) to within the specified tolerance listed in Table 9 over the recorded size of the OD of the back impeller hub.
22. Continue reassembly per Section VII, Paragraph C, steps 3 through 25.
23. Make sure that the forcing bolts (611) are below the surface of the suction cover (9) Align suction cover with volute (1) and slowly slide suction cover onto volute. Avoid sideways motion that may damage composite impeller or suction cover wear ring (7). Secure suction cover with locknuts (617) on studs (632). Tighten forcing bolts finger tight. If applicable, tighten jam nuts (621) to secure forcing bolts.
24. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.

25. Reconnect suction and discharge piping. Connect auxiliary piping.
26. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
27. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

K. ABRASIVE SEPARATOR. The abrasive separator separates foreign particles from the fluid pumped, helping preserve the life of the mechanical seal. The foreign particles collect at the bottom of the abrasive separator. If the mechanical seal should ever need to be replaced, disassemble the abrasive separator and check to make sure the abrasive separator is not clogged. Additionally, if leakage is detected at the abrasive separator, disassemble the abrasive separator and check the O-rings. Replace old, worn, or damaged O-rings with new O-rings. Refer to Figure 7 if the abrasive separator is mounted on the discharge flange and Figure 8 if mounted on the suction flange.

Item Number	Description
82	Cone Body
83	Cone Cap
89G	O-ring
89H	O-ring
400	Tubing
401	Tubing
411	Male Tube Connector
555	Union
834	Jamnut

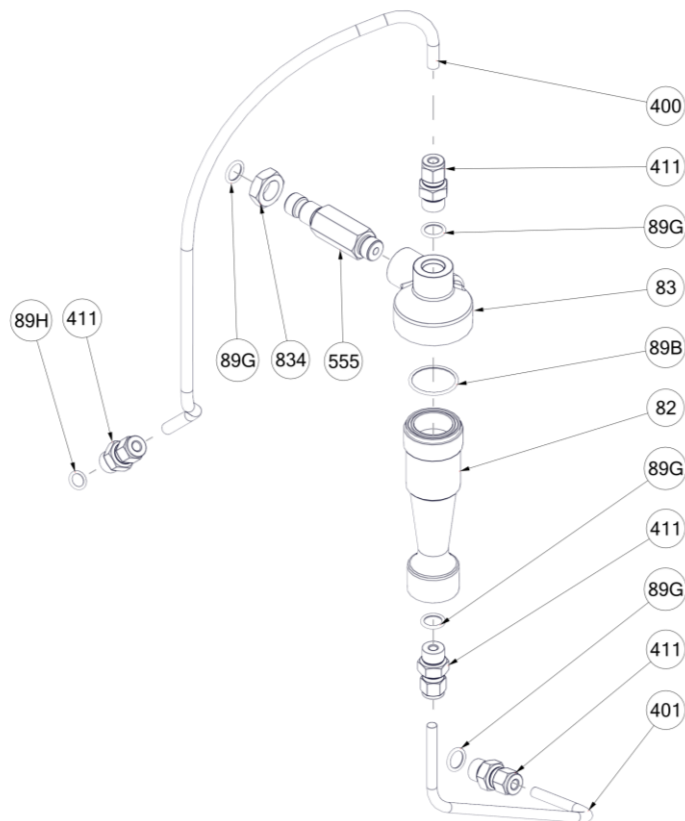


Figure 7. Discharge Mounted Abrasive Separator

K.1 Discharge Mounted Abrasive Separator.

Reassembly.

Disassembly.



DANGER

Before attempting to disassemble the pump, the electrical power supply to the motor must be locked out and tagged in the “OFF” position to prevent injury or death to personnel servicing the pumping unit.

1. Stop the pumping unit per Section IV, Paragraph F.
2. Shut off and close all valves controlling flow of liquid to and from the pump.
3. Remove abrasive separator assembly from volute (1) at union (555) by removing jamnut (834) and O-ring (89G).
4. Disconnect male tube connectors (410 and 411) nuts from tubing (400 and 401). Remove tubing. Remove male tube connector bodies. Remove O-rings (89G and 89H) from male tube connector bodies.
5. Remove tubing (400 and 401) from abrasive separator.
6. Remove the cone cap (83) from the cone body (82) by unscrewing it. Remove O-ring (89B).
7. Remove O-ring (89G) from cone cap (83).
8. Remove union (555) from cone cap (83).
9. Check to make sure no foreign particles are clogging the cone body (82). Remove all foreign particles as necessary.



CAUTION

During reassembly, install new O-rings, if disturbed from position. O-rings, may have been damaged during disassembly.

1. Lubricate and install new O-ring (89B).
2. Install cone cap (83) onto cone body (82). Lubricate and install O-ring (89G).
3. Secure union (555) to cone cap (83).
4. Lubricate and install new O-rings (89G) on male tube connector (411) bodies. Install male tube connector bodies in the cone cap (83) and cone body (82).
5. Connect tubing (400 and 401) on the cone cap (83) and cone body (82) by tightening the male tube connectors (410 and 411) nuts on the end of the tubing onto the tube connector bodies.
6. Connect tubing (400 and 401) to cone cap (
7. Lubricate and install new O-ring (89G) on jamnut (834). Secure abrasive separator assembly to volute (1) and tighten jamnut.
8. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
9. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

Item Number	Description
82A	Cone Body
82B	Cone Cap
82C	O-ring
89E	O-ring
89G	O-ring
400	Tubing
411	Male Tube Connector
250	Union
618	Jamnut

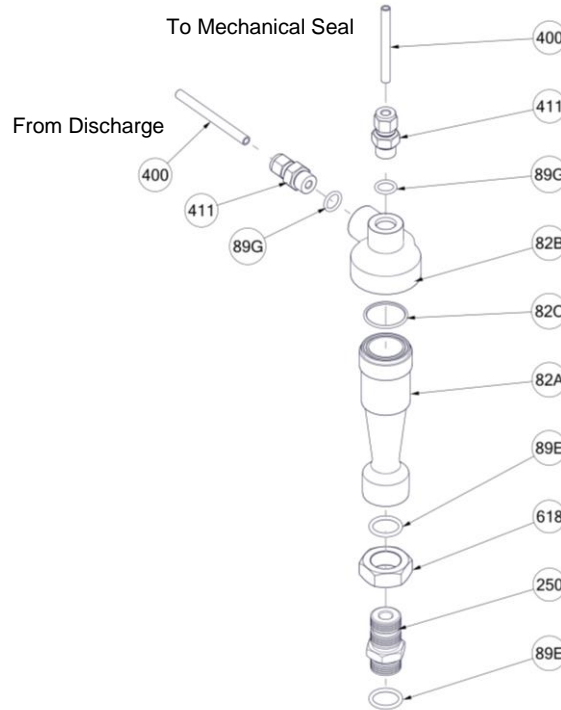


Figure 8. Suction Mounted Abrasive Separator

K.2 Suction Mounted Abrasive Separator.

Disassembly



DANGER

Before attempting to disassemble the pump, the electrical power supply to the motor must be locked out and tagged in the "OFF" position to prevent injury or death to personnel servicing the pumping unit.

1. Stop the pumping unit per Section IV, Paragraph F.
2. Shut off and close all valves controlling flow of liquid to and from the pump.
3. Disconnect male tube connector (410 and 411) nuts from tubing (400 and 401). Remove tubing. Remove male tube connector bodies from cone cap (82B). Remove O-rings (89G) from male tube connector bodies.
4. Loosen jamnut (618). Remove abrasive separator assembly from volute (1) by removing the union (250) and O-rings (89E) from the volute.
5. Remove the cone cap (82B) from the cone body (82a) by unscrewing it. Remove O-ring (82C).

6. Remove union (250) from cone cap (82B).
7. Check to make sure no foreign particles are clogging the cone body (82). Remove all foreign particles as necessary.

Reassembly



CAUTION

During reassembly, install new O-rings, if disturbed from position. O-rings, may have been damaged during disassembly.

1. Lubricate and install new O-ring (82C).
2. Install cone cap (82B) onto cone body (82A).
3. Lubricate and install O-rings (89E) onto union (250). Confirm jamnut (618) is on union (250).
4. Secure union (250) to cone cap (82B).
5. Lubricate and install new O-rings (89G) on male tube connector (410 and 411) bodies. Install male tube connector bodies into the abrasive separator.
6. Secure abrasive separator assembly to volute (1). Confirm position of abrasive separator and tighten jam nut (618).

7. Connect tubing (400 and 401) to abrasive separator. Secure tubing with male tube connector (410 and 411) nuts.
10. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual in Appendix B.
11. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

L. MOTOR. The motor should be maintained in accordance with the manufacturer's instructions. Refer to Appendix B for the motor manufacturer's manual.

VIII. PARTS LISTS AND DRAWINGS.

This section contains Tables 10 and 11 that note the recommended spare parts for these pumping units. Table 10 parts correspond to Figure 3 and Table 11 parts correspond to Figures 4 and 5. Refer to Appendix A for the sectional assembly drawing specific to your unit and for the actual part numbers and recommended spare parts.

Table 10. Recommended Spare Parts List for JM Shaft Pumps

Item	Description	Item	Description
2	Impeller	73X	Gasket - Impeller Washer
7	Wear Ring	89A	O-ring – Suction and Backcover/Volute
7X	Wear Ring	89B	O-ring – Abrasive Separator
14	Shaft Sleeve	89C	O-ring – Shaft Sleeve
24	Impeller Capscrew	89D	O-ring – Plugs and Tube Connector
28	Impeller Washer	89F	O-ring – Impeller Capscrew
32	Impeller Key	89G	O-ring – Union, Tube Connector
63	Throttle Bushing	90	Mechanical Seal
73	Gasket - Sleeve	667	Setscrew – Wear Ring

Table 11. Recommended Spare Parts List for JP Shaft Pumps

Item	Description	Item	Description
2	Impeller	89A	O-ring – Backcover/Volute
7	Wear Ring	89B	O-ring – Abrasive Separator
7X	Wear Ring	89D	O-ring – Shaft Sleeve
14	Shaft Sleeve	89E	O-ring – Seal Gland
24	Impeller Bolt	89F	O-ring – Drain Plug
28	Impeller Washer	89G	O-ring – Union, Tube Connector, Plug
32	Impeller Key	89H	O-ring – Tube Connectors
63	Throttle Bushing	89J	O-ring – Impeller Washer
73	Gasket - Sleeve	90	Mechanical Seal
73X	Gasket - Impeller Washer	667	Setscrew – Wear Ring



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