(F998) I-780

780 – 17.02.EN

CARVER PUMP™
Built for purpose

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 information to properly maintain the total pumping unit. The information presented should improve your knowledge and understanding of the M Series pumps, thus improving 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 any drawings done for your specific pump. For motor information refer to the motor manufacturers manual.

CAUTION

These instructions should be read completely 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 where readily available on the pump service record page and inspection and repair record provided at the front of this manual. 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 11 or 12, Recommended Spare Parts. For actual part numbers for your unit see the sectional assembly drawing specific for you unit.

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

- Serial number of pump (located on nameplate)
- Part name (Refer to Sectional Assembly drawing for your unit or exploded views.)
- Part number (Refer to Sectional Assembly drawing for your unit.
- Item number (Refer to Sectional Assembly drawing for your unit.
- 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 Materials Authorization (RMA) 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 outline dimensional drawing specific to your unit.

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

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 that 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.

CAUTION

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:

DANGER

Before attempting to work on 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. 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 bearing balls and indentations in the race of the ball bearing, which is termed "false brinelling." False brinelling will lead to premature bearing noise and 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.

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 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.

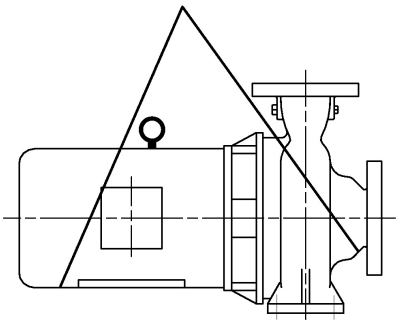

Figure 1. Sling Position for Lifting Pump

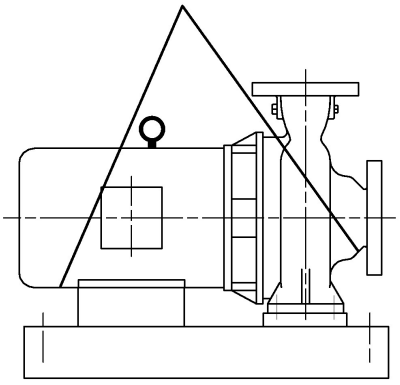

Figure 2. Sling Position for Lifting Pumping Unit

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.

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 and reinstall any removed guards or shrouds.

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 flanges.

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 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 fittings 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. Refer to the motor vendor's manual for motor information and information on connecting to the power supply.

CAUTION

Connection to the power supply must be affected 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, manually rotate the shaft 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 Casing 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.

CAUTION

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 casing.
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 casing.
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 the 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 manufacturer's motor manual. Provide pump assembly with a protective cover. Drain casing (1) by removing plug (553A) in bottom of casing. If necessary, flush pump to remove corrosive or toxic pumpage. Reinstall plug in casing 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 1 to eliminate the most common causes of those problems.

For the motor troubleshooting refer to the manufacturer's motor manual.

Table 1. Pumping Unit Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Failure to deliver liquid.	1. System head greater than anticipated.	1. Check pump rating against actual head condition.
	2. Pump not primed.	2. Prime pump in accordance with Section IV, Paragraph B.
	3. Check valve stuck or improperly installed.	3. Adjust and/or reverse valve.
	4. Impeller or suction clogged.	4. Inspect suction and impeller. Clean as necessary.
	5. Incorrect impeller diameter.	5. Replace impeller or trim impeller to correct diameter. Consult with Carver Pump Company before trimming impellers.
Excessive power consumption.	1. System head lower than anticipated	1. Adjust pressure flow.
	2. Specific gravity or viscosity of fluid is too high	2. Check oil temperature and adjust as necessary.
	3. Mechanical defects such as binding rotating elements.	3. Check for excessive pipe strain. Check foundation bolting. Replace defective parts.
	4. System head lower than anticipated design condition.	4. Adjust system head. Trim impellers to actual condition.
	5. Incorrect impeller diameter.	5. Replace impeller or trim impeller to correct diameter. Consult with Carver Pump Company before trimming impellers.
Insufficient discharge or flow.	1. Discharge head greater than anticipated.	1. Check pump rating against actual head condition.
	2. Air or gases in fluid.	2. Adjust and/or redesign suction system. Add fluid to system. Check for air leaks in suction.
	3. Impeller or suction partially clogged.	3. Inspect strainer and impeller and clean as necessary.
	4. Wrong direction of rotation.	4. Reverse direction of rotation.

Table 1. Pumping Unit Troubleshooting - Continued

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Insufficient discharge or flow. - Continued	5. Specific gravity or viscosity of fluid is too high. 6. Incorrect impeller diameter.	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 (0.0015”) at 3600 RPM and 3.0 of overall displacement (unfiltered) peak to peak mils (0.003”) 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 2, Recommended Torque Values or the sectional that applies to your unit. 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 2. Maximum 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 Cap Screw - Torque (ft-lbs) allowed (with Loctite)
(Acceptable for composite impellers and/or sleeves.)

Screw Size	Torque (ft-lbs)
3/8-16 UNC	13
1/2-13 UNC	21

Table 3. Pump Design and Disassembly, Reassembly Reference

Pump Design		Disassembly	Reassembly
A	Removable suction cover, no removable mechanical seal gland	Section VII, Paragraph B and Figure 3	Section VII, Paragraph C and Figure 3
B	Removable suction cover, with removable mechanical seal gland	Section VII, Paragraph D and Figure 4	Section VII, Paragraph E and Figure 4
C	Suction cover/casing combined, no removable mechanical seal gland	Section VII, Paragraph F and Figure 5	Section VII, Paragraph G and Figure 5
D	Suction cover/casing combined, with removable mechanical seal gland	Section VII, Paragraph H and Figure 6	Section VII, Paragraph I and Figure 6

VII. SERVICE AND REPAIR.

Refer to Table 3 to see your pump design designation to find the correct disassembly and reassembly for your pump. During disassembly, reference the sectional drawing specific to your unit for the Parts List that corresponds to the part numbers used in this manual. Refer to Paragraph J for parts inspection. Refer to Tables 11 and 12 for recommended spare parts.

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

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 casing 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.

Prepare the pumping unit for disassembly using the following list:

1. Read this entire section and study the exploded view or sectional assembly drawing for your 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. Disconnect piping and gauge line as necessary.
6. Drain casing (1) by removing plug (553A). If necessary, flush pump to remove corrosive or toxic pumpage. Reinstall plug in casing when fluid is completely drained.

B. DISASSEMBLY OF "DESIGN A" PUMP. 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. 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 casing.

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 (561) are removed from pumping unit to avoid damage to tubing (605) and to allow separation of pump parts. Do not attempt to reshape tubing (605) as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (561A) nuts from tubing (605). Remove tubing. Remove male tube connector (561A) body. Remove O-rings (700B) from male tube connector (561A) body.
3. If equipped with an abrasive separator, see Section VII, Paragraph L for disassembly of abrasive separator.
4. Remove hex nuts (837A) attaching the motor bracket/ adaptor (71) to the casing (1).
5. If equipped, remove the bolt (800E) and lockwasher (850A) from the adaptor/motor bracket (71) foot. Remove bolt (800A) and lockwasher (850B) 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 casing (1) and suction cover (9). Attach hoisting straps to lifting lugs on motor (200) and through the motor bracket/ adaptor (71) to distribute weight evenly and support the motor during disassembly. Loosen jam nuts (833B) on forcing bolts (800D). Tighten forcing bolts (800D) to loosen motor bracket/ adaptor (71) from casing (1).

CAUTION

When removing motor/back cover/ motor bracket 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 casing (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. Unless replacing wear ring, the casing (1), suction cover wear ring (7), and suction cover (9) will remain assembled to the piping. Ensure that no foreign matter such as dirt, chips, tools, etc. are caught in the piping or casing (1) as this debris will be drawn into the pump and cause extensive damage.
9. Remove O-ring (700A) from motor bracket/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), back cover 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 cap screw has right-handed threads.

Impeller washer gasket is a multi-piece gasket.

10. Remove impeller cap screw (24), impeller washer (28), impeller washer gasket (73X), impeller cap screw O-ring (700F) and impeller (2) from motor shaft. Remove impeller key (32A).
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 hex nuts (837A). Remove motor bracket/adaptor (71) from motor (200). Wear ring (7X) will remain secured to motor bracket with setscrews (864) if present.
14. Remove stationary element of mechanical seal (90) from motor bracket/ adaptor (71).
15. Remove throttle bushing (63) from motor bracket/ adaptor (71).
16. Remove shaft sleeve O-ring (700D) from motor shaft.
17. If necessary, remove slinger (40) from motor shaft.

NOTE

Refer to Section VII, Paragraph M for shaft adaptor removal if needed due to repair or motor replacement.

C. REASSEMBLY OF "DESIGN A PUMP". 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. 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 J before continuing with reassembly.

NOTE

If equipped with a shaft adapter and shaft adapter was removed or motor was replaced refer to Section VII, Paragraph M.

2. If removed, install slinger (40) on motor shaft.
3. Lubricate and install shaft sleeve O-ring (700D) onto motor shaft.

4. Install throttle bushing (63) into motor bracket/ adaptor (71) making sure to line up pin of throttle bushing with groove in motor bracket/ adaptor.

NOTE

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

5. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into motor bracket/ adaptor (71) aligning pin in bushing to groove in stationary element.
6. Ensure backcover wear ring (7X) is secured with setscrews (864) to motor bracket/ adaptor (71).
7. Secure motor bracket/ adaptor (71) to motor (200) with locknuts (837C) on studs (820A). Back out forcing bolts (800D) below seating surface of the motor bracket/ 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), wear ring (7), wear ring (7X), and shaft sleeve (14).

8. 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.
9. 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.

10. If removed, use cyanoacrylate adhesive to 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 Design A Seal Installation	250-1100101-801
1-1/4	Tool/Seal Retainer Design A Seal Installation	250-1100102-801
1-5/8	Tool/Seal Retainer Design A Seal Installation	250-1100103-801

CAUTION

Over tightening of impeller cap screw (24) may damage composite shaft sleeve (14). DO NOT over torque impeller cap screw. Refer to Table 3.

NOTE

Impeller cap screw (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.

11. Install impeller key (32A), into motor (200) shaft keyway. Install mechanical seal (90) 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 (700F). Secure impeller with impeller cap screw (24). Torque impeller cap screw as required on sectional assembly for your unit.
12. Install O-ring (700A) on motor bracket/ 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 wear ring (7) is secured with setscrews (864) to casing (1).
16. Confirm that the shims for the motor bracket/ adaptor (71) feet and motor (200) feet, if present from disassembly, are in place.

CAUTION

When installing motor/motor bracket/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, if applicable.

17. Install motor/motor bracket/adaptor assembly into casing (1), being careful not to damage impeller (2). Secure casing (1) to motor bracket/adaptor (71) with locknuts (837A) on studs (820B). Tighten forcing bolts (800D) finger tight. Tighten jam nuts (833B) to secure forcing bolts (800D).
18. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
19. If removed, install suction cover (9) on casing (1) with locknuts (837B) on studs (820B).
20. Install O-rings (700D) on male tube connector (561). Install male tube connectors. Install tubing (605) and reconnect male tube connectors.
21. Install O-ring (700D) on plug (533). Reinstall plug in casing (1).
22. Secure motor (200) feet to base (23) with bolts (800A) and lockwashers (850B).
23. Secure motor bracket/adaptor (71) feet to the base (23) with bolts (800E) and lockwashers (850A).
24. Connect auxiliary piping.
25. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.
26. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual.
27. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

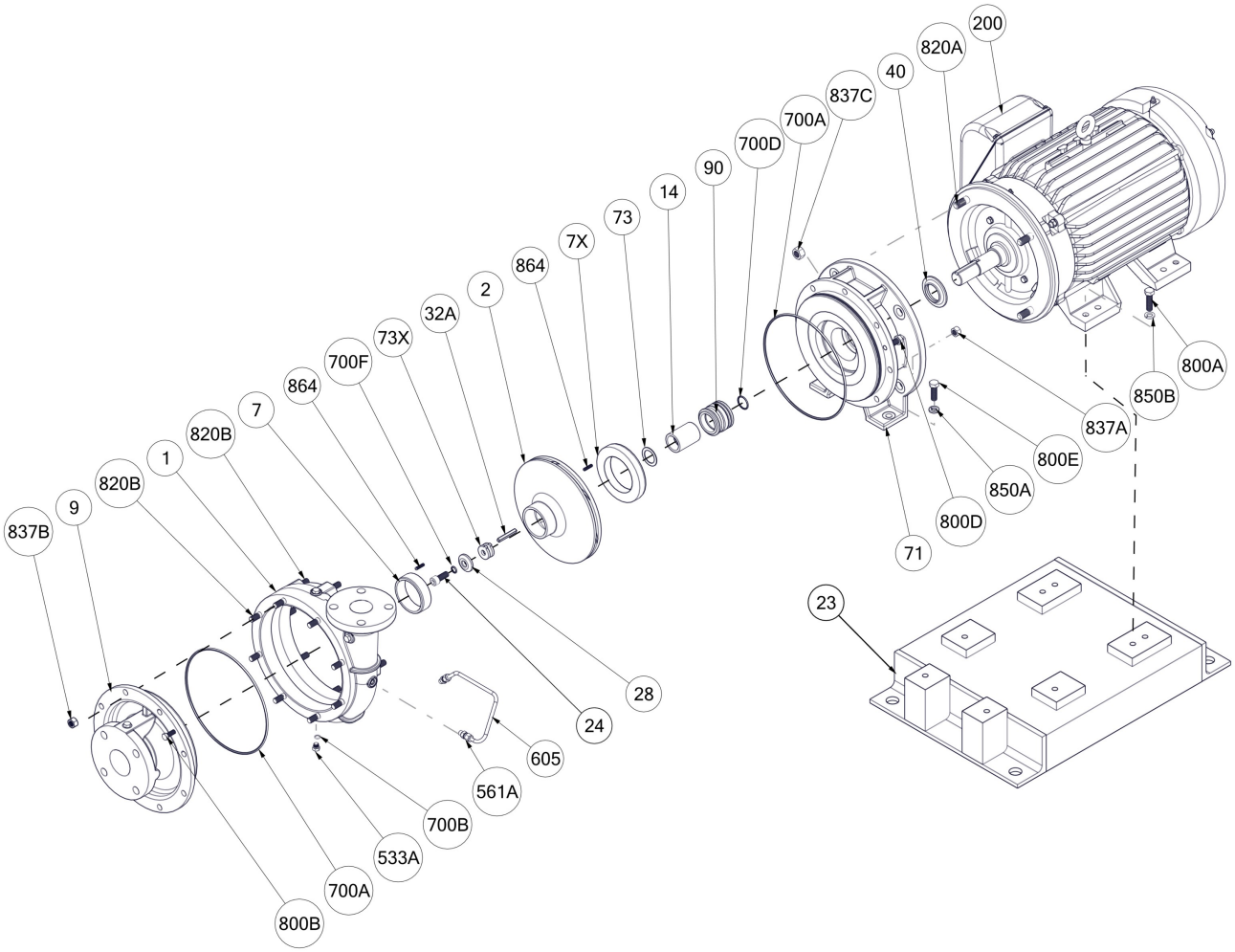

Figure 3. Reference Exploded View for “Design A” Pumps

Table 6. Parts List for "Design A" Pumps

Item Number	Description	Item Number	Description
1	Casing	605	Tubing
2	Impeller	700A	O-ring – Suction and Adaptor/Motor Bracket
7	Wear Ring – Suction Cover	700B	O-ring – Plugs and Tube Connector
7X	Wear Ring – Adaptor	700D	O-ring – Shaft Sleeve
9	Suction Cover	700F	O-ring – Impeller Cap Screw
14	Shaft Sleeve	800A	Bolt – Motor/Base
23	Base	800B	Forcing Bolt – Suction Cover
24	Cap Screw – Impeller	800D	Forcing Bolt – Back Cover
28	Washer – Impeller	800E	Bolt – Adaptor/Motor Bracket/Base
32A	Key – Impeller	820A	Stud – Adaptor/Motor Bracket/Motor
40	Slinger	820B	Stud – Casing/Adaptor/Motor Bracket
*63	Throttle Bushing	820B	Stud – Suction/Casing
71	Adaptor/Motor Bracket	*833A	Jam Nut – Suction Forcing
73	Gasket – Sleeve	*833B	Jam Nut – Adaptor Forcing
73X	Gasket – Impeller Washer	837A	Hex Nut – Adaptor/Motor Bracket /Motor
90	Mechanical Seal	837B	Hex Nut – Suction/Casing
200	Electric Motor	837C	Hex Nut – Adaptor/Motor Bracket /Casing
*226A	Nameplate	850A	Lockwasher – Adaptor/Motor Bracket /Base
*226B	Rotation Plate	850B	Lockwasher – Motor/Base
561A	Male Tube Connector	864	Setscrew – Wear Rings
553A	Plug	*888	Drivescrew - Nameplates

*Items not shown on exploded view

D. DISASSEMBLY OF "DESIGN B" PUMP. 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. 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 casing from the system.

After completion of dismantling, all parts should be thoroughly cleaned or replaced by new ones if necessary. All sealing faces should be perfectly clean.

NOTE

Mark or number each component while dismantling according to sequence.

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

NOTE

Male tube connectors (561A and 561B) are removed from pumping unit to avoid damage to tubing (605) and to allow separation of pump parts. Do not attempt to reshape tubing as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (561A and 561B) nuts from tubing (605). Remove tubing. Remove male tube connector bodies. Remove O-rings (700B) from male tube connector bodies.
3. If equipped with an abrasive separator, see Section VII, Paragraph L for disassembly of abrasive separator.
4. Remove locknuts (837B) from studs (820C) attaching the back cover (11) to the casing (1).
5. Remove bolt (800A) and washer (850) 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 casing (1) and suction cover (9). Attach hoisting straps to lifting lugs on motor (200) and through the motor bracket (71) to distribute weight evenly and support the motor during disassembly. Loosen jam nuts (833B) on forcing bolts (800D). Tighten forcing bolts to loosen motor bracket from casing.

CAUTION

When removing motor/back cover/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, if equipped.

7. Carefully remove the motor/impeller assembly from the casing (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 casing (1), 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 casing (1) as this debris will be drawn into the pump and cause extensive damage.
9. If equipped with a component mechanical seal (90), remove locknuts (837C) from studs (820C) to relieve spring pressure on the mechanical seal gland (17).
10. Remove O-ring (700A) from back cover (11).

CAUTION

If equipped with composite parts, these 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) and back cover wear ring (7X).

Impeller cap screw (24) has right-handed threads.

11. Remove impeller cap screw (24), impeller washer (28), impeller washer gasket (73X) and impeller (2) from motor (200) shaft. Remove impeller key (32A).

NOTE

If equipped with a component mechanical seal, DO NOT remove rotating element of mechanical seal (90) from shaft adapter (6) at this point, especially if mechanical seal is relatively clean and in good working condition. If removed Carver Pump Company recommends the mechanical seal be replaced.

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

12. For component mechanical seals, 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.

NOTE

Refer to mechanical seal vendor instructions for proper cartridge mechanical seal removal procedure.

13. For cartridge mechanical seals, loosen bolts (800C) and washers (850) holding the cartridge seal to the back cover (11). Proceed with removal per manufacturers instructions.
14. Remove nuts (837A) from studs (820A) to remove back cover (11) from motor bracket (71).
15. Remove mechanical seal gland (17) 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 shaft sleeve O-ring (700D) from motor (200) shaft.
19. If needing repair, remove nuts (837B) from studs (820D) holding motor bracket (71) to motor (200).
20. For replacement of component mechanical seals. Remove stationary element of component mechanical seal (90) from back cover (11).
21. If necessary, remove slinger (40) from motor (200) shaft.

NOTE

Refer to Section VII, Paragraph M for shaft adaptor removal, if needed, due to repair or motor replacement.

E. REASSEMBLY OF "DESIGN B" PUMP. During reassembly, install parts 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. 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 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.

Use Liquid Blue Loctite on item's 24, 800A, 800C and all stud tap ends. Lubricate all other fasteners with anti-seize before assembly.

1. Complete Section VII, Paragraph L, Parts Inspection before continuing with reassembly.

NOTE

If equipped with a shaft adapter and shaft adapter was removed or motor was replaced refer to Section VII, Paragraph M.

Use Liquid Blue Loctite on all stud tap ends

2. If removed, install studs (820B) into motor, Loctite tap end
3. If motor bracket (71) was removed, install motor bracket on studs (820B) and secure with lock nut (837B), refer to sectional assembly for torque values.
4. If removed, install slinger (40) on motor shaft.
5. Lubricate and install shaft sleeve O-ring (700D) onto motor (200) shaft.
6. Install throttle bushing (63) into mechanical seal gland (17) making sure to line up pin of throttle bushing with groove in the mechanical seal gland.

NOTE

If equipped with a component mechanical seal, the spring holder from the mechanical seal (90) may have remained attached to the impeller (2), unless it was necessary to remove it.

For component mechanical seals, refer to mechanical seal vendor instructions for proper mechanical seal installation procedure.

7. If installing a component mechanical seal (90), lubricate O-ring on stationary element of mechanical seal. Install stationary element of mechanical seal into back cover (11) aligning pin in bushing to groove in stationary element.
8. Install mechanical seal gland (17) assembly on motor (200) shaft.
9. Install back cover (11) onto motor bracket (71). Secure with lock nuts (837A) onto studs (820A), refer to sectional assembly for torque values.
10. Back out forcing bolts (800D) below seating surface of the back cover.

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), back cover wear ring (7X), and shaft sleeve (14).

11. For component mechanical seal, lubricate outside of the shaft sleeve (14) to facilitate the axial positioning of component mechanical seal (90). Install rotating element of mechanical seal on the shaft sleeve. Clean and dry seal faces.
12. For component mechanical seal, lubricate outside of the shaft adaptor (6) with Dow 111. Install shaft sleeve (14) with rotating element of

component 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.

13. For component mechanical seal, if removed, glue spring holder of component 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.

CAUTION

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

NOTE

Impeller cap screw (24) has right-handed threads.

14. Install impeller key (32A), into shaft adapter (6) keyway.

NOTE

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

15. Install component mechanical seal spring in spring holder.
16. Align impeller (2) with impeller key (32A) and spring of component mechanical seal, then slowly slide impeller straight on shaft adapter. Avoid sideways motion that may damage composite impeller. Install impeller washer (28). Secure impeller with impeller cap screw (24). Torque impeller cap screw as required on sectional assembly.
17. Install O-ring (700A) on back cover (11).

NOTE

For cartridge mechanical seals, refer to mechanical seal vendor instructions for proper mechanical seal installation procedure.

18. Install cartridge mechanical seal (90) onto shaft adapter (6) and secure with bolts (800C) to back cover (11).
19. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
20. Return rotor assembly to pump location.
21. Ensure wear ring (7) is secured with setscrews (864) to suction cover (9).
22. Confirm that the shims for the motor (200) feet, if present from disassembly, are in place.

CAUTION

When installing motor/back cover/motor bracket 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.

23. Install motor/back cover/adaptor assembly into casing (1), being careful not to damage impeller (2). Secure casing (1) to back cover (11) with locknuts (837B) on studs (820B). Tighten forcing bolts (800D) finger tight. Tighten jam nuts (833B) to secure forcing bolts (800D).
24. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
25. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.

26. Install O-rings (700B) on male tube connector (561B). Install male tube connectors. Install tubing (605) and reconnect male tube connectors.
27. Install O-ring (700B) on plug (553). Reinstall plug in casing (1).
28. Secure motor (200) feet to base (23) with bolts (800A) and washers (850).
29. If applicable, secure back cover (11) feet to the base (23) with bolts (800A) and washers (850A).
30. Connect auxiliary piping.
31. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual.
32. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

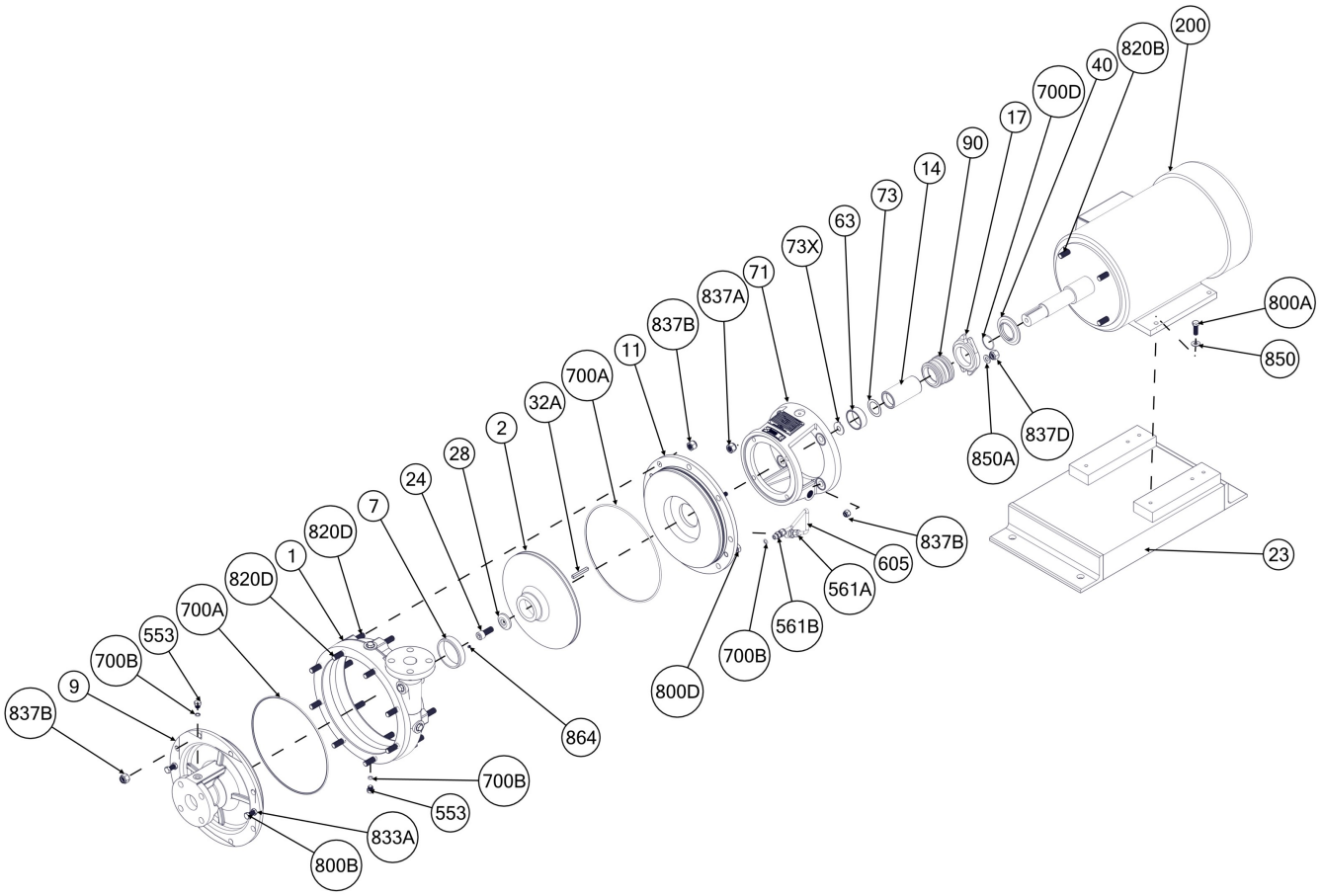

Figure 4. Reference Exploded View for Design B Pumps

Table 7. Parts List for Design B Pumps

Item Number	Description	Item Number	Description
1	Casing	605	Tubing
2	Impeller	700A	O-ring - Casing
7	Wear Ring – Suction Cover	700B	O-ring – Plugs/Fittings
9	Suction Cover	700D	O-ring – Shaft Sleeve
11	Back Cover	800A	Bolt – Motor/Base
14	Shaft Sleeve	800B	Forcing Bolt – Suction Cover
23	Base	800C	Bolt – Mechanical Seal
24	Cap Screw – Impeller	800D	Forcing Bolt – Back Cover
28	Washer – Impeller	*820A	Stud – Motor Bracket/Back Cover
32A	Key – Impeller	820B	Stud – Motor Bracket/Motor
40	Slinger	*820C	Stud – Back Cover/Gland
63	Throttle Bushing	820D	Stud – Casing/Backcover
71	Motor Bracket	833A	Jam Nut – Suction Cover
73	Gasket - Sleeve	*833B	Jam Nut – Back Cover
73X	Gasket – Impeller Washer	837A	Lock Nut – Motor Bracket\Back Cover
90	Mechanical Seal	837B	Lock Nut – Motor Bracket\Motor\Suction Cover and Back Cover
200	Motor	837D	Lock Nut – Back Cover/Gland
*226A	Nameplate	850	Washer – Mechanical Seal, Motor\Base
*226B	Nameplate Rotation	850A	Washer – Mechanical Seal Gland
553	Plug	864	Set Screw – Wear Ring
561A	Male Connector – Mechanical Seal	888	Drive Screw - Nameplates
561B	Male Connector - Discharge		

* Item not shown on exploded view

F. DISASSEMBLY OF DESIGN C PUMP. 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. 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 (561A) are removed from pumping unit to avoid damage to tubing (605A and 605B) and to allow separation of pump parts. Do not attempt to reshape tubing as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (561A) nuts from tubing (605A and 605B). Remove tubing. Remove male tube connector body. Remove O-rings (700H) 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 (800A) and lockwasher (850) 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 motor bracket (71) to distribute weight evenly and support the motor during disassembly. Loosen jam nuts (833B) on forcing bolts (800D). Tighten forcing bolts to loosen motor bracket from casing (1).

CAUTION

When removing motor bracet 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 casing (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 casing (1) with casing wear ring (7) is left in place. Ensure that no foreign matter such as dirt, chips, tools, etc. are caught in the piping or casing as this debris will be drawn into the pump and cause extensive damage.
8. Remove O-ring (700A) from the motor bracket (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), back cover wear ring (7X), and shaft sleeve (14).

Impeller cap screw (24) has right-handed threads.

9. Remove impeller cap screw (24), impeller washer (28), impeller washer gasket (73X), and impeller (2) from motor shaft. Remove impeller key (32A).
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 (200) shaft. If mechanical seal is to be replaced, remove rotating elements of mechanical seal from shaft sleeve.
12. Remove locknuts (837A) from studs (820A). Remove motor bracket (71) from motor (200).
13. Wear ring (7X) will remain secured to motor bracket (71) with setscrews (864).
14. Remove stationary element of mechanical seal (90) from motor bracket (71).
15. Remove throttle bushing (63) from motor bracket (71).
16. Remove shaft sleeve O-ring (700D) from motor (200) shaft.
17. If necessary, remove slinger (40) from motor (200) shaft.

NOTE

Refer to Section VII, Paragraph M for shaft adaptor removal if needed due to repair or motor replacement.

G. REASSEMBLY OF DESIGN C PUMP. 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. 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 J before continuing with reassembly.

NOTE

If equipped with a shaft adapter and shaft adapter was removed or motor was replaced refer to Section VII, Paragraph M.

2. If removed, install slinger (40) on motor shaft.
3. Lubricate and install shaft sleeve O-ring (700D) onto motor shaft.

4. Install throttle bushing (63) into motor bracket (71) making sure to line up pin of throttle bushing with groove in motor bracket.

NOTE

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

5. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into motor bracket (71).
6. Secure motor bracket (71) to motor with locknuts (837A) on studs (820B).
7. Ensure motor bracket wear ring (7X) is secured with setscrews (864) to motor bracket (71). Back out forcing bolts (800D) below seating surface of the motor bracket.

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).

8. 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.
9. Install O-ring (700D). 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 cap screw (24) may damage composite shaft sleeve (14). DO NOT over torque impeller cap screw.

NOTE

Impeller cap screw (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.

10. Install impeller key (32A), 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 (700J). Secure impeller with impeller bolt (24). Torque impeller cap screw as required on sectional assembly.
11. Install O-ring (700A) on motor bracket (71).
12. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
13. Return rotor assembly to pump location.
14. Ensure casing wear ring (7) is secured with setscrews (864) to casing (1).
15. 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.

16. Install motor/motor bracket assembly into casing (1), being careful not to damage composite impeller (2). Secure casing (1) to motor bracket (71) with locknuts (837B) on studs (820A and 820C). Tighten forcing bolts (800D) finger tight. Tighten jam nuts (833B) to secure forcing bolts.
17. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
18. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph L for assembly procedures for the abrasive separator.
19. Install O-rings (700H) on male tube connector (561A). Install male tube connectors. Install tubing (605A and 605B) and reconnect male tube connectors.
20. Install O-ring (700F) on plug (553A). Reinstall plug in casing (1).
21. Secure motor (200) feet to base (23) with bolts (800A) and lock washers (850).
22. Connect auxiliary piping.
23. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual.
24. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

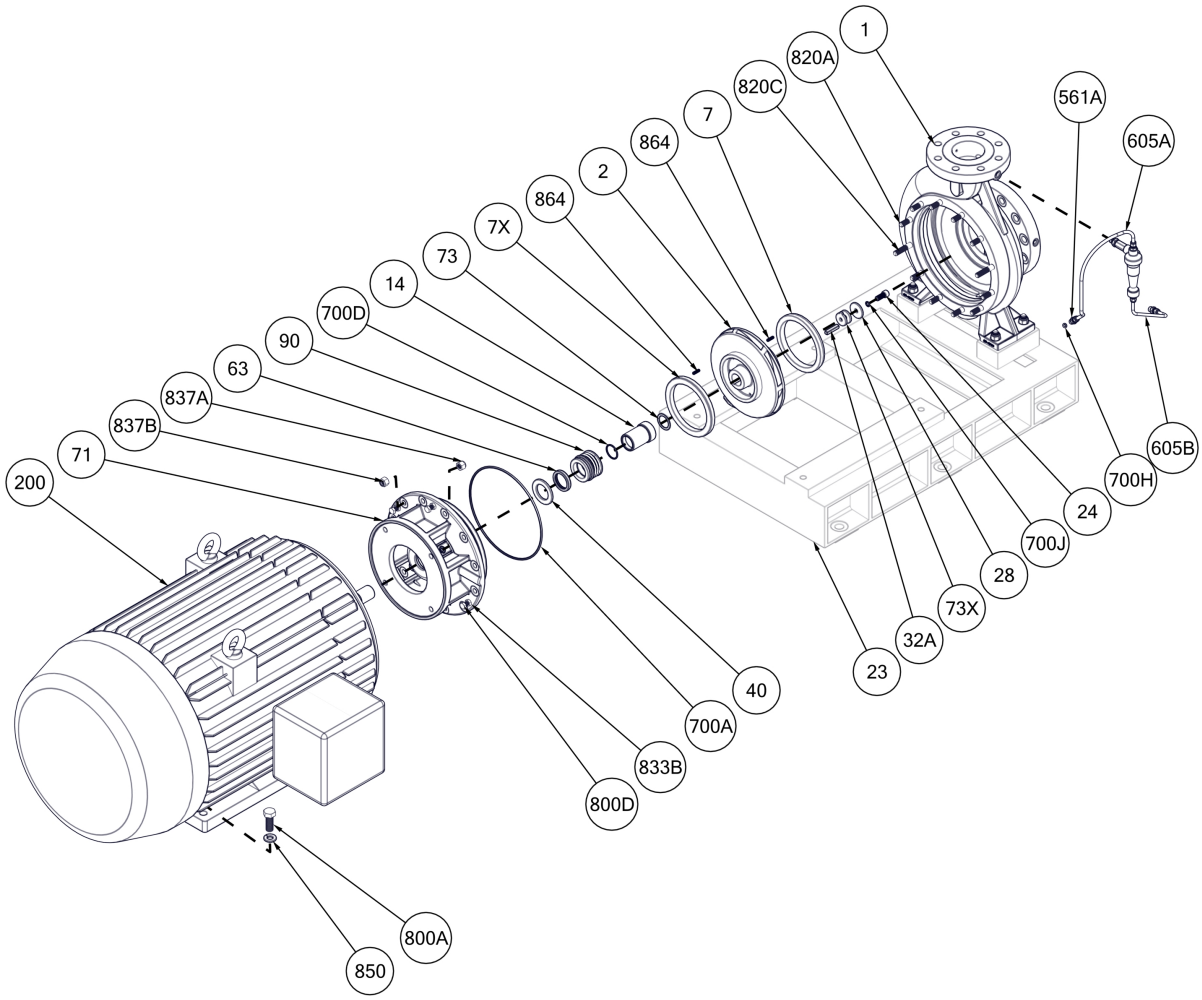

Figure 5. Reference Exploded View for Design C Pumps

Table 8. Parts List for Design C Pumps

Item Number	Description	Item Number	Description
1	Casing	561A	Male Tube Connector
2	Impeller	605	Tubing
7	Wear Ring – Casing	700A	O-ring – Motor Bracket
7X	Wear Ring – Motor Bracket	700D	O-ring – Shaft Sleeve
14	Shaft Sleeve	*700F	O-ring – Casing Drain
23	Base	*700G	O-ring – Tube Connector, Plug
24	Impeller Bolt	700H	O-ring – Seal Tube Connector
28	Washer – Impeller	700J	O-ring – Impeller Washer
32A	Key – Impeller	800A	Bolt – Motor/Base, Casing/Base
40	Slinger	800D	Forcing Bolt – Back Cover
63	Throttle Bushing	820A	Stud – Motor Bracket/Casing
71	Motor Bracket	820B	Stud – Motor Bracket/Motor
73	Gasket – Sleeve	820C	Stud – Motor Bracket/Casing
73X	Gasket – Impeller Washer	833B	Jam Nut – Backcover Forcing
90	Mechanical Seal	837A	Locknut – Motor Bracket/Motor
200	Electric Motor	837B	Locknut – Motor Bracket/Casing
*226	Nameplate	*837C	Locknut – Casing/Base
*226U	UID Plate	850	Lockwasher – Motor/Base
*226X	Rotation Plate	864	Set Screw – Wear Rings
*553A	Plug – Casing Drain	*888	Drive Screw - Nameplates
*553B	Plug		

* Items not shown on exploded view

H. DISASSEMBLY OF DESIGN D PUMP. The instructions that follow are an aid for properly trained personnel to service your Carver Pump. These instructions refer to Figure 6 and Table 9. If a specific sectional assembly drawing exists for a pumping unit, then that drawing should be referred to for service work. Read this entire section and study Figure 6 and Table 9 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 (561A) are removed from pumping unit to avoid damage to tubing (605) and to allow separation of pump parts. Do not attempt to reshape tubing as it has been accurately shaped to minimize length and reduce pump space envelope.

2. Disconnect male tube connector (561A) nuts from tubing (605). Remove tubing. Remove male tube connector body. Remove O-rings (700H) 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 (800A) and lockwasher (850A) 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 adaptor (71) to distribute weight evenly and support motor during disassembly. Tighten forcing bolts (800D) to loosen back cover (11) from casing (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, if applicable.

6. Carefully remove the motor/impeller assembly from the casing (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 casing (1) with 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 casing as this debris will be drawn into the pump and cause extensive damage.
8. Remove O-ring (700A) from the back cover (11).
9. Remove locknuts (837D) from studs (820D) 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), wear ring (7), back cover 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 (200) shaft. Remove impeller key (32A).
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.

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

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 (837A) from studs (820C).
14. Remove back cover (11) and mechanical seal gland (17). Wear ring (7X) will remain secured to back cover with setscrews (864).
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 (700E) from mechanical seal gland (17).
19. Remove shaft sleeve O-ring (700D) from motor (200) shaft.
20. Remove locknuts (837C) from studs (820B). Remove adaptor (71) from motor (200).
21. If necessary, remove slinger (40) from motor shaft.

I. REASSEMBLY OF DESIGN D PUMP. During reassembly, install parts as in accordance with instructions. These instructions refer to Figure 6 and Table 9. If a specific sectional assembly drawing exists for a pumping unit that drawing takes precedence and should be referred to for service work. Read this entire section and study Figure 6 and Table 9 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.

33. Complete Section VII, Paragraph H before continuing with reassembly.
34. If removed, install slinger (40) on motor shaft.
35. Lubricate and install shaft sleeve O-ring (700D) onto motor shaft.
36. Install throttle bushing (63) into mechanical seal gland (17) making sure to line up pin of throttle bushing with groove in mechanical seal gland.

NOTE

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

37. Lubricate O-ring on stationary element of mechanical seal (90). Install stationary element of mechanical seal into mechanical seal gland (17).
38. Install mechanical seal gland (17) assembly on motor (200) shaft.
39. Secure adaptor (71) to motor with locknuts (837B) on studs (820B).
40. Ensure wear ring (7X) is secured with setscrews (864) to back cover (11). Back out forcing bolts (800D) below seating surface of the backcover.
41. Secure back cover (11) to adaptor (71) with locknuts (837C) on studs (820C).

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), wear ring (7), wear ring (7X), and shaft sleeve (14).

42. Lubricate outside of the 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.
43. 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 cap screw (24) may damage composite shaft sleeve (14). DO NOT over torque impeller cap screw.

NOTE

Impeller cap screw (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.

44. Install impeller key (32A), 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 (700J). Secure impeller with impeller bolt (24). Torque impeller bolt as required on sectional assembly.
45. Secure mechanical seal gland (17) to back cover (11) with locknuts (837D) on studs (820D).
46. Install O-ring (700A) on back cover (11).
47. Rotate the motor shaft by hand to ensure it rotates freely and no rubbing noises are present.
48. Return rotor assembly to pump location.
49. Ensure wear ring (7) is secured with setscrews (864) to casing (1).
50. 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.

51. Install motor/backcover/adaptor assembly into casing (1), being careful not to damage composite impeller (2). Secure casing (1) to back cover (11) with locknuts (837B) on studs (820B). Tighten forcing bolts (800D) finger tight.
52. Rotate the motor shaft by hand, if accessible, to ensure it rotates freely and no rubbing noises are present.
53. Install abrasive separator assembly if equipped. Refer to Section VII, Paragraph K for assembly procedures for the abrasive separator.
54. Install O-rings (700H) on male tube connector (561A). Install male tube connectors. Install tubing (605) and reconnect male tube connectors.
55. Install O-ring (*700F) on plug (*553). Reinstall plug in casing (1).
56. Secure motor (*200) feet to base (*23) with bolts (*800A) and lockwashers (*850).
57. Connect auxiliary piping.
58. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual.
59. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

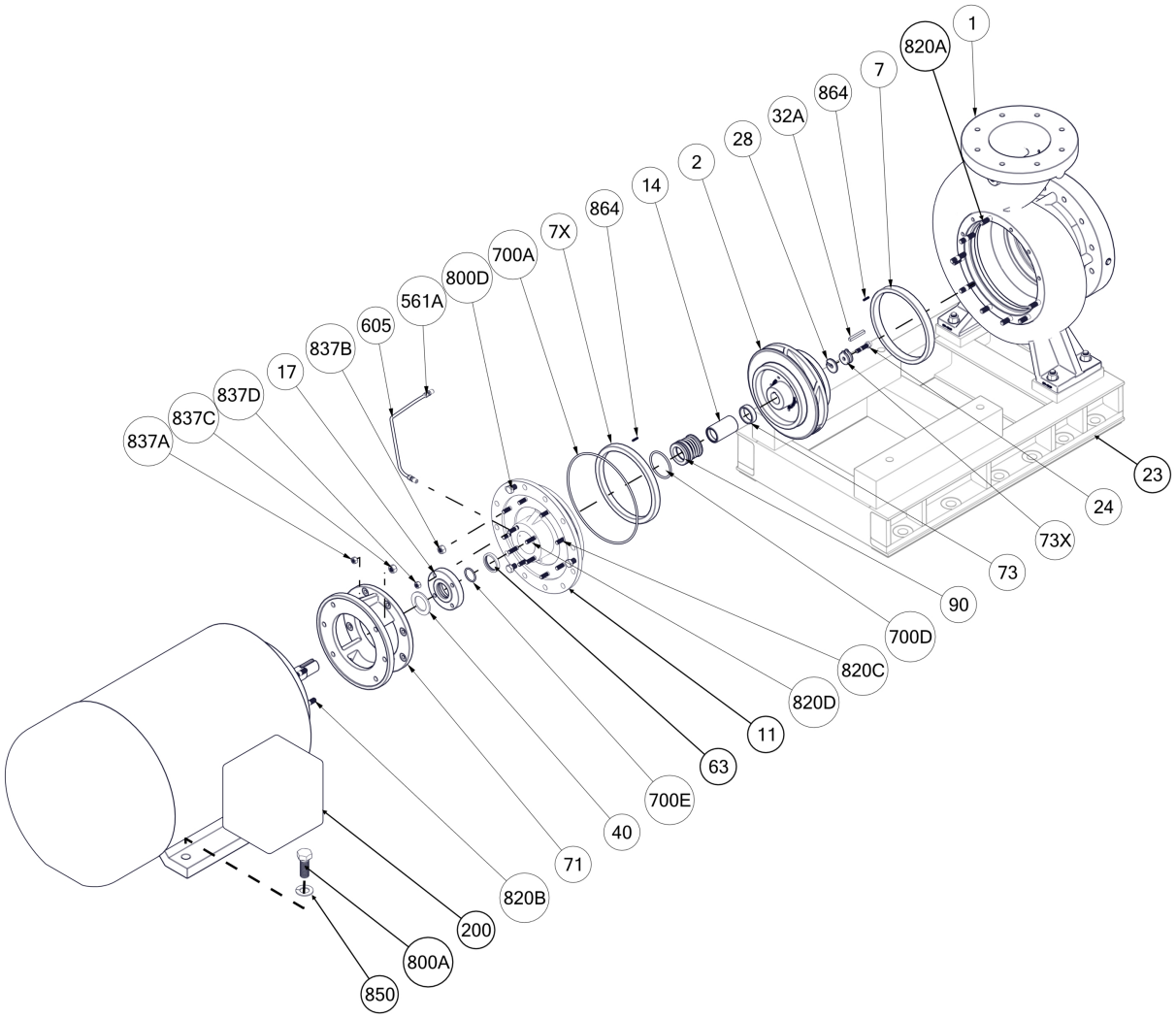

Figure 6. Reference Exploded View for Design D Pumps

Table 9. Parts List for Design D Pumps

Item Number	Description	Item Number	Description
1	Casing	*553B	Plug
2	Impeller	605	Tubing
7	Wear Ring – Casing	700A	O-ring – Back Cover
7X	Wear Ring – Back Cover	700D	O-ring – Shaft Sleeve
11	Back Cover	700E	O-ring – Mechanical Seal Gland
14	Shaft Sleeve	*700F	O-ring – Casing Drain
17	Mechanical Seal Gland	*700H	O-ring –Tube Connector, Plug
23	Base	700J	O-ring – Impeller Washer
24	Impeller Bolt	800A	Bolt – Motor/Base
28	Washer – Impeller	*800B	Bolt – Casing/Base
32A	Key – Impeller	800D	Forcing Bolt – Back Cover
40	Slinger	820A	Stud – Back Cover/Casing
63	Throttle Bushing	820B	Stud – Adaptor/Motor
71	Motor Bracket	820C	Stud – Adaptor/Back Cover
73	Gasket – Sleeve	820D	Stud – Seal Gland/Back Cover
73X	Gasket – Impeller Washer	837A	Locknut – Adaptor/Back Cover
90	Mechanical Seal	837B	Locknut – Back Cover/Casing
*131	Shaft Guard	837C	Locknut – Adaptor/Motor
200	Electric Motor	837D	Locknut – Mechanical Seal Gland
*226	Nameplate	*837E	Locknut –Casing/Base
*226U	UID Plate	850	Lockwasher – Motor/Base
*226X	Rotation Plate	864	Setscrew – Wear Rings
561A	Male Tube Connector	*888	Drivescrew – Nameplates
*553A	Plug – Casing Drain		

* Items not shown on exploded view

J. 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 or shaft adapter 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 or shaft adapter should be replaced. Refer to motor manufacturers manual for further information.
3. Inspect casing for pitting, scoring, and erosion. The inside of the casing should be free of any

pits or grooves. Replace the casing 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 10. Factory Wear Ring Diametrical Clearance (Inches)
(If not otherwise stated on sectional assembly.)

Pump Size	Front Wear Ring Clearance (Inches)*	Back Wear Ring Clearance (Inches)*
1-1/4 X 1 X 5	.009/.014	N/A
2 X 1-1/2 X 5	.012/.016	N/A
2-1/2 X 2 X 5	.012/.016	N/A
4 X 3 X 5	.016/.020	N/A
1-1/4 X 1 X 7	.016/.020	N/A
1-1/2 X 1-1/4 X 7	.016/.020	N/A
2-1/2 X 2 X 7	.012/.016	N/A
3 X 2-1/2 X 7	.012/.016	N/A
4 X 3 X 7	.014/.018	.014/.018
5 X 4 X 7	.014/.020	.012/.016
1-1/2 X 1-1/4 X 10	.014/.020	N/A
2 X 1-1/2 X 10	.018/.020	N/A
2-1/2 X 2 X 10	.008/.016	.008/.016
3 X 2-1/2 X 10	.016/.020	.016/.020
4 X 3 X 10	.010/.016	.010/.016
5 X 4 X 10	.016/.020	.016/.020
6 X 4 X 10	.016/.020	.016/.020

*Verify clearance by checking sectional drawing.

Table 10. Factory Wear Ring Clearance (Inches) - Continued

Pump Size	Front Wear Ring Clearance (Inches)*	Back Wear Ring Clearance (Inches)*
6 X 5 X 10	.023/.025	.021/.026
2 X 1 X 11	.012/.015	.012/.015
4 X 2 X 11	.016/.020	.016/.020
4 X 3 X 11	.016/.020	.016/.020
5 X 4 X 11	.016/.020	.016/.020
6 X 4 X 11	.018/.022	.018/.022
8 X 6 X 11	.019/.023	.019/.023
4 X 3 X 13	.017/.021	.017/.021
6 X 4 X 13	.018/.022	.018/.022
6 X 6 X 13	.019/.023	.019/.023
8 X 6 X 13	.020/.024	.020/.024
10 X 8 X 13	.021/.025	.021/.025
12 X 10 X 13	.023/.027	.023/.027

*Verify clearance by checking sectional drawing.

K. REPLACEMENT OF WEAR RINGS. The M Series pump has a replaceable wear rings (7 and 7X) inserted into the casing (1) or the suction cover (9) and the back cover (11) or motor bracket (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.

NOTE

To replace wear ring (7), the casing (1) or the suction cover (9) must be removed from system.

To replace the wear rings, follow the disassembly procedures for your unit to the point where the back cover or motor bracket and the suction cover or casing has been removed and the wear ring is accessible. Once the wear ring is accessible, use the following procedures:

1. Disconnect suction and discharge piping.
2. Remove setscrews (864) from suction cover (9) or casing (1) wear ring (7). Remove wear ring from suction cover or casing. This can best be accomplished on a lathe.
3. Inspect impeller (2) hub for damage.

NOTE

Suction cover (9) or casing (1) may be drilled for new setscrews (864) as many times as necessary, as long as it will support the wear ring and allow setscrews to be installed.

4. Press new wear ring (7) into suction cover (9) or casing (1). Beveled edge of wear ring (7) is installed toward impeller (2). Ensure that the new casing or suction cover wear ring is seated flat in the casing or suction cover.

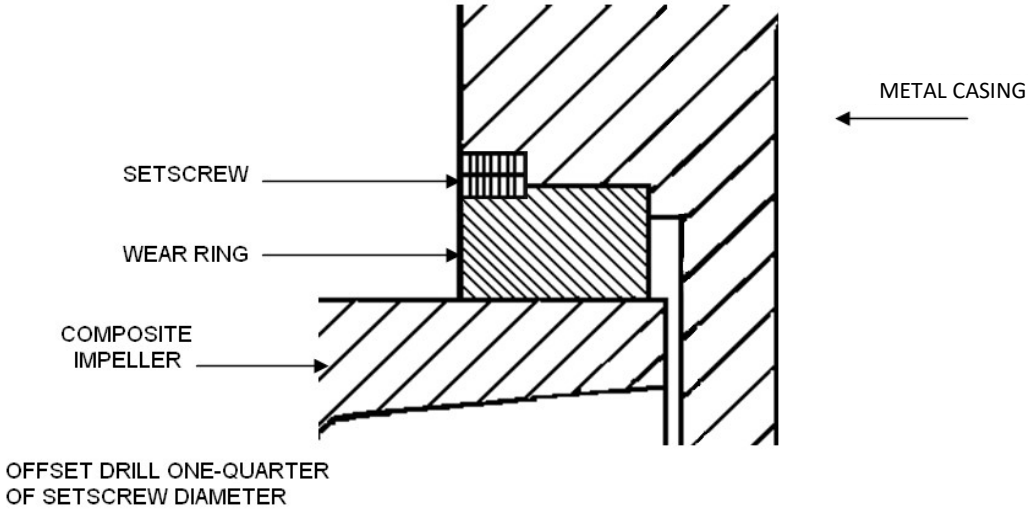

Figure 7. Proper Pinning of Pressed-In Wear Ring

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.

5. To secure casing or 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 casing wear ring. Insert setscrews (864) in holes.
6. Place impeller (2) on an arbor and mount between centers in a lathe or a grinder. Indicate back of impeller (2) hub to within 0.002 T.I.R. maximum to be sure arbor and impeller (2) are running square.
7. Turn wearing surface of impeller (2) until a 63 RMS or better finish is obtained.
8. Measure outside diameter of front impeller (2) hub and record the value.
9. Mount suction cover (9) or casing (1) with new wear ring (7) installed in a lathe. Indicate male rabbet to within 0.002 T.I.R. maximum.
10. Bore wear ring (7) to within specified tolerance (listed in Table 10) over recorded size of outside diameter of front impeller (2) hub.
11. Measure wear ring (7) ID and record.
12. Remove setscrews (864) from back cover/motor bracket wear ring (7X). Remove the back cover/motor bracket wear ring from the back cover/motor bracket. This can be best accomplished on a lathe. Take this work to a machine shop.

NOTE

Back cover/motor bracket (11 or 71) may be drilled for new setscrews (864) as many times as necessary, as long as it will support the wear ring and allow setscrews to be installed.

13. Carefully press new undersized back cover/motor bracket wear ring (7X) into back cover/motor bracket (11 or 71). The beveled edge of the back cover/motor bracket wear ring is installed towards the impeller (2). Ensure that the new back cover/motor bracket wear ring is seated flat in back cover/motor bracket.

NOTE

The drill center point for the composite part is offset radially one-quarter of the setscrew diameter into the metal casing 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.

14. To secure back cover/motor bracket wear ring (7X) drill and tap two holes, number 10-24 UNC x 3/8 inch deep 120 degrees apart, along edge of casing wear ring. Insert setscrews (864) in holes.
15. Measure back cover/motor bracket wear ring (7) ID and record.
16. 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.
17. Measure back impeller (2) wear ring wearing surface OD and record.
18. Mount the back cover/motor bracket (11 or 71) with new back cover/motor bracket 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.
19. Bore back cover/motor bracket 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.
20. Take the impeller (2), casing (1) or the suction cover (9) and the back cover (11) or motor bracket (71) with new wear rings (7 and 7X) installed back to the pumping unit and reassemble per your units reassembly procedures.
21. Reconnect suction and discharge piping. Connect auxiliary piping.
22. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manufacturers manual.
23. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

L. 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 8 if the abrasive separator is mounted on the discharge flange and Figure 9 if mounted on the suction flange.

Item Number	Description
82A	Cone Body
82B	Cone Cap
700B	O-ring
700G	O-ring
700H	O-ring
605C	Tubing
605D	Tubing
561C	Male Tube Connector
555	Union
833C	Jamnut

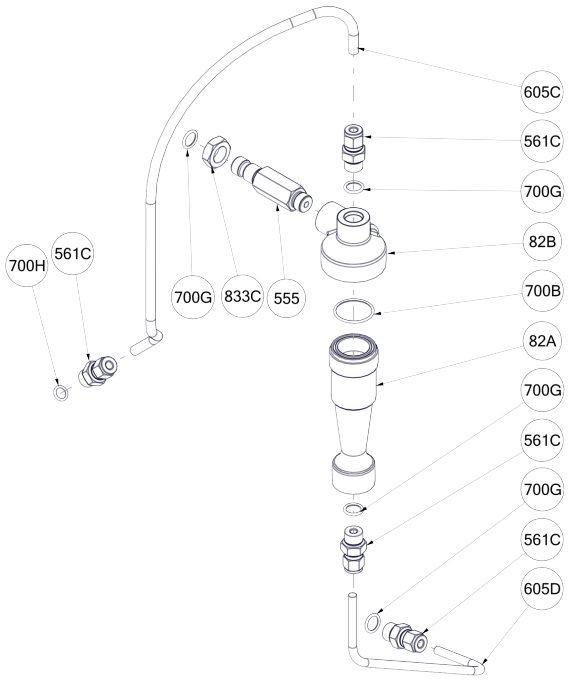

Figure 8. Discharge Mounted Abrasive Separator

L.1 Discharge 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. Remove abrasive separator assembly from casing (1) at union (555) by removing jamnut (833C) and O-ring (700G).
4. Disconnect male tube connectors (561C and 561D) nuts from tubing (605C and 605D). Remove tubing. Remove male tube connector bodies. Remove O-rings (700G and 700H) from male tube connector bodies.
5. Remove tubing (605C and 605D) from abrasive separator.
6. Remove the cone cap (82B) from the cone body (82) by unscrewing it. Remove O-ring (700B).
7. Remove O-ring (700G) from cone cap (82B).
8. Remove union (555) from cone cap (82B).
9. Check to make sure no foreign particles are clogging the cone body (82A). 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 (700B).
2. Install cone cap (82B) onto cone body (82A). Lubricate and install O-ring (700G).
3. Secure union (555) to cone cap (82B).
4. Lubricate and install new O-rings (700G) on male tube connector (561C) bodies. Install male tube connector bodies in the cone cap (82B) and cone body (82A).
5. Connect tubing (605C) on the cone cap (82B) and cone body (82A) by tightening the male

tube connectors (561C) nuts on the end of the tubing onto the tube connector bodies.

6. Connect tubing (605C) to cone cap (82A).
7. Lubricate and install new O-ring (700G) on jamnut (833C). Secure abrasive separator assembly to casing (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.
9. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

Item Number	Description
82A	Cone Body
82B	Cone Cap
700C	O-ring
700E	O-ring
700G	O-ring
605C	Tubing
561C	Male Tube Connector
555	Union
833C	Jamnut

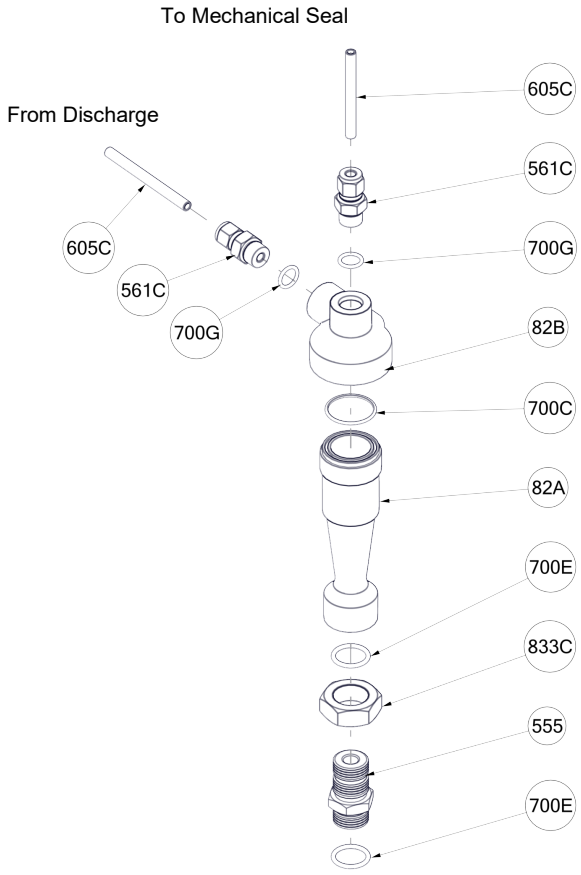

Figure 9. Suction Mounted Abrasive Separator

L.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 (561C) nuts from tubing (605C). Remove tubing. Remove male tube connector bodies from cone cap (82B). Remove O-rings (700G) from male tube connector bodies.
4. Loosen jamnut (833C). Remove abrasive separator assembly from casing (1) by removing the union (555) and O-rings (700E) from the casing.
5. Remove the cone cap (700B) from the cone body (82A) by unscrewing it. Remove O-ring (700C).
6. Remove union (555) from cone cap (82B).

7. Check to make sure no foreign particles are clogging the cone body (82A). 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 (700C).
2. Install cone cap (82B) onto cone body (82A).
3. Lubricate and install O-rings (700E) onto union (555). Confirm jamnut (833C) is on union (555).
4. Secure union (555) to cone cap (82B).
5. Lubricate and install new O-rings (700G) on male tube connector (561C) bodies. Install male tube connector bodies into the abrasive separator.
6. Secure abrasive separator assembly to casing (1). Confirm position of abrasive separator and tighten jam nut (833C).
7. Connect tubing (605C) to abrasive separator. Secure tubing with male tube connector (561C) nuts.
10. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor, refer to the motor manual.
11. Start pumping unit in accordance with Section IV, Paragraphs A, B, C, and D.

M. Replacement of Shaft Adapter. If pumping unit is equipped with a shaft adapter that was removed and needs to be replaced or a motor needs to be repaired or replaced, use the following steps:

Disassembly

1. Disassemble pumping unit per the pumping unit design disassembly instructions.
2. Loosen socket head cap screw on the shaft collar (68) and remove the shaft collar, refer to Figure 10.
3. Remove the shaft adapter (6) from the motor (200) shaft.
4. Remove half key (32B) from motor (200) shaft keyway.

Reassembly

1. Complete Section VII, Paragraph L, Parts Inspection before continuing with reassembly.
2. Clamp a dial indicator on the motor (200) shaft and take readings on the motor C-face rabbet and seating surface. TIR should not exceed 0.004 inch. If TIR exceeds this limit, repair or replace motor.
3. Place dial indicator on the unit and take reading at end of motor shaft on motor (200) shaft. TIR should not exceed 0.004 inch. If TIR exceeds this limit, repair or replace motor.

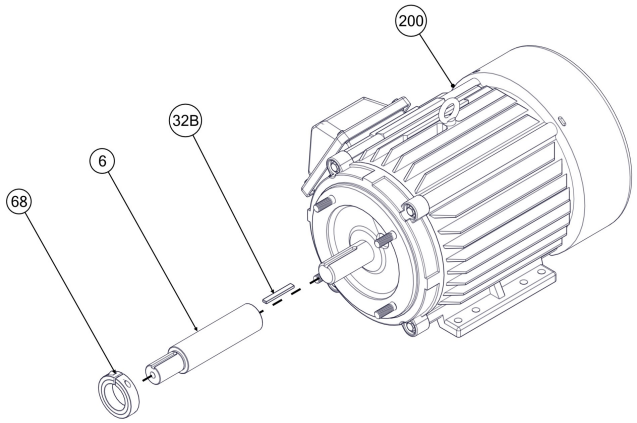

Figure 10. Shaft Adapter Exploded View

NOTE

Clean the OD of the motor shaft with solvent before installing shaft adapter

The tool used to assure proper spacing of the shaft adapter is a bar with two diameters, the OD of the motor shaft and the OD of the shaft adapter at the shaft. Special tool, part number can be found on the notes of the sectional assembly specific for your unit or Table 14.

4. Install special tool, shaft adapter locator, on motor (200) with flat side towards motor and large slot with recessed slot over motor shaft.
5. Install half key (32B) in motor shaft keyway, refer to Figure 10.
6. Install shaft adapter (6) on motor (200) shaft with slit in shaft adapter opposite from keyway of motor shaft.
7. Install shaft collar (68) onto shaft adapter (6) with shaft collar slot opposite of slot of shaft adapter and secure both the shaft adapter and

shaft collar by tightening the socket head cap screw of the shaft collar, refer to sectional assembly for torque value.

8. Place dial indicator on unit and take reading at impeller journal on shaft adapter (6). TIR should not exceed 0.004 inch. If TIR exceeds this limit, loosen shaft collar (68) and reposition shaft adapter (6). Repeat step until the TIR is within tolerance.
9. Remove special tool, shaft adapter locator, from motor (200).
10. To complete reassembly, return to your pumping units reassembly instructions.

N. MOTOR. The motor should be maintained in accordance with the manufacturer's instructions. Refer to the motor manufacturer's manual.

VIII. PARTS LISTS AND DRAWINGS.

This section contains Tables 11, 12 and 13 that note the recommended spare parts for these pumping units. Table 11 parts correspond to Figure 3, Table 12 parts correspond to Figures 4 and 5 and Table 13 parts correspond to Figure 6. Refer to the sectional assembly drawing specific to your unit and for the actual part numbers and recommended spare parts.

Table 11. Recommended Spare Parts List for Designs A and B Pumps

Item	Description	Item	Description
2	Impeller	73X	Gasket - Impeller Washer
7	Wear Ring	700A	O-ring – Suction and Back Cover/Casing
7X	Wear Ring	700B	O-ring – Abrasive Separator
14	Shaft Sleeve	700C	O-ring – Shaft Sleeve
24	Impeller Capscrew	700D	O-ring – Plugs and Tube Connector
28	Impeller Washer	700F	O-ring – Impeller Capscrew
32A	Impeller Key	700G	O-ring – Union, Tube Connector
63	Throttle Bushing	90	Mechanical Seal
73	Gasket - Sleeve	864	Setscrew – Wear Ring

Table 12. Recommended Spare Parts List for Designs C and D Pumps

Item	Description	Item	Description
2	Impeller	700A	O-ring – Back Cover/Casing
7	Wear Ring	700B	O-ring – Abrasive Separator
7X	Wear Ring	700D	O-ring – Shaft Sleeve
14	Shaft Sleeve	700E	O-ring – Seal Gland
24	Impeller Bolt	700F	O-ring – Drain Plug
28	Impeller Washer	700G	O-ring – Union, Tube Connector, Plug
32A	Impeller Key	700H	O-ring – Tube Connectors
63	Throttle Bushing	700J	O-ring – Impeller Washer
73	Gasket - Sleeve	90	Mechanical Seal
73X	Gasket - Impeller Washer	864	Setscrew – Wear Ring

Table 13. Recommended Spare Parts List for Pumps with Shaft Adapter

Item	Description	Item	Description
2	Impeller	90	Mechanical Seal
6	Shaft Adapter	700A	O-ring – Casing
7	Wear Ring	700B	O-ring – Drain Plug
24	Impeller Cap Screw	837A	Locknut – Motor Bracket/Back Cover
28	Impeller Washer	837B	Lock Nut – Motor Bracket
32A	Impeller Key	864	Setscrew – Wear Ring
32B	Half Key		

Table 14. Special Tool for Optional Shaft Adapter Installation

Shaft Adapter	Special Tool for Alignment
006-STUB-ETA-TSC-01-202	250-STUB-ETA-02
006-STUB-ETA-TC-01-202	250-STUB-ETA-01
006-STUB-365Z-TSC-01-205	250-STUB-364TSC-01
006-STUB-365TCZ-TC-01-202	250-STUB-365JP-01
006-STUB-365JP-TSC-01-202	250-STUB-365JP-01
006-STUB-365JP-TC-02-205	250-STUB-365JP-02
006-STUB-365JP-TC-01-202	250-STUB-365JP-02
006-STUB-286JP-TSC-01-205	250-STUB-284JP-01
006-STUB-256JP-TC-01-202	250-STUB-254JP-01
006-STUB-256JP-TC-01-205	250-STUB-254JP-01
006-STUB-215JP-TC-01-205	250-STUB-213JP-01
006-STUB-184JP-TC-01-202	250-STUB-184JP-01
006-STUB-145JP-TC-01-205	250-STUB-143JP-01

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