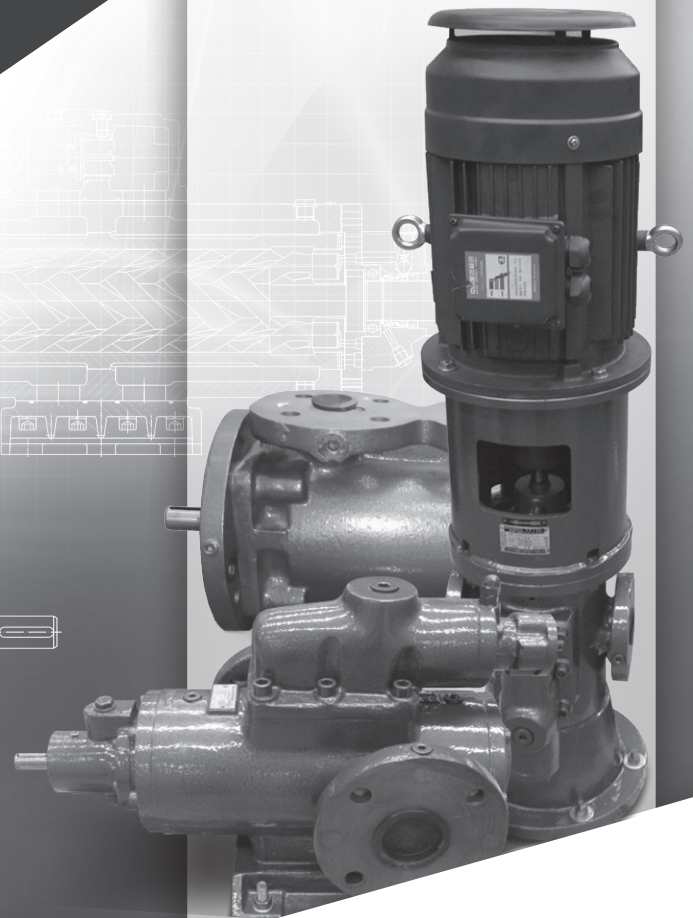


Blackmer®

IOM

Installation
Operation
Maintenance
Manual

S SERIES
Triple Screw Pumps



Where Innovation Flows


PSG®
a DOVER company

blackmer.com



TABLE OF CONTENTS

| | | |
|------------------|---|----|
| SECTION 1 | INTRODUCTION | 1 |
| | FOREWORD | 1 |
| | SAFETY PRECAUTIONS | 2 |
| SECTION 2 | PRODUCT SPECIFICATIONS | 3 |
| | 3N/3M/3PF MODELS | 3 |
| | PUMP IDENTIFICATION. | 3 |
| | STRUCTURAL DESIGN. | 4 |
| | PRESSURE LIMITING VALVE. | 4 |
| | PUMPING UNIT STRUCTURE. | 4 |
| SECTION 3 | RECEIVING, HANDLING AND STORAGE. | 5 |
| | LOADING AND UNLOADING | 5 |
| | STORAGE AND PRESERVATION | 5 |
| SECTION 4 | INSTALLATION | 6 |
| | LOCATION | 6 |
| | FOUNDATION | 6 |
| | PIPING SYSTEM | 8 |
| | PIPING SYSTEM ACCESSORIES | 8 |
| | COUPLING ALIGNMENT | 9 |
| | LUBRICATION | 9 |
| | FLUSHING THE PUMP. | 9 |
| SECTION 5 | OPERATION | 10 |
| | PUMP PREPARATIONS | 10 |
| | STARTING THE PUMP | 10 |
| | RUNNING THE PUMP | 10 |
| | STOPPING THE PUMP | 10 |
| SECTION 6 | TROUBLESHOOTING | 11 |
| SECTION 7 | ROUTINE AND PREVENTIVE MAINTENANCE | |
| | ROUTINE MAINTENANCE. | 12 |
| | INDIVIDUAL PART MAINTENANCE | 12 |
| SECTION 8 | DISASSEMBLY AND REASSEMBLY | 15 |
| | SAFETY PRECAUTIONS | 18 |
| SECTION 9 | 3N / 3M SERIES PUMPS GENERAL INFORMATION | 19 |
| | DISASSEMBLY | 20 |
| | REASSEMBLY. | 21 |
| | CROSS-SECTIONAL DIAGRAMS | |
| | 3NH PUMPS | 25 |
| | PARTS LISTS 3NH PUMPS | 26 |
| | CROSS-SECTIONAL DIAGRAMS | |
| | 3MH PUMPS | 33 |
| | PARTS LISTS 3MH PUMPS | 34 |

FOREWORD

This manual is intended to assist those who are involved with the installation, operation and maintenance of a Blackmer® S Series Triple Screw Pumps. Strictly follow the safety rules stipulated in this manual. These instructions must be thoroughly reviewed in their entirety and fully understood prior to the pump installation, operation or maintenance care. Special appropriate attention should be given to pump lubrication, heating, cooling and sealing during pump installation, operation and maintenance.

Local and/or company practices must be observed and followed at all times.

This manual covers the Blackmer S Series Triple Screw Pumps 3M, 3N and 3PF models.

This is a SAFETY ALERT SYMBOL.

When you see this symbol on the product, or in the manual, look for one of the following signal words and be alert to the potential for personal injury, death or major property damage.

DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE:
Indicates special instructions which are very important and must be followed.

NOTICE:

Blackmer Power Pumps **MUST** only be installed in systems, which have been designed by qualified engineering personnel. The system **MUST** conform to all applicable local and national regulations and safety standards.

This manual is intended to assist in the installation and operation of Blackmer Power pumps, and **MUST** be kept with the pump.

Pump service shall be performed by qualified technicians **ONLY**. Service shall conform to all applicable local and national regulations and safety standards.

Thoroughly review this manual, all instructions and hazard warnings, **BEFORE** performing any work on the pump.

Maintain **ALL** system and pump operation and hazard warning decals.

WARNING

Hazardous pressure can cause personal injury or property damage.

Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury, death or major property damage.

WARNING

Hazardous voltage. Can shock, burn or cause death.

Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death.

WARNING

Hazardous machinery can cause serious personal injury.

Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death.

WARNING

Do not operate without guard in place.

Operation without guards in place can cause serious personal injury, major property damage, or death.

WARNING

Hazardous or toxic fluids can cause serious injury.

If pumping hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance.

WARNING

Hazardous pressure can cause personal injury or property damage.

Failure to relieve system pressure prior to performing pump service or maintenance can cause serious personal injury or property damage.

CAUTION

Heavy assemblies can cause personal injury or property damage.

Always use a lifting device capable of supporting the full weight of the pump assemblies.

NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

SAFETY PRECAUTIONS

This manual contains basic references that are to be observed during pump transportation, installation, operation and maintenance, and, therefore, should be kept as part of the permanent pump records and readily accessible as a reference to any person working or maintaining the pumping unit.

The instructions within this manual must be thoroughly reviewed in their entirety and fully understood prior to pump installation, operation or maintenance care.

These pumps have been designed for safe and reliable operation when properly used and maintained in accordance with the instructions contained within this manual. A pump is a pressure-containing device with rotating parts that can be hazardous. Failure to read and comply with installation, operation and maintenance instructions will void the responsibility of the manufacturer and may result in bodily injury or equipment damage.

Markings and Instructions on Pump Unit

Instructional references regarding direction of rotation, fluid-flow orientation, safety warning, etc., are clearly marked on the pump. Please observe and follow all indicated safety markings and instructions.

Failure to observe safety references can result in the following:

- Equipment failure
- Maintenance and service policies voided
- Environmental pollution due to hazardous substance leakage
- Personal endangerment as a result of electrical, mechanical and chemical influences

Qualified Personnel and Training

All persons installing, operating, maintaining and inspecting the pumping unit must have the required qualifications for work to be performed. All instructions and safety markings must be observed, understood and adhered to by all personnel working on or around the pumping unit. If installation or operational knowledge is inadequate, training must be provided. The scope of the personal responsibilities, competency and supervisory duties must be closely controlled by the purchaser of the pumping unit.

Safety Guidelines

All work performed on or around the pumping unit must be completed by qualified personnel.

- Machine components that are either hot or cold must be protected on-site to prevent personal endangerment.
- The pump must be stopped and power locked out before performing any maintenance.
- Safety markings on the pumping unit must not be removed.
- Leakage of hazardous media (i.e., toxic, flammable, explosive, etc.) must be collected in a way that no damage to personnel or environment occurs.
- If the pumped media is explosive, toxic or flammable, a warning or alarm device must be installed, pump housing must be well ventilated and the operating site must be a no smoke/fire zone.
- To prevent damage due to electricity, all electrical devices must be safely protected, functional and controlled.

Pump Must Meet Specified Operating Parameters

Unless there is written permission by Blackmer, the pump must not be operated at higher parameters than specified. Adhering to these specifications is meant to prevent danger to persons and damage to equipment.

Pump Monitoring

Suitable measuring devices must be installed to inspect and control the pump during operation. Generally, pressure gauges are to be installed on suction and discharge lines near the pump.

NOTE: A pressure relief valve (external bypass valve) must be installed in the discharge pipe of the pump.

The S Series Triple Screw Pump manufactured by Blackmer is a type of positive displacement rotatory screw pump for handling clear, lubricating liquid without solid content. The internal structure of the Triple Screw Pump includes a male drive screw with double-end screws, two female double-end secondary screws and the case that holds the three screws. The sealed chamber moving at a uniform speed is formed between the case and the three rotating screws along the axial direction. During the male drive screw rotation, liquid moves in the sealed chamber along the axial direction continuously and smoothly from suction to discharge.

3N/3M /3PF MODELS

The axial force applied on the drive screw surface of the 3N/3M /3PF pump models is balanced by the balance piston so that the rolling bearing takes a small residue axial force and thus extends the life of the bearing. The balance of the secondary screws is achieved by the balance sleeve. For the 3PF series, the axial force applied on the drive screw is balanced by the balanced piston; meanwhile, the secondary screw is driven by hydraulic force. The surface of the screws transmit the torque generated by hydraulic friction so that there is no wearing on the screw surfaces. The axial force of the secondary screw is applied to the end cover.

The liquid suction of the pump is specially designed to ensure consistent liquid flow rate at uniform speed and lower resistance losses. The pump has a relatively low NPSHr value and, therefore, has a strong suction capability. The suction and discharge of the pump are located at the sides of the pump body or top of the body. This ensures that when the pump stops, enough media is kept in the pump body for strong self-prime capability.

PUMP IDENTIFICATION

A pump identification tag, containing the pump serial number, I.D. number, and model designation, is attached to each pump. It is recommended that the data from this tag be recorded and filed for future reference. If replacement parts are needed, or if information pertaining to the pump is required, this data must be furnished to a Blackmer representative.

TECHNICAL DATA*

| | 3N | 3M | 3PF |
|-------------------------------|---------------------|-----------------------|---------------------|
| Maximum Pump Speed | 3600 rpm | 3600 rpm | 3600 rpm |
| Maximum Operating Temperature | 248°F (120°C) | 248°F (120°C) | 248°F (120°C) |
| Maximum Differential Pressure | 580 psi (40 bar) | 1450 psi (100 bar) | 580 psi (40 bar) |

INITIAL PUMP START-UP INFORMATION

Model No. _____
 Serial No. _____
 ID No. _____
 Date of Installation: _____
 Inlet Gauge Reading: _____
 Discharge Gauge Reading: _____
 Flow Rate: _____

* Technical Data is for standard materials of construction.
 Consult Blackmer Material Specs for optional materials of construction.

STRUCTURAL DESIGN

BEARING AND LUBRICATION

The 3N, 3M and 3PF pump models use the deep groove ball bearing. Internal or external bearings can be used based on working conditions.

As shown in Figure 2.1, when an internal bearing is used, the bearing is lubricated by the media. When an external bearing is used, the bearing is lubricated by lubricating grease.

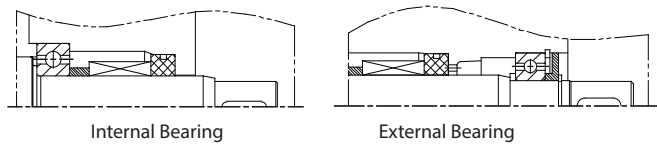


Figure 2.1 – Bearing Locations

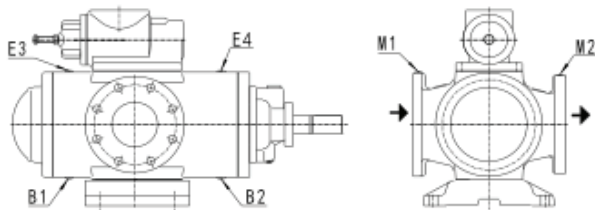
SHAFT SEAL

Triple Screw Pumps use a single mechanical seal, as shown in Figure 2.2.



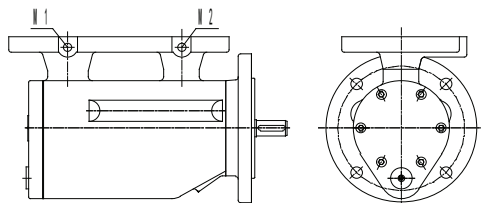
Figure 2.2 – Single Mechanical Seal

CONNECTIONS



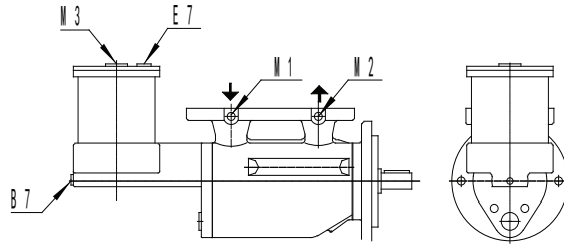
| | | |
|-------|---|-----------------------|
| B1/B2 | ▶ | Drainage Connection |
| E3/E4 | ▶ | Vent Connection |
| M1/M2 | ▶ | Instrument Connection |

Figure 2.3 – 3N/3M Models



| | | |
|--------|---|-----------------------|
| M1/M2: | ▶ | Instrument Connection |
|--------|---|-----------------------|

Figure 2.4 – 3PF, without filter



| | | |
|----------|---|-----------------------|
| B7 | ▶ | Drainage Connection |
| E7 | ▶ | Vent Connection |
| M1/M2/M3 | ▶ | Instrument Connection |

Figure 2.5 – 3PF, with filter

PRESSURE LIMITING VALVE

Blackmer positive displacement pumps are equipped with a pressure limiting valve to prevent excess pressure build up. The starting pressure of the pressure limiting valve is typically 10% higher than the rated working pressure of the pump. If the discharge pipe is restricted or shut-off, the pressure of the pump will build rapidly and the pressure limiting valve will open. If the discharge pipe is restricted for a long period of time the temperature of the media will rise, possibly damaging the pump.

When operating the pump, all valves in the discharge pipe must be open. The pressure limiting valve on the pump cannot be used to control the flow or pressure.

NOTICE: The pump pressure-limiting valve is designed to protect the pump from excessive pressure and must not be used as a system pressure control valve.

FILTER

3PF model is equipped with an integrated filter with a 60-mesh screen to avoid the large solids entering the pump.

A vacuum/pressure meter is installed on the filter to indicate the pressure drop. When pressure loss occurs on the filter, the user is reminded to clean the filter to avoid clogging of the system.

PUMP UNIT STRUCTURE

DRIVE

The pump can be connected to various motor or other drivers via coupling.

Please refer to the data sheet of the contract for the specific motor parameters.

SHAFT CONNECTION

The power is transmitted via elastic coupling. No radial force is applied on the drive screw.

A safety protection device must be installed on the coupling of the pump unit to avoid accidents.

BASE-PLATE

Mechanical support must be designed for the base-plate in order to limit the error of coupling flanges alignment to less than 50 μm (0.002 inch) under the worst pressure, torque and allowed piping stress applied simultaneously.

RECEIVING

Place equipment in a controlled environment upon receipt.

Ordinary packing crates for the pump are not suitable to withstand outdoor storage conditions beyond a 30-day limit from date of delivery, not withstanding favorable/unfavorable outdoor conditions. Improper storage can damage the equipment, thus voiding product warranty.

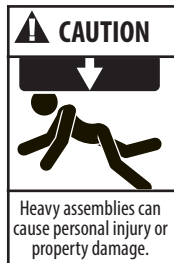
Special long-term storage packing can be supplied by Blackmer upon request.

It is at the client's discretion to observe and relate the packing and storage requirements in the Technological Agreement with Blackmer.

Parts and quality checkpoint.

Upon receipt of shipment, carefully check the pump, driver, spare parts, accessories and documentation in accordance with the supplied Packing List to ensure no components are missing or damaged. The identity of any missing or damaged components must be communicated to the carrier and Blackmer. Damage claims should be made at the time of the receipt and check.

LOADING AND UNLOADING



1. For transportation purposes, use suitable lifting tools and attach lifting hooks to places marked on packing. Strictly observe applicable safety regulations for lifting heavy loads.

NOTE: Do not lift pump by bearing housing.

2. When lifting the pump, attach lifting hooks to outlet flanges as seen in Figure 3.1.
3. When lifting the pumping unit (motor included), chain should be attached to the hook of the base-plate. Make sure that no pipes or attached auxiliaries are damaged. See Figure 3.2 for reference.

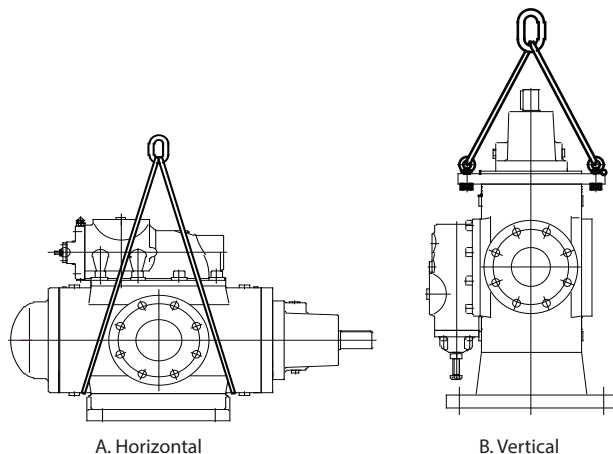


Figure 3.1 – Lifting the Pump Head

STORAGE AND PRESERVATION

Pump units are affixed to the skids on the inside of the packing crates in order to help prevent damage from standard loading and unloading. All pump openings are covered with blank flanges or special protective caps to keep pump cavity clean and free of debris.

If pump is not to be installed or operated immediately, or if pump is to be installed, but not operated immediately, the pump units must be preserved as indicated below:

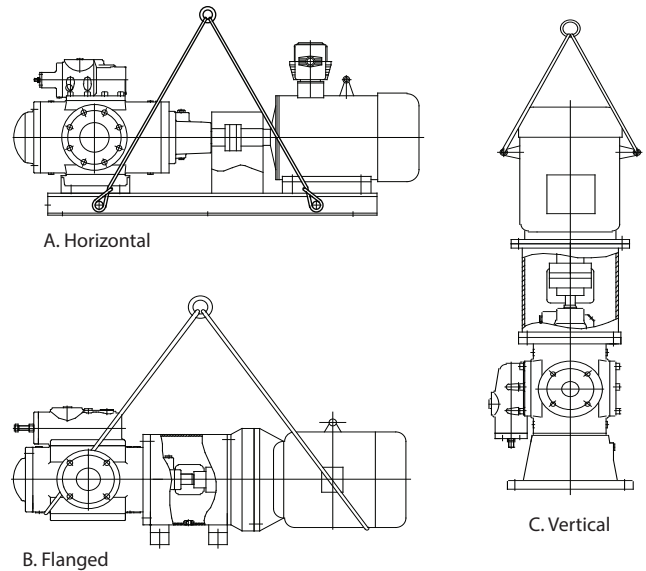


Figure 3.2 - Lifting the Pumping Unit

1. Store in a clean and dry location.
2. Apply acid and resin-free grease to all internal parts of the pump.
3. Ensure blank flanges or special protective caps covering pump openings are properly attached.
4. Coat preservatives on all exposed shaft elements and places that are not protected by paint.
5. Cover the pump and driver with plastic or waterproof canvas.

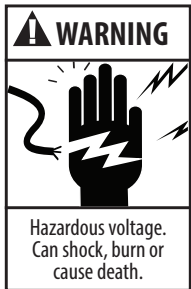
The following installation instructions are to assist in the proper pump installation. Trouble-free operation of a pump begins with proper installation practices and will also extend the life of your pump. Should any questions arise during the installation process, please contact the Blackmer Service Department for assistance.

The installation method of the pump depends on the model, specification, motor and on-site conditions.

- For horizontal pump installation, the B3 type motor is usually installed on the general base-plate.
- The flanged pump must be supported with brackets and foot for horizontal or vertical installation.
- The vertical-foot pump takes less space, and it can be installed on the concrete foundation or base-plate brackets.
- Please refer to installation drawings for installation type and dimensional requirements.

NOTICE:

Blackmer power pumps must only be installed in systems designed by qualified engineering personnel. System design must conform with all applicable regulations and codes and provide warning of all system hazards.



- ⚠ Install, ground and wire to local and National Electrical Code requirements.
- ⚠ Install an all-leg disconnect switch near the unit motor.
- ⚠ Disconnect and lockout electrical power before installation or service.
- ⚠ Electrical supply **MUST** match motor nameplate specifications.

⚠ Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.

PRE-INSTALLATION CLEANING NOTICE:

New pumps contain residual test fluid and rust inhibitor. If necessary, flush pump prior to use. Foreign matter entering the pump **WILL** cause extensive damage. The supply tank and intake piping **MUST** be cleaned and flushed prior to pump installation and operation.

LOCATION

The pump has been built to meet the requirements of a specific pump capacity at a specific pressure. To meet these requirements, consideration must be taken regarding the suction and discharge side of the pump during installation. This information must be provided to Blackmer engineers by the purchaser and specified according to the pre-planned location of the pump installation site. If, after receipt, the location of the pump is changed and these pre-planned conditions are altered, please consult Blackmer engineers immediately to ensure safe operation of the pump.

An appropriate amount of space must be kept for laying the pump foundation. This is a critical pre-condition for pump assembly and disassembly, installation, operation and maintenance.

It is suggested to locate the pump as close as possible to the source of the media supply. Ideally, the pump location should be clean and dry with enough space to perform the installation, maintenance and preservation.

NOTE: If it is necessary to install the pump in a pit or cavity, measurements must be taken and considered in an effort to prevent flooding or any other unforeseen challenge to the installation, maintenance or preservation of the pump.

FOUNDATION

Ground foundation should be suitable to absorb vibration and provide rigid support for the entire pump unit. Generally, reinforced concrete is used as a foundation material; however, a steel structure foundation is also acceptable.

FOR STEEL-STRUCTURE FOUNDATIONS

The design of the steel foundation must connect (bear) the complete surface of the foundation and can be connected to the base-plate via bolts or welding.

NOTE: If the base-plate is only supported at four (4) points, the middle part of the pump unit may sink, thus affecting the alignment of the coupling and severe noise may occur.

FOR CONCRETE FOUNDATIONS

The concrete foundation must be level with a smooth surface and able to bear the weight of the complete pump unit.

NOTE: The specification of the concrete foundation must meet the B25 standard.

GROUTING

Proper measures must be taken to locate and hold the anchor (foundation) bolts in the correct place while directly pouring the concrete. The pipe sleeve's inside diameter should be approximately three to four times that of the outside diameter of the anchor bolt.

1. After grouting, secure the pipe sleeves and adjust the anchor bolt slightly to mate with the bolt holes on the base-plate (see Figure 4.1).

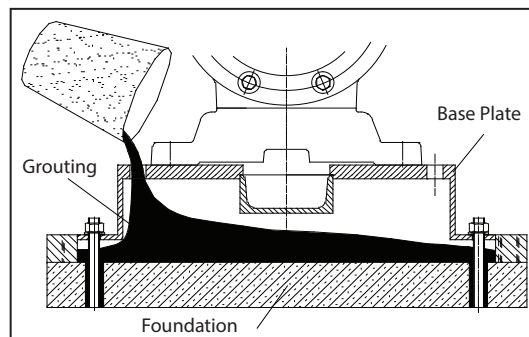


Figure 4.1 – Grouting

2. Pour the liquid cement and sand to fill the space underneath the base-plate. Mix the liquid through the pouring-hole on the base-plate to remove any air in the liquid. Two methods are commonly used to secure and prevent bolts from turning:

Option A: Weld a lug to the anchor bolt head to prevent bolt turning (see Figure 4.2)

Option B: The bolt may be a rod construction bent at 90 degrees below the pipe sleeve. Pack the space between the anchor bolt and the sleeve to prevent concrete or grout from entering this area. Anchor (foundation) bolts must be long enough to allow 20 mm to 40 mm (0.79 inches to 1.58 inches) of space for grouting under the base-plate. When pump is level, the bolts should extend 6 mm to 10 mm (0.24 inches to 0.4 inches) through the screw nuts.

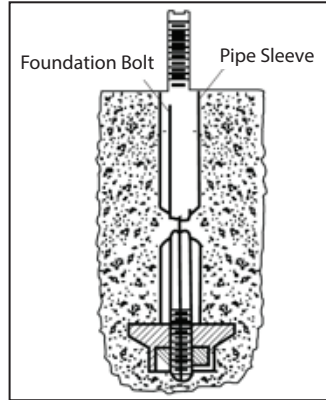


Figure 4.2 – Anchor (Foundation) Bolt

NOTE: If the pump unit needs to be installed on a steel deck plate or another structure, directly install the pump on the surface or install as close as possible to the main structural parts, roof beams or main walls. Support is needed to maintain the concentricity of the pump and motor and to prevent damage caused by structures or base-plates being out of shape.

PUMP ALIGNMENT ON FOUNDATION

1. The foundation must be made rough and cleaned before lifting the pump and motor onto the foundation.
2. A wedge must be placed close to anchor bolts, then remove the stuffing in the sleeve and clean the base-plate.
3. The complete unit must be carefully placed on the wedge so that the bolt holes pass through the anchor bolts.
4. Adjust the wedge so that the bottom of the base-plate is 20 mm to 40 mm (0.79 inches to 1.58 inches) higher than the foundation for grouting.
5. Check the alignment of the pump and motor. Align and calibrate the unit with a level if needed (see Figure 4.3).

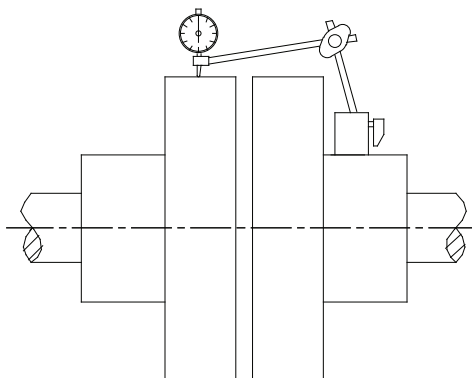


Figure 4.3 – Alignment and Calibration of Pumping Unit

6. Now, the nuts may be put onto the bolts and hand tightened.
7. Steel pieces are suggested to be placed in the middle of the base-plate if the distance between the anchor bolt holes must be greater than 750 mm (29.5 in).

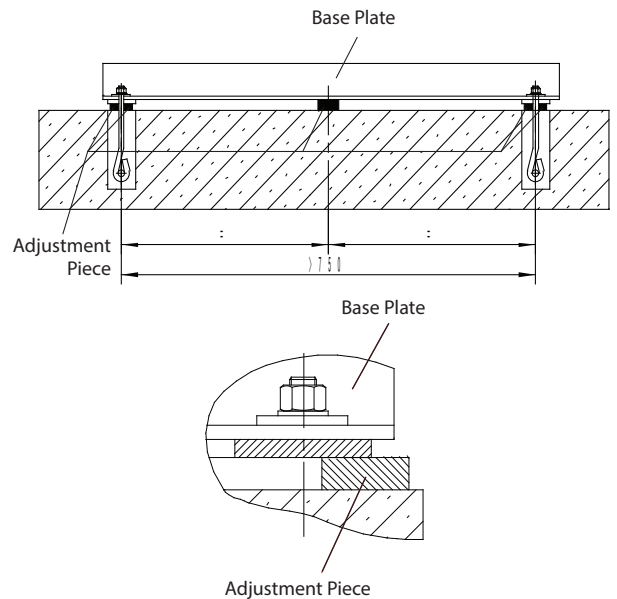


Figure 4.4 – Adjustment

8. Templates must be placed around the foundation for grouting (refer to Figure 5.1). The mixture used for grouting includes one (1) share of cement and two (2) shares of sand.
9. Add water to the mixture to make a thick sludge that can flow freely. The rough surface of the top must be wetted with an adequate amount of water.
10. Then pour the sludge through the grouting hole on the base-plate. The mixture must be stirred with a iron bar to release the air trapped in it.
11. When the sludge is fully cured, remove the templates. The sludge usually cures in 72 hours after grouting.
12. Now tighten the anchor bolts and re-check the alignment of the coupling.

NOTE: When tightening the nut on the anchor bolts to secure the base-plate on the foundation, no additional forces may be applied to the base-plate as this may cause deformation.

PIPING SYSTEM

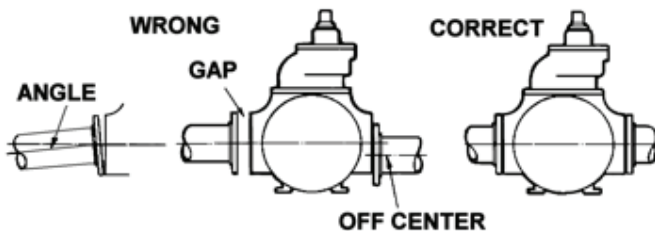
Since the pump's basic operating parts are designed to be affixed on screws, extremely close running clearances exist between the screws and the body; therefore, it is very important to have the piping (especially the suction-side piping) cleaned thoroughly before connecting the piping to the pump flanges.

After the pump unit has been installed and secured on its foundation, pipe connections may be installed.

NOTE: Please see pump outline drawing for location of all pipe connections, flange sizes and other notes pertinent to piping. Pipes should be as short and direct as possible. Use long radius elbows to change direction when needed.

Suction piping must be at least the same size of the inlet diameter; it is acceptable if the suction pipes are one class larger than the inlet. For example, if the size of the inlet is 150 mm (6 in), the suction pipes could be 200 mm (8 in). The pipe diameter (length of pipe should be four [4x] times that of the pipe's diameter) is used to connect the suction pipes and the inlet. Discharge piping should be the same size as the diameter of the outlet.

All major piping parts, including suction pipes, discharge pipes, valves and strainers, should be supported independently and installed properly to avoid any unnecessary strain on the pump. The piping flanges must be properly aligned with the pump flanges. To check alignment, insert flange bolts through the pipe and pump flange. If the bolts are easily moved within the bolt holes and if the flange faces are parallel with each other, the piping is properly aligned.



All the valves and filters on the suction pipes and discharge pipes shall be supported independently and secured to avoid transmitting the stress to the pump body. The flange of the pipes shall be straightly facing the flanges on the pump. Check the alignment between the pipes and ports by looking at the through holes on the pipe flanges and port flanges. If the bolts can move freely through the holes and the flanges are parallel to each other, then it is deemed that the pipes are aligned.

If the pump is required to operate with suction lift, the suction piping system must be properly made in relation to the original design.

NOTE: NPSHa of suction piping must be larger than pump's NPSHr. The pump cannot be expected to overcome deficiencies in the suction piping system, such as narrow/thin runs of suction piping, numerous elbows, valves and excessively high points above pipe suction, etc. In such cases, cavitation will invariably occur and the pump may not operate at normal capacity.

Pump and pump accessories should be kept apart by valves to avoid any force while pressure testing or washing the piping system.

PIPING SYSTEM ACCESSORIES

SUCTION STRAINERS

Blackmer suggests that suction strainers be installed on the suction side of the pump at least temporarily until the new system is deemed clean of solid residue. The screen area of the strainer should be as large as possible. Generally, the strainer screen should be constructed of 40 meshes, and 10 or 20 meshes for high-viscosity applications. The net screen area should be approximately five (5) to eight (8) times the flow cross-sectional area of the suction pipe. However, if the viscosity of the media is in excess of 200 mm²/s, then approximately 10 to 20 times the pipe cross-sectional area is suggested for the net screen area. The maximum differential pressure is 0.1 bar (1.5 psig). Install pressure gauges on either side of the strainer to indicate when the strainer should be cleaned. The installed strainer should be easy to maintain and clean.

Generally, strainers can be used on all liquids except for those of an extremely high viscosity. In these cases, the strainer cannot be installed; therefore, piping and accessory cleaning is mandatory.

CHECK VALVE

If the discharge piping system is subject to a high static head and if the fluid handled flows back into the pump cavity when stopping the pump, a check valve should be installed. This valve will prevent hydraulic shock acting upon the pump, and, most importantly, it allows for separately starting the pump in a parallel connection system.

PRESSURE RELIEF VALVE

An external pressure relief valve must be installed between the pump discharge flange and the gate valve (on the discharge pipe after the discharge port) to protect the pump and the piping system. The pressure and flow rating should match the working pressure and flow of the pump, and media through the valve must return to the suction source.

NOTICE: The pump internal pressure-limiting valve is designed to protect the pump from excessive pressure and must not be used as a system pressure control valve.

GAUGES

Proper gauges must be installed to monitor and control the pump while in operation. A pressure gauge and a vacuum gauge can be separately installed on the inlet and outlet piping near the pump.

COUPLING ALIGNMENT

Coupling angle deviation, radial deviation and axial clearance should be kept at a minimum in order to prevent noises and vibration and to reduce wear and tear on bearings and couplings.

NOTE: Coupling axial clearance, per specifications, should be within 2 mm to 5 mm (0.08 inch to 0.2 inch). If using special coupling, please consult with the manufacturer’s specifications and requirements.

If the coupling is misaligned, it will greatly reduce the lifespan of the coupling, bearing and seal of the pump. Therefore, the coupling alignment must be carefully checked and calibrated.

The Blackmer pump aggregate (including driver, base-plate and other accessories) has been aligned (coupling) prior to delivery. However, stresses caused by lifting, transporting and pipe connecting can cause minor distortions that will disturb the alignment. Therefore, realignment should be done while installing the pump.

Check coupling alignment after the base-plate has been leveled prior to grouting. After suction and discharge piping is connected, make a final pre-startup coupling alignment check. If the product to be pumped is high in temperature, then, during the first operation, a hot coupling alignment should be made once the pump has reached its operating temperature.

FLUSHING THE PUMP

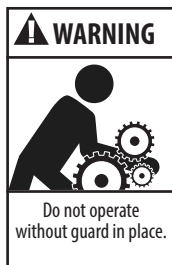
NOTICE: If flushing fluid is to be left in the pump for an extended time, it must be a lubricating, non-corrosive fluid. If a corrosive or non-lubricating fluid is used, it must be flushed from the pump immediately.

1. To flush the pump, run the pump with the discharge valve open and the intake valve closed. Bleed air into the pump through the intake gauge plug hole or through a larger auxiliary fitting in the intake piping. Pump air for 30 second intervals to clean out most of the pumpage.
2. Run a system compatible flushing fluid through the pump for one minute to clear out the remainder of the original pumpage.
3. To remove the flushing fluid, follow step 1 above.

NOTICE: After flushing the pump some residual fluid will remain in the pump and piping.

NOTICE: Properly dispose of all waste fluids in accordance with the appropriate codes and regulations.

NOTICE: The pump pressure-limiting valve is designed to protect the pump from excessive pressure and must not be used as a system pressure control valve.



Operation without guards in place can cause serious personal injury, major property damage, or death.

LUBRICATION

Since the internal bearing is lubricated by the media being pumped, there is no need to lubricate the bearing separately.

The external bearing is lubricated by grease, which can be injected into the bearing with an oil gun (see Figure 5).

Lithium-based grease (such as ZL-3) is ideally used at -20°C to 120°C (-34°F to 248°F). The lubricating interval is 2,000 hours under normal working conditions.

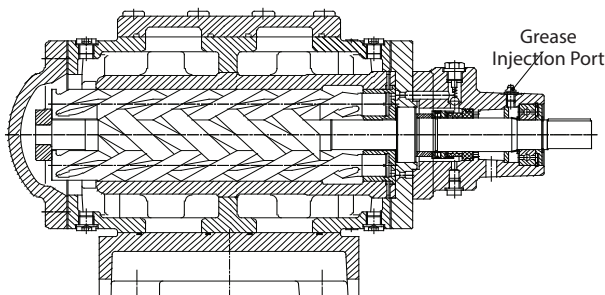


Figure 5 – Grease Injection Port

PUMP PREPARATIONS

The final pre-startup check is very important to avoid operational difficulties. Listed below are several key components to be checked prior to pump operation.

1. Inspect all piping. Check individual piping support; check for leaks and unnecessary piping strain on the pump; flush all piping to ensure removal of foreign material from the system; check that all valves and gauges are functional; check mesh-size suitability.
2. Ensure pump cavity is filled with pumping media.
3. Check pressure gauges and all other meters.
4. Check all electrical equipment (i.e., cables, control lines and accessories).
5. Ensure all valves on the suction and discharge lines are open.
6. Check rotation shafts by rotating the coupling by hand to determine whether the pump shafts and motor shafts turn freely and rotate smoothly at a uniform speed. If any rubbing or binding occurs, the cause must be located and corrected before starting the pump.
7. Check that the motor rotation is correct; refer to the rotation directional mark located on the pump.

STARTING THE PUMP

1. Open the suction and discharge valves wide in order to keep the entire piping system unobscured.

NOTE: Ensure that all valves and devices on the suction and discharge sides are opened before starting the pump.

2. Rotate the coupling by hand to determine if rubbing or binding occurs.
3. Start motor/driver.
4. The pump must be stopped if there is no capacity after starting. Restart the pump after several minutes. If there is still no capacity, the cause must be determined. Please refer to the Troubleshooting section of this manual for further instruction.

RUNNING THE PUMP

1. Check the pumping unit for unusual noise or vibration. Any unusual vibration or change in sound must be investigated and corrected to normal operating conditions.
2. Check bearing housing temperature. Bearing temperature can safely rise to between 65°C and 75°C (149°F and 167°F). Pumped medium or spot environmental temperature should be considered when determining whether temperature exceeds normal operating conditions.

Bearing temperature up to 90°C (194°F) is considered to be normal. Within this limit, the stability of the temperature is the best indicator of normal operation. A sudden increase in temperature indicates that a bearing problem is developing and the bearing should be checked immediately.

CAUTION: Do not attempt to measure the temperature by hand!

STOPPING THE PUMP

1. Remove power to the motor to stop the pump.
2. Close the gate valves on the suction and discharge pipes.

NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

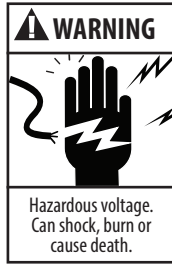
Possible pump failures and root causes are listed below. If your pump failure is not included in the list below, or the root cause cannot be identified, please consult the factory or sales office.

The pressure must be released and the pump must be drained for troubleshooting.

| NO MEDIA FLOW | BELOW CAPACITY | INCONSISTENT FLOW | INCREASE IN NOISE OR VIBRATIONS | EXCESSIVE TEMPERATURE/OVERHEATING | SHAFT DOES NOT TURN | MOTOR OVERLOAD | TROUBLESHOOTING |
|---------------|----------------|-------------------|---------------------------------|-----------------------------------|---------------------|----------------|---|
| • | | | | | • | | The pump was not filled before initial startup. • Fill the pump with the pumping media. |
| • | | | | | | | The orientation of the motor is not right. • Adjust the orientation of the motor. |
| | • | • | • | | | | Leakage in suction pipe or shaft seal. • Tighten the flanges connection bolts; check the shaft seal. |
| | • | • | • | | | | Air in the piping system. • Open the vent on the piping system to remove the air. |
| | | | • | | | • | The actual viscosity of the media is different from the viscosity capability of the pump model selection. • Double-check the viscosity of the media being pumped. |
| | • | • | | • | | | Pressure valve leaks. • Check the valve seat or replace the spool. |
| | • | | • | | | | High vacuum at the suction. • Reduce the suction height or increase the pipe size at the suction. |
| | • | | | | | | Motor speed is too low. • Double-check the voltage and frequency against the nameplates on the motor. |
| | • | | | | • | • | Discharge pressure is too high. • Adjust the set point of the pressure valve • Reduce the discharge pressure. |
| | | | | | • | | Foreign matter or impurities in the pump • Disassemble the pump, remove the foreign matter, grind the damaged spot; check the suction filter and strainer. |
| | | | | | • | | Ball bearing is damaged. • Replace the ball bearing. |
| | | | • | • | • | | Fatigue of the spring in the pressure valve. • Replace the spring. |
| | • | • | | | | • | Spool is locked. • Repair or replace the spool. |
| • | | | | | • | | The screws are locked, or the screw is jammed with the balance sleeve. • Repair or replace. |
| | • | | | • | • | | The media being pumped losses lubricity at high temperature. |
| | | | | | • | | Reflex hole is blocked. • Open up the hole with special tool. |
| | • | • | • | • | | | Pressure valve is opened. • Reset the opening pressure of the pressure valve; it should be 10% higher than the working pressure. |
| | | | • | | | | Coupling misalignment. • Adjust the alignment of the coupling per Section 4.3. |



Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury, death or major property damage.



Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death.



Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death.



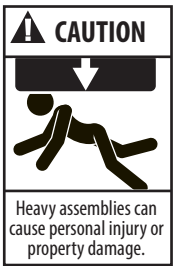
Operation without guards in place can cause serious personal injury, major property damage, or death.



If pumping hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance.



Failure to relieve system pressure prior to performing pump service or maintenance can cause serious personal injury or property damage.



Always use a lifting device capable of supporting the full weight of the pump assemblies.

NOTICE:
Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

Routine checks and maintenance will extend the lifespan of the pump and motor.

ROUTINE MAINTENANCE

- Ensure that the pump is never running dry
- Ensure that the motor is not overloaded
- Check for leakage on the suction and discharge pipes as this would prevent air from entering the piping
- Check for mechanical seal leakage
- Monitor the reading on the thermometer and pressure gauges
- **GROUND RESISTANCE TESTING:** Check the groundings of the motor case and pump base-plate; the grounding resistance must be equal to or less than 1Ω. Ground resistance testing is to be performed every three months.

INDIVIDUAL PART MAINTENANCE

BEARING AND LUBRICATION

The sliding bearing is lubricated by the pumped media; no maintenance is required. The lifespan of the sliding bearing is designed based on the lifespan of the pump under average working conditions; however, the lifespan may decrease depending on the amount of foreign materials contained in the media being pumped.

The internal deep-groove ball bearing is also lubricated by the media being pumped.

However, the external deep-groove ball bearing is lubricated by grease injected from the grease injection port, which is added on a regular basis. The bearing without the grease injection port does not require maintenance. Under normal working conditions, the designed lifespan of the deep groove ball bearing is 25,000 hours.

The actual lifespan of the bearing may be shorter than the designed lifespan due to non-continuous operation, high temperature, low viscosity media or media with poor lubricity. Therefore, it is suggested to check the noise and temperature at the bearing regularly. Abnormal noise or obvious temperature rise indicates the bearing is damaged. If this is the case, the bearing must be checked or replaced as soon as possible.

MECHANICAL SEAL

The leakage of non-volatile media due to commissioning is allowed. However, if serious leakage occurs, the mechanical seal must be replaced. Other types of seals do not require maintenance.

NOTE: Dry running of the pump may damage the mechanical seal; therefore, ensure the pump is filled with liquid and the air is removed from the pump prior to startup.

FILTER

The filter must be cleaned regularly to ensure that the pressure drop between suction and discharge of the filter is less than 0.01 MPa (1.45 psig).

Toxic or hazardous and/or polluting media must be drained and collected using the appropriate safety measures.

The strainer of the filter should be cleaned in a bath of detergent. Toxic detergents should only be used under the conditions meeting the safety requirements.

NOTE: The strainer must be soaked in a detergent solution; otherwise, the dirt will pollute the filter that is being cleaned.

After cleaning, the detergent must be completely removed from the filter and the filter dried with compress air.

The concentration of the detergent solution depends on the nature and stickiness of the dirt.

A soft brush may also be used to clean the strainer. However, it is suggested to replace the strainer if it is blocked.

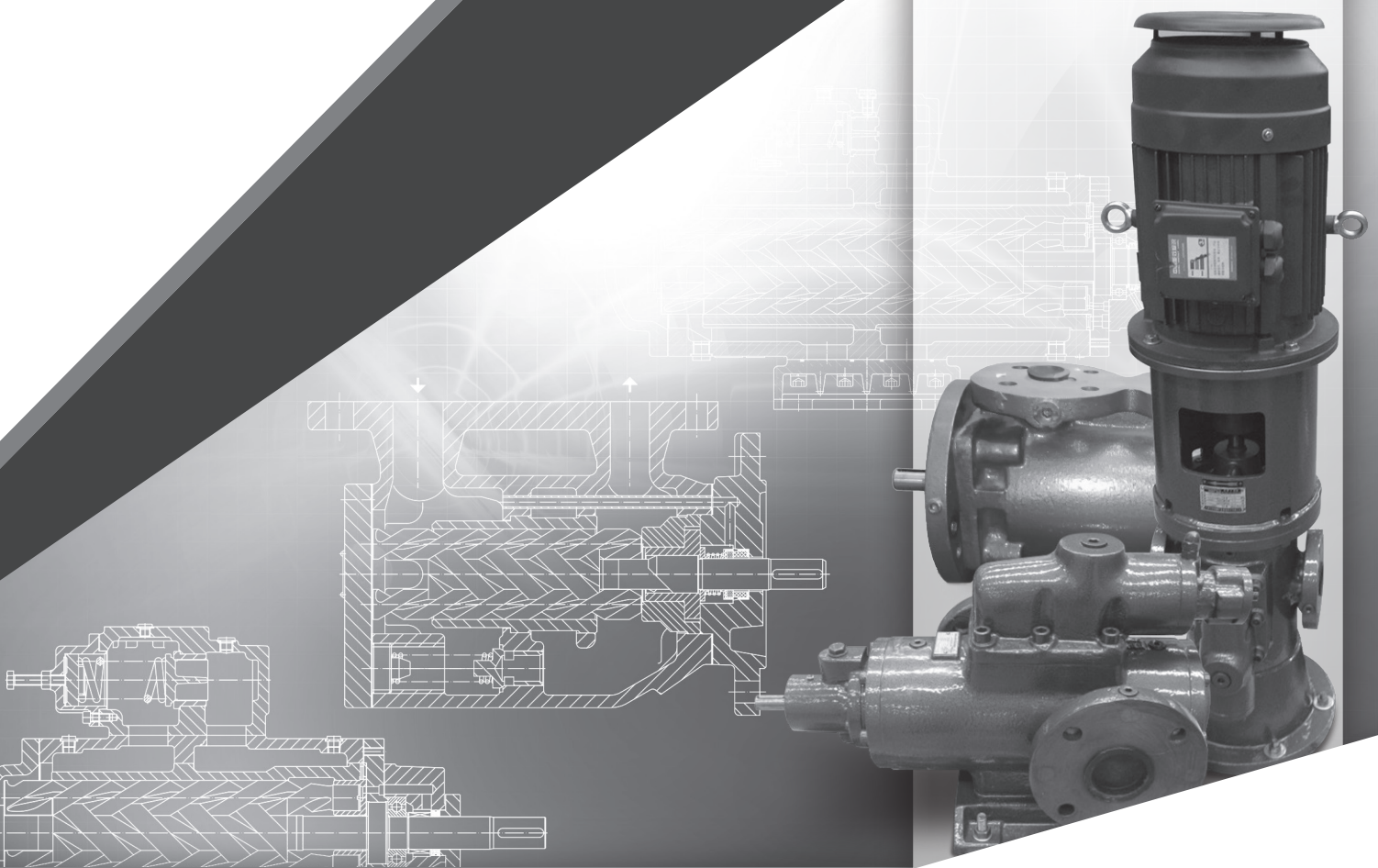
COUPLING (EXCLUDING MAGNETIC COUPLING)

Regularly check and maintain the coupling elastomer; replace a worn elastomer, if necessary.

Blackmer[®]

Disassembly & Reassembly

S SERIES
Triple Screw Pumps



Where Innovation Flows

PSG[®]
a **DOVER** company

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TABLE OF CONTENTS

SECTION 8 **INTRODUCTION** 17
SAFETY PRECAUTIONS 18

SECTION 9 **3N / 3M SERIES PUMPS GENERAL INFORMATION** 19
DISASSEMBLY 20
REASSEMBLY. 21
CROSS-SECTIONAL DIAGRAMS
 3NH PUMPS 25
PARTS LISTS 3NH PUMPS 26
CROSS-SECTIONAL DIAGRAMS
 3MH PUMPS 33
PARTS LISTS 3MH PUMPS 34


INTRODUCTION

The following instructions have been divided into three sections to accommodate the different triple screw pump types: 3N and 3M.

All disassembled parts must be labeled immediately in order to avoid confusion during reassembly. After disassembling the screw pump, all parts must be cleaned thoroughly and checked to ensure that they are reusable. Before reassembly, the surfaces of the individual parts should be carefully cleaned and checked.


The following parts should not be reused for operational safety reasons:

- Gaskets
- O-rings
- Mechanical seal
- Bearing




This is a SAFETY ALERT SYMBOL.


When you see this symbol on the product, or in the manual, look for one of the following signal words and be alert to the potential for personal injury, death or major property damage.



Warns of hazards that WILL cause serious personal injury, death or major property damage.



Warns of hazards that CAN cause serious personal injury, death or major property damage.



Warns of hazards that CAN cause personal injury or property damage.

NOTICE:

Indicates special instructions which are very important and must be followed.

NOTICE:

Blackmer Power Pumps **MUST** only be installed in systems, which have been designed by qualified engineering personnel. The system **MUST** conform to all applicable local and national regulations and safety standards.

This manual is intended to assist in the installation and operation of Blackmer Power pumps, and **MUST** be kept with the pump.

Pump service shall be performed by qualified technicians **ONLY**. Service shall conform to all applicable local and national regulations and safety standards.



Thoroughly review this manual, all instructions and hazard warnings, **BEFORE** performing any work on the pump.

Maintain **ALL** system and pump operation and hazard warning decals.





Hazardous pressure can cause personal injury or property damage.

Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury, death or major property damage.

Hazardous voltage. Can shock, burn or cause death.

Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death.




Hazardous machinery can cause serious personal injury.

Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death.




Do not operate without guard in place.

Operation without guards in place can cause serious personal injury, major property damage, or death.




Hazardous or toxic fluids can cause serious injury.

If pumping hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance.




Hazardous pressure can cause personal injury or property damage.

Failure to relieve system pressure prior to performing pump service or maintenance can cause serious personal injury or property damage.




Heavy assemblies can cause personal injury or property damage.

Always use a lifting device capable of supporting the full weight of the pump assemblies.

NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

SAFETY PRECAUTIONS

This manual contains basic references that are to be observed during pump transportation, installation, operation and maintenance, and, therefore, should be kept as part of the permanent pump records and readily accessible as a reference to any person working or maintaining the pumping unit.

The instructions within this manual must be thoroughly reviewed in their entirety and fully understood prior to pump installation, operation or maintenance care.

These pumps have been designed for safe and reliable operation when properly used and maintained in accordance with the instructions contained within this manual. A pump is a pressure-containing device with rotating parts that can be hazardous. Failure to read and comply with installation, operation and maintenance instructions will void the responsibility of the manufacturer and may result in bodily injury or equipment damage.

NOTE: In addition to the Safety Precautions identified in this section, special safety information is included within proceeding chapters where appropriate.

Markings and Instructions on Pump Unit

Direct instructional references regarding direction of rotation, fluid-flow orientation, safety warning, etc., are clearly marked on the pump. Please observe and follow all indicated safety markings and instructions.

NOTE: Failure to observe safety references can result in the following dangers:

- Equipment failure
- Maintenance and service policies voided
- Environmental pollution due to hazardous-substance leakage
- Personal endangerment by subject of electrical, mechanical and chemical influences

Qualified Personnel and Training

All persons installing, operating, maintaining and inspecting the pumping unit must have the required qualifications for work to be performed. All instructions and safety markings must be observed, understood and adhered to by all personnel working on or around the pumping unit. If installation or operational knowledge is inadequate, training must be provided. The scope of the personnel responsibilities, competency and supervisory duties must be closely controlled by the customer.

Safety References for Customers

- All work performed on or around the pumping unit must be completed by qualified personnel.
- Machine components that are either hot or cold must be protected on-site to prevent personal endangerment.
- Safety shield on the pumping unit must not be removed from the machine while the pump is running.
- Leakage of hazardous media (i.e., toxic, flammable, explosive, etc.) must be collected in a way that no damage to personnel or environment occurs.
- If the pumped media is explosive, toxic or flammable, a warning or alarm device must be installed, pump casing must be well-ventilated and the operating site must be a no smoke/ fire zone.
- To prevent electrical damage, all electrical devices must be safely protected, functional and controlled.

Pump Operating Parameters

Unless there is written admission by S Series, the pump must not be operated at higher parameters than specified. Adhering to these specifications prevents danger to personnel and equipment damage.

Pump Monitoring

Suitable measuring devices must be installed to inspect and control the pump during operation. Generally, pressure gauges are to be installed on suction and discharge lines near the pump.

TORQUE VALUES BY BOLT SIZE

| Fastener Size | M5 | M6 | M8 | M10 | M12 | M16 | M20 | M24 | M30 | M36 |
|---------------|----|----|----|-----|-----|-----|-----|-----|-----|-----|
| Torque (Nm) | 2 | 4 | 8 | 15 | 26 | 64 | 120 | 210 | 430 | 740 |

1. PURPOSE

This manual is intended as instructions for disassembly and reassembly of Blackmer Triple Screw Pump products. The manual doesn't take into account specific information relating to the installation, operation and maintenance of the pump.

2. APPLICATION AND FUNCTION

Blackmer Triple Screw Pumps are self-priming positive displacement pumps with external or internal bearings. The pump consists of three screws (one main screw and two idlers) and a bearing, mechanical seal, liner, casing and bearing/seal housing. The main screw (coupled to the driver/motor) performs the pumping work while the idlers seal off the pumping chambers. The torque is transmitted to the idler screws by a rolling contact. The screws are in contact with each other as well as with the surrounding liner. Subsequently, the medium must always have certain lubricating properties. The pumped fluid creates a barrier between the rotating elements, preventing metal-to-metal contact of the rotating elements. The liquid film also supports the screws in the liner, eliminating contact between the screws and the liners. Additionally, Blackmer supplies a relief valve to protect the pump against excessive pressure. This valve is actuated at an approximately set pressure value above the maximum differential pressure to allow the medium to flow back to the pump intake chamber.

3. DESIGN FEATURES

- Turbulence-free and pulsation-free flow
- Replaceable cartridge/liner construction for easy maintenance
- Low maintenance and long life
- High-efficiency pump with low operating costs
- Axially balanced screws eliminates axial forces to bearings
- One shaft seal for easy maintenance and low costs
- Resistant against aeration for low noise, minimized vibration

4. STRUCTURAL DESIGN

4.1 Bearing and Lubrication

3N, 3M Triple Screw Pumps use grooved ball bearings. Depending on the different working conditions, the pumps can feature an internal or external bearing design (see Fig. 2.1). When the pump design is an internal bearing type, the bearing will be lubricated by the medium. When the pump design is an external bearing type, the bearing will be lubricated by grease lubrication.

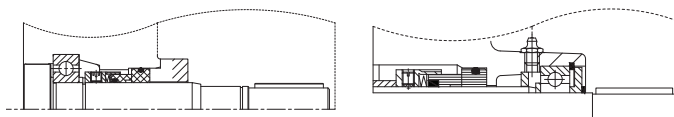


Fig. 2.1 – Bearing Location

4.2 Shaft Seal

Blackmer Triple Screw Pumps use a single mechanical seal (see Fig.2.2).

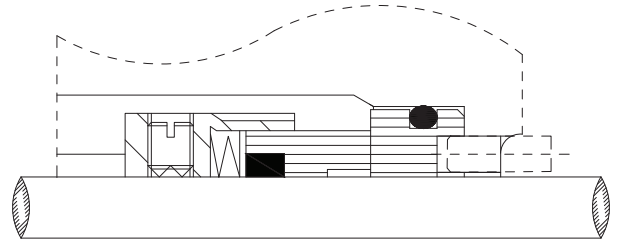


Fig. 2.2 – Single Mechanical Seal

4.3 Connections

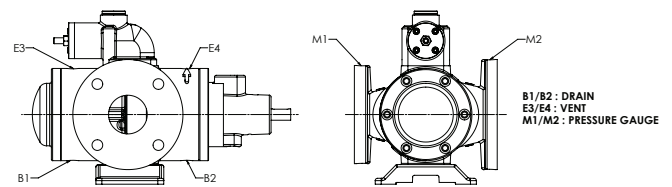


Fig. 2.3 – 3N / 3M

4.4 Relief Valve

The relief valve is installed for pressure overload protection. The opening pressure of the relief valve is 10% or 1 bar higher than the rating operating pressure of pump.

ATTENTION: Pumps equipped with a safety valve cannot be used to control flow or pressure. An overload protection device in the controller or a pressure relief valve (return valve) in the pressure pipeline must be provided for pumps supplied without an installed pressure relief valve.

1. GENERAL

Please note that all the parts (e.g., greasing chamber disc, spacer ring, and adjusting ring, etc.) are marked in the cross-section drawings (Fig. 4, page 23 and Fig. 5, page 24) to avoid any mistakes when dismantling and assembling of the pump. All parts should be cleaned thoroughly after dismantling and checked to ensure they are reusable.

The following parts must be replaced:

- Gaskets
- O-rings
- Mechanical seal
- Bearing

2. PREPARATIONS FOR DISASSEMBLY OF SCREW PUMP

2.1 Cut off the electricity supply to the motor. Close the stop valves in the suction and discharge pipelines. Depressurize the pressure inside the pump.

Ensure the motor cannot start unexpectedly.

2.2 Unscrew the drain plug located in the high- and low-pressure chamber of the pump casing and the drain plug in the seal housing. Collect the liquid in a suitable container. Rotate the driving spindle during draining and drain off the oil completely from the casing.

ATTENTION: After draining, tighten the same plug and washer to the pump. The high-temperature, toxic or polluted medium must be dealt with using proper methods to avoid harming people and the environment. In cases where there is high-temperature medium inside pump, the pump must be cooled to ambient temperature before proceeding to the next operation.

2.3 Remove instrument or instrument signal wire from the pump (if any).

2.4 Remove coupling guard (if any). Remove the motor and the pump from the base plate or support. Move the motor and pump to a proper working station. If the coupling has a spacer, generally do not move the motor, only dismantle the spacer of coupling.

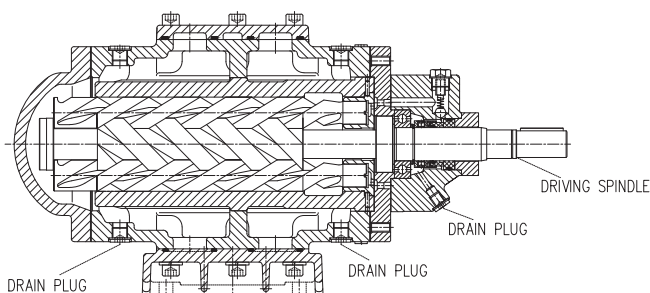


Fig. 2.4 - Drain

3. DISASSEMBLY OF SCREW PUMP

3.1 3N/3M Series E type (or external bearing type) disassembly of screw pump (Fig. 5, page 24).

3.1.1 Dismantle pump end-side coupling and take off the key (128) in the coupling.

3.1.2 Dismantle the socket head screw (110) of front cover (03) and pump casing (01) and take out the rotor assembly from the pump. Dismantle the screw (111) and take off back cover (04) and gasket (21).

3.1.3 Loosen the circlip (124) and take out the circlip from the driving spindle using circlip pliers (12). Then, disassemble the spacer bush (16). Loosen the circlip (120) and take out the circlip from seal housing (05).

3.1.4 Unscrew the screw (113). Disassemble seal housing (05) by using forcing screw and then disassemble rotary part unit of mechanical seal (200) from driving spindle (12).

Disassemble the stationary ring of the mechanical seal (200) and bearing (101) from seal housing (05). Disassemble the supporting washer (11) and greasing chamber disc (10).

ATTENTION: When dismantling the seal housing (05), do not hit the seal housing against the screw set to avoid damaging the stationary ring of the mechanical seal (200).

3.1.5 Disassemble rotating part unit of mechanical and spacer ring (17) from driving spindle (12).

3.1.6 Unscrew stop screw (19) and washer (134). Remove spring (122) and ball (127).

3.1.7 Unscrew the screw (20). Separate front cover (03) and insert (02), and then disassemble gasket (24).

3.1.8 Take out driving spindle (12) and idler spindle (13) with balance bush (08) from pump casing inserts (02).

ATTENTION: Remove driving spindle (12) and idler spindle (13) carefully and put the screw set in a safe area to protect it from any damage.

3.2 3N/3M Series U type (or internal bearing type) disassembly (Fig. 4, page 23)

3.2.1 Dismantle pump end-side coupling and take off the key (128) in the coupling.

3.2.2 Dismantle the socket head screw (110) of front cover (03) and pump casing (01) and take out the rotor assembly from the pump. Dismantle the screw (111) and take off back cover (04) and gasket (21).

3.2.3

a . Size 40 to 120 Unscrew the screw (113). Disassemble seal housing (05) and the stationary ring of the mechanical seal (200) by using forcing screws.

ATTENTION: When dismantling the seal housing (05), do not hit the seal housing (05) against the screw set to avoid damaging the stationary ring of the mechanical seal (200).

b. Size 210 to 2900/3600 Unscrew the screw (116). Disassemble seal cover (09) with the stationary ring of the mechanical seal (200). Unscrew the screw (113). Disassemble packing box (05) by using forcing screw and then disassemble the rotating part unit of the mechanical seal (200).

3.2.4 Unscrew the stop screw (19) and aluminum gasket (134). Disassemble spring (122) and ball (127).

3.2.5 Loosen the circlip (124) and take out of the circlip from the driving spindle. Disassemble bearing (101) by using thruster or bearing puller (see Fig. 2.5).

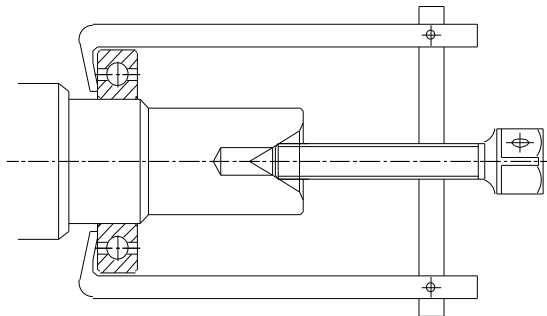


Fig. 2.5 – Assembly of Bearing

3.2.6 Unscrew the screw (20). Separate front cover (03) and pump casing insert (02), and then disassemble gasket (24).

3.2.7 Take out driving spindle (12) and idler spindle (13) with balance bush (08) from pump casing inserts (02).

ATTENTION: Remove driving spindle (12) and idler spindle (13) carefully and put the screw set in a safe area to protect it from any damage.

4. ASSEMBLY OF SCREW PUMP

ATTENTION: Before assembly, check all parts for wear, such as pump casing insert, driving and idler spindles, balance bush, bearing, mechanical seal, gasket and so on. Replace with spare parts according to the need.

Before assembly, cleaning of all parts is mandatory.

4.1 3N/3M Series E type (or external bearing type) assembly of screw pump (Fig. 5, page 24).

4.1.1 Push idler spindle (13) with balance bush (08) and driving spindle (12) into the insert (02). Press balance bushes (08) into the pump casing insert (02) with proper alignment to match the dowel pins in the insert (02).

4.1.2 Mount front cover (03) with gasket (24) into pump casing insert (02) from the driving spindle side. Connect front cover (03) and pump casing insert (02) by socket head screw (20).

4.1.3 Attach gasket (21) to pump casing (01) with lubricating grease, then mount driving spindle, idler spindle and pump casing insert into pump casing (01). Keeping suction flange on right-hand side, fasten the screw (110).

4.1.4 Mount spacer ring (17) onto driving spindle (12), and then mount rotary part of mechanical seal (200) onto driving spindle (12). Push the stationary ring of the mechanical seal into seal housing (05), and then mount seal housing (05) along with gasket (22). Connect seal housing (05) and front cover (03) by screw (113).

ATTENTION: When mounting seal housing (05), keep it parallel to the axial line of seal housing (05) and driving spindle (12) in order to avoid any damage to the stationary ring of the mechanical seal.

Before assembly, cleaning of the mechanical seal (200) is mandatory.

4.1.5 Mount ball (127) and spring (122) into oil return hole of seal housing (05). Screw the stop screw (19) with washer (134) to seal housing (05).

4.1.6 Mount greasing chamber disc (10) and supporting washer (11).

- 4.1.7** Mount bearing (101) onto driving spindle 12 by bearing assembly sleeve (Fig. 2.6).

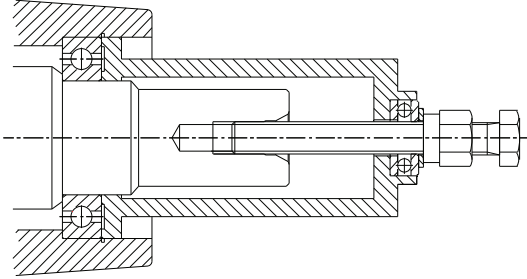


Fig. 2.6 Assembly of Bearing

- 4.1.8** Mount the circlip (120) into seal housing (05) by circlip pliers. Push spacer bush (16) onto driving spindle (12), and then mount circlip (124) onto driving spindle (12) by circlip pliers.
- 4.1.9** Mount back cover (04) with gasket (21) to pump casing (01). Connect them by screw (111).
- 4.1.10** Mount key (128) into the groove of driving spindle (12), and mount the pump end-side coupling half onto driving spindle.

ATTENTION: When mounting the coupling half, do not beat violently to avoid any damage to the bearing and mechanical seal.

- 4.2** 3N/3M Series U type (or internal bearing type) for assembly of screw pump (Fig. 4, page 23).

- 4.2.1** Push idler spindle (13) with balance bush (08) and driving spindle (12) into the pump casing insert (02). Press balance bushes (08) into the pump casing insert (02) with proper alignment to match the dowel pins in insert (02).

- 4.2.2** Mount front cover (03) with gasket (24) into pump casing insert (02) from the driving spindle side. Connect front cover (03) and pump casing insert (02) by socket head screw (20).

- 4.2.3** Attach gasket (21) to pump casing (01) with lubricating grease, then mount driving spindle, idler spindle and pump casing insert into pump casing (01). Fasten the screw (110).

- 4.2.4** Heat the bearing at a temperature to 80°C, then take it to the driving spindle (12) and install the screw inner washer (11) to the driving spindle (12) and circlip (124) to the driving shaft.

ATTENTION: Heat the bearing evenly by dipping in hot oil.

- 4.2.5** Mount ball (127) and spring (122) into oil return hole of seal housing (05). Tighten the stop screw (19) with washer (134) to seal housing (05).

4.2.6

- a. Size 40 to 120** Mount the rotating part of the mechanical seal (200) onto driving spindle (12). Push the stationary ring of the mechanical seal (200) into seal housing (05), then fit seal housing (05) and front cover (03) by screw (113).

- b. Size 210 to 2900/3600** Mount the rotating part of the mechanical seal (200) to driving spindle (12). Connect seal housing (05) and front cover (03) by screw (113). Push the stationary ring of the mechanical seal (200) into seal housing (05), and then mount seal cover (09). Connect seal cover (09) and seal housing (05) by screw (116).

ATTENTION: When mounting seal housing (05), keep it parallel to the axial line of seal housing (05) and driving spindle (12) in order to avoid any damage to the stationary ring of the mechanical seal.

Before assembly, cleaning of the mechanical seal (200) is mandatory.

- 4.2.6** Mount back cover (04) with gasket (21) to pump casing (01). Connect them by screw (111).

- 4.2.7** Mount key (128) into the groove of driving spindle (12), and mount pump end-side coupling half onto driving spindle.

ATTENTION: When mounting the coupling half, do not beat violently to avoid any damage to the bearing and mechanical seal

- 4.3** Connect and mount on test table. Fill pump with pumping fluid, then start up the pump as per instructions in Section 5 of Installation, Operation and Maintenance (IOM) Manual.

CROSS-SECTIONAL DIAGRAMS

3N/3M SERIES U

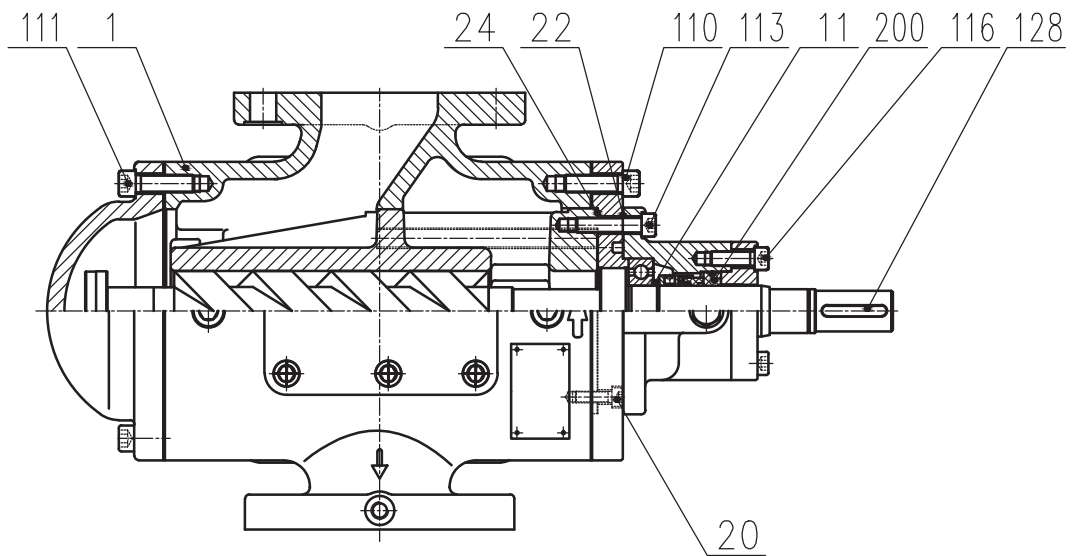
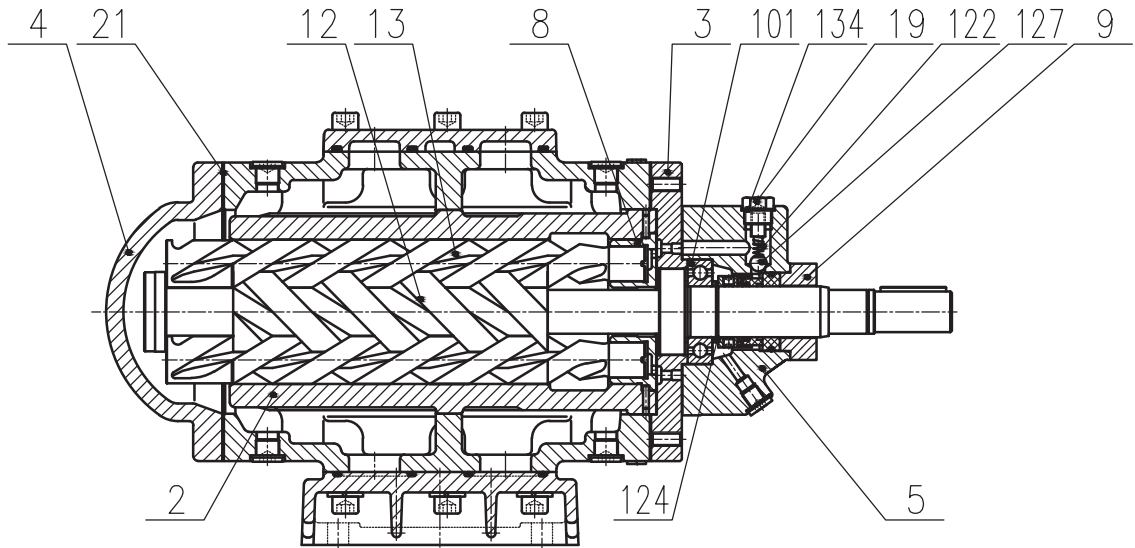


Fig. 4

CROSS-SECTIONAL DIAGRAMS

3N/3M SERIES E

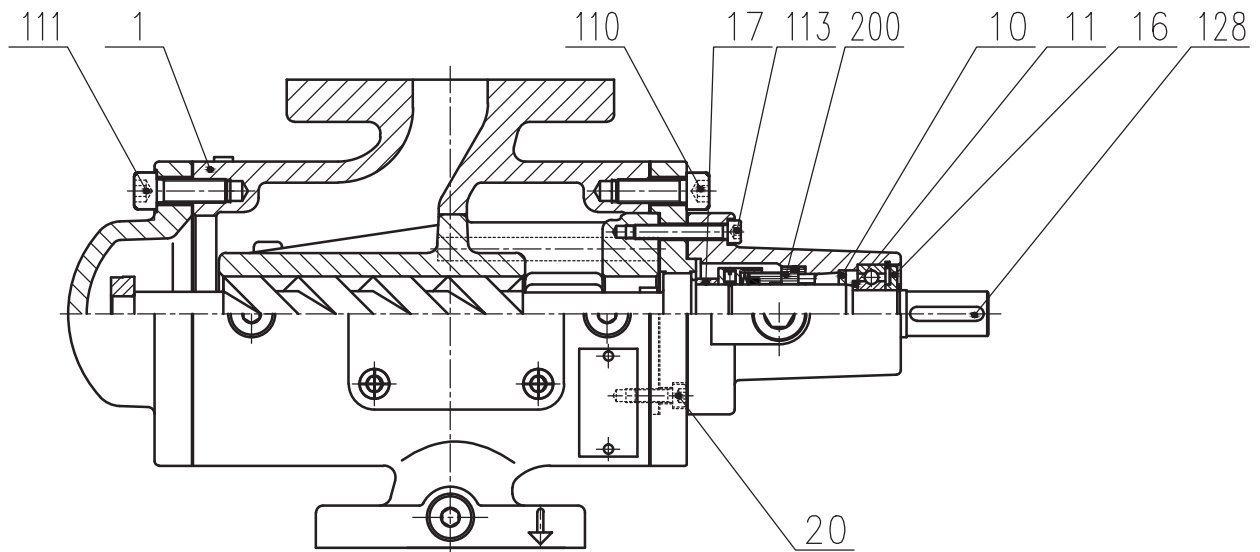
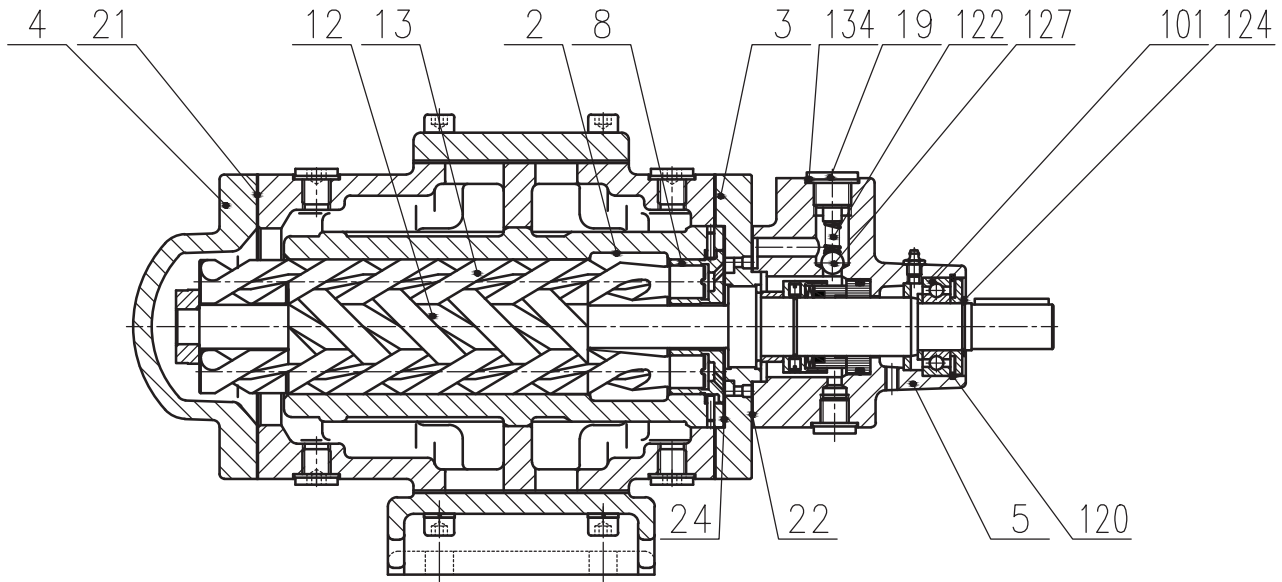
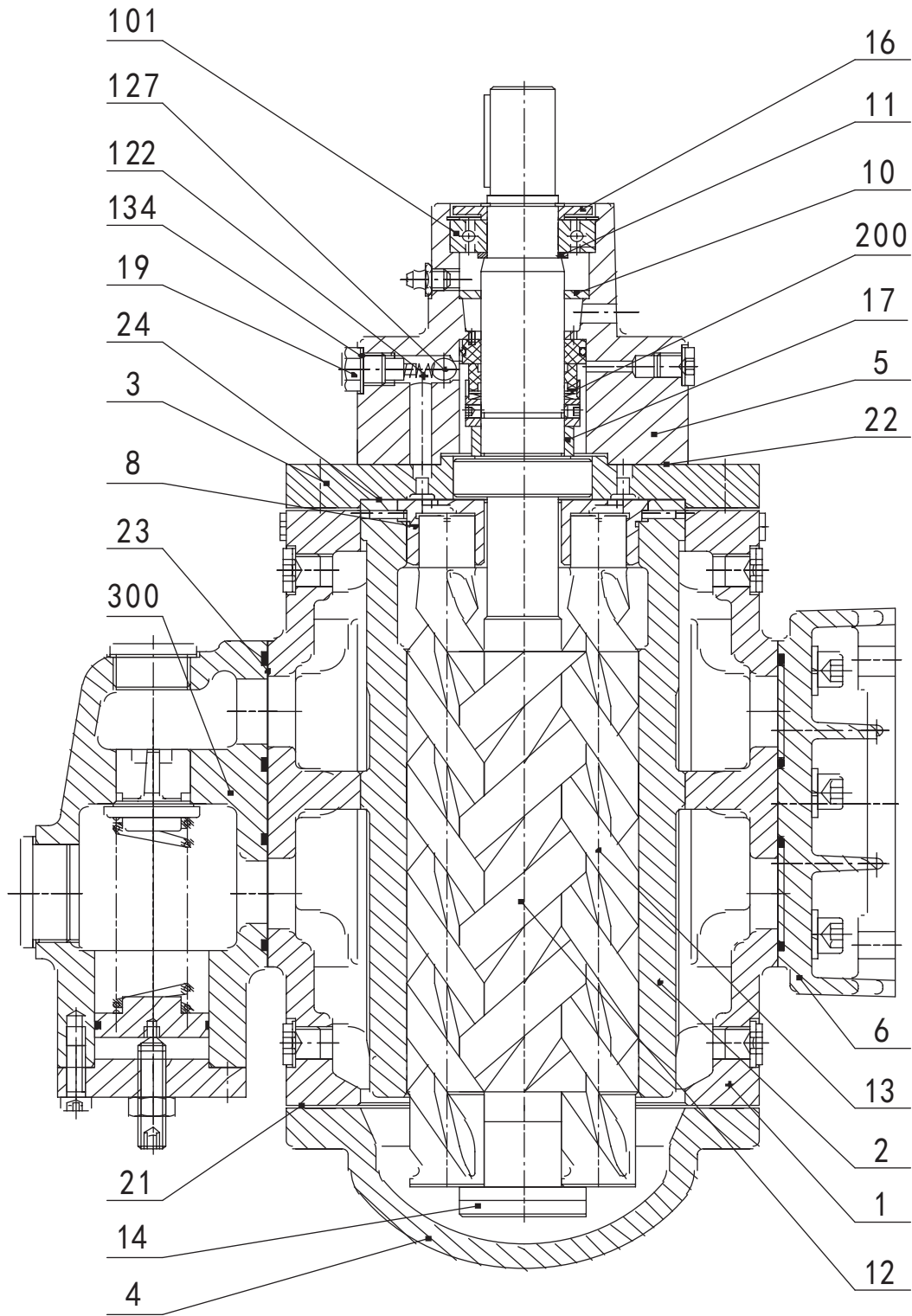


Fig. 5

CROSS-SECTIONAL DIAGRAMS

3NH-E6.7 PUMP





TRIPLE SCREW PUMP 3N SERIES

| Parts List | | | File No. | 3NHN40EE6.7 |
|-------------------|---------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3N40-01 | Pump Casing | 1 | |
| 2 | 3N40-02 | Pump Casing Insert | 1 | |
| 3 | 3N40E-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N40-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N40EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3N80-06 | Pump Foot | 1 | |
| 8 | 3N40-08 | Balance Bush | 2 | |
| 10 | 3N40EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N40EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3N40E-12 | Driving Shaft | 1 | |
| 13 | 3N40-13 | Driven Shaft | 2 | |
| 14 | 3N40-14 | Circlips | 1 | |
| 16 | 3N40EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N40EE6.7-17 | Space Bush | 1 | |
| 19 | 3N210-19 | Plug Screw | 1 | |
| 21 | 3N40-21 | Pump End Gasket | 2 | |
| 22 | 3N40-22 | Shaft Sealing Housing Gasket | 1 | |
| 23 | 3N80-23 | Valve Bottom Gasket | 2 | |
| 24 | 3N40-24 | Pump Cover Gasket | 1 | |
| 101 | 6004 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 9.5 | Steel Ball | 1 | |
| 134 | A17 X 21 | Washer | 1 | |
| 200 | 3N40EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|------------|
| Parts List | File No. | 3NH80EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|---------------|-----------------------------------|----------|
| 1 | 3N80-01 | Pump Casing | 1 |
| 2 | 3N80-02 | Pump Casing Insert | 1 |
| 3 | 3N80-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N80-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N80EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3N80-06 | Pump Foot | 1 |
| 8 | 3N80-08 | Balance Bush | 2 |
| 10 | 3N80EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N80EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3N80E-12 | Driving Shaft | 1 |
| 13 | 3N80-13 | Driven Shaft | 2 |
| 14 | 3N80-14 | Circlips | 1 |
| 16 | 3N80EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N80EE6.7-17 | Space Bush | 1 |
| 19 | 3N210-19 | Plug Screw | 1 |
| 21 | 3N80-21 | Pump End Gasket | 2 |
| 22 | 3N80-22 | Shaft Sealing Housing Gasket | 1 |
| 23 | 3N80-23 | Valve Bottom Gasket | 2 |
| 24 | 3N80-24 | Pump Cover Gasket | 1 |
| 101 | 6204 | Groove Ball Bearing | 1 |
| 122 | 077 3413 050 | Spring | 1 |
| 127 | 9.5 | Steel Ball | 1 |
| 134 | A17 X 21 | Washer | 1 |
| 200 | 3N80EE6.7-200 | Mechanical Seal | 1 |
| 300 | DS35A-300 | Relief Valve | 1 |

| Parts List | | | File No. | 3NH120EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3N120-01 | Pump Casing | 1 | |
| 2 | 3N120-02 | Pump Casing Insert | 1 | |
| 3 | 3N120-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N120-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N120-05 | Shaft Sealing Housing | 1 | |
| 6 | 3N210-06 | Pump Foot | 1 | |
| 8 | 3N120-08 | Balance Bush | 2 | |
| 10 | 3N120EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N120EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3N120E-12 | Driving Shaft | 1 | |
| 13 | 3N120-13 | Driven Shaft | 2 | |
| 14 | 3N120-14 | Circlips | 1 | |
| 16 | 3N120EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N120EE6.7-17 | Space Bush | 1 | |
| 19 | 3N210-19 | Plug Screw | 1 | |
| 21 | 3N120-21 | Pump End Gasket | 2 | |
| 22 | 3N120-22 | Shaft Sealing Housing Gasket | 1 | |
| 23 | 3N120-23 | Valve Bottom Gasket | 2 | |
| 24 | 3N120-24 | Pump Cover Gasket | 1 | |
| 101 | 6205 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 9.5 | Steel Ball | 1 | |
| 134 | A17 X 21 | Washer | 1 | |
| 200 | 3N120EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS38A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|-------------|
| Parts List | File No. | 3NH210EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|----------------|-----------------------------------|----------|
| 1 | 3N210-01 | Pump Casing | 1 |
| 2 | 3N210-02 | Pump Casing Insert | 1 |
| 3 | 3N210-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N210-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N210EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3N210-06 | Pump Foot | 1 |
| 8 | 3N210-08 | Balance Bush | 2 |
| 10 | 3N210EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N210EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3N210-12 | Driving Shaft | 1 |
| 13 | 3N210-13 | Driven Shaft | 2 |
| 14 | 3N210-14 | Circlips | 1 |
| 16 | 3N210EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N210EE6.7-17 | Space Bush | 1 |
| 19 | 3N210-19 | Plug Screw | 1 |
| 21 | 3N210-21 | Pump End Gasket | 2 |
| 22 | 3N210-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N210-24 | Pump Cover Gasket | 1 |
| 101 | 6206 | Groove Ball Bearing | 1 |
| 122 | 077 3413 050 | Spring | 1 |
| 127 | 11 | Steel Ball | 1 |
| 134 | A17 X 21 | Washer | 1 |
| 200 | 3N210EE6.7-200 | Mechanical Seal | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |
| 300 | DS35A-300 | Relief Valve | 1 |



TRIPLE SCREW PUMP 3N SERIES

| Parts List | | | File No. | 3NH280EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3N280-01 | Pump Casing | 1 | |
| 2 | 3N280-02 | Pump Casing Insert | 1 | |
| 3 | 3N280-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N280-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N280EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3N940-06 | Pump Foot | 1 | |
| 8 | 3N280-08 | Balance Bush | 2 | |
| 10 | 3N280EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N280EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3N280E-12 | Driving Shaft | 1 | |
| 13 | 3N280-13 | Driven Shaft | 2 | |
| 14 | 3N280-14 | Circlips | 1 | |
| 16 | 3N280EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N280EE6.7-17 | Space Bush | 1 | |
| 19 | 3N210-19 | Plug Screw | 1 | |
| 21 | 3N280-21 | Pump End Gasket | 2 | |
| 22 | 3N280-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N280-24 | Pump Cover Gasket | 1 | |
| 101 | 6207 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 11 | Steel Ball | 1 | |
| 134 | A17 X 21 | Washer | 1 | |
| 200 | 3N280EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS44A-300 | Relief Valve | 1 | |
| 300 | DS38A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|-------------|
| Parts List | File No. | 3NH440EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|----------------|-----------------------------------|----------|
| 1 | 3N440-01 | Pump Casing | 1 |
| 2 | 3N440-02 | Pump Casing Insert | 1 |
| 3 | 3N440-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N440-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N440EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3N940-06 | Pump Foot | 1 |
| 8 | 3N440-08 | Balance Bush | 2 |
| 10 | 3N440EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N440EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3N440E-12 | Driving Shaft | 1 |
| 13 | 3N440-13 | Driven Shaft | 2 |
| 14 | 3N440-14 | Circlips | 1 |
| 16 | 3N440EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N440EE6.7-17 | Space Bush | 1 |
| 19 | 3N940-19 | Plug Screw | 1 |
| 21 | 3N440-21 | Pump End Gasket | 2 |
| 22 | 3N440-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N440-24 | Pump Cover Gasket | 1 |
| 101 | 6208 | Groove Ball Bearing | 1 |
| 122 | 077 3413 062 | Spring | 1 |
| 127 | 14 | Steel Ball | 1 |
| 134 | A21 X 26 | Washer | 1 |
| 200 | 3N440EE6.7-200 | Mechanical Seal | 1 |
| 300 | DS44A-300 | Relief Valve | 1 |
| 300 | DS35A-300 | Relief Valve | 1 |

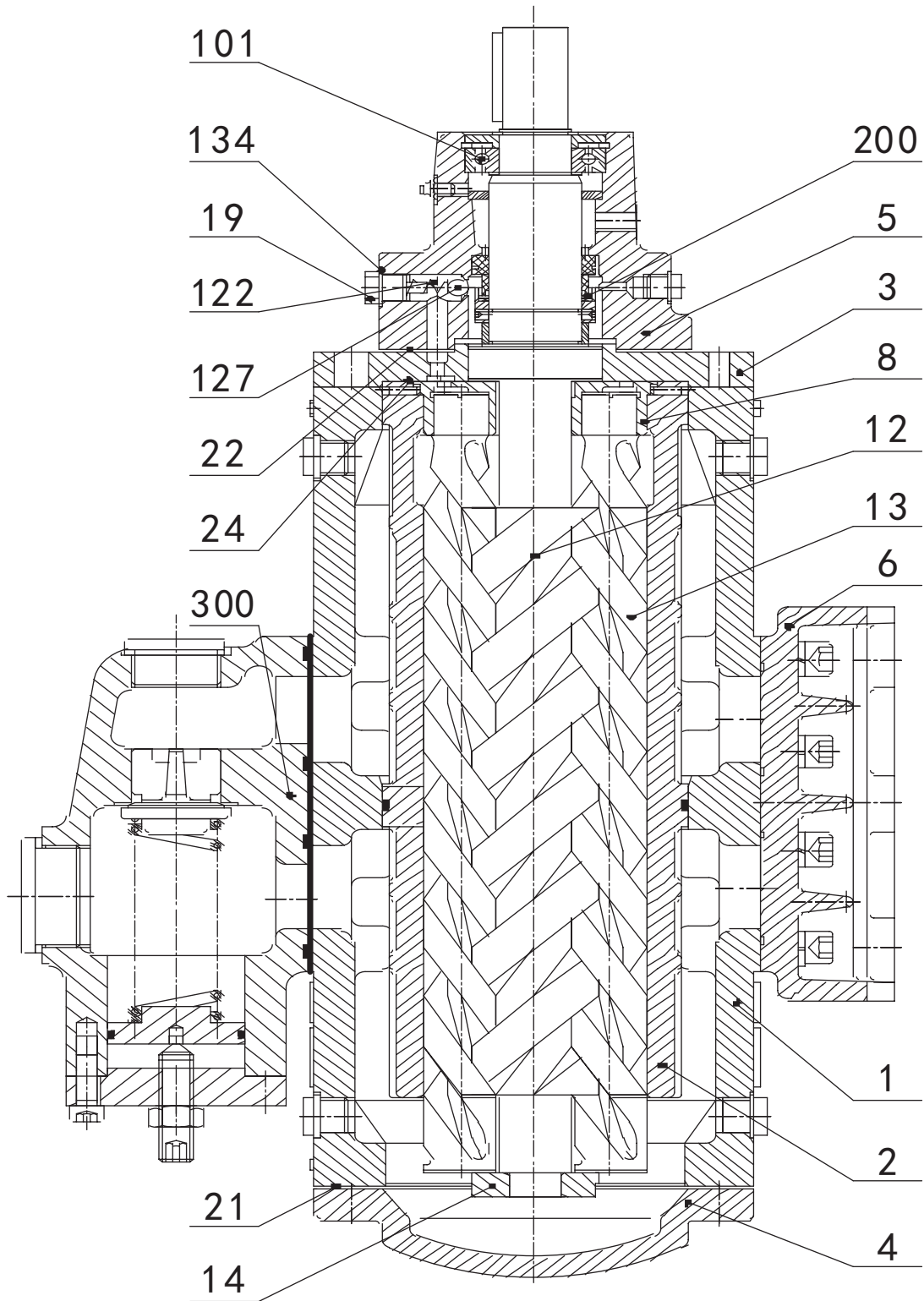


TRIPLE SCREW PUMP 3N SERIES

| Parts List | | | File No. |
|-------------------|----------------|-----------------------------------|-----------------|
| | | | 3NH660EE6.7 |
| | | | Page |
| | | | 1/1 |
| No. | Code | Name of Parts | Quantity |
| 1 | 3N660-01 | Pump Casing | 1 |
| 2 | 3N660-02 | Pump Casing Insert | 1 |
| 3 | 3N660-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N660-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N660EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3N940-06 | Pump Foot | 1 |
| 8 | 3N660-08 | Balance Bush | 2 |
| 10 | 3N660EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N660EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3N660E-12 | Driving Shaft | 1 |
| 13 | 3N660-13 | Driven Shaft | 2 |
| 14 | 3N660-14 | Circlips | 1 |
| 16 | 3N660EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N660EE6.7-17 | Space Bush | 1 |
| 19 | 3N940-19 | Plug Screw | 1 |
| 21 | 3N660-21 | Pump End Gasket | 2 |
| 22 | 3N660-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N660-24 | Pump Cover Gasket | 1 |
| 101 | 6209 | Groove Ball Bearing | 1 |
| 122 | 077 3413 062 | Spring | 1 |
| 127 | 18 | Steel Ball | 1 |
| 134 | A27 X 32 | Washer | 1 |
| 200 | 3N660EE6.7-200 | Mechanical Seal | 1 |
| 300 | DS44A-300 | Relief Valve | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |

CROSS-SECTIONAL DIAGRAMS

3M SERIES E PUMP



| Parts List | | | File No. | 3NH940EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3N940-01 | Pump Casing | 1 | |
| 2 | 3N940-02 | Pump Casing Insert | 1 | |
| 3 | 3N940-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N940-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N940EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3N940-06 | Pump Foot | 1 | |
| 8 | 3N940-08 | Balance Bush | 2 | |
| 10 | 3N940EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N940EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3N940E-12 | Driving Shaft | 1 | |
| 13 | 3N940-13 | Driven Shaft | 2 | |
| 14 | 3N940-14 | Circlips | 1 | |
| 16 | 3N940EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N940EE6.7-17 | Space Bush | 1 | |
| 19 | 3N940-19 | Plug Screw | 1 | |
| 21 | 3N940-21 | Pump End Gasket | 2 | |
| 22 | 3N940-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N940-24 | Pump Cover Gasket | 1 | |
| 101 | 6210 | Groove Ball Bearing | 1 | |
| 122 | 007 3413 062 | Spring | 1 | |
| 127 | 18 | Steel Ball | 1 | |
| 134 | A27 X 32 | Washer | 1 | |
| 200 | 3N940EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS47A-300 | Relief Valve | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |

| | | |
|-----------------------------------|----------|------------|
| Parts List (3MH40EE6.7) | File No. | 3MH40EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|---------------|-----------------------------------|----------|
| 1 | 3M40-01 | Pump Casing | 1 |
| 2 | 3M40-02 | Pump Casing Insert | 1 |
| 3 | 3N40E-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N40-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N40EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3N210-06 | Pump Foot | 1 |
| 8 | 3N40-08 | Balance Bush | 2 |
| 10 | 3N40EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N40EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3M40E-12 | Driving Shaft | 1 |
| 13 | 3M40-13 | Driven Shaft | 2 |
| 14 | 3M40-14 | Circlips | 1 |
| 16 | 3N40EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N40EE6.7-17 | Spacer Bush | 1 |
| 19 | 3N210-19 | Plug Screw | 1 |
| 21 | 3N40-21 | Pump End Gasket | 2 |
| 22 | 3N40-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N40-24 | Pump Cover Gasket | 1 |
| 101 | 6004 | Groove Ball Bearing | 1 |
| 122 | 077 3413 050 | Spring | 1 |
| 127 | 9.5 | Steel Ball | 1 |
| 134 | A17 X 21 | Washer | 1 |
| 200 | 3M40EE6.7-200 | Mechanical Seal | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |

| Parts List | | | File No. | 3MH80EE6.7 |
|-------------------|---------------|-----------------------------------|-----------------|------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3M80-01 | Pump Casing | 1 | |
| 2 | 3M80-02 | Pump Casing Insert | 1 | |
| 3 | 3N80-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N80-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N80EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3M210-06 | Pump Foot | 1 | |
| 8 | 3N80-08 | Balance Bush | 2 | |
| 10 | 3N80EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N80EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3M80E-12 | Driving Shaft | 1 | |
| 13 | 3M80-13 | Driven Shaft | 2 | |
| 14 | 3N80-14 | Circlips | 1 | |
| 16 | 3N80EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N80EE6.7-17 | Space Bush | 1 | |
| 19 | 3N210-19 | Plug Screw | 1 | |
| 21 | 3N80-21 | Pump End Gasket | 2 | |
| 22 | 3N80-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N80-24 | Pump Cover Gasket | 1 | |
| 101 | 6204 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 9.5 | Steel Ball | 1 | |
| 134 | A17 X 21 | Washer | 1 | |
| 200 | 3M80EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS38A-300 | Relief Valve | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|-------------|
| Parts List | File No. | 3MH120EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|----------------|-----------------------------------|----------|
| 1 | 3M120-01 | Pump Casing | 1 |
| 2 | 3M120-02 | Pump Casing Insert | 1 |
| 3 | 3N120-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N120-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N120EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3M210-06 | Pump Foot | 1 |
| 8 | 3N120-08 | Balance Bush | 2 |
| 10 | 3N120EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N120EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3M120E-12 | Driving Shaft | 1 |
| 13 | 3M120-13 | Driven Shaft | 2 |
| 14 | 3N120-14 | Circlips | 1 |
| 16 | 3N120EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N120EE6.7-17 | Space Bush | 1 |
| 19 | 3N210-19 | Plug Screw | 1 |
| 21 | 3N120-21 | Pump End Gasket | 2 |
| 22 | 3N120-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N120-24 | Pump Cover Gasket | 1 |
| 101 | 6205 | Groove Ball Bearing | 1 |
| 122 | 077 3413 050 | Spring | 1 |
| 127 | 9.5 | Steel Ball | 1 |
| 134 | A17 X 21 | Washer | 1 |
| 200 | 3M120EE6.7-200 | Mechanical Seal | 1 |
| 300 | DV38A-300 | Relief Valve | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |

| Parts List | | | File No. | 3MH210EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3M210-01 | Pump Casing | 1 | |
| 2 | 3M210-02 | Pump Casing Insert | 1 | |
| 3 | 3N210-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N210-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N210EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3M210-06 | Pump Foot | 1 | |
| 8 | 3M210-08 | Balance Bush | 2 | |
| 10 | 3NS210D4.2-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N210-11 | Bearing Spacer | 1 | |
| 12 | 3N210EE6.7-12 | Driving Shaft | 1 | |
| 13 | 3M210-13 | Driven Shaft | 2 | |
| 14 | 3N210-14 | Circlips | 1 | |
| 16 | 3N210EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3M210EE6.7-17 | Space Bush | 1 | |
| 19 | 3N210-19 | Plug Screw | 1 | |
| 21 | 3N210-21 | Pump End Gasket | 2 | |
| 22 | 3N210-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N210-24 | Pump Cover Gasket | 1 | |
| 101 | 6306 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 11 | Steel Ball | 1 | |
| 133 | A17 X 21 | Washer | 5 | |
| 200 | 3M210EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DS38A-300 | Relief Valve | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|-------------|
| Parts List | File No. | 3MH280EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|----------------|-----------------------------------|----------|
| 1 | 3M280-01 | Pump Casing | 1 |
| 2 | 3M280-02 | Pump Casing Insert | 1 |
| 3 | 3N280-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N280-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3N280EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3M440-06 | Pump Foot | 1 |
| 8 | 3N280-08 | Balance Bush | 2 |
| 10 | 3N280EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N280EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3M280E-12 | Driving Shaft | 1 |
| 13 | 3M280-13 | Driven Shaft | 2 |
| 14 | 3M280-14 | Circlips | 1 |
| 16 | 3N280EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N280EE6.7-17 | Space Bush | 1 |
| 19 | 3N210-19 | Plug Screw | 1 |
| 21 | 3N280-21 | Pump End Gasket | 2 |
| 22 | 3N280-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N280-24 | Pump Cover Gasket | 1 |
| 101 | 6207 | Groove Ball Bearing | 1 |
| 122 | 077 3413 050 | Spring | 1 |
| 127 | 11 | Steel Ball | 1 |
| 134 | A17 X 21 | Washer | 1 |
| 200 | 3M280EE6.7-200 | Mechanical Seal | 1 |
| 300 | DV44B-300 | Relief Valve | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |

| Parts List | | | File No. | 3MH440EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3M440-01 | Pump Casing | 1 | |
| 2 | 3M440-02 | Pump Casing Insert | 1 | |
| 3 | 3N440-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N440-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N440EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3M440-06 | Pump Foot | 1 | |
| 8 | 3M440-08 | Balance Bush | 2 | |
| 10 | 3N440EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N440EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3M440E-12 | Driving Shaft | 1 | |
| 13 | 3M440-13 | Driven Shaft | 2 | |
| 14 | 3N440-14 | Circlips | 1 | |
| 16 | 3N440EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3M440EE6.7-17 | Space Bush | 1 | |
| 19 | 3N440-19 | Plug Screw | 1 | |
| 21 | 3N440-21 | Pump End Gasket | 2 | |
| 22 | 3N440-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N440-24 | Pump Cover Gasket | 1 | |
| 101 | 6208 | Groove Ball Bearing | 1 | |
| 122 | 077 3413 050 | Spring | 1 | |
| 127 | 14 | Steel Ball | 1 | |
| 134 | A21 X 26 | Washer | 1 | |
| 200 | 3M440EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DV44B-300 | Relief Valve | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |

| | | |
|-------------------|----------|-------------|
| Parts List | File No. | 3MH660EE6.7 |
| | Page | 1/1 |

| No. | Code | Name of Parts | Quantity |
|-----|----------------|-----------------------------------|----------|
| 1 | 3M660-01 | Pump Casing | 1 |
| 2 | 3M660-02 | Pump Casing Insert | 1 |
| 3 | 3N660-03 | Pump Cover, Driving Shaft | 1 |
| 4 | 3N660-04 | Pump Cover, Driven Shaft | 1 |
| 5 | 3660EE6.7-05 | Shaft Sealing Housing | 1 |
| 6 | 3M440-06 | Pump Foot | 1 |
| 8 | 3N660-08 | Balance Bush | 2 |
| 10 | 3N660EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 |
| 11 | 3N660EE6.7-11 | Bearing Spacer | 1 |
| 12 | 3M660E-12 | Driving Shaft | 1 |
| 13 | 3M660-13 | Driven Shaft | 2 |
| 14 | 3N660-14 | Circlips | 1 |
| 16 | 3N660EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 |
| 17 | 3N660EE6.7-17 | Space Bush | 1 |
| 19 | 3N940-19 | Plug Screw | 1 |
| 21 | 3N660-21 | Pump End Gasket | 2 |
| 22 | 3N660-22 | Shaft Sealing Housing Gasket | 1 |
| 24 | 3N660-24 | Pump Cover Gasket | 1 |
| 101 | 6209 | Groove Ball Bearing | 1 |
| 122 | 077 3413 062 | Spring | 1 |
| 127 | 18 | Steel Ball | 1 |
| 134 | A27 X 32 | Washer | 1 |
| 200 | 3M660EE6.7-200 | Mechanical Seal | 1 |
| 300 | DV44B-300 | Relief Valve | 1 |
| 300 | DS38A-300 | Relief Valve | 1 |

| Parts List | | | File No. | 3MH940EE6.7 |
|-------------------|----------------|-----------------------------------|-----------------|-------------|
| | | | Page | 1/1 |
| No. | Code | Name of Parts | Quantity | |
| 1 | 3M940-01 | Pump Casing | 1 | |
| 2 | 3M940-02 | Pump Casing Insert | 1 | |
| 3 | 3N940-03 | Pump Cover, Driving Shaft | 1 | |
| 4 | 3N940-04 | Pump Cover, Driven Shaft | 1 | |
| 5 | 3N940EE6.7-05 | Shaft Sealing Housing | 1 | |
| 6 | 3M440-06 | Pump Foot | 1 | |
| 8 | 3N940-08 | Balance Bush | 2 | |
| 10 | 3N940EE6.7-10 | Bearing-Inner-Ring Adjusting Ring | 1 | |
| 11 | 3N940EE6.7-11 | Bearing Spacer | 1 | |
| 12 | 3M940E-12 | Driving Shaft | 1 | |
| 13 | 3M940-13 | Driven Shaft | 2 | |
| 14 | 3N940-14 | Circlips | 1 | |
| 16 | 3N940EE6.7-16 | Bearing-Outer-Ring Adjusting Ring | 1 | |
| 17 | 3N940EE6.7-17 | Space Bush | 1 | |
| 19 | 3N940-19 | Plug Screw | 1 | |
| 21 | 3N940-21 | Pump End Gasket | 2 | |
| 22 | 3N940-22 | Shaft Sealing Housing Gasket | 1 | |
| 24 | 3N940-24 | Pump Cover Gasket | 1 | |
| 101 | 6212 | Groove Ball Bearing | 1 | |
| 122 | 007 3413 062 | Spring | 1 | |
| 127 | 18 | Steel Ball | 1 | |
| 134 | A27 X 32 | Washer | 1 | |
| 200 | 3M940EE6.7-200 | Mechanical Seal | 1 | |
| 300 | DV50B-300 | Relief Valve | 1 | |
| 300 | DS35A-300 | Relief Valve | 1 | |



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